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## O-1-001

**'Macro effects' of 'micro elements': Trace elements in demography, populational health, and economics**A.V. Skalny<sup>1,2</sup><sup>1</sup> RUDN University, Moscow, Russia<sup>2</sup> Trace Element Institute for UNESCO, Lyon, FranceE-mail address: [skalny3@microelements.ru](mailto:skalny3@microelements.ru).

Multiple studies have demonstrated significant effects of both essential and toxic trace elements in a particular organism. However, data on demographic effects of trace elements are insufficient. The objective of a series of studies performed during the last decades (2000s–2010s) was to assess the element status of Russian population its interaction with demography. Based on data from hair trace elements content in more than 60,000 adults and 15,000 children the rate of trace element deficiency and excess in Russia was evaluated. It has been revealed that high content of hair toxic trace elements is associated with reduced birth rate, increased mortality and morbidity. The impact of Hg and Pb on the costs of IQ loss in children was evaluated. In turn, essential trace element deficiency (Se) is associated with decreased life expectancy and higher morbidity and mortality. At the same time, the relationship with demographic parameters was more significant after consideration for interaction (ratios) between particular trace elements (e.g. Hg/Se). The potential benefits of trace element status regulation are discussed.

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## O-1-002

**Functional genomics of mammalian selenoproteins**

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Selenium has both beneficial and toxic effects in human health. The importance of having adequate amounts of this micronutrient in the diet is primarily due to the fact that selenium is used in selenoproteins in the form of selenocysteine. In this presentation, discussion will be focused on evolution and function of selenium utilization in mammals. Comparative and functional genomics methods allow assessing the use of selenium at the levels of proteins, cells, organs and entire organisms. The most challenging is the functional analysis of about a half of mammalian selenoproteins, for which no function is currently known. New functions are also being discovered for previously characterized selenoproteins, such as reversible regulation of actin through methionine-R-sulfoxidation. More generally, selenoproteins with known functions are oxidoreductases, and the tight link between selenium and redox biology offers an opportunity to better understand selenoproteins and use this information to examine questions central to the redox control of cellular processes.

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## O-1-003

**New perspectives of functional genomics of selenoproteins in food animals**

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Swine and poultry are two major food-producing species, and can also be used as models for human medicine. We have studied regulations and functions of selenome and selenoproteome of pigs and chicks by dietary intakes of Se, vitamin E, and fat. No universal mechanism was found for a global regulation of the genome or proteome by dietary Se in pigs. Both Se deficiency and excess exerted dual effects on gene transcripts of various selenoproteins. In the high fat-induced obesity, *SELENOI* and *SELENOV* exhibited the strongest correlations with the obesity-related gene expression and phenotypes of pigs. The Se excess was diabetogenic, resulting in hyperinsulinemia and altered insulin signaling and energy metabolism in pigs. The classical Se/vitamin E deficiency diseases of chicks were associated with down-regulation of GPX1, GPX4, SELENOF, SELENON, SELENOF, and SELENOW in the liver, muscle, and pancreas, activating the p53/caspases/COX2/FAK/PI3K/Akt/NF-κB, and p38 MAPK/JNK/ERK signaling pathways. Dietary vitamin E deficiency elevated the production of GPX4, along with mRNA levels of 6 selenoproteins, in tissues of chicks.

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## O-1-004

**Dual role of selenium in health and disease**Marco Vinceti<sup>1,\*</sup>, Tommaso Filippini<sup>1</sup>, Lauren A. Wise<sup>2</sup><sup>1</sup> University of Modena and Reggio Emilia, Modena, Italy<sup>2</sup> Boston University School of Public Health, Boston, United StatesE-mail address: [marco.vinceti@unimore.it](mailto:marco.vinceti@unimore.it) (M. Vinceti).

The relation between selenium and the etiology of human diseases is still partially unclear, appears to have a Janus-faced nature and is influenced by the chemical form of the element. While selenium was suggested to decrease cancer risk by observational studies and a randomized controlled trial (RCT), recent large RCTs showed no effect or even adverse effects of selenium on cancer risk, suggesting that the earliest studies were affected by exposure misclassification or unmeasured confounding. RCTs also showed no influence of selenium on cardiovascular risk and an adverse effect on diabetes risk. Conversely, RCTs indicated a beneficial effect of selenium on Keshan disease, a cardiomyopathy described in low-selenium areas in China, though the etiology of this disease is still not entirely elucidated. Selenium may also be involved in the etiology of neurological disease. This dual and intriguing activity of selenium on human health shown by epidemiologic studies is mirrored by laboratory studies. Thus, there is the need of a reassessment of what constitutes a safe intake of selenium in humans.

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## O-1-005

**Low selenium status in Europe – Does it matter?**J. Alexander<sup>1,\*</sup>, J. Aaseth<sup>2</sup>, U. Alehagen<sup>3</sup><sup>1</sup> Norwegian Institute of Public Health, Norway<sup>2</sup> Innlandet Hospital trust and Hedmark University College, Norway<sup>3</sup> Linköping University, SwedenE-mail address: [jan.alexander@fhi.no](mailto:jan.alexander@fhi.no) (J. Alexander).

In humans, twenty-five genes encode for selenoproteins. These are involved in a wide variety of functions, most notably redox homeostasis, thyroid hormone metabolism, protein folding and degradation, calcium transport and as yet unknown functions. Whereas overt Se deficiency in humans is rare, accumulating evidence indicate that suboptimal supply, as seen in Europe with low expression of selenoproteins, may affect health and contribute to cardiovascular disease, cancer, defective immune response and neurodegenerative conditions. Up to now selenium intake and status received little attention by clinical medicine. Larger clinical chemistry laboratories analyse selenium in blood/plasma, but often with unclear indications and little guidance in the interpretation. Lower end reference limits are frequently far below that compatible with a recommended intake and full expression of selenoproteins. Individuals with low selenium status and particularly those at risk for cardiovascular disease may benefit from extra selenium supply.

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## O-1-006

**Zinc as a modulator of regulatory T cell development**

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**Purpose:** Zinc is an essential trace element for the immune system and its homeostasis must be delicately regulated. Zinc deficiency is accompanied by signs of chronic inflammation and is observed in allergies and autoimmune diseases.

**Scope:** Investigating the capacity of zinc for promoting regulatory T cells (Treg). Methods: TH1: Mixed lymphocyte culture, kidney transplantation. TH2: Allergen-induced proliferation. TH17: Experimental autoimmune encephalitis.

**Results:** Zinc supplementation induced regulatory T cells in vitro and in vivo in TH1, TH2 and TH17 models. This effect is mediated by a stabilization of the Treg-specific transcription factor Foxp3 by inhibition of the histone deacetylase SIRT1 by zinc. Furthermore, Treg cell differentiation is promoted by zinc due to an enhancing effect on TGF $\beta$  and the upregulation of the transcription factor KLF-10 and the downregulation of IRF-1. Zinc-induced Tregs are antigen-specific and only induced after T cell activation. Whereas zinc induced Tregs, cyclosporine inhibited the generation of Tregs.

**Conclusion:** Zinc is a gatekeeper of immune responses. Zinc supplementation should be taken into account in allergy, autoimmunity and transplantation.

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## O-1-007

**Genetic influences on dietary zinc requirements**

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Zinc (Zn) homeostasis is a regulatory process primarily controlled by the gut mucosa and the exocrine pancreas, and is well-maintained over a wide range of dietary Zn intakes. This does not necessarily imply that Zn status for all individuals is adequate for optimal biological function at all Zn intakes that are practically achievable with natural diets. Zn transporters, some of which are ubiquitously expressed and some of which have specialised functions and their role in regulating Zn homeostasis and metabolism is currently being defined in more detail. Single Nucleotide Polymorphisms (SNPs) that cause amino acid substitutions may have an impact on Zn transporter function or the association of transporters and their activation. Notable examples are rare mutations of ZIP4 that cause acrodermatitis enteropathica, which results in severe zinc deficiency, and also acute maternal milk Zn deficiency caused by mutations in ZnT2. A systematic examination of SNP impact on Zn metabolism and status is under investigation. A controlled human intervention study is in progress to investigate the association between the body capacity to maintain adequate Zn status and the incidence of particular SNPs, especially those which play a major role in Zn absorption and excretion.

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## O-1-008

**Zinc and diabetes: Beyond ZnT8**

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Zn transporter ZnT8 plays a critical role in  $\beta$ -cell function. Genetic factors, such as variations in SLC30A8 may have important effects on Zn-insulin interaction. Besides, participation of Zn in cell signaling processes suggests Zn may have insulin-mimetic roles. Also, Zn inhibits release of inflammatory cytokines involved in  $\beta$ -cell destruction; it presents antioxidant functions and has anti-apoptotic effects in a number of cells and tissues. Thus, zinc is an interesting candidate to become a co-adjuvant to diabetes therapy. Zinc supplementation may have beneficial effects on glycemic control as indicated by a modest but significant reduction of fasting glucose and a trend to decreased HbA1c, as reported in some short or medium term (6 months or less) studies. Nevertheless, no significant differences were observed regarding glycemic control during a two-year zinc supplementation on type-2 diabetes patients recently carried out by our group. A recent review of Zn supplementation trials highlighted the relevance of Zn status condition prior to intervention. A therapeutic role of Zn in type-2 diabetes remains as an open question.

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## O-1-009

**Nutrigenomics: The role of trace elements in gene expression**

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Trace elements act at epigenetic, transcriptional and post-transcriptional levels to control the expression of proteins that function in cellular trace element homeostasis and to regulate cellular functions that require trace elements. The presentation will include a broad overview of some of these mechanisms, with reference to specific examples. The focus will then be on the seemingly dual function of the transcription factor ZNF658. ZNF658 appears to function in both the regulation of expression of transporters involved in zinc homeostasis and in the control of ribosome biogenesis. The concept that ZNF658 is a key point of linkage between cellular zinc balance and the regulation of ribosome biogenesis will be explored.

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## O-1-010

**The significance of selenoproteins for human health revealed by inborn errors of metabolism**

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The significance of the 25 genes encoding selenoproteins for human health is increasingly recognized through the identification of patients with inborn errors in selenoprotein biosynthetic factors or in individual selenoproteins. Mutations in selenoprotein N lead to SEP1-related myopathy, mutations in glutathione peroxidase 4 cause respiratory failure and bone defects, and mutations in thioredoxin reductase 2 (TXNRD2) are associated with familial glucocorticoid deficiency. Recently, we identified patients with mutations in TXNRD1. Pathogenic mutations in selenocysteine synthase cause neurodevelopmental disorders, but also other factors epistatic to selenoprotein biosynthesis, such as SECIS-binding protein 2 and tRNA[Ser]Sec, are known to cause complex disorders. Mutations in the latter two genes involve impaired metabolism and action of thyroid hormones which lead to delayed bone growth and maturation. Mutations in SECISBP2 sometimes affect nervous system development, muscle, inner ear, skin, and immune system function underlining the significance of selenoproteins for the organism.

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## O-1-011

**Maternal selenium status during pregnancy and clinical outcome in the infant**

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Pregnant women and infants are at risk for selenium deficiency. We have investigated selenium levels in healthy never-pregnant ( $n = 158$ ), pregnant and lactating women and their infants at age 6 months ( $n = 114$ ), and related this to infant clinical outcome. Serum selenium were measured by an ICP-MS in controls, in pregnancy week 18, 28, 36 and 6 weeks, 4 and 6 months postpartum, in infants at 6 months. Neurodevelopment was assessed with Ages and Stages. Median maternal selenium levels were reduced by 20% in pregnancy week 36, increased and remained stable postpartum. A maternal selenium level  $\leq 0.90 \mu\text{mol/L}$  in pregnancy week 18 was negatively related to infant neurodevelopment at 6 months ( $B = -20, p = 0.01$ ), whereas a selenium level  $\leq 0.78 \mu\text{mol/L}$  in pregnancy week 36 was associated with an increased risk (OR 4.8) for infant infection during the first 6 weeks of life. Based on this, we suggest a cutoff for maternal serum selenium deficiency of  $0.90 \mu\text{mol/L}$  in pregnancy week 18, and  $0.78 \mu\text{mol/L}$  in pregnancy week 36.

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## O-1-012

**Roles of Selenium (Se) exposure in ALS development**

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Amyotrophic lateral sclerosis (ALS) is a severe lethal neurodegenerative disorder and no effective treatment is available. Clinical studies suggested that ALS was inversely associated with organic Se. However, inorganic Se increased ALS risk. This study used an ALS model to investigate roles of organic and inorganic Se in ALS. Our data showed that Na selenate (an inorganic Se) orally dosed at 5 mg/kg daily starting from 90 days post birth reduced the life span by 8 days compared to controls [ $129 \pm 9$  ( $n = 5$ ) vs.  $137 \pm 11$  ( $n = 6$ )]. In contrast, organic diphenyl diselenide (DDSe) orally dosed at 5 mg/kg in the same way significantly increased the life span by 19 days [ $156 \pm 3$  ( $n = 5$ ) vs.  $137 \pm 11$  ( $n = 6$ )]. However, DDSe dosed at 100 mg/kg in the same way markedly shortened the life span by 12 days [ $125 \pm 8$  ( $n = 5$ ) vs.  $137 \pm 11$  ( $n = 6$ )]. These data suggest that organic and inorganic Se at low dose levels exert the opposite effects on ALS development. The high dose of the organic Se is as toxic as the inorganic Se. Our research will help understand the mechanism of ALS pathogenesis and to identify the novel treatment for ALS.

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O-1-013

**Effect of knockdown of Sep15 and tunicamycin-induced ER stress on differentiation of lens epithelial cells**

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Sep15 is a resident of endoplasmic reticulum. Sep15 knock-out mice developed a prominent nuclear cataract at an early age, however, the mechanism remains unclear. In the present study, the knockdown of Sep15 in hLE cells decreased expression of  $\beta$ -crystallin, as a biomarker of cell differentiation, and aggravated the inhibition of tunicamycin. Analysis on FGF signal in cell differentiation showed that tunicamycin treatment and Sep15 knockdown inhibited the bFGF-induced phosphorylation of ERK1/2 and Akt, which were downstream of FGF/MAPK and FGF/PI3K pathway, respectively. Moreover, sodium selenite supplementation maintained redox and ER homeostasis via increased expression of selenoproteins, such as Sep15, that protected hLE cells against oxidative stress and apoptosis induced by Sep15 knockdown and tunicamycin treatment, and ameliorated tunicamycin-induced ER stress. In conclusion, hLE cell differentiation was inhibited by Sep15 knockdown and tunicamycin-induced ER stress, and the inhibition might be induced via FGF-dependent signaling.

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O-1-014

**Selenium pathway genotypes are associated with colorectal cancer risk and modified by selenium status**D.J. Hughes<sup>1,\*</sup>, V. Fedirko<sup>2</sup>, J.S. Jones<sup>2</sup>, C. Méplan<sup>3</sup>, L. Schomburg<sup>4</sup>, S. Hybsier<sup>4</sup>, E. Riboli<sup>5</sup>, J. Hesketh<sup>3</sup>, Jenab M on behalf of EPIC<sup>6</sup><sup>1</sup> RCSI, Dublin, Ireland<sup>2</sup> Emory University, Atlanta, GA, USA<sup>3</sup> Newcastle University, UK<sup>4</sup> Charité – Medical University, Berlin, Germany<sup>5</sup> Imperial College London, UK<sup>6</sup> IARC, Lyon, FranceE-mail address: [davidhughes@rcsi.ie](mailto:davidhughes@rcsi.ie) (D.J. Hughes).

**Objective:** Suboptimal selenium (Se) intake and selenoprotein gene variation may contribute to colorectal cancer (CRC). We examined association of Se pathway genotypes and Se status interaction with CRC risk in the European Prospective Investigation into Cancer and Nutrition (EPIC).

**Methods:** 1040 SNPs in 154 Se pathway genes were genotyped by *Illumina* for 1478 matched CRC case–control pairs and assessed by multivariate logistic regression.

**Results:** Genetic variation in 63 genes was associated with CRC risk, although for the selenoprotein genes only *TXNRD1* SNPs retained significance with multiple testing considerations. Interaction with Se status (existing serum Se and Selenoprotein P data) and pathway analyses will also be presented.

**Conclusions:** Detailed investigation of Se metabolism is needed to explore relevance of particular risk Se pathway genotypes for CRC etiology.

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O-1-015

**A review of human selenium toxicity as supported by animal studies**

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Selenium toxicity to humans has been documented since 1964. Studies by Rosenfeld and Beath (1964) and by Reid et al. (2004) reported nail and hair loss similar to reports seen in farm animals. These changes though noticeable are hard to quantify. Reports of effects on enzyme systems emerged in the late 1950s (Mills et al., 1957). Since that time studies have shown that selenium at low doses was capable of increasing enzyme activity of glutathione peroxidase (GSH-Px). At high dosages of selenium the response seen was of depressing the enzyme activity of glutathione peroxidase (GSH-Px) (Valentine et al., 1988; Jensen et al., 1977; Jensen et al., 1979). This presentation will assess the effects of selenium exposure as determined in body fluid, blood, and its relationship on toxicity indicators as those mentioned above and other indicators as found in more recent reports (Thompson et al., 1993; Tinggi, 2003). Correlations of these studies to exposure amounts through daily intake of drinking water, food, and clinical supplementation will be presented. Hopefully an additional clinical understanding of environmental sources of selenium and health will emerge.

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O-1-016

**Correlation of serum selenium level with monocytes chemoattractant protein-1 in obese and healthy subjects**Mutakin<sup>1,\*</sup>, Holis A. Holik<sup>1</sup>, Rizky Abdulah<sup>1</sup>, Hiroshi Koyama<sup>2</sup><sup>1</sup> Faculty of Pharmacy, Universitas Padjadjaran, Indonesia<sup>2</sup> Department of Public Health, Gunma University Graduate School of Medicine, JapanE-mail address: [mutakin@unpad.ac.id](mailto:mutakin@unpad.ac.id) ( Mutakin).

Previous study reported an association between selenium status and visceral obesity. The aim of this study was to investigate possible correlation between selenium nutritional status and monocytes chemoattractant protein-1 (MCP-1), a protein that has a role in development of obesity, diabetes and cardiovascular diseases, in obese and healthy subjects from Bandung city, Indonesia. Plasma selenium level, GPx activity and MCP-1 concentration from obese ( $n=78$ ) and healthy subjects ( $n=79$ ) were determined. The means of plasma Se level, Gpx activity and MCP-1 in obese subjects were higher than healthy subjects (obese: 100 ng/ml, 166.7 and 320.8 pg/ml respectively; healthy: 76 ng/ml, 120.3 and 208 pg/ml respectively). The correlation between Se level and MCP-1 in obese subjects was negative ( $r=-0.029$ ,  $P<0.001$ ) and the correlation in healthy subjects was also negative ( $r=-0.533$ ,  $P<0.001$ ). The



results indicated that the subject who has a higher Se level, he has a lower MCP-1 concentrations regardless obese or not.

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**O-1-017**

**Effects of dietary selenium against lead toxicity on the role of hydrogen sulfide in the regulation of apoptosis via mitochondrial pathway in chicken liver**



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Hydrogen sulfide (H<sub>2</sub>S), is a gaseous intracellular signal transducer. It regulates the cell cycle, apoptosis and the oxidative stress. Complex antagonistic interactions between Se and heavy metals have been reported in previous studies. However, little is known about the effect of Se on Pb toxicity on the relationship between apoptosis and H<sub>2</sub>S in chicken liver. In this study, we fed chickens either with Se or Pb or both Se and Pb supplement and later analyzed the role of the mitochondria activated apoptotic pathway and H<sub>2</sub>S in liver of the chicken exposed to Pb. The results showed that Pb diet induced morphological changes and excessive apoptosis in chicken liver via mitochondrial pathway, included the disruption of mitochondrial metabolism and ion homeostasis, and exhibited higher H<sub>2</sub>S production and H<sub>2</sub>S-producing enzymes. In addition, Se alleviated the Pb-induced increase in apoptosis and H<sub>2</sub>S. In conclusion, Se can antagonize the toxic effects of Pb on chicken liver injury and protect it against mitochondria-mediated apoptosis via inhibiting the production of H<sub>2</sub>S.

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**O-1-018**

**Selenium supplementation ameliorates electromagnetic field-induced oxidative stress in the HEK293 cells**



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Recent studies show the adverse effects of electromagnetic fields-EMF on tissues. Selenium-Se shows antioxidant properties by inhibiting oxidative damage. The aim of this study is to investigate the effect of Se on EMF exposed human embryonic kidney cells-HEK293 by means of alterations in malondialdehyde-MDA, superoxide dismutase-SOD and glutathione peroxidase-GSH-Px levels. Our study included control, EMF (exposed to 2.4 GHz EMF for 1 h), 100 nM Se + EMF, 200 nM Se + EMF groups. Element groups were incubated for 48 h with Se supplemented mediums before EMF exposure. In the EMF group, MDA levels were increased following EMF exposure; however, GSH-Px and SOD levels were decreased. Se supplemented groups determined a reduction in the MDA levels as to EMF group, although the SOD and GSH-Px levels found to increase. Our findings show that Se supplementation prevented EMF-induced oxidative stress by increasing the GSH-Px and SOD activities and reducing MDA levels. Se can be

an useful for the prevention of oxidative stress caused by EMF exposure.

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**O-1-019**

**Synergy between selenium and dietary isothiocyanates causes up-regulation of selenoproteins resulting in greater protection against cell damage**



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Selenoproteins thioredoxin reductase 1 (TrxR-1) and glutathione peroxidase-2 (GPX2) have antioxidant responsive element (ARE) in their gene promoters. Nuclear factor E2-related factor 2 (Nrf2) binds to ARE and upregulates >100 genes, most of which possess anti-oxidative, anti-inflammatory and anti-cancer properties. When human hepatocytes are exposed to Nrf2 activators such as sulforaphane (SFN) an isothiocyanate derived from glucosinolates, it induces the migration of Nrf2 into cell nucleus, which results in up-regulation of both TrxR-1 and GPX2 at mRNA levels. Cultured cells exposed to both SFN and Se resulted in a greater induction of both TrxR-1 and GPX2 at mRNA and protein/activity levels. Having identified the synergy between SFN and Se we subsequently investigated beneficial effects in relation to protection against free radicals, and toxic nanoparticles-mediated cell death in various cell types, and in Cocksackie virus-induced cardiomyopathy. Results will be presented and discussed in the context of lower effective doses of Se and the U-shaped risk-benefit curve.

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**O-1-020**

**The higher hepatoprotective effect of organic selenium compounds compared to inorganic selenium**



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The aim of this work is to study influence of new selenoorganic compound on the quantity of liver marker enzymes such as cytochromes P450 and b5 in acute chemical hepatitis and comparative assessment with sodium selenite. Materials. Piperidine(dibutylseleno)phosphate-PSP is newly synthesized selenoorganic compound. Its LD<sub>50</sub> was 300 mg/kg. Acute hepatitis was modeled by intragastric injection of yellow phosphorus water suspension. Results. The model of phosphoric acute intoxication lead to cytolysis of hepatocytes as evidenced by increase of liver specific enzymes, reduction of cytochromes P<sub>450</sub> and b<sub>5</sub>. Starting from 7th day of PSP treatment on the background of acute hepatitis significantly improves the studied parameters. So, PSP (*p* < 0.05) increased significantly amount of cytochromes and activity of microsomal monooxygenases. This is explained by the antioxidant effect of organic selenium compound to different links of organism protection. Conclusion. PSP is strong inductor of liver cells' monooxygenases system and has in therapeutic doses higher hepatoprotective effect than sodium selenite.

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O-1-021

### The alleviation of selenium against lead-induced apoptosis by regulating endoplasmic reticulum pathway in chicken kidneys

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To study the alleviation of Se on Pb-induced poisoning in bird kidneys, 7-day-old cocks were randomly divided into the control, Se, Pb, and Se + Pb group. The control group was fed drinking water and commercial diet.  $(\text{CH}_3\text{OO})_2\text{Pb}$  was added in drinking water (350 mg/L Pb).  $\text{Na}_2\text{SeO}_3$  was added in the commercial diet (1 mg/kg Se). Following contents were performed in kidneys: On the 30th, 60th, and 90 days, ultrastructure; GPx, GSH, MDA, NO contents, SOD and iNOS activities, NF- $\kappa$ B, TNF- $\alpha$ , COX-2, PTGEs, iNOS, GRP78, GRP94, IRE, ATF4, ATF6, caspase3, and Bcl-2 mRNA levels; on the 90 day, Se and Pb concentrations; and NF- $\kappa$ B, COX-2, PTGEs, GRP78, GRP94, IRE, ATF4, ATF6, Bcl-2, Caspase12, and caspase3 protein levels. Our results indicated that all detected factors increased and kidney damage occurred except Se and Bcl-2 decreased in the Pb group. Se alleviated the above changes except of IRE protein level caused by Pb. Se alleviated Pb-induced apoptosis chicken kidneys via endoplasmic reticulum pathway.

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O-1-022

### Selenium regulation oxidation processes induced by sodium nitrite in the blood of rats

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Rats were exposed to separate and combined action  $\text{NaNO}_2$  and  $\text{Na}_2\text{SeO}_3$  by injection with exposures 1–48 h. From the first 15 min observed increase level of MetHb and peaking 5 times during the first hour. Results of 2 and 48 h exposure showed that injection of selenite inhibits accumulation of the lipid peroxidation products to 20% and increase activity of the glutathione peroxidase in erythrocytes, but it has nosignificant influence on the nitrite induced accumulation MetHb. This is explained by the fact that protection from exposure nitrite carried inclusion of selenium in the haemoglobin molecule, and, based on the provisions of  $\text{HbO}_2$  and Hb spectral peaks, we can conclude that MetHb content increases by reducing  $\text{HbO}_2$ . All this indicate that included in the globin part of the Hb in the position Cys $\beta$ -93 selenium helps straitened nitrite from this position (HbSNO) transfer it to the heme groups, or as free form to the blood stream, while simultaneously reducing the toxic effects on haemoglobin and red blood cells. This work was supported by Grant EİF-2014-9(24)KETPL-14/01/1-M-11.

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O-1-023

### The effects of sodium selenite supplementation and X-ray irradiation on TE-8 cell survival

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Previous study demonstrated that supplementation of non-cancerous human esophageal cells (CHEK-1 cells) with 50 nM sodium selenite 72 h prior to 2 Gy X-ray irradiation may protect the cells from radiation-induced damage. The present study investigated the effects of 50 nM sodium selenite supplementation 72 h prior to X-ray irradiation treatment on cancerous human esophageal (TE-8 cells) cell survival. Cell viability assay with 2 Gy X-ray irradiation dose and clonogenic assay with three different X-ray irradiation doses (2 Gy, 4 Gy and 8 Gy) were performed after supplementation. The results showed that cell viability and surviving rate of TE-8 cells with 50 nM sodium selenite supplementation were lower than the cells treated by X-ray irradiation only. Supplementation with 50 nM of sodium selenite prior to X-ray irradiation treatment could decrease cell survival of TE-8 cells.

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O-1-024

### Selenium as a therapeutic factor for metal toxicity

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Micronutrient intake has a significant effect on the metal toxicity which can modify the body's response by altering their metabolism and transport. We assessed the effect of micronutrient status on the toxicity of three nonessential metals: aluminum, lead and mercury and their interaction with micronutrients at several points: absorption and excretion of toxic metals; transport of metals in the body; binding to target proteins; metabolism and sequestration of toxic metals; and finally, in secondary mechanisms of toxicity such as oxidative stress. Selenium (Se) is an essential micronutrient with important biological and biochemical functions in organisms because of its unique antioxidant properties. It is one such nutrient that is essential for the activation of the GSH peroxidase enzyme. Se and metal (M) bind with an exceptionally high affinity that sequesters Hg, Pb and Al and possibly renders it biologically inert. We reported that chelator and Se, supplementation more promising therapy against metal-induced toxicity compared to chelator alone. Combination of micronutrients could be a better choice for metal intoxication.

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## O-1-025

**Effect of selenium against lead-induced damage on the gene expression of heat shock proteins and cytokines in peripheral blood neutrophils of chickens**

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Lead (Pb), a ubiquitous environmental toxic heavy metal. Few studies could investigate the protect role of Se in chickens. Our study investigated that selenium protect inflammatory response and HSPs expression in neutrophils induced by Pb. One hundred eighty Hailanhe chickens were randomly divided into 4 groups (45 chickens per group). The control group (basic diet + 0.49 mg/kg Se); the Se group (basic diet + 1.00 mg/kg Se); the Pb group (basic diet + 350.00 mg/kg Pb); and the Se and Pb compound group (basic diet + 1.00 mg/kg Se and 350.00 mg/kg Pb). The results showed that after Pb treatment the mRNA levels of IL-1 $\beta$ , IL-1R, IL-4, IL-8, IL-10, IL-12 $\beta$ , TGF- $\beta$ 4, HSP27, 40, 60, 70, 90 increases significantly and the expression of IL-2, IFN- $\gamma$  mRNA decreased compared with control group. The protein levels of HSP60, HSP70 also increased in Pb treatment group. In Se + Pb treatment group was relieved. Therefore, our study interested that Pb could decreased the immune function of neutrophils, Se could relieve the toxic effect induced by Pb.

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## O-1-026

**hZip1 regulates zinc homeostasis in human gut epithelial cells**

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The gut has a major role in zinc homeostasis by regulating intestinal zinc absorption. Zip1 (SLC39A1) is a putative transmembrane zinc transporter that is postulated, but not conclusively proven to mediate zinc influx in the gut. We investigated a role for hZip1 (human Zip1) in zinc uptake by human enterocytes. Both hZip1 mRNA and protein were detected in human intestinal tissue and in cultured Caco-2 human colonic cells. In differentiated Caco-2 cells, the hZip1 protein was located near but not on the apical microvilli. <sup>65</sup>Zn studies were carried out to establish if hZip1 participated in cellular zinc accumulation. In Caco-2 cells overexpressing hZip1 protein, zinc accumulation was increased while in Caco-2 cells harbouring an hZip1 siRNA construct, zinc accumulation was decreased. In conclusion, considering the absence of hZip1 at the apical plasma membrane but the increased zinc uptake in hZip1-overexpressing cells, we propose that hZip1 is an intracellular sensor whose main role is to regulate, but not directly mediate zinc accumulation in human gut cells.

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## O-1-027

**Structural analysis of the ZIP4 cytosolic domain**

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The plasma membrane human (h)ZIP4 transporter functions to increase the cytosolic concentration of zinc. hZIP4 dysfunction has been implicated in pancreatic, liver and brain cancers where its surface expression is abnormally increased. During cellular homeostasis, high zinc concentrations result in hZIP4 ubiquitination and proteasomal degradation. hZIP4 ubiquitination likely occurs at a conserved lysine within a large intracellular loop located between transmembrane domains 3 and 4 (M3M4). Therefore, the hZIP4 intracellular loop has been hypothesized to act as a zinc sensor. We have recombinantly expressed and purified the large intracellular M3M4 loop of hZIP4 for metal binding and structural studies. M3M4 coordinates two zinc ions sequentially. Structural analysis reveals that the intracellular loop is an intrinsically disordered region, and remains disordered upon zinc binding. Our data support a model in which structural changes in the large intracellular loop of hZIP4 in response to zinc regulate the plasma membrane levels of the hZIP4 transporter.

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## O-1-028

**Effects of zinc and melatonin supplements on immunity parameters of rats with breast cancer**S.B. Baltaci<sup>1</sup>, R. Mogulkoc<sup>1,\*</sup>, A.K. Baltaci<sup>1</sup>, A. Emsen<sup>2</sup>, H. Artac<sup>2</sup>

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The aim of the study was to determine the effects of zinc and melatonin supplements on the immunity parameters of female rats with induced breast cancer. Group 1; Control, Group 2; 7,12-Dimethylbenz[a]anthracene (DMBA), Group 3; DMBA + Zinc, Group 4; DMBA + Melatonin, Group 5; DMBA + Zinc + Melatonin. The rats' breast cancer was induced by DMBA 80 mg/kg. Groups 3,4,5 received daily 5 mg/kg doses of zinc, melatonin, and zinc + melatonin respectively. Lymphocyte rates, T-lymphocyte subgroups, B-lymphocyte and natural killer cells NK and NKT were evaluated. It was found that a notable increase occurred in the cell types related to the immunity parameters in the supplemented groups; especially compared to the Group 2. The most significant increase in lymphocyte, T-lymphocyte and CD4 lymphocyte rates was found in Group 5. The highest NKT cell rates were found in Group 3. Findings show that zinc and melatonin supplements have led to an increase in the immunity parameters of rats with breast cancer. The most significant increase in immunity parameters have occurred in group 5.

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O-1-029

**In vitro and in vivo physiology of low nanomolar concentrations of Zn<sup>2+</sup> in artificial cerebrospinal fluid**

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Artificial cerebrospinal fluid (ACSF), i.e., brain extracellular medium, which includes Ca<sup>2+</sup> and Mg<sup>2+</sup>, but not other divalent cations such as Zn<sup>2+</sup>, has been used for in vitro and in vivo experiments. The present study deals with the physiological significance of extracellular Zn<sup>2+</sup> in ACSF. Spontaneous presynaptic activity is suppressed in the stratum lucidum of brain slices from young rats bathed in ACSF containing 10 nM ZnCl<sub>2</sub>, indicating that extracellular Zn<sup>2+</sup> modifies hippocampal presynaptic activity. To see the in vivo action of 10 nM ZnCl<sub>2</sub> on long-term potentiation (LTP), the recording region was perfused using a recording electrode attached to a microdialysis probe. The magnitude of LTP was not modified in young rats by perfusion with ACSF containing 10 nM ZnCl<sub>2</sub>, compared to perfusion with ACSF without Zn<sup>2+</sup>, but attenuated by perfusion with ACSF containing 100 nM ZnCl<sub>2</sub>. The present study indicates that the basal levels of extracellular Zn<sup>2+</sup>, which are in the range of low nanomolar concentrations, are critical for synaptic activity.

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O-1-030

**Intracellular accumulation of Aβ<sub>1-42</sub> is induced by binding to extracellular Zn<sup>2+</sup>, followed by cognitive decline**

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The interaction of Aβ<sub>1-42</sub> with extracellular Zn<sup>2+</sup> was essential for in vivo uptakes of Aβ<sub>1-42</sub> and Zn<sup>2+</sup> into dentate granule cells. Both uptakes were blocked in the presence of CaEDTA, an extracellular Zn<sup>2+</sup> chelator and Cd<sup>2+</sup>, a competing metal with Zn<sup>2+</sup> for Aβ-binding. In vivo perforant pathway long-term potentiation (LTP) was not attenuated under perfusion with 1000 nM Aβ<sub>1-42</sub> in artificial cerebrospinal fluid (ACSF) without Zn<sup>2+</sup>. However, LTP was attenuated under pre-perfusion with 5 nM Aβ<sub>1-42</sub> in ACSF containing 10 nM Zn<sup>2+</sup>, an estimated concentration of extracellular Zn<sup>2+</sup>. Aβ<sub>1-42</sub>-induced attenuation of LTP was rescued in the presence of CaEDTA and CdCl<sub>2</sub>, and observed even with 500 pM Aβ<sub>1-42</sub>. Aβ<sub>1-42</sub>-induced memory decline was rescued by co-injection of CdCl<sub>2</sub> into the dentate gyrus. The present study indicates that picomolar Aβ<sub>1-42</sub> is extracellular Zn<sup>2+</sup>-dependently taken up into dentate granule cells in the normal brain, resulting in Aβ<sub>1-42</sub>-induced cognitive decline via increase in intracellular Zn<sup>2+</sup>.

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O-1-031

**Protective effects of zinc against apoptosis in HEK293 cells induced by 2.45 GHz electromagnetic fields**Derviş Özçelik<sup>1,\*</sup>, Nural Pastacı Özsoğacı<sup>1</sup>, Matem Tuncdemir<sup>2</sup><sup>1</sup> *Department of Biophysics, Cerrahpaşa Faculty of Medicine, Istanbul University, Turkey*<sup>2</sup> *Department of Medical Biology, Cerrahpaşa Faculty of Medicine, Istanbul University, Turkey**E-mail address: dozcelik@istanbul.edu.tr (D. Özçelik).*

Several epidemiological studies have shown that exposure to electromagnetic fields-EMF can be harmful to human health. The purpose of this study is to examine apoptosis and Zn protective effect induced by EMF in human kidney embryonic cells-HEK293. For our experiment 4 groups were formed as: control, EMF, 50 μM Zn + EMF, 100 μM Zn + EMF. The cells of EMF groups were exposed 2.45 GHz EMR for 1 h. Zn groups were incubated with Zn for 48 h before EMF exposure. Bcl-2 and caspase-3 were assessed immunohistochemically and apoptosis were performed by TUNEL method. As a result, the number of the apoptotic cells and caspase-3 were increased at EMF groups compared to the control, although bcl-2 was decreased. Zn treated groups showed a reduction in the number of apoptotic cells and caspase-3 from that of EMF group, although the bcl-2 found to increase. Our findings show that EMF caused apoptosis in HEK293 cells. Zn seems to have protective effects on the EMF-induced apoptosis by decreasing caspase-3 and increasing bcl-2 which are apoptosis-related proteins.

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O-1-032

**Zinc improve gut barrier integrity in a co-cultured cell model**Cuong D. Tran<sup>1,\*</sup>, Rama Addepalli<sup>2</sup>, Simone Osborne<sup>2</sup><sup>1</sup> *CSIRO Health and Biosecurity, Adelaide, Australia*<sup>2</sup> *CSIRO Agriculture and Food, St Lucia, Australia**E-mail address: cuong.tran@csiro.au (C.D. Tran).*

Gut barrier integrity disruption is one of the major aetiological factors associated with numerous diseases. Zinc plays a key role in maintaining all major physiological functions and may be used to improve gut integrity. This study investigated the efficacy of zinc on preventing TNF-α-induced gut leakiness. A co-culture system with Caco-2 and HT29-MTX-E12 cells was established in transwells. TNF-α (100 ng/ml) and zinc salts (100 μM zinc sulphate, acetate, oxide, monoglycerolate and acexamate) were co-incubated for 24 h before transepithelial electrical resistance (TEER) and cytotoxicity measurements were taken. Cytotoxicity results showed no difference in cell death in the co-culture systems incubated with TNF-α and/or different zinc salts compared to control cells. TNF-α alone significantly increased (23%) TEER compared to control cells. TEER decreased significantly in response to all zinc salt treatments (sulphate > acetate = oxide = monoglycerolate = acexamate, 34, 27, 20, 16 and 24%, respectively) compared to TNF-α-treated cells. The findings suggest that zinc improves gut barrier integrity in vitro.

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## O-2-001

**Manganese-induced neurotoxicity: Lessons from worms to human neonates**

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Manganese (Mn) levels are tightly regulated, as high levels of Mn result in accumulation in the brain and cause a neurological disease known as manganism. Exposure to high Mn-containing environments increases the risk of developing manganism. Combining genetics and biochemical assays, we established in the nematode (*C. elegans*) and other experimental models that dopamine (DA) is responsible for Mn-induced DAergic neurodegeneration, and that this process (1) requires functional DA-reuptake transporter (DAT-1), (2) is associated with oxidative stress and lifespan reduction, (3) and is enhanced by iron deficiency. The presentation will focus on the mechanisms of Mn uptake and efflux into the brain, genetic susceptibility to Mn-induced damage, and molecular mechanisms of neurotoxicity. Additional studies will address the role of parenteral nutrition (PN) as a risk factor for increased Mn brain deposition, and demonstrate that hepatic cholestasis is a risk factor for increased brain Mn deposition in neonates receiving PN (supported by NIEHS R01 ES10563).

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## O-2-002

**Altered adult neurogenesis: Implications in Manganese (Mn)-induced Parkinsonian disorder**W. Zheng<sup>1,\*</sup>, X. Fu<sup>1</sup>, J. Chen<sup>2</sup>, W. Jiang<sup>1</sup>, Y.S. Du<sup>2</sup>

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Neural stem/progenitor cells in adult subventricular zone (SVZ) and subgranular zone (SGZ) have the ability to self-renew and migrate to olfactory bulb (OB) or hippocampal granule cell layer (GCL). This presentation shows that in rats exposed to 4-wk oral gavages of Mn, there was a 48% increase of BrdU(+) proliferating cells in Mn-exposed SVZ than in controls. In the SGZ, however, Mn exposure caused a 37% reduction of BrdU(+) cells. Another group of adult rats received BrdU injections for 3 days followed by 4-wk oral Mn gavages. There were significantly fewer BrdU/DCX(+) immature neuroblasts and BrdU/NeuN(+) mature neurons detected in the SVZ and GCL after Mn exposure ( $p < 0.05$ ). Our observations suggest that Mn exposure initially enhances the cell proliferation in adult SVZ mainly by increasing type-B neural stem cells. Yet, in the OB and GCL Mn exposure reduces the surviving adult-borne cells and markedly inhibits their differentiation into mature neurons, leading to an overall decreased adult neurogenesis in these regions. Our findings support an important role of adult neurogenesis in Mn-induced Parkinsonian disorder.

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## O-2-003

**Aquatic ecotoxicology of metals: Trophic transfer, accumulation and effects and implications for ecological risk assessment**

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The fate of metals in aquatic environments and their toxicity depends on a complex suite of interactions with physical, chemical and biological factors. The propensity of a metal to be accumulated by living organisms depends on the affinity of the element for biological surfaces, which, in turn, depends on its speciation. Once incorporated inside cells, the fate of the metal and its effects will depend on the ability of the organism to detoxify, and ultimately eliminate, the metal. Metals inappropriately bound to sensitive subcellular components, such as mitochondria or metabolic enzymes, induce oxidative stress and metabolic costs. Each species within a food web possesses its own capacity for metal accumulation, storage, detoxification and elimination. This species-specific response, combined with behavioral and ecological considerations of predator-prey interactions, greatly modifies the capacity of metals to efficiently transfer along food webs and to induce toxicity. Environmental risk assessment of metals in aquatic environments must take into account the complexity of metal interactions with abiotic and biotic components.

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## O-2-004

**Current strategies in treatment of trace element toxicity**

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Chelating agents form complex ring-like structures for removing metals. Meso 2,3-dimercaptosuccinic acid (DMSA) and dimer-captopropionicsulfonate (DMPS) have gained increased acceptance among clinicians. The need for newer chelators is driven by the need to achieve: (i) unavailability of prophylactic measures, (ii) limitations in the available chelators, (iii) faster and safer metal elimination, (iv) limited efficacy of monotherapy, and (v) cost. We examined various DMSA derivatives with lipophilic properties. Monoisoamyl DMSA (MiADMSA, a C5 branched chain alkyl monoester of DMSA) was found to be more effective than DMSA. Drug Controller General of India approved this molecule for human trials. Nanoparticles were also used as drug delivery carriers with carriers like liposomes, micelles, and nanoparticles to increase therapeutic efficacy. Nanoparticles evade the reticuloendothelial system such as liver Kupffer cells and spleen macrophages and deliver to the desired site effectively. However, their transition from bench to clinic requires extensive toxicity evaluation apart from the body excretion of these materials.

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O-2-005

**Chelator combination as therapeutic strategy in mercury and lead poisonings**J. Aaseth<sup>1,\*</sup>, A.A. Tinkov<sup>2,3</sup><sup>1</sup> Innlandet Hospital Trust and Innlandet University College, Norway<sup>2</sup> Orenburg State Medical University, Moscow, Russia<sup>3</sup> RUDN University, Moscow, RussiaE-mail address: [jaol-aas@online.nov](mailto:jaol-aas@online.nov) (J. Aaseth).

The chelating agents dimercaptosuccinate (DMSA) and 2,3-Dimercapto-1-propanesulfonate (DMPS), being less toxic than British anti-lewisite (BAL), are effective in enhancing urinary excretion of Hg and Pb. SH-dextran is also effective in scavenging mercury from blood into urine. However, strategies for mobilization of brain deposits of toxic metals may require a combination of agents: a water soluble agent (e.g. DMPS) will remove circulating metal into urine, while a lipophilic chelator could act as a shuttling agent to facilitate the brain-to-blood efflux. Early experiments showed promising results with the SH-dextran-BAL combination. The DMPS-BAL or the DMPS-MiADMSA combination could be preferred in cases of long-term Hg exposure. The efficacy of extracellularly distributed DMSA might be improved when combined with a shuttling agent, ionophore Memsin. Previously, BAL was combined EDTA in severe cases. It is reasonable that low-dose BAL or MiADMSA can increase mobilization of Pb from brain in DMSA-treatment. But further research is called for in this pharmacological field.

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O-2-006

**Metal bioimaging at the nanoscale**

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The progress of trace element research in man and animals is strongly linked to the progress of the development of novel analytical techniques. Modern bioimaging allows the investigation of biological tissue and cells from the micro to the nanometer scale. Element specific bioimaging is of particular interest as it enables localization of trace elements at cellular level. This can be achieved with Nano Secondary Ion Mass Spectrometry (NanoSIMS) providing highest spatial resolution (40 nm) combined with high sensitivity for imaging of chemical elements. This lecture focuses on analytical techniques for trace element imaging in biological cells including specific sample preparation strategies since physiological important metal ions are often highly diffusible. All this will be illustrated by localization of trace metals in cell cultures of model organisms. An example for <sup>13</sup>C stable isotope labelling of metabolites will be presented enabling the localization of physiological processes inside a cell. Correlative imaging with other bioimaging techniques allowed the confirmation of results. In outlook shows the prospects of bioimaging for trace metal research in health and disease.

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O-2-007

**Speciation in trace elements analysis: Combination with metabolomics and application to neurodegenerative disorders**

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Transition metals play a crucial role in brain function. Chronic Mn exposure leads to a Parkinson-like complaint. Deciphering uncontrolled transport across neural barriers and the neurodegenerative mechanisms is a major task. We identified Mn species as carrier across neural barriers by a two-dimensional speciation approach paired serum/cerebrospinal fluid (CSF) using SEC-ICP-DRC-MS and CZE-ICP-DRC-MS. Mn-citrate was identified by ESI-FT-ICR-MS as most important Mn-carrier. A change from Mn-transferrin to Mn-citrate was observed, too. Molecular mechanisms were analyzed by Mn and Fe speciation in rat brains: Fe(II)/(III) ratio was shifted and markers for oxidative stress, inflammation and lipid peroxidation were found. Several hundred metabolites were shifted, dependent on different Mn species. In CSF from idiopathic Parkinsonian patients (i-PD) cross correlations of transition element species showed significant differences between PD-cases and controls. Cu-amino-acid fraction was involved in each of correlations.

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O-2-008

**Single cell ICP-MS quantification of elements in individual cells – Advanced instrumental approach to researches in ecology, biology and medicine**Chady Stephan<sup>1,\*</sup>, Kenneth Neubauer<sup>1</sup>,  
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Nanoparticles (NPs) in either human or environmental health is under debate. Usual techniques for NPs analysis are time-consuming. The method of a single particle inductively coupled plasma mass spectrometry (SP-ICP-MS) has speed and capability for NPs size and concentration results. The concept has been expanded to single cells by ICP-MS (SC-ICP-MS) to elements in individual cells can be measured. Now, large numbers of individual cells can be analyzed rapidly, to give a picture of the cell interaction with NPs and with dissolved elements. By SC-ICP-MS, both Au NPs and ionic Au can be measured in lake algae, allowing for the study of cellular interaction and uptake. Cancers are affected by Platinum compounds, but they tend to develop resistance. By applying SC-ICP-MS to cell lines sensitive and resistance to cisplatin and observing differences in drug uptake and distribution among cells, the resistance can be studied and understood.

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**O-2-009**

**Blood transfusions as a source of exposure to heavy metals**



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Environmental pollutants present in the blood of blood donors are transferred to recipients of the blood. This has led to concern about possible harmful effects, especially on children receiving large transfusions. To investigate the extent of heavy metal exposure from blood transfusions, we measured whole blood concentrations of lead, mercury and cadmium in a total of 352 randomly selected blood donors in three Norwegian cities (Bergen, Tromsø and Kirkenes), using ICP-MS. Most donors had very low concentrations, but a few showed concentrations up to about 0.5 µmol/L, 130 nmol/L and 35 nmol/L for lead, mercury and cadmium respectively. There were strong positive correlations between metal concentrations and the age of the donors.

**Conclusion:** Selecting young blood donors may reduce the risk that small children are given blood containing possibly toxic amounts of heavy metals. To eliminate the risk, heavy metals in the donated blood must be measured.

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**O-2-010**

**Ultraclean paired sampling for metal studies in neurodegenerative disorders**



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Exposures to metals with neurotoxic properties seem to contribute to neurodegenerative disorders. Paired sampling implies simultaneous lumbar puncture and venipuncture and analysis of metal concentrations in cerebrospinal fluid and blood and paired sampling allows for conclusions about barrier properties. Yet previous studies of metal concentrations in these compartments have given variable results and brought contamination issues to the fore. Thorough quality control and ultraclean sampling techniques are necessary for reproducible and internationally comparable results. Nitric acid washed perfluoroalkoxyalkane vials rinsed with ultraclean high polarity water, an operation room equipped with high efficiency particulate arresting air filters and an air-lock system allowing only filtered air into the sampling room are recommended. Nonsmoking assisting nurses without nail polish or mascara are mandatory, as is protective draping of the patient. Details of ultraclean sampling techniques are presented.

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**O-2-011**

**Consequences of Aluminum exposure on higher cognitive functions**



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Aluminum (Al) is known for its neurotoxic effects on cholinergic system; however, the exact mechanism is unknown. We studied the neurotoxic mechanisms of Al on cholinergic system. Mice were treated with AlCl<sub>3</sub> (250 mg/kg) through oral route for 42 days. Learning and memory, acetylcholine levels, gamma oscillations were assessed in Al-treated animals. Results showed impaired memory and poor adaptation to new environment in Al-treated animals (*n* = 9) compared to the control. High Al deposition and severe neurodegeneration was observed in Al-treated animals (*n* = 8) compared to control. The acetylcholine levels in cortex and hippocampus (*n* = 4) were significantly reduced in Al-treated vs. the control group. Al treatment caused permanent damage in hippocampal circuit and blocked facilitatory effect of nicotine on gamma oscillation (*n* = 6). These results indicated that neurotoxicity induced by oral exposure of Al caused reduced memory, elevated anxiety and impaired adaptation to a new environment. This study will help to understand the possible mechanism of cognitive decline induced by Al.

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**O-2-012**

**Influence of aluminum on the gene expression; interaction of aluminum with GATA binding transcription factor**



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It was reported that the risk of hypertension increased in the aluminum exposure in manufacturing employees. The up-regulation of the renin expression by aluminum is a strong indication of the influence of aluminum on the renin-angiotensin-aldosterone system (RAAS), resulting in possible induction of essential hypertension. RAAS was assumed to relate to the production of erythropoietin in kidneys under the inhibitory binding to the promoter by GATA2. In the present report DNA binding to GATA2-C terminal domain and complete inhibition by aluminum was shown by EMSA. The complete inhibition of DNA binding to GATA2-C terminal domain by aluminum was also observed by the measurement of CD spectra and SPR of the protein domain. GATA2 may have an important role in the process of the regulation of the expression of renin gene and may be susceptible to aluminum.

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## O-2-013

**Para-aminosalicylic acid in the treatment of manganese toxicity**

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Manganese excess associated with occupational and environmental exposure can induce acute effects, with a syndrome known as manganism, similar for a number of symptoms to Parkinson's disease. A possible remedy should be chelation therapy. Para-aminosalicylic acid (PAS) in its use in China demonstrated effective in reducing symptoms of manganism. There is evidence of a N-acetylated metabolite (AcPAS) that seems effective in reducing manganese levels in brain. Based on these reports we studied the protonation and the complex formation equilibria of PAS and of AcPAS with the target metal ion Mn<sup>2+</sup>. This study has documented a substantial Mn chelating potential of both ligands. In the actual case, the metabolism of PAS leads to a derivative with unusual stronger chelating ability than the parent molecule. It is presumed that the relatively small molecule Ac-PAS can penetrate across the blood-to-brain border and exert its Mn<sup>2+</sup> mobilizing action intracellularly.

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## O-2-014

**Intranasal exposure to silver nanoparticles (SNP) in rats induce silver deposition in the striatum**

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SNP are widely used in medicine as they have a high antibacterial activity. In mammals, SNP penetrate the organism via the respiratory tract. While SNP in vitro can cause oxidative stress, damage of DNA, inhibition of mitochondrial activity. It is known that neurons are particularly sensitive to these processes. The goal of this study was to detect brain regions, which is the most sensitive to the SNP. The investigation was done on 25 male Wistar rats. SNP were applied for 30 days with single intranasal injection per day. Levels of silver were measured in different brain regions: olfactory bulbs, frontal cortex, hippocampus, striatum, cervical spinal cord. Silver from nanoparticles accumulates mainly in the striatum and to a lesser extent in the hippocampus. In parallel, blood copper status and distribution silver in rat body were determined. The potential toxicity properties of SNP are discussed.

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## O-2-15

**Intranasal exposure to manganese induces inflammation, oxidative stress and activation of calpains in rat brain**

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Inhalation of manganese (Mn) leads to depletion of dopamine and deterioration of motor function. The goal of this study was to assess factors involved in Mn-induced neurodegeneration. Mn-exposed rats received intranasal injections of 1 mg MnCl<sub>2</sub> once per day, for 10 weeks. Mn was 2-fold elevated in the olfactory bulb, temporal lobe, hippocampus and 4-fold for striatum. We found time-dependent decrease in SOD3 level, 2.5-fold increased IL-1 $\beta$ , TNF- $\alpha$  mRNA expression and 5-fold increased IBA-1 mRNA indicating the induction of inflammation in the rat striatum. In addition, we found increase in NF $\kappa$ B level, in m-/ $\mu$ -calpains mRNA, protein and activity levels (directly induced by Mn) in the rat striatum indicating neurodegeneration. We did not detect such changes in the hippocampus. The work was supported by RFBR 17-04-01043.

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## O-2-016

**Lysosomes and concentration of gadolinium in brain**

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Gadolinium (Gd) a lanthanide which is used in medicine and industry. So, many studies have shown the toxicity of this element in different organs but not the brain. The purpose of our work is to localize the Gd in the brain, determine the cells involved in the concentration of Gd, specify the organelles involved in the concentration of Gd and show possible lesions induced by the accumulation of Gd. Wistar rats were used. A first group received a soluble solution of Gd, the second is serving as control. 24 h after the last injection all rats were anesthetized, brain was then removed, animals were sacrificed. The ultrastructural study showed the presence of charged lysosomes of electron dense material in nerve cells, oligodendrocytes and axons. Our results confirmed previous work showing that Gd precipitates similarly in the lysosomes of different cellular varieties such as: mammary glands, kidney and hepatic cells always associated with phosphorus. In conclusion, alteration of the endoplasmic reticulum and mitochondria has been reported.

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## O-2-017

**Biophysical studies of the amyloid- $\beta$  peptide and interactions with lead (Pb) ions**

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The mechanisms for the pathology of Alzheimer's disease (AD) is still not known. Alzheimer's disease belongs to the category of 'misfolded protein diseases', and on the molecular level characterised by cerebral senile plaques that consist of insoluble amyloid- $\beta$  (A $\beta$ ) peptides aggregated into amyloid fibrils. Disturbed metal homeostasis of endogenous metal ions is another characteristics of AD. The self-assembly of monomeric A $\beta$  peptides into ordered structures is modulated by certain metal ions. Low concentration of lead, a well-known toxic metal, has been observed in senile plaques. From a combination of spectroscopic methods such as nuclear magnetic resonances and fluorescence spectroscopy, we here report changed biophysical properties and aggregation kinetics of A $\beta$  caused by Pb(II) and Pb(IV) ions. Pb(IV) ions show a specific A $\beta$  binding mode and modulates the aggregation process. The relevance of the molecular observations is discussed in relation to AD and will be further studied in more details.

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## O-2-018

**Mercury and Alzheimer's disease: Hg(II) ions display specific binding to the amyloid-beta (A $\beta$ ) peptide**

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Growing evidence links metal exposure to neurodegenerative diseases such as Alzheimer's disease (AD), yet the role of metals in AD pathogenesis is unresolved. AD pathology involves deposition inside the brain of amyloid plaques, consisting mainly of aggregated amyloid- $\beta$  (A $\beta$ ) peptides. These peptides specifically bind metal ions such as Cu(II) and Zn(II), and such binding modulates A $\beta$  aggregation. Here, we use nuclear magnetic resonance (NMR) spectroscopy to show that Hg(II) ions bind to the N-terminal part of the A $\beta$ (1–40) peptide. Circular dichroism (CD) spectroscopy, solid state atomic force microscopy (AFM), and fluorescence spectroscopy measurements confirm that Hg(II) ions strongly affect the A $\beta$  peptide's aggregation into amyloid fibrils. This suggests that AD metal chemistry likely is more complex than previously thought. Our results may be of direct medical importance given the human exposure to mercury from e.g. tooth fillings.

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## O-2-019

**Combination therapy with HEDTA along with micronutrients against aluminium exposed rats**

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The toxicity of aluminium (Al) in humans and animals by different routes exposure. The leaching of Al due to the increased use of it in packaging of foodstuffs the potential source of contamination is higher which accumulate in human. It is inhibitor of essential elements of similar characteristics. The aim of the study was therapy micronutrients with N-(2-hydroxyethyl) ethylenediaminetriacetic acid (HEDTA) was given against Al in rats. Aluminium nitrate (32.5 mg/kg, i.p.) was administered to rats, treated with HEDTA along with Fe/Mg for 3 days. The activity of AChE was inhibited in brain. Significant rise was noted in the AST, ALT and creatinine whereas serum protein and albumin was found to be decline after toxicant exposure. TBARS level was significantly higher and total glutathione content were lower during toxicity. Decrease in activity of various enzymes viz. SOD, ATPase, G-6-Pase and SDH were seen. Combination therapy showed over all improvement in the biochemical and histopathological changes in liver, kidney and brain. In conclusion, combination of HEDTA + Fe showed better protection than HEDTA + Mg.

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## O-2-020

**Manganese exposure regulates exosome-mediated extracellular miRNAs in cell culture model of Parkinson's disease**

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To determine the role of manganese (Mn) in Parkinson's disease (PD)-like neurological disorders, we characterized the effect of Mn on  $\alpha$ -synuclein ( $\alpha$ Syn) and its exosomal release using a dopaminergic cell model of PD. Mn exposure in human  $\alpha$ Syn-expressing dopaminergic cells induced the release of exosomes prior to cytotoxicity. Our miRNA profiling of Mn-exposed exosomes led to the discovery of increased expression of certain miRNAs that regulate key biological pathways, including protein misfolding and inflammation. Collectively, our results provide a glimpse of how Mn modulates extracellular miRNA content through exosomal release from dopaminergic neuronal cells, thereby potentially contributing to progressive neurodegeneration. Further characterization of extracellular miRNAs and their targets will have major impacts on biomarker discovery and translational strategies for environmentally linked neurodegenerative diseases including PD [ES026892 and ES019267].

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O-2-021

### Manganese exposure induces neuroinflammation by impairing mitochondrial dynamics in astrocytes



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Mitochondrial dysfunction and oxidative stress have been linked to manganese (Mn)-induced neurotoxicity. Astrocytes serve as a major target of Mn neurotoxicity, but the cellular mechanisms underlying Mn-induced astroglial dysfunction are not completely understood. Herein, we examined the interrelationship between mitochondrial dysfunction and astrocytic inflammation in an *in vitro* model of Mn neurotoxicity. Mn significantly impaired both the basal and ATP-linked respiration rates as well as mitochondrial mass and energy production in astrocytes. Furthermore, Mn exposure in astrocytes stimulated the release of proinflammatory cytokines and exacerbated  $\alpha$ -synuclein-induced neuroinflammation. Lastly, the antioxidant mito-apocynin dampened Mn-induced inflammatory gene expression, further supporting the role of mitochondrial dysfunction in astroglial toxicity. Collectively, we demonstrate for the first time that Mn drives proinflammatory events in astrocytes by impairing mitochondrial bioenergetics (NIH grants ES026892 and NS088206).

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O-2-022

### Brain metal distribution and neuro-inflammatory profiles after chronic vanadium (V) administration and withdrawal in mice



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**Objective:** To study micro spatial distribution of V and cellular injury profile after chronic vanadium exposure.

**Methodology:** A total of 85 male BALB/c mice were divided into three major groups of V treated, matched controls, and withdrawal group. LA-ICP-MS, histology staining, and immunohistochemistry for microglia (Iba-1), astrocytes (GFAP), neurons (Neu-N) and Neu-N + nucleus double labelling immunofluorescence were done.

**Results:** There was progressive increase in V uptake in exposed mice with regional variability. The withdrawal brains (15 months after) still showed presence of V in the brain. There was cellular degeneration and glial cells activation in V exposed animals relative to the control. With exposure into latter age, the evident neuropathology was microgliosis, while progressive astrogliosis became more attenuated.

**Conclusion:** Chronic administration of vanadium in mice resulted in accumulation which showed regional variability with time. The metal load and pathological effects were in most part eliminated from the brain even after a long time withdrawal of V.

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O-2-023

### Chemical imaging of environmental samples with fast X-ray fluorescence microscopy



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X-ray fluorescence microscopy (XFM) is ideal for quantitatively map trace elements in plant, biological and environmental samples across length scales from mm to nm. The high sensitivity and penetration of XFM allows analysis with a minimum of sample preparation. Fast, efficient X-ray fluorescence detection, pioneered by the Maia detector system at the Australian Synchrotron, enables high definition mapping approaching megapixel per minute rates. Rapid acquisition allows higher-dimensional studies such as fluorescence tomography and X-ray absorption near edge structure (XANES) imaging which maps the oxidation state or chemical speciation with spatial context. XANES imaging was first demonstrated in a geochemical context and has been applied with micron resolution and moderate definition across diverse fields from environmental chemistry to arsenic toxicity in crops. Recent studies visualizing *in vivo* coordination environments of metals in biological systems and demonstrating the efficiency and sensitivity at environmentally relevant concentrations will be presented.

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O-2-024

### Determination of cobalt and cyanocobalamin in urine by HPLC-ICP-MS



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Effective from the 1st January 2015, cobalt was listed as a prohibited substance in international athletics. It was cited as a hypoxia-inducible factor (HIF) stabilizer by the World Anti-Doping Agency (WADA). The International Federation of Horseracing Authorities has also limited the use of cobalt. As cobalt is an essential co-factor in cyanocobalamin (vitamin B<sub>12</sub>), WADA have noted that cyanocobalamin is not prohibited. The aim of our study was to develop a method that would be suitable for testing athletes for cobalt misuse. This was achieved by coupling HPLC separation with ICP-MS detection. Using a Hamilton PRP-1 Reversed Phase (150 mm × 4.1 mm; 5  $\mu$ m particle size) column and a mobile phase of 30% (v/v) methanol adjusted to pH 9.0 with ammonium, we could separate inorganic cobalt from cyanocobalamin. The high sensitivity and specificity of ICP-MS detection enabled us to quantitatively determine the concentration of cyanocobalamin in urine when both inorganic cobalt and cyanocobalamin were present.

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## O-2-025

**Mass balance studies of iron without the need of subsampling using Large Sample Neutron Activation Analysis**

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**Objective:** A assessment of iron in food without subsampling using Large Sample Neutron Activation Analysis (LS-NAA).

**Materials and methods:** Fe was measured both in approximately 1 kg freeze-dried food as well as in moist products. A (commercially available) porridge fine wheat grain was used as a reference sample (assumed to be homogeneous in the Fe content). The amount of Fe in the fine wheat grain was also measured using traditional INAA.

**Results and conclusion:** The results obtained for the moist sample were statistically equivalent to those found for the dried sample ( $73.1 \pm 4$ ,  $74 \pm 3$  mg/kg, respectively). The moisture content of the fresh food did not cause any problem during the irradiation such as radiolysis and excessive gas formation due to low radiation dose. The applicability of LS-NAA was further illustrated by measurement of Fe in commercially available microwave meals which was found to be  $30 \pm 2$  mg/kg. LS-NAA is a novel and attractive approach for measurement of element content of the dietary intake by the double portion technique collected during 5–7 days in mass balance experiments.

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## O-2-026

**Elemental bioimaging in bone by micro-X-ray-fluorescence spectroscopy ( $\mu$ XRF)**

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Bone tissue is the largest depot of minerals in human organism. Therefore, bone health and integrity depend on the balance of major, minor and trace elemental constituents of bone. Our group in Atominstut, Vienna has expertise in elemental imaging of biological tissues, especially bone (including studying trace elements in disease), using the most advanced nondestructive method of  $\mu$ XRF. The technique allows determination of spatial distribution of elements on micrometer scale. The results of following projects will be presented: (1) The project performed in our laboratory is dedicated to bioresorbable magnesium-based orthopedic implants and their influence on bone tissue during degradation process. Interestingly, one of the implant components, yttrium was found to migrate further into bone over time and to remain in tissue even after the complete degradation of the implant. (2) Examination of manganese in male osteoporosis showed the tendency of lower manganese levels in osteoporotic samples compared to healthy controls. (3) Study of human osteosarcoma revealed increased zinc content in tumorous in comparison to healthy tissue.

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## O-2-027

**X-ray fluorescence determination of zinc**

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Currently zinc compounds are considered as independent medicinal products. Thereby the development of new methods of this microelement's analysis is required. X-ray fluorescence analysis – is one of the most convenient and accessible nondestructive methods. EDX-7000 (Shimadzu, Japan) spectrometer with the range of elements determination from Na to U was used for the research. Spectra were recorded with an X-ray tube with the Rh-anode at high voltage of 5–50 kV, amperage from 1 to 1000  $\mu$ A. To receive particles of certain size ( $37 < d < 63 \mu\text{m}$ ) we controlled the dispersity using granulometry and lactose homogenization. Mixing the sample of  $\text{ZnSO}_4$  with lactose of given dispersity we constructed the calibration curve, which allowed to assess some metrological characteristics of method, e.g. the correlation coefficient ( $R = 0.99$ ), errors and the limit of detection ( $1.0 \times 10^{-4}\%$ ). These metrological characteristics were also determined for other matrix of organic-nature.

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## O-2-028

**Feasibility of measuring zinc in human nails using X-ray fluorescence**

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A number of adverse health effects have been identified as resulting from zinc deficiency. Zinc supplementation may therefore be indicated for certain populations or individuals. A rapid and straightforward means of assessing zinc intake in humans would be of considerable medical benefit. We tested the feasibility of measuring zinc levels in human fingernails or toenails, using a portable X-ray fluorescence technique. Whole nail models (or phantoms) were first constructed from resin, and dosed with various concentrations of zinc. These different concentration “nails” were then cut into small slices. The re-combination of these various slices into different configurations allowed the modeling of different time-dependent zinc exposure scenarios. Using a portable X-ray fluorescence device, we tested whether the zinc signal received could differentiate between these various exposure scenarios. The X-ray fluorescence approach was found to be highly sensitive and capable of differentiating between realistic exposure histories.

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O-2-029

**Biological monitoring of toxic metals in occupational health**

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The Australian Work Health and Safety (WHS) Act places a duty of care on persons conducting a business to monitor the health of workers. Exposure to toxic metals can cause serious health effects such as cancer, reproductive defects, kidney or liver damage and neurological disturbances. Health surveillance usually includes biological exposure monitoring, involving the measurement of metal levels in body fluids. In Western Australia maximal action levels are based on the American Conference of Governmental Industrial Hygienists [ACGIH]. Biological Exposure Indices [BEI] are revised annually and extensively quoted internationally. The legislation stipulates that health surveillance is supervised by a registered medical practitioner with experience in health monitoring. The laboratory providing a biological monitoring service for toxic metals should provide the following services: (1) a recommendation for the appropriate sample relevant to each metal; (2) determine what indices or cut-offs will be quoted with the results; (3) consider providing an analytical method which includes metal speciation where appropriate; (4) participate in an external quality control scheme.

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O-2-030

**The impact of seawater physico-chemical parameters and sediment metal contents on the mussel's heavy metal concentrations – A chemometric approach**

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The concentrations of 15 elements were studied in the mussel *M. galoprovialis* collected in four different seasons at three locations from the coastal area of Montenegro. The impact of a seawater temperature, salinity, O<sub>2</sub>, total organic carbon, and metals contents in sediments samples on the metal content in mussels was analyzed. By statistical analysis it was found that the temperature and salinity had no impact only on Hg concentration. In mussels Hg concentration depended on the total organic carbon and O<sub>2</sub>. The results showed good discrimination between the mussel samples taken from different seasons. Metal content in sediments did not impacted metal content in mussels directly.

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O-2-031

**Biomonitoring of trace elements and minerals trace in children living in Chelyabinsk region**

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**Introduction:** Human biomonitoring is well-recognized tool for estimating the exposure of population to environmental pollutants. The aim of this study is to obtain on the impact of environmental pollutants of the environment on the content of trace elements and minerals in the biological samples of the children population in Chelyabinsk region.

**Methods:** Biological samples (blood and hair) of 258 children 13–16 aged living in Karabash and control territories (Varna, Tomino) were tested using inductively coupled plasma mass spectrometry.

**Results:** Maximum high levels of toxic elements As, Cd, Pb were in whole blood samples of children, living near smelting plant. Blood Ca and Mg content in children from Varna exceeded the respective values from Tomino and Karabash by 32% ( $p = 0.021$ ) and 42% ( $p < 0.001$ ), and 19% ( $p < 0.001$ ) and 9% ( $p < 0.001$ ).

**Conclusion:** Comparative analysis of blood and hair could be recommended as non-invasive biomonitoring in children and adolescents living in adverse environmental conditions.

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O-2-032

**Trace elements in marine aerosols**

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We have investigated trace elements concentrations in the marine aerosols of Arctic, Atlantic oceans and seas. The samples collected in highland regions of the Arctic Ocean are considered as background values: the least levels of concentrations typical of Cd and Pb ( $\sim 0.01$  ng/m<sup>3</sup>), the highest ones—of Al, Fe, and Zn ( $\sim 100$  ng/m<sup>3</sup>). The composition of the aerosol of coastal areas of the Black, Caspian, and Baltic Seas is more varied: the concentration of the elements constitutes from 1 to 10<sup>6</sup> ng/m<sup>3</sup>. Sometimes the concentration of Ni, Fe, and Cr exceeds the safety levels for the air of the working areas of industrial enterprises (up to 5 mg/m<sup>3</sup>). Thus, marine aerosol may be the main source of trace elements for human beings in the coastal areas of the seas.

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**O-2-033**

**Respiratory complex II inhibitors as tools to study trace element toxicity**



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We tested action of a few complex II (CII) inhibitors on metals/metalloids-induced toxicity using isolated rat liver mitochondria (RLM) and two rat cell lines, ascites hepatoma AS-30D and neuron-like PC12. We found that malonate (dicarboxylate-binding site inhibitor) improved respiratory function of RLM energized by CI substrates, namely it partially restored respiration in state 3 and maximally uncoupled respiration disturbed by Cd<sup>2+</sup> and smoothed over Cd<sup>2+</sup>-induced changes in basal and resting state respiration rates of RLM energized by CI or CII substrates. Malonate did not affect RLM swelling produced by Cd<sup>2+</sup>, Hg<sup>2+</sup>, Cu<sup>2+</sup>, Zn<sup>2+</sup>, or Ca<sup>2+</sup> in sucrose media in the presence of CIV substrates while it enhanced the selenite-induced one. Malonate exhibited some protection against Cd<sup>2+</sup>-evoked necrosis of AS-30D and PC12 cells and decreased ROS production promoted by Cd<sup>2+</sup> in PC12 cells. Thenoyl-trifluoroacetone (Q-binding site inhibitor) per se induced AS-30D cells apoptosis that inhibited by co-incubation with Cd<sup>2+</sup>. Decylubiquinone did not protect the cells against necrosis but modulated apoptosis produced by Cd<sup>2+</sup>.

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**O-2-034**

**Cadmium exposure and associated factors among a general population from Southern Brazil**



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Cadmium is a toxic metal widely distributed in the environment. The aim of this population-based study was to evaluate the socioeconomic, environmental, and lifestyle determinants of blood cadmium in Brazilian adults. A total of 959 adults, aged 40 years or older, living in a city in Southern Brazil, were randomly selected. Socioeconomic, dietary, lifestyle and occupation background was obtained by interviews. Blood cadmium was measured by ICP–MS. The geometric mean (GM) of blood cadmium was 0.39 µg/L (95%CI, 0.38–0.41). In the adjusted multivariate analysis, the ratio for GM blood cadmium was significantly higher in former smokers (1.17; 95%CI, 1.04–1.30) and in current smokers (2.43; 95%CI, 2.14–2.76) compared with non-smokers, and was close to significance in participants with higher blood lead levels (1.09; 95%CI, 1.00–1.19).

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**O-2-035**

**Human exposure analysis of vanadium and arsenic in hair and nails**



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Vanadium and arsenic levels were evaluated in scalp hair, fingernails and toenails from participants living in Río Negro (low exposure) and La Pampa (high exposure). This study investigated the influence of the ingestion of high levels of these elements via drinking water, on the participants' biological tissues, and therefore on their health status. Hair, fingernails and toenails were used as biomarkers as they are non-invasive and can be reliably used to evaluate the levels of vanadium, arsenic and other trace elements, and their correlation to health disorders. The elemental levels in human samples from La Pampa showed significantly higher median values, compared to Río Negro, for vanadium and arsenic in hair, fingernails and toenails. The study found that vanadium levels exceeding the proposed normal level in 85% of the hair samples, 66% of the fingernails and 80% of the toenails. Similarly, arsenic levels were found exceeding the reported reference range in 61% of the hair samples, 65% of the fingernails and 76% of the toenails. A significant correlation was found between the levels of vanadium/arsenic and health problems.

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**O-2-036**

**Low level mercury exposure, neurodevelopment and genetic polymorphisms in Slovenian and Croatian birth cohorts**



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Association between prenatal exposure to metals and health outcome may be modified by certain gene polymorphisms. In the present study, we evaluated association between prenatal exposure to mercury (Hg) and neurodevelopment in birth cohorts from Slovenia (*n* = 237) and Croatia (*n* = 124), taking into account relevant confounders (co-exposure to other metals, status of essential metal(loid)s, SES, smoking, etc.) and polymorphisms in genes involved in elimination of Hg or directly in neurodevelopment. Mercury was measured in cord blood and maternal hair; neurodevelopment was assessed using Bayley Scales of Infant and Toddler Development (3rd Ed.) at 18 months of age, genotyping was done by TaqMan pre-designed assays. Among the subgroups studied, significantly negative association between low-to-moderate Hg exposure and cognitive function was obtained for apolipoprotein E epsilon 4 carriers ( $\beta = -5.4, p = 0.043$ ), which indicates an importance of genetic component in risk assessment.

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## O-3-001

**Iodine deficiency in pregnancy and lactation and the effects of maternal iodine supplementation on the offspring**

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Iodine deficiency during pregnancy and infancy may irreversibly impair brain development and increase infant mortality. Iodine requirements in pregnancy and lactation are sharply increased and infants younger than 1 year are at high risk for iodine deficiency because their requirements per kilogram bodyweight for iodine and thyroid hormones are higher than at any other time in the lifecycle. Salt iodization remains the key strategy to control iodine deficiency in populations. But there is a question whether salt iodization, a mass fortification strategy, can cover the needs of pregnancy and infancy. In regions where iodized salt is not available or available only to a negligible extent, pregnant and lactating women, and infants should be supplemented with iodine. For pregnant and lactating women, WHO recommends either a daily dose of 250 µg as potassium iodide or one annual depot dose of 400 mg as oral iodized oil. Recent studies have examined the efficacy of these recommendations for pregnant and lactating women, and the findings will be presented in this lecture.

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## O-3-002

**Serum and hair trace element levels in children with autism spectrum disorder (ASD)**A.V. Skalny<sup>1,3,\*</sup>, N.V. Simashkova<sup>2</sup>, T.P. Klyushnik<sup>2</sup>, M.G. Skalnaya<sup>1</sup>, A.A. Tinkov<sup>1,4</sup><sup>1</sup> RUDN University, Russian Academy of Medical Sciences, Moscow, Russia<sup>2</sup> Scientific Center for Mental Health, Russian Academy of Medical Sciences, Moscow, Russia<sup>3</sup> Trace Element Institute for UNESCO, Lyon, France<sup>4</sup> Orenburg State Medical University, Orenburg, RussiaE-mail address: [skalny3@microelements.ru](mailto:skalny3@microelements.ru) (A.V. Skalny).

Hair and serum trace element levels in children with ASD ( $n = 140$ ) were assessed using ICP-MS. The obtained data demonstrate that ASD is associated with significantly higher hair levels of As, Cu, Fe, and Se, exceeding the respective control values by 29%, 8%, 5%, and 13%, whereas only serum Cu concentration was significantly higher (+8%). Boys were characterized by significantly increased hair Al (+60%), As (+35%), Cu (+25%), Fe (+25%), and Se (+9%) levels, whereas in girls only Se content was elevated (+15%) in comparison to the control group. Serum Al, Mn, and Ni levels were increased by 19%, 20%, and 20% in boys. In girls, only serum Cu (+20%) were elevated as compared to controls. Age also significantly affected hair and serum trace element levels. Therefore, it is highly recommended to evaluate the concentrations of trace elements in several bioindicative matrices to offer ASD patients an adequate personalized nutritional correction.

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## O-3-003

**Trace element concentrations in breast milk**

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Breast milk is the best source of nutrition for the newborn infant, and exclusive breast feeding is recommended by WHO up to 6 months of age. Human milk provides all the nutrients including essential trace elements, but can also be a potential source of elements which are dangerous for a baby, and their content reflects the environmental pollution and the mother's diet. The aim of this study is to provide updated information on concentrations of a wide range of essential, non-essential and toxic elements in human milk collected from a significant group of healthy lactating women living in Modena, Italy, together with information on dietary habits. Samples were collected between day 30 and 40 after childbirth, and the trace element concentrations were determined by ICP-Mass spectrometry. Preliminary results show that concentrations in human milk of Fe, Zn, Cu, Se and Mn are in line with reference WHO standard. No detectable levels of Pb were found, whereas Cd was detected in more than one third of mother's milk samples, although none in amount that could represent a health hazard.

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## O-3-004

**An Internet based strategy to precise iodine intake optimization**

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Improper iodine intake remains in the general population after the Universal Salt Iodization (USI) eliminated Iodine Deficiency Disorders in China. As iodine content in diets and the environment varies dramatically, a single level of table salt iodization does not fit everyone. By transforming the paper based Iodine Specific Food Frequency Questionnaire (I-FFQ) into an Internet-based App that calculates precise iodine intake with a food composition database, an accurate, fast, free and convenient self-evaluation tool is made available to the public as a simple individual guidance to choose from multiple levels of iodization salt. To achieve an optimal iodine intake, a tailored diet guidance is constructed from user's physiological data and diet trend as the feedback result, along with a table salt option suggestion. By prioritizing food with popularity and iodine concentration using data analyzed from thousands of I-FFQ surveys, we improved App usability. Revising USI with the combined strategy of our App and multi-level salt iodization, optimal iodine intake can be easily achieved. Grant Nos. NSFC81330064, UNCEF, 14ZCZDSY00022, 15KPXM01SF037.

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## O-3-005

**Trace elements and anti-oxidants in cancer treatment**

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Except for platinum and in a minor indication arsenic, trace elements have not yet been fully recognized as pharmaceutical anticancer drugs. Like anti-oxidants, some of them are used as nutritional supplements, either to prevent cancer but with many unsuccessful studies, or in cancer patients but without real proof of efficacy. We shall try to consider how it could be possible to improve these results. Pharmacological and toxicological studies could help to determine the best schedule of treatment. However, it is on the use of identifying relevant biomarkers to monitor the treatments that we shall emphasize. Cancer cells have a pro-oxidant status, but with great differences according to the type of cancer, the histology, the staging, and they also vary after chemotherapy or radiotherapy. It could thus be useful to characterize the oxidative status in cancer patients and then to adapt the doses of selected trace elements and/or anti-oxidants to the levels of markers of the oxidative stress. Discussions will be opened on the best markers to assay in the plasma of cancer patients. It could be the same approach for other targets than the redox potential.

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## O-3-006

**Recent developments and recommendations in trace element requirements in beef cattle**J.S. Caton<sup>1,\*</sup>, T.E. Engle<sup>2</sup>

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Trace elements have long been identified as essential components in the diets of beef cattle and are required for many biochemical reactions and physiological processes. The objective of this review is to briefly discuss recent developments and recommendations in trace element nutrition in beef cattle. Recently, research committees on two continents have reviewed the literature and updated their nutrient requirements, including trace elements, for beef cattle. Primary publications arising from these efforts, Nutrient Requirements of Beef Cattle (NRC; 8th Edition; 2016), and Nutrient Requirements of Zebu and Crossbred Cattle (Br-Corte, 3rd Edition, 2016) provide current recommendations. Recent data on gene expression of metal binding proteins in developing bovine embryos will be presented. Dietary cobalt requirements for beef cattle were increased from 0.10 to 0.15 mg Co/kg DM, and maximum tolerable concentrations of certain minerals have changed in the NRC. Future research needs in trace element research for beef cattle will be provided with associated implications on meeting projected future world food demands.

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## O-3-007

**Factors affecting trace element content of cow milk and cheese**

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Milk provides significant quantities of essential trace elements (TE) such as iodine, selenium and zinc via chemical species with a high bioavailability. In cow feeding experiments and field studies, the relationship between the content of TE in feed and milk was investigated. Samples, freeze-dried, were analysed for the above-mentioned TE by ICP-MS, hydride AAS and ICP-OES. There was a dose response for iodine and selenium. Rapeseed feeds lower iodine concentrations in milk, which is caused by isothiocyanates and further derivatives of glucosinolates acting as iodine antagonists. Manufacturing of cheese results in an equilibrium of ionic iodine present in cheese and whey, while selenium or zinc accumulate in the cheese only. Based on these results, recommendations for the iodine and selenium content in cow feed will be discussed in the context of optimizing TE concentrations in milk and milk products to meet the TE requirement of humans. In Germany at present, the selenium supplementation of the cow feed is sufficient or at an upper margin, contrasting with a relatively low feed-iodine supplementation and thus a too low milk iodine content.

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## O-3-008

**Trace minerals in ruminants**

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In ruminants microbial digestion in the rumen precedes mammalian digestion in the abomasum and small intestine. The pH in the rumen environment is only slightly acidic (6.0–6.8) and interactions with microorganisms and metabolites produced during rumen fermentation results in many minerals existing in insoluble forms. Some of the metal complexes formed in the rumen remain insoluble even under acidic conditions, and are poorly available for absorption in the small intestine. Recent research has focused on the regulation of transporters involved in iron (Fe) and copper (Cu) metabolism. The major intestinal Fe import transporter, divalent metal transporter 1 (DMT1), can also import manganese (Mn) into the small intestine. Competition for DMT1 may explain the antagonistic interaction that occurs between Fe and Mn. Differences among cattle breeds in Cu metabolism have been related to differences in expression of certain Cu transporters. Studies have indicated that chromium (Cr) supplementation of cattle diets can increase insulin sensitivity. Responses (increased immunity, milk production, growth) to Cr supplementation are greatest under stress or other conditions that decrease insulin sensitivity.

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O-3-009

**Effect of injectable trace minerals vs. adjuvant on measurements of innate and humoral immune responses of beef heifers**Luana S. Caramalac, Philippe Moriel,  
Luis F.A. Artioli, John D. Arthington\**University of Florida, Range Cattle Research and Education Center, Ona, USA**E-mail address: jarth@ufl.edu (J.D. Arthington).*

Innate and adaptive immune responses are impacted by the trace mineral status of beef cattle. Previous studies have revealed increased acute phase protein responsiveness and neutralizing antibody titers in calves provided injectable trace minerals (ITM) simultaneously to a novel antigen. It is unclear if this response is the direct result of increased trace mineral status or an adjuvant-like activity resulting from ITM administration. The objective of the current study was to compare the proinflammatory response of growing beef heifers receiving a 2.5 mL s.c. injection of ITM (60, 10, 15 and 5 mg/mL of Zn, Mn, Cu and Se) or a squalene-based oil-in-water adjuvant (ADJ) simultaneously to two 5-mL i.m. injections of a porcine red blood cell (PRBC) solution. Results reveal increased Se status among heifers receiving ITM vs. ADJ. Although both ITM- and ADJ-treated heifers experienced a proinflammatory reaction, heifers receiving ADJ had greater acute phase protein concentrations and neutralizing antibody titers to PRBC challenge.

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O-3-010

**Practice guideline for zinc deficiency**H. Kodama<sup>1,\*</sup>, H. Itakura<sup>2</sup>, H. Ohmori<sup>3</sup>,  
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T. Hosoi<sup>8</sup>, H. Yosida<sup>9</sup><sup>1</sup> *Teikyo Heisei University, Tokyo, Japan*<sup>2</sup> *Emirio Moriguchi Clinic, Japan*<sup>3</sup> *National Hosp Organization Yanai Medical Hosp, Japan*<sup>4</sup> *Shiga University Medical Science, Japan*<sup>5</sup> *Osaka Shouin Women's University, Japan*<sup>6</sup> *Kanazawa University, Japan*<sup>7</sup> *National Center for Chill Health Develop., Japan*<sup>8</sup> *National Hosp Geriatric Med, Japan*<sup>9</sup> *Jikei University, Japan**E-mail address: kodamah2018@gmail.com (H. Kodama).*

Although zinc deficiency is often observed, it is less known in clinical practice. Thus, a task force of mineral nutrition in Japanese Society for Clinical Nutrition developed clinical practice guideline for zinc deficiency. The diagnostic criterion is based on symptoms of zinc deficiency such as dermatitis, alopecia, short stature in children, taste abnormality and so on as well as the serum zinc level. Zinc deficiency and marginal deficiency are diagnosed by the serum zinc levels of less than 60 µg/dL and 60–80 µg/dL, respectively. For the treatment of zinc deficiency, zinc of 50–100 mg/day in adults, and 1–3 mg/kg/day in children are recommended. Zinc deficiency is often observed in patients with chronic liver diseases, diabetes mellitus, chronic inflammatory bowel diseases or chronic kidney diseases. In such cases, treatment with zinc improves conditions of the basic diseases.

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O-3-011

**Comparison of zinc and copper status in subjects with and without metabolic syndrome**Susan Darroudi<sup>1,1</sup>, Maryam Tayefi<sup>2,1</sup>,  
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The prevalence of the metabolic syndrome using IDF guidelines in an Iranian population is 32.1%. Metabolic syndrome increases cardiovascular morbidity and mortality. It has been reported that zinc and copper levels develop chronic diseases such as metabolic syndrome and CHD. We compared serum zinc and copper levels of 5000 subjects (MASHAD study data) with and without metabolic syndrome. Subjects, who have normal plasma level of copper, were at risk of zinc deficiency. Plasma copper did not correlate with any of the metabolic syndrome components, while zinc levels correlated positively with all the components. These findings suggest that serum zinc levels might be associated with metabolic syndrome.

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O-3-012

**Trace elements and cell membranes at pregnancy**S.V. Suprun\*, G.P. Evseeva, T.N. Larina,  
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The technique of erythrocytes transformation as the general model for assessment of the susceptibility of cell membranes to the effect of toxic elements (Pb, Ni), and essential element (Se) in vitro has been used to estimate individual sensitivity of the organism of pregnant women ( $n=453$ ) to the influence of trace elements. We have noted the increase in transition and destructive forms of erythrocytes in association with I, Se, Cu, Fe deficiency. Indigenous women and city newcomers have the 1.7–2.0-fold higher number of degenerative forms under the influence of Pb in vitro, decreased the level of discocyte to 40% under the influence of Ni in vitro. Women from the industrial part of the city have higher transformation, than pregnant women from the ecologically favorable area, especially when exposed to Pb. Se positively influences erythrocyte transformation in rural women's blood. Data should be used in early diagnoses and reasonable correction at various pathology, influence of heavy metals in excess or small doses in the chronic mode.

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**O-3-013**

**The metal-ligand homeostasis as a mechanism of ischemic stroke pathogenesis**



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The objective was to investigate the association between the concentrations of trace elements (TE) and brain damage biomarkers in the serum of patients with ischemic stroke and in the healthy group. TE levels were assessed using ICP–MS. The concentration of S100 protein, NR2Ab and VEGF was determined by enzyme immunoassay. Comparative analysis showed significant difference in the concentration of Se, Zn, Mn, Mg, Cu, Fe ( $p < 0.001$ ) and brain damage markers ( $p < 0.0001$ ) in serum. Correlation analysis revealed a significant association of these proteins with TE ( $p < 0.005$ ). The concentration of TE is significantly different at normal and elevated (abnormal) protein concentration ( $p < 0.0008$ ). The study confirmed the hypothesis of the significant role of the metal-ligand homeostasis in pathogenesis of ischemic stroke.

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**O-3-014**

**Molecular biomarkers for ischemic stroke: Vascular endothelial growth factor (VEGF) and trace elements**



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Optimizing content of trace elements (TE) is a possible way to reduce apoptosis in the ischemic processes in brain tissue. VEGF protein is a key mediator of angiogenesis, conjugated with neurogenesis. Serum TE levels in patients diagnosed with ischemic stroke (IS) were assessed using ICP–MS. VEGF concentration was evaluated by enzyme immunoassay. One of the possible techniques of the search is method of optimal valid partitioning (OVP), using permutation test for statistical verification. OVP methods shows the conjugation of the concentrations VEGF with Mg ( $p = 0.0015$ ); Mn ( $p = 0.0001$ ); Cu ( $p = 0.003$ ); Zn ( $p = 0.00005$ ). Therefore, interrelation between VEGF and TE levels may be indicative of role of trace elements in biochemical and molecular mechanisms of ischemic stroke pathogenesis.

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**O-3-015**

**Plasma zinc and inflammatory and lipid profiles in institutionalized elderly individuals**



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**Objective:** To evaluate plasma zinc and their associations with various factors in institutionalized elderly individuals.

**Methods:** Participants ( $n = 255$ ) were clinically assessed for lipid, glycemic, and inflammatory profiles, zinc intake and plasma zinc.

**Results:** plasma zinc concentration ( $\mu\text{g/dl}$ ) were distributed in four quartiles (Q1: $<71.1$ ; Q2: $71.1-83.3$ ; Q3: $<83.3-93.7$ ; Q4: $>93.7$ ). IL-6, TNF- $\alpha$ , total cholesterol, LDL-c and triglycerides were significantly higher in the Q1 compared to the other (total cholesterol and LDL-c (Q1>Q2; Q3; Q4); triglycerides and IL-6 (Q1 > Q3; Q4); and TNF- $\alpha$  (Q1 > Q3); all  $p < 0.05$ . Significant negative correlations were observed between plasma zinc and the time of institutionalization ( $p = 0.036$ ), IL-6 ( $p = 0.036$ ), TNF- $\alpha$  ( $p = 0.009$ ), total cholesterol ( $p < 0.001$ ), LDL-c ( $p < 0.001$ ) and triglycerides ( $p = 0.003$ ).

**Conclusion:** low plasma zinc concentration may contribute to worse inflammatory and lipid profiles in institutionalized elderly individuals.

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**O-3-016**

**Serum trace element levels in prediabetic and diabetic postmenopausal women**



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Serum from 80/65 prediabetic/diabetic postmenopausal women and 80 age-matched controls were examined for trace element content and markers of diabetes. Prediabetic subjects were characterized by increased serum Cu and Zn levels and increments of the ceruloplasmin (CP), higher glucose, Ins, HOMA-IR, HbA1c and ferritin. Serum Zn in type 2 DM was significantly lower ( $p < 0.001$ ) compared to controls. Serum Zn levels negatively correlated with insulin, HbA1c, and HOMA-IR values in diabetic women. Multiple regression analysis demonstrated a significant inverse association between serum Zn ( $\beta = -0.169$ ;  $p = 0.031$ ) and HOMA-IR values both in crude model incorporating all trace elements and in the model adjusted for anthropometric and biochemical parameters. Additionally, prediabetes and type 2 DM can be related to the non-bound CP Cu accumulation and intracellular Fe deposition. The present data indicate the role of Zn status in insulin resistance and impairment of  $\beta$ -cell function, whereas other trace elements may be involved in impaired glucose metabolism.

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O-3-017

### The effect of nutrition supplements on the level of some trace elements in the biomedical samples of patients with hepatitis virus in Egypt



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**Objectives:** To estimate hair, nail, blood, RBC and serum Fe, Cu, Zn and Se levels in hepatitis patients and evaluate the impact of nutrition therapy on levels of these elements and life quality.

**Methods:** 20 controls (10 males and 10 females) and 149 cases (47 chronic, 54 cirrhosis and 48 acute) were examined. The samples were analyzed for element content using ICP–MS.

**Results:** The mean Cu levels in patients with hepatitis virus were significantly higher than that of the control group, whereas, the mean Fe, Zn, and Se levels in the patients were significantly lower than those of the control group. On the basis of this study, we identified the impact of natural supplements to improve the treatment of viral liver damage, using the level of Fe, Cu, Zn and Se which might serve as biomarkers for increased survival and reduced disease progression.

**Conclusion:** Zn supplementation may be encouraged in patients with hepatitis C virus as it is an antioxidant and it is negatively correlated with liver damage parameters.

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O-3-018

### The relationship of Zn, Cu, Fe levels between serum, aorta and left internal mammary artery in atherosclerosis



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Trace elements are crucial for vital enzymatic reactions as zinc (Zn) being a co-factor for anti-oxidant enzymes; and copper (Cu) with iron (Fe) functioning in atherosclerotic lipid peroxidation through Fenton reaction. Aorta exposing high pulsatile pressure is sensitive for atherosclerosis because of its fast metabolism and poor oxygenation. We aimed to compare serum Zn, Cu and Fe levels with aortic and left internal mammary artery (LIMA) tissue levels in 33 patients inevitably underwent coronary artery by-pass graft operation (CBAG). Serum and tissue trace elements were measured by spectrophotometer. Aortic Cu and Fe levels were higher than serum levels. Aortic Fe level was higher than LIMA Fe. Pre-op Cu and Fe levels were higher than post-op. Our study points out that high aortic tissue Fe level has oxidative effects. LIMA has a natural protection with its directly luminal nutrition. In conclusion, serum Zn, Cu and Fe levels in CBAG patients might be monitored to reveal minor alterations for ameliorating the treatment.

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O-3-019

### Zinc status and cardiometabolic risk factors in metabolic syndrome



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We evaluate zinc status and their associations with cardiometabolic factors in patients with metabolic syndrome (MS). The study included 88 patients with MS and 37 controls. We performed clinical and anthropometric assessments, and evaluated zinc intake, plasma and erythrocyte zinc, and 24-h urinary zinc excretion. Zinc intake was significantly lower in the MS group ( $p < 0.001$ ). There were no significant differences in plasma zinc (all  $p > 0.05$ ) between groups. We found significantly higher erythrocyte zinc ( $p < 0.001$ ), and urinary zinc excretion in the MS group ( $p = 0.008$ ). There were significant associations between zincuria and fasting blood glucose ( $r = 0.479$ ), waist circumference ( $r = 0.253$ ), triglyceride ( $r = 0.360$ ), glycated hemoglobin ( $r = 0.250$ ), homeostatic model assessment–insulin resistance ( $r = 0.223$ ), and high-sensitivity C-reactive protein ( $r = 0.427$ ) (all  $p < 0.05$ ) in the MS group. Patients with MS had alterations in zinc metabolism mainly characterized by an increase in erythrocyte zinc and higher zincuria.

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O-3-020

### Characteristics of trace element excretions during continuous ambulatory peritoneal dialysis



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Limited studies have been reported on alterations of trace elements (TE) in continuous ambulatory peritoneal dialysis (CAPD). Our objective was to investigate and assess the characteristics of daily TE excretions in patients receiving CAPD. This cross-sectional study included 57 CAPD patients (nonanuric/anuric: 43/14) and 11 healthy subjects in Wuhan, China between 2013 and 2014. The dialysate and urine of patients and urine of healthy subjects were collected. The concentrations of chromium (Cr), manganese (Mn), copper (Cu), zinc (Zn), selenium (Se), molybdenum (Mo) and arsenic (As) in dialysate and urine were determined using inductively coupled plasma mass spectrometer. It was found that daily Cr, Mn, Cu, excretions in all patients and Zn, Se and Mo excretions in nonanuric patients were higher than healthy subjects, while As excretion in anuric patients was lower. Our findings indicated that CAPD patients may suffer from deficiency of some essential TEs, while anuric patients are at risk of As accumulation.

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## O-3-021

**Metallothioneins polymorphisms and trace elements in pregnant females (PHIME study)**

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Various functions of metallothioneins (MTs), proteins involved in metal(loid)s homeostasis and detoxification and cellular protection from oxidative stress, could be modified by single nucleotide polymorphisms (SNPs). The purpose of the study was to estimate associations between genotypes of 12 selected MT SNPs (*MT1a*, *MT1b*, *MT1e*, *MT1f*, *MT1g*, *MT1x*; *MT2a*; *MT3*; *MT4*) and trace elements (As, Cd, Pb, Hg, Zn, Cu, Se, Mn, Ca, Fe, Mg) in coastal Croatian cohort of pregnant females ( $n=205$ ;  $\bar{x}=30$  years; 3rd trimester). Venous DNA extracts were used for SNP genotyping by TaqMan assays while the concentrations of trace elements were determined in blood, serum, plasma, urine, hair and maternal milk. Obtained associations were tested by multiple linear regression models for possible confounders (age, body mass index, education, current/pre-pregnancy smoking, sea food consumption and essential element status). Among significant associations the most evident were those between Zn and SNPs of *MT1E*, *MT1F* and *MT2a*.

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## O-3-022

**The diagnostic criteria and changes in the elemental composition at a sudden death of young people**

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The sudden cardiac death (SCD) among the young people is a serious medical and social problem. Identification of risk factors and cure of premorbid states are the important tasks for cardiologists, pediatricians and forensic medical experts, studying the mechanisms and causes of death using the biochemical, pathomorphological methods. The aim of this work is to reveal the main disorders of the trace element composition in young persons (<35 y.o.) as the factors of SCD. Materials and methods: A total of 816 forensic medical cases of SCD which occurred in 2011–2015 among young people (78% of men, 22% of women) were studied. The preceding conditions were high physical or athletic activity. Results and discussion: In 83% of cases, signs of the connective tissue dysplasia leading to a lethal cardiac pathology were observed. The elemental composition changes were also expressed in persons with the connective tissue dysplasia accompanied by the development of myocardial ischemia and fatal arrhythmia. In particular, the decreased levels of K, Mg, Zn, F, and Se, being responsible for synthesis of collagen and bone mineralization, were detected.

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## O-3-023

**Iodine deficiency disorders in Uttarakhand State, India**

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**Objective:** To assess the status of iodine nutrition in a population of Uttarakhand (UK) State.

**Methodology:** Udham Singh Nagar (USN), Nainital (N), Pauri Garhwal (PG) districts were included. In each district, 30 clusters were identified. Total of 6143 school age children (SAC) (USN 1807, N 2269, PG 2067) 5430 adolescent girls (AGs) (USN 1823, N 1811, PG 1796), 1727 pregnant mothers (PMs) (USN 632, N 614, PG 481), 2013 neonates (USN 649, N 670, PG 694) were included in study. Clinical examination of thyroid of SAC, AG and PM was conducted. Spot urine and salt samples were also collected. Cord blood samples were collected from neonates for estimation of TSH.

**Results:** In SAC, TGR was 13.2% (USN), 15.9% (N), and 16.8% (PG). Median UIC level was 150  $\mu\text{g/l}$  (USN), 125  $\mu\text{g/l}$  (N), and 115  $\mu\text{g/l}$  (PG). In AGs, TGR was 6.8% (USN), 8.2% (N), and 5.6% (PG). Median UIC level was 250  $\mu\text{g/l}$  (USN), 200  $\mu\text{g/l}$  (N), 183  $\mu\text{g/l}$  (PG). In PMs, TGR was 16.1% (USN), 20.2% (N), and 24.9% (PG). Median UIC level was 124  $\mu\text{g/l}$  (USN), 117  $\mu\text{g/l}$  (N), 110  $\mu\text{g/l}$  (PG). In neonates, TSH levels >5 mIU/L were found in 55.3 (USN), 76.4 (N), 72.8% (PG).

**Conclusion:** UIC level in PMs and TSH levels in neonates indicate prevalence of ID in 3 districts.

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## O-3-024

**Analysis of the iodine status for Chinese pregnant women**

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To evaluate the iodine status of Chinese pregnant women by thyroid function and urinary iodine level. A total of 1762 blood samples were obtained from pregnant women participated in the 2015 China National Nutrition and Health Survey. Plasma levels of thyroid stimulating hormone (TSH), free triiodothyronine (FT3), free thyroxine (FT4), thyroid peroxidase antibody (TPOAb) and thyroglobulin antibody (TGAb) were determined for thyroid function evaluation by using an automated chemiluminescence immunoassay analyzer. Urinary iodine level (UIL) was also measured for 5633 women. The prevalence of normal thyroid function for this cohort was 85.2%. The median urinary iodine (MUI) of all the pregnant women was 146.6  $\mu\text{g/L}$ , percentage of UIL >500  $\mu\text{g/L}$  was 2.27%. Pregnant women with MUI >250  $\mu\text{g/L}$  had higher incidence of sub-clinical hypothyroidism. Although half of the pregnant women with MUI <150  $\mu\text{g/L}$ , the data did not showed the negative effect on their thyroid function. The iodine status of this population is generally adequate, which should be paid more attention to continually.

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O-3-025

**Analysis of lead and cadmium in cereal products and diets of selected children**U. Tinggi<sup>1,\*</sup>, N. Schoendorfer<sup>2</sup><sup>1</sup> Queensland Health Forensic and Scientific Services, 39 Kessels Road, Coopers Plains, QLD 4108, Australia<sup>2</sup> Children's Nutrition Research Centre, The University of Queensland, Herston, QLD 4006, AustraliaE-mail address: [ujang.tinggi@health.qld.gov.au](mailto:ujang.tinggi@health.qld.gov.au) (U. Tinggi).

Exposure to toxic metals such as lead (Pb) and cadmium (Cd) from foods is a concern for young children. The aims of the study were to analyse the levels of Pb and Cd in breakfast cereals, rice products and diets of selected children, and to estimate the daily intakes of Pb and Cd in these children. The samples ( $n=87$ ) of ready-to-eat breakfast cereals and rice products ( $n=36$ ) were collected and obtained from various markets in Brisbane, Australia. The samples for a duplicate diet study were collected for 3 consecutive days from normal healthy children ( $n=15$ ). The analysis was performed using ICP–MS after microwave digestion. The levels of Pb and Cd found in breakfast cereals and rice products ranged from  $<0.01$  to  $0.25$  mg/kg for Pb and  $<0.01$  to  $0.11$  mg/kg for Cd. The estimated daily intakes of Pb and Cd in children varied widely and ranged from  $0.90$  to  $11.7$  ( $5.6 \pm 3.5$   $\mu\text{g/day}$ ) for Pb and  $0.98$  to  $9.5$  ( $4.0 \pm 2.2$   $\mu\text{g/day}$ ) for Cd. The study shows low intakes of Pb and Cd in children.

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O-3-026

**Exploration of the appropriate recommended nutrient intake of iodine in euthyroid Chinese fertile women: An iodine balance experiment**

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**Objective:** To explore the appropriate recommended nutrient intake of iodine in euthyroid Chinese adults.

**Materials and methods:** A 4-wk, double-blind, self-controlled study was conducted in 30 euthyroid Chinese adults. Unified diet with different iodine content were provided in two different periods respectively, monitor and determine the total quantities of iodine intake and excretion in three days of each week, 12 days and 360 samples in total.

**Results:** The 24-h iodine intakes in the two periods were  $200.59 \pm 63.26$   $\mu\text{g/d}$  and  $571.13 \pm 95.3$   $\mu\text{g/d}$ ; while the 24-h iodine expelled was  $125.08 \pm 42.11$   $\mu\text{g/d}$  and  $270.36 \pm 76.87$   $\mu\text{g/d}$ , respectively. Only 16 cases presented negative balance. When the total iodine intake reached  $84.84$   $\mu\text{g/d}$ , it equaled to total iodine excretion and the 'zero iodine balance' was reached.

**Conclusions:** The RNI calculated based on Chinese adults was  $118.78$   $\mu\text{g/d}$  and we recommend further research to confirm the accuracy. Grant Nos. 81330064, 31340033 and 14ZCZDSY00022.

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O-3-027

**Toxic elements in some local complementary foods from Cameroon**

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Food security still remains a very important issue in Cameroon. Beside malnutrition due to poor nutrients intakes, population are also exposed to contaminant from food.

**Objectives:** to determine the levels of toxic elements in common local complementary foods.

**Materials and Methods:** Complementary foods made of maize, Irish potatoes, legumes and dry fish powder were cooked in triplicate and analyze for toxic minerals using HR-ICP–MS.

**Results:** Median contents expressed in  $\mu\text{g/g}$  were 105 and 1 for Al and Pb, respectively, and in  $\text{ng/g}$  9 and 98 for Cd, and Hg respectively. Median extraction percentage were respectively 11, 7.2, 3.8, 1.7 for Pb, Cu, As, Cd, Al, Hg. There were correlations between cadmium and molybdenum with the correlation coefficients over 0.9.

**Conclusion:** From the total content and extraction rate of those minerals, the children were not exposed to high doses. Further studies on rat model will help to study the toxicity of the food with high content of Al, Hg, Pb and Cd.

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O-3-028

**New functional food based on nano selenium-enriched probiotics as antagonistic effect against cadmium toxicity**Simona Cavalu<sup>1,\*</sup>, Simona Vicas<sup>2</sup>, V. Laslo<sup>2</sup>, Anca Hermenean<sup>3</sup>, J. Prokisch<sup>4</sup><sup>1</sup> University of Oradea, Faculty of Medicine and Pharmacy, Romania<sup>2</sup> University of Oradea, Faculty of Environmental Protection, Oradea, Romania<sup>3</sup> Vasile Goldis University of Arad, Romania<sup>4</sup> University of Debrecen, HungaryE-mail address: [simona.cavalu@gmail.com](mailto:simona.cavalu@gmail.com) (S. Cavalu).

Heavy metals have adverse effects in human metabolism and the conventional treatment is based on chelation therapy that could induce several adverse effects. The aim of our work was to develop functional food based on nano-Se particles obtained by green synthesis using *Lactobacillus casei*. The structural characterization of selenium nanoparticles, morphology and particles size distribution was evaluated by Atomic Force Microscopy and Dynamic Light Scattering. The ability to annihilate toxic effect of cadmium was conducted using *in vitro* and *in vivo* studies. The binding ability of cadmium by functional food was demonstrated by FTIR spectroscopy. An animal model of cadmium-induced toxicity was used in order to show the protective effect of functional food enriched in probiotics and nano-Se. Biochemical and histopathology analysis also confirmed the protective effect of functional food containing nano-Se.

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## O-3-029

**Anti-obesity effect of trace elements from *Plantago* species**

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Recent studies have demonstrated that *Plantago* may possess antidiabetic and antiobesity effect. However, it is questionable whether trace elements from *Plantago* may significantly contribute to anti-obesity effect. Data on trace element content of *Plantago* species raw material do not directly correspond to the tissue trace element content in *Plantago*-treated animals. At the same time, V and Si from *Plantago* aqueous extract significantly cumulated from extracts resulting an increased tissue (liver, adipose tissue, hair) content. Using *Plantago* extracts in animal models of diet-induced metabolic syndrome resulted in species-specific protective effect, being maximal in *P. maxima*. *P. maxima*-treated rats were characterized by lower adiposity, insulin resistance, inflammation, and fatty liver. At the same time, tissue trace element levels were more tightly associated with metabolic parameters of animals than antioxidant status. Therefore, it is proposed that trace elements may at least partially mediate antiobesity effect of *Plantago* preparations.

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## O-3-030

**Effects of green tea polyphenols on trace elements status of rats fed with food restriction or high-fat diet**

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Few studies have been reported on the anti-nutritional properties of tea extracts under different diet patterns. We test the effects of green tea polyphenols (GTPs) on trace elements (TEs) status in rats fed on food restriction or high-fat diet. Thirty-six Wistar rats were randomly fed on standard chow (SC) diet, food restriction (FR) or high-fat (HF) diet with or without GTPs (200 mg/kg BW). Levels of Mn, Fe, Cu, Zn, Se, Mo and Co in whole blood and diets were measured by inductively coupled plasma mass spectrometer. Both FR and HF diet caused lower intakes of all these TEs. Besides, decreased Co and Mn, Zn, Co levels in whole blood were shown in rats fed on FR and HF diet, respectively. Furthermore, GTPs did not affect the whole blood levels of all these TEs in rats fed on SC diet, but did alter levels of Zn, Se and Co in rats fed on FR and HF diet, separately. Our results suggest the anti-nutritional properties of GTPs depends on elements species and the levels of TEs in dietary patterns with lower TEs intakes may be prone to be affected by GTPs.

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## O-3-031

**Bangladeshi improved complementary feeding recipes rich in trace elements**

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**Background:** Iron and zinc deficiency are most prevalent among pre-school aged children of Bangladesh. Consumption of iron (4.17 mg) and zinc (3.2–2.6 mg) rich food are found to be below their Recommended Dietary Allowances.

**Objective:** To develop improved complementary feeding recipes rich in trace elements from locally available ingredients. Methods: A qualitative study including a baseline and Trials of Improved Practices (TIPs) was conducted. Thirty-five recipes were developed considering the “WHO indicators to assess adequacy of complementary practices” and laboratory analysis was done for energy, calcium, iron and zinc. TIPs were carried out including cooking sessions and acceptability evaluation.

**Result:** Iron and zinc rich (mg/100 g) recipes were Vegetable roll (Fe 3.8 & Zn 2.12) & Buter halwa (Fe 2.73 & Zn 1.04) and Pumpkin coconut halwa (Fe 2.59 & Zn 0.95). Calcium rich (mg/100 g) dishes were Pumpkin payesh (321), Small fish chop (203) and Suji-halwa (173). All the recipes were fully accepted by children.

**Conclusion:** These locally made recipes will help to meet the requirements of trace elements.

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## O-3-032

**Iodine status among pregnant Norwegian women**

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**Objective:** To evaluate iodine status based on calculated iodine intake and urinary iodine concentration in a group of pregnant Norwegian women.

**Methods:** During 2016, 785 pregnant women were recruited from eight different Mother and Health Child Centers, representative for the Oslo and Akershus region. Iodine concentration was measured in spot urine samples by inductively coupled plasma/mass spectrometry (ICP/MS). Information about intake of food and supplements was collected by 24-h dietary recall and food frequency questions covering intake the last month.

**Results:** The median UIC was 92 µg/L and 80% had UIC below WHO recommendations of 150 µg/L. Median iodine intake was 151 µg/day from food alone and 199 µg/day from food and iodine-containing supplements. The main dietary sources of iodine was milk and seafood. The correlation between calculated iodine intake and UIC was high, with  $r_s = 0.51$ .

**Conclusion:** Suboptimal iodine status was widespread and public health strategies are needed to improve and secure adequate iodine status in pregnant Norwegian women.

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## O-3-033

**Thyroid disturbance is associated with developmental status in children below 4 years with chronic excessive iodine exposure**Inger Aakre<sup>1,2,\*</sup>, Tor A. Strand<sup>2</sup>, Sigrun Henjum<sup>1</sup><sup>1</sup> Oslo and Akershus University College, Oslo Norway, Norway<sup>2</sup> University of Bergen, Bergen, NorwayE-mail address: [inger.aakre@hioa.no](mailto:inger.aakre@hioa.no) (I. Aakre).**Objective:** We explored if young children's developmental status was associated with thyroid hormone status in an area of excessive iodine exposure.**Methods:** We selected and examined 298 Algerian children, 18–48 months. Early child development was measured using Ages and Stages Questionnaires 3 (ASQ-3), consisting of five domains: Communication, Gross Motor, Fine Motor, Problem-Solving and Personal-Social. Urinary iodine concentration (UIC), thyroid hormones (TSH, fT3 and fT4) and serum thyroglobulin (Tg) were measured.**Results:** We found 72% with excessive iodine status, indicated by a median UIC  $\geq 300$   $\mu\text{g/L}$  and 14% had a thyroid disturbance. Children with thyroid disturbances and TSH outside the reference had significantly lower probability of being in the top two tertiles of the developmental score showing adjusted odds ratios (95% CI) of 0.46 (0.23, 0.93) and 0.42 (0.19, 0.94) respectively.**Conclusion:** We found an association between developmental status and thyroid hormone disturbances among children, probably caused by excessive iodine intakes.<http://dx.doi.org/10.1016/j.jtemb.2017.03.114>

## O-3-034

**Selenium concentration in Brazil nuts: Are there differences according to country regions?**Silvia M. Cozzolino<sup>1,\*</sup>, Graziela B.S. Duarte<sup>1</sup>, Bruna Z. Reis<sup>1</sup>, Alexandre C. Pimentel<sup>1</sup>, Luiza G.R. Albuquerque<sup>2</sup>, Pedro V. Oliveira<sup>2</sup><sup>1</sup> Department of Food and Experimental Nutrition, Brazil<sup>2</sup> Department of Fundamental Chemistry, University of São Paulo, BrazilE-mail address: [smfcozzo@usp.br](mailto:smfcozzo@usp.br) (S.M. Cozzolino).

The selenium (Se) concentration in Brazil nuts can vary because its content in soil, genetic selection of trees, and nuts processing steps. The aim of this study was to evaluate the Se concentration in Brazil nuts samples sold in markets of different regions of Brazil. The samples were purchased from local markets in the following States: São Paulo (SP), Maranhão (MA), Pará (PA) and Amazonas (AM). Concentration of Se was determined by inductively coupled plasma optical emission spectrometry (ICP-OES). The results were expressed in  $\mu\text{g/g}$  of lyophilized food. The minimum Se content was observed in samples from SP, with 5.0  $\mu\text{g/g}$ . Other samples from this same State varied from 7.2 to 11.6  $\mu\text{g/g}$ . The maximum Se content was observed in samples from AM (29.9 and 71.5  $\mu\text{g/g}$ ). Samples from PA presented 12.5  $\mu\text{g/g}$  and from MA varied from 9.8 to 18.2  $\mu\text{g/g}$ . In conclusion, Se content can vary until 14 times between different regions, and great differences are also observed between samples from the same state.

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## O-3-035

**An experience of evaluating the element status of schoolchildren in Tajikistan for World Food Programme (WFP)**A.R. Grabeklis<sup>1,2</sup><sup>1</sup> Yaroslavl State University, Yaroslavl, Russia<sup>2</sup> RUDN University, Moscow, RussiaE-mail address: [andrewgrabeklis@gmail.com](mailto:andrewgrabeklis@gmail.com).

Trace element and mineral status of younger schoolchildren in Tajikistan was studied in framework of WFP & Tajikistan international project on improvement of school nutrition. It was involved 588 children 7–10 y/o of both sexes residing in Ayni, Panjakent and Nurek districts and attending schools with different involvement in WFP programs. The study included evaluation of anthropometric data, analysis of school menus and average food rations, investigation of 25 biologically important chemical elements in hair of children, main food products and drinking water. There were found widespread copper, iodine, cobalt deficiencies in children, combined with low amounts of many important micronutrients in diet. The most satisfactory state was found in schools involved in a pilot project combining the WFP program (provision with fortified flour, peas, oil and salt) and improved scheme of school nutrition (organized hot meals). Following the findings, recommendations on improving provision of children with lacking minerals and trace elements were developed for WFP, national ministries, local schools and households.

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## O-3-036

**Can selenium-enriched mushrooms elicit increased anti-oxidant properties and synthesis of bio-active compounds?**Poonam Bhatia<sup>1</sup>, Ranjana Prakash<sup>2</sup>, N. Tejo Prakash<sup>3,\*</sup><sup>1</sup> Department of Biotechnology, Thapar University, Patiala 147004, India<sup>2</sup> School of Chemistry and Biochemistry, Thapar University, Patiala 147004, India<sup>3</sup> School of Energy and Environment, Thapar University, Patiala 147004, IndiaE-mail address: [ntejoprakash@thapar.edu](mailto:ntejoprakash@thapar.edu) (N. Tejo Prakash).

Edible mushrooms viz., *Volvariella volacea*, *Agaricus bisporus*, *Pleurotus florida*, *P.sajor-kaju*, *P.djamor*, *P.citrinopileatus* and *P.ostreatus* were cultivated on selenium (Se) rich post-harvest agricultural (paddy and wheat) residue so as to examine their potential to mobilize Se and induce bioactivity. The Se content and Se-induced anti-oxidant activity were quantified using variety of techniques. Se uptake by mushrooms were significantly higher than control. The enhanced antioxidant activity viz., DPPH scavenging, Fe chelation and lipid peroxidation inhibiting activity, was attributed to the elevated levels of Se accumulation in these mushrooms. Presence of molecule closer to seleno-ergothioneine, an analog to ergothioneine, was detected as a function of Se accumulation. Thus, the study demonstrated the use of Se hyperaccumulated agri-residues as substrates for producing Se-rich mushrooms for their potential use as selenium supplements/neutraceuticals.

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## O-3-037

**Effects of K application on bean development and micronutrient uptake under drought conditions**

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Drought is one of the most important stress factors affecting agricultural productivity worldwide while bean is one of the most sensitive crops. It is important to understand the factors that may enhance our capacity to handle this stress factor. In this study, the effects of K application on drought tolerance of bean were evaluated using 100 and 200 ppm K (compared to 39 ppm K control) under PEG 6000 treatment for drought stress, representing  $-0.42$  MPa osmotic pressure. Trial was conducted in 4 replicates under fully-controlled hydroponic conditions. Apparent positive influence of plant development was observed especially at 100 ppm K application at drought conditions while MDA levels were decreased with K treatments. Similarly, K applications led to decreased  $H_2O_2$  radicals in plant tissues while effected positively plant micronutrient contents, especially Zn, B, Fe and Cu. Mn contents were increased at drought treatment and higher levels were attained at 200 ppm K applications.

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## O-3-038

**The Health impact assessment via bioaccessibility of Se under the influence of Se-Hg antagonism in rice of China**

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Se is an essential trace element for human health. For Chinese residents, especially those who live in inland China, rice consumption is an important resource of Se. One of the biochemical function of Se is the antagonism with other heavy metals, e.g. Hg. Based on our former researches, Hg was reported to be able to concentrated in rice and hazard to human health. Thus, to accurately assess the health benefit/risk through rice consumption, Se and Hg bioaccessibility data should be applied. In this research, we collected 10 rice samples in Enshi, Hubei province, which was reported as a high Se background concentration area, 10 rice samples from Wanshan, Guizhou province, which used to be a Hg mining area, and 10 rice samples from other provinces of China. Physiologically Based Extraction Test (PBET) was applied to access bioaccessibility data of Se and Hg in rice.  $Se/Hg_{bioaccessibility}$  data and Se-Health Benefit Value ( $Se-HBV_{bioaccessibility}$ ) was calculated to accurately assess the potential health impact for Chinese rice consumers.

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## O-3-039

**Serum mineral levels in goats of different physiological stages pertaining to season in Central Trinidad**

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Serum macro and micro-mineral concentrations were evaluated in serum for goats, pertaining to season, farms and physiological stages, for potential constraints to animal performance. Mineral levels were determined by Atomic Absorption, but P calorimetrically. In the wet season, the order of serum minerals limiting production was Cu, Zn, Mg, Ca and P in goats ( $P < 0.05$ ;  $P < 0.01$ ;  $P < 0.001$ ). In both the dry and wet seasons, the order of forage minerals probably limiting production was Na, Cu, Mg and Zn, respectively. Regarding farms, minerals of major importance probably limiting production was Mg, Cu and Zn at two particular farms. The low serum mineral concentrations probably of physiological importance were Ca in non-pregnant and lactating goats; P, Cu and Mg in pregnant and lactating goats, and Zn in lactating goats. Levels of mineral deficiencies implied that optimal performance of animals was being compromised.

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## O-3-040

**SiMMin™: On line software tool to simulate copper balance in feeding programs of pigs**

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Copper (Cu) is commonly supplied in excess in piglet diets, because it can have beneficial effects on growth performance. As a result, high Cu levels are found in animal wastes and may exceed maximal authorised Cu value when manure is used as organic fertiliser. Cu retention in growing pig is calculated based on the difference in Cu body content between the beginning and the end of a defined period. In order to estimate easily the Cu excretion, the software siMMin™ Cu has been developed with the support of INRA, with the following variables: feeding programs on the farm, growth performance and Cu concentrations in each feed. In addition, it enables to simulate changes in each variable compared to the existing situation, and to measure the rate of improvement in the total reduction of Cu excretion in the life of the growing pig. SiMMin™ Cu is on line since December 2016, in English language, at [www.animine.eu/simmin/](http://www.animine.eu/simmin/). This software should be later available in national languages for major pig producing countries, like it has been realised in German and in Chinese for the Zn application.

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## O-3-041

**Variability and effect of processing on iron and zinc content in colour grains of sorghum (*Sorghum bicolor* (L.) Moench)**S. Hemalatha<sup>1,\*</sup>, Gutti Aliya<sup>1</sup>, B.D. Biradar<sup>1</sup><sup>1</sup> UAS, Dharwad, IndiaE-mail address: [hemalathas@uasd.in](mailto:hemalathas@uasd.in) (S. Hemalatha).

Twenty six sorghum [*Sorghum bicolor* (L.) Moench] genotypes used as food, fodder, feed and fuel in tropical countries were classified based on visual colour appearance as red, yellow, cream and white colour grains and analyzed for variability in iron and zinc content and effect of processing on its bioaccessibility. The sorghum genotypes exhibited highly significant variation of iron and zinc among all the genotypes and also within the grain colour groups. The mean iron content ranged between 8.85 to 19.65 mg/100 g in red colour genotypes, 4.33–11.33 mg/100 g, 4.45–12.32 mg/100 g and 4.55–18.28 mg/100 g in yellow, cream and white colour genotypes. The mean zinc content ranged between 0.33 to 2.27 mg/100 g in red colour genotypes, 0.44–1.85 mg/100 g in yellow and 0.32–1.65 mg/100 g in cream colour genotypes and 0.45–1.50 mg/100 g in yellow colour sorghum genotypes. Among the different processing methods, traditional processing methods like cooking sorghum into rice and popping improved both iron and zinc bioaccessibility.

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## O-3-042

**Effect of long-term zinc supplementation on zinc status and claw quality in sows**M.M.J. van Riet<sup>1,2,\*</sup>, E.-J. Bos<sup>1,2</sup>, G.P.J. Janssens<sup>2</sup>, B. Ampe<sup>1</sup>, P. Bikker<sup>3</sup>, D. Vanhautehem<sup>2</sup>, F. van Bockstaele<sup>2</sup>, P. Cornillie<sup>2</sup>, W. Van Den Broeck<sup>2</sup>, G. Du Laing<sup>2</sup>, D. Maes<sup>2</sup>, F.A.M. Tuytens<sup>1,2</sup>, S. Millet<sup>1,2</sup><sup>1</sup> ILVO, Melle, Belgium<sup>2</sup> Ghent University, Merelbeke/Ghent, Belgium<sup>3</sup> Wageningen University & Research, Wageningen, The NetherlandsE-mail address: [miriam.vanriet@ugent.be](mailto:miriam.vanriet@ugent.be) (M.M.J. van Riet).

This study evaluated the impact of Zn supplementation on Zn status and claw quality in sows throughout 3 reproductive cycles. Sows ( $n = 131$  at the start) were allotted to 1 of 3 diets with 0, 50 or 100 mg Zn/kg added to a basal diet with 47 and 129 mg Zn/kg during gestation and lactation, resp. Per cycle, blood was collected at d0, 50, 108 and 143 to assess Zn status and claw quality was determined at d50, 140 and after slaughter. Zinc supplementation did not influence Zn concentration in plasma, liver, bone, horn wall, nor serum MT concentration ( $P > 0.10$ ). Differences in claw quality between treatment groups were found for heel horn erosion score, heel height, toe:heel ratio, and distance between dermal papillae of the heel horn ( $P < 0.05$ ). Zinc supplementation had only a minor influence on Zn status and claw quality in sows, whereas reproductive phase (i.e. gestation and lactation) influenced these characteristics.

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## O-3-043

**Effects of dietary CuSO<sub>4</sub> on copper related gene expression in the gut of weaned pigs**P. Bikker<sup>\*</sup>, L. Kruijt, J. van Baal

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Introduction. A pharmacological supplement of CuSO<sub>4</sub> is generally used in diets of pigs until 12 weeks of age to improve growth performance. We studied the effect of period of supplementation on growth performance, fecal consistency, and Cu transport-related genes in the GI-tract. Methods. Five treatments with 100 pigs each, receiving a diet with 160 mg Cu/kg during 8, 6, 4, 2 and 0 weeks post-weaning (T1 to T5, resp.), followed by 15 mg Cu/kg diet. On day 56, tissues samples of 8 pigs of T1 and T5 were harvested. Results. CuSO<sub>4</sub> (160 mg/kg) enhanced feed intake and growth rate, with a final BW of 37.5 for T1 and 34.1 kg for T5. Withdrawal of the Cu supplement reduced growth rate and fecal consistency. Pigs fed 160 mg Cu/kg had higher liver and bile Cu contents, and higher duodenal MT1A and lower DMT1 mRNA levels. CTR1, CTR2, ATP7A and ATP7B were differentially expressed along the GI-tract, but not affected by dietary Cu. CTR1 and DMT1 were differentially expressed in male and female pigs. Conclusion. Withdrawal of the Cu supplement reduced growth performance, fecal consistency and affected expression of copper transporter genes.

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## O-3-044

**Effect of Se deficiency-induced redox, glycometabolism and inflammatory response on erythrolysis in chickens**Jinxin Zhao, Haidong Yao, Ziwei Zhang, Shiwen Xu<sup>\*</sup>

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The aim of the present study was to explore the molecular mechanism of erythrocyte hemolysis which induced by Se deficiency in chickens. Chickens were randomly divided into two groups fed with normal or low Se diet for 18 days. During 18 days, the erythrocytes of exudative diathesis (ED group) and control (C group) chickens were extracted and osmotic fragility was detected. The results showed that osmotic fragility of erythrocytes increased in ED group. The activities of GSH-Px, CAT and SOD were impaired ( $P < 0.05$ ), meanwhile H<sub>2</sub>O<sub>2</sub> and MDA levels were elevated ( $P < 0.05$ ) by low Se intake. Low Se intake also stimulated IL-1 $\beta$ , TNF- $\alpha$ , NF- $\kappa$ B, and iNOS levels ( $P < 0.05$ ). In addition, HK2 and PK were up-regulated ( $P < 0.05$ ), while SDH, PDHX and UCP mRNA levels were down-regulated ( $P < 0.05$ ) in ED group. In conclusion, this study demonstrated that erythrocyte hemolysis induced by Se deficiency may be involved in the switch of glucose metabolism and inflammatory response in erythrocytes and oxidative stress may be a potential erythrolysis mechanism.

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**O-3-045**

**Effect of chromium supplementation on endocrine variables and immune response of cold-stressed buffalo calves (*Bubalus bubalis*)**



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The aim of this study was to evaluate the effect of inorganic Cr on hormone and immune status of buffalo calves under low ambient temperature. 24 Murrah buffalo calves were assigned to 4 treatments for a period of 120 days. Feeding regimen was the same in all the groups, except the calves in the four respective groups were additionally supplemented with 0.0, 0.5, 1.0, and 1.5 mg of Cr/kg DM in the form of CrCl<sub>3</sub>·6H<sub>2</sub>O. Physiological variables and glucose concentration did not differ among treatments, whereas; buffalo calves fed with 1.5 mg of Cr/kg DM had lower ( $P < 0.05$ ) insulin concentration. 1.5 mg of Cr/kg DM increased B and T-cell proliferation, neutrophil phagocytic activity and ferric reducing antioxidant power value, whereas total immunoglobulin and immunoglobulin G levels were the highest in 1.0 and 1.5 mg of Cr/kg DM fed calves. Results of present study revealed that dietary supplementation of inorganic Cr improved insulin potency and immune status in cold-stressed buffalo calves.

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**O-3-046**

**Dynamic flow-through evaluation of bioaccessible selenium and zinc in pet food**



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Bioaccessible Se and Zn in pet food was assessed using an affordable and robust flow-through device designed for dynamic leaching experiments. A simple configuration is proposed using regenerated cellulose filters placed in polypropylene holders to entrap the solid sample, featuring a disposable, single use extraction chamber. The kinetic extraction profile of fast leachable Se and Zn was evaluated by ICP-MS, under non-exhausting conditions. Surrogate biological media mimicking digestive compartments were applied as extractants. Results were compared to batchwise experiments. The proposed approach was suitable for evaluation of bioaccessible Se and Zn either in inorganic or organic form. Useful kinetic information of Se and Zn release is provided for designing new products with precise mineral delivery.

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**O-3-047**

**Improved muscle selenium concentrations in growing pigs fed organic selenium**



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In young farm animals selenium deficiency may lead to heart or skeletal muscular degenerations. Both manifestations occur commonly in growing pigs in spite of Se supply up to the maximum allowed level in feed. The usual Se source in feed for pigs is sodium selenite (SS). A study comparing different sources of Se in pig feed was conducted with the main objective to examine Se concentrations in muscles of pigs during their fast growing period from 30 kg body weight until time of slaughter. The effect of SS, Se yeast (SY) and Se methionine (SM) or no added Se was compared. At similar feed concentrations of total Se, feed added SM resulted in approximately three times higher muscle Se concentrations than feed added SS. Feed added SY resulted in muscle Se between those observed with feed added SM and SS. Organic Se and particularly SM in animal feed increases Se storage in skeletal muscle, an organ particularly vulnerable to Se deficiency. Increased muscle Se also contributes to increased Se intake via meat consumption.

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**O-3-048**

**Efficacy of selenium from hydroponically produced selenium-enriched kale sprout in laying hens**



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A 6-week trial was conducted to compare the efficacy of Se from hydroponically produced Se-enriched kale sprout (HPSeKS), sodium selenite (SS) and Se-enriched yeast (SeY) in laying hens. One hundred and forty-four, 40-week-old, hens were randomly divided into 4 groups, according to Completely Randomized Design. Each group consisted of 4 replicates with 9 hens each. The dietary treatments were T1: basal diet, T2, T3 and T4: basal diet added 0.30 mg Se/kg from SS, SeY and HPSeKS, respectively. The results showed that Se supplementation did not affect ( $P > 0.05$ ) productivity of hens. Hens fed Se from HPSeKS and SeY had higher ( $P < 0.05$ ) Se bioavailability compared to hens fed Se from SS. Egg Se concentration of hens fed Se from HPSeKS was similar ( $P > 0.05$ ) to that of hens fed Se from SeY, but higher ( $P < 0.05$ ) than that of hens fed Se from SS. In conclusion, the results indicated that the efficacy of Se from HPSeKS was equal to that of Se from SeY, which was higher than that of Se from SS.

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## O-3-049

**Feeding Se-biofortified hay to weaned beef calves increases nasopharyngeal microbial diversity**Jean Hall<sup>1,\*</sup>, Anitha Isaiah<sup>2</sup>, Jan Suchodolski<sup>2</sup><sup>1</sup> Oregon State University, Corvallis, OR, USA<sup>2</sup> Texas A&M University, College Station, TX, USAE-mail address: [jean.hall@oregonstate.edu](mailto:jean.hall@oregonstate.edu) (J. Hall).

The nasopharyngeal microbiota plays an important role in overall respiratory health. Recent evidence suggests that cattle diagnosed with bovine respiratory disease complex have significantly less bacterial diversity. The objective of this study was to determine whether feeding weaned beef calves Se-enriched alfalfa hay for 9 weeks in a preconditioning program prior to entering the feedlot alters nasal microbiota. Microbial DNA was extracted from nasal swabs and amplified and sequenced. Alpha rarefaction curves comparing species richness and overall diversity showed that Se-supplementation tended to be associated with an enriched nasal microbiota. ANOSIM of unweighted UniFrac distances showed that calves fed high Se-biofortified alfalfa hay clustered separately compared with control calves in the PCoA plot. Lactobacillales and Flavobacteriales were increased in control calves; Clostridiales and Bacteroidales were increased in calves fed Se-biofortified hay. Feeding Se-biofortified hay to beef calves prior to entering the feedlot may be a strategy for enriching the nasopharyngeal microbiome.

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## O-3-050

**Trace element levels (Mg, Si, Ca and P) in Turkish Van Cats**F. Ates Alkan<sup>1,\*</sup>, C. Ozkan<sup>2</sup>, B. Dokuzeylül<sup>3</sup>, A. Kaya<sup>2</sup>, E. Or<sup>3</sup>, B. Barutçu<sup>1</sup><sup>1</sup> Biophysics Department, Cerrahpasa Medical Faculty, Istanbul University, Turkey<sup>2</sup> Internal Medicine Department, Veterinary Faculty, Yuzuncu Yil University, Van, Turkey<sup>3</sup> Internal Medicine Department, Veterinary Faculty, Istanbul University, Istanbul, TurkeyE-mail address: [fatmaate@istanbul.edu.tr](mailto:fatmaate@istanbul.edu.tr) (F. Ates Alkan).

Turkish Van Cats (TVC) are known with white silky fur, different-coloured eyes, perfect hunting, excellent intelligence and learning capabilities. Trace element abnormalities in animals appear with clinical symptoms. The main object is to investigate to evaluate magnesium (Mg), silicon (Si), calcium (Ca) and phosphorus (P) levels and the variants like gender, age and eye-colour in sixty TVC. Trace element levels were determined by ICP-OES. Si levels were found to be higher in blue-yellow eye coloured group than blue-blue eye-coloured group. Mg levels were found to be lower in 3–4 age group than 5–11 months and >5 age groups. Si levels of 5–11 age group were found to be higher than 3–4 age and >5 age group. Consequently, trace element levels variate due to gender, eye colour and age range features in TVC. It could be beneficial if this condition is considered and paid attention to animals nutrition and trace element addition from the prevention of diseases.

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## O-3-051

**Overexpression of pig GPx1 gene and its effects on GP5-based DNA vaccination against porcine reproductive and respiratory syndrome virus (PRSSV)**

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Glutathione peroxidase 1 (GPx1), a selenoenzyme, plays an important role in immune regulation of animals. PRRSV causes huge economic losses in swine industry worldwide, and the protective efficacy of vaccines against PRSSV is incomplete. Thus, it is need to develop safer and more effective PRRSV vaccines. In this study, a full-length cDNA of pig GPx1 was cloned and characterized from the liver of pigs by RACE, and comprises 878 bp. The sequence contains a selenocysteine (sec) codon (187–189) and selenocysteine insertion sequence (SECIS) (690–781). Furthermore, we constructed a recombinant plasmid co-expressing GPx1 and the envelope glycoprotein (GP5) encoding gene of PRRSV (pcDNA3.1-GPx1-LSynORF5). We observed less-severe clinical signs and rectal temperatures, and that GP5-specific antibody, PRRSV-specific neutralizing antibody, IFN- $\alpha$  levels and lymphocyte proliferation were increased in pigs immunized with pcDNA3.1-GPx1-LSynORF5 compared with a construct encoding PRRSV GP5 or JXA1-R. These results demonstrated that inclusion of GPx1 in a PRRSV DNA vaccine leads to an adjuvant effect, enhancing the humoral and cellular responses.

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## O-3-052

**Effects of nitric oxide applications on the microelement contents of bread wheat genotypes exposed to drought stress**

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Increasing the agricultural land is impossible, yet impoverishing the plant and development of agricultural practices that may decrease the negative effects of the adverse conditions may help us provide the required increase in crop production. Drought is one of the major abiotic stresses to consider. Nitric oxide (NO) is an intrinsically produced plant signal, effective under stress conditions. Two bread wheat genotypes (Göksu 99, variety developed for irrigated conditions and Karahan 99, bred for drought conditions) were used. Plants under 14 days of drought treatment (%15 PEG 6000) were supported with 100  $\mu$ M NO applications at their 3-leave stage. Betterment of growth parameters were determined in the presence of NO. Zn, Fe, B, Mn and Cu contents of the plants with NO applications were also positively influenced. MDA levels decreased more in control groups of Karahan 99 with NO applications. MDA levels of both of the genotypes were almost similarly decreased under drought conditions with NO applications.

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## O-3-053

**Profound studies of organic form microelements influence on biological object functioning**

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The majority of scientific studies in the field of bioelementology that make research of different trace element influence on biological objects do not always concentrate their attention on chemical form of trace elements, though this issue has a significant value. Animal breeding, agriculture and human medicine industries use trace element complexes received by chemical way of production and also chelate compositions where carbon acids are used (EDTA etc.). Using nanotechnologies, the Ukrainian group has succeeded to obtain trace elements in organic form where natural food acids (citric acid, etc.) are used as chelating agents. On the base of organic trace elements there were produced microfertilizers and fungicides for organic agriculture, veterinary medicine that allow to reduce the application of antibiotics in animal breeding, food supplements that are widely used for food fortification. So today, the research in the field of bioelementology should be directed to study of trace element compositions in organic form aiming their further implementation in all sorts of production.

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## O-4-001

**Copper metabolism in the rat liver during development**

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Copper (Cu), potentially high toxicity agent, is essentially nutrient from its roles as a co-factor for cuproenzymes and participant in signaling pathways. In mammals, the liver is a central organ, controlling Cu turnover through the body. It is responsible for Cu absorption, distribution, and excretion. In ontogenesis, there are two types of Cu metabolism: embryonic and adult. Specific profiles and expression levels of the genes encoding of Cu-transporting proteins correspond to each of them. At the level of transcription, splicing, translation and secretion, the expression of genes encoding ceruloplasmin, main extracellular Cu-containing protein, and proteins mediating its metallation were studied in liver of the newborns and in mammary glands (MG) of the females in the same times. It was shown that the molecular-genetics mechanisms responsible for Cu homeostasis in newborns, switching Cu type metabolism and mechanism supporting of Cu balance in milk are coordinated. The role of disturbance of this coordination in development of Cu related disorders (cardiovascular, neurodegeneration, and oncology diseases) is discussed.

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## O-4-002

**Epigallocatechin gallate (EGCG) offers neuroprotection by altering iron metabolism in Parkinson's disease**

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Parkinson's disease (PD) is associated with oxidative stress, inflammation, and excess iron. We investigated the role of hepcidin in a 6-hydroxydopamine (6-OHDA)-induced neurodegeneration in a cell culture model. Hepcidin knockdown upregulated ferroportin (Fpn) and significantly decreased 6-OHDA-induced apoptosis, oxidative stress and reduced intracellular iron. We then investigated the neurorescue effects of EGCG in 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP)-induced PD and the its effect on iron-related proteins in three groups of mice: Control, MPTP, MPTP + EGCG. MPTP treatment significantly ( $P < 0.05$ ) shortened mice falling from rotarod, decreased striatal dopamine, and increased protein carbonyls. However, EGCG significantly rescued neurotoxicity by reversing those adverse effects. EGCG group had significantly higher Fpn in substantia nigra than MPTP group, but had no significant effect on hepcidin and divalent metal transporter-1 expression. Overall, by upregulating Fpn and reducing oxidative stress, EGCG protected against MPTP-induced functional and neurochemical deficits in a hepcidin-independent mechanism.

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## O-4-003

**Regulation of iron uptake by the blood-brain-barrier**

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The brain requires timely and region specific iron delivery. Our studies have established the blood-brain-barrier (BBB) as the key site for regulation of brain iron uptake. The endothelial cells store iron and make it available for cellular functions within endothelial cells or release it to the brain. In this study, we demonstrate that both iron-poor transferrin (apo-Tf) and an iron chelator, deferoxamine (DFO), stimulate release of iron from iron-loaded endothelial cells in an in vitro BBB model. The divalent metal transporter 1 (DMT-1) plays an essential role in the release of iron from endosomes into the cytoplasm. In the BBB model, inhibition of DMT1 reduces the release of iron and transferrin from the abluminal membrane. These data support an endosome-mediated model of transferrin bound iron uptake into the brain. Our studies on iron and the BBB identify potential mechanisms for local regional regulation of brain iron uptake and provide a potential mechanism to explain the disconnect in the ratio of transferrin to iron transport into the brain that has confused the field since the beginning of transport studies examining brain iron uptake.

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O-4-004

**Boron's molecular biology explains its anticancer properties**

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We reported boron reduced cancer risk (Chu, 2004; Barranco, 2007) and now can explain how. Key discoveries were identification of a BA molecular target and a downstream pathway that redirects cellular gene expression to manage stress (Henderson 2009; 2014). Serum BA is 10  $\mu\text{M}$  in men at the mean U.S. boron intake. 10  $\mu\text{M}$  BA activates the eIF2 $\alpha$ /ATF4 integrated stress pathway in human prostate cells (Kobylewski, 2015). Activated genes/proteins include: eIF2 $\alpha$ , phosphorylation up 150% at 1 h post-treatment; binding immunoglobulin protein (BiP, 78-kDa glucose-regulated protein), protein up 198% at 1 h; DNA damage-inducible protein 34 (GADD34), mRNA up 125% and protein 153% at 2 h; and activating transcription factor 4 (ATF4), mRNA up 135% and protein 145% at 1 h. These genes protect against DNA damage from UV light and arsenite, and induce the antioxidant response element that regulates antioxidant enzyme expression. This explains how boron supplementation was able to protect against arsenic induced histopathological changes and lipid peroxidation, reduce oxidative stress to malathion and increase superoxide dismutase expression (Kucukkurt, 2015; Coban, 2014; Bhasker, 2016).

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O-4-005

**On decoding the syntax of human hair bioelement metabolism**

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Human hair (HH) is a suitable long term biological indicator for assessing the nutritional status of bioelements (BioE). Every BioE has its individual biological assay sigmoid curve, and every such give has a distinct, central linear segment of a range of concentrations wherein the rate of BioE incorporation into the HH is in the dynamic equilibrium with the HH growth and its saturation capacity. This is adequate reference range of BioE indicating a satisfactory nutritional status or harmless environmental exposure. Concentrations below that linear range are considered deficient and those above it as excessive. New adequate/acceptable Min-Max reference range values for the HH BioE are ( $\mu\text{g/g}$ ): Ca  $\sigma$  290–1200,  $\varphi$  440–4400; Zn  $\sigma\varphi$  130–200; P  $\sigma\varphi$  120–200; Na  $\sigma$  84–1450,  $\varphi$  55.6–1307; Mg  $\sigma$  20–850,  $\varphi$  40–450; Cu  $\sigma$  8.50–18.95,  $\varphi$  9.11–18.04; Al  $\sigma$  3–39–27.74,  $\varphi$  1.93–20.02; B  $\sigma$  0.578–4.776,  $\varphi$  0.434–2.570; Li  $\sigma$  0.015–0.100,  $\varphi$  0.014, 0.086; Sr  $\sigma$  0.418–2.950,  $\varphi$  0.846–7.260; I  $\sigma$  0.15–1.97,  $\varphi$  0.15–2.06; Se  $\sigma$  0.013–0.98,  $\sigma$  0.08–0.93; Ag  $\sigma$  0.015–0.215,  $\varphi$  0.024–0.695. The metabolic syntax of BioE is discussed. New hypothesis on the metabolic etiology of depression is proposed.

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O-4-006

**Dietary iron intake as a cause of brain iron accumulation in adult rats**

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Brain iron (Fe) accumulation is a hallmark of Alzheimer's and Parkinson's disease. Here, we have traced Fe from feed into brain by continuous feeding of a stable isotope ( $^{57}\text{Fe}$ ) to Wistar rats (6–8 months,  $n=7$ ) over 16 wks. Fraction of dietary Fe recovered in brain was marginal ( $0.000537 \pm 0.000076\%$ ) but considerable when expressed relative to total brain Fe content ( $9.19 \pm 0.71\%$ ). Continuous feeding of multiple Fe isotopes ( $^{54}\text{Fe}$ ,  $^{57}\text{Fe}$ ,  $^{58}\text{Fe}$ ) over 20 wks ( $n=8$ ) revealed that brain Fe influx exceeds efflux, leading inevitably to brain Fe accumulation over time. In a subsequent tracer study, we exposed adult rats ( $n=7$ ) to normal (200 ppm), high (2000 ppm) or low (2 ppm) dietary Fe over 16 wks. Brain Fe uptake from feed was associated with intestinal Fe uptake and not iron status or dietary intake alone. In good agreement with human post mortem studies, iron appears to accumulate in the mammalian brain even in healthy individuals over life-time. Extent of iron accumulation, however, appears to be subject to dietary iron exposure and regulatory mechanism of iron absorption.

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O-4-007

**Iron accumulates in the primate choroid of the eye with aging as revealed with synchrotron X-ray (SXR) fluorescence microscopy**Marta Ugarte<sup>1,2,3,\*</sup>, Kalotina Geraki<sup>4</sup>, Glen Jeffery<sup>3</sup><sup>1</sup> Moorfields Eye Hospital NHS Foundation Trust, London EC1V 2PD, UK<sup>2</sup> NIHR Biomedical Research Centre, Moorfields Eye hospital and UCL Institute of Ophthalmology, London, UK<sup>3</sup> UCL Institute of Ophthalmology, London EC1V 9EL, UK<sup>4</sup> I18, Diamond Light Source, Didcot OX11 0DE, UK  
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Objective: To determine the distribution and content of Fe, Zn and Cu in the macular retina, choroid and retrobulbar optic nerve of young and aged male non-human primates, *Macaca Fascicularis*. Materials and Methods: Thirty  $\mu\text{m}$ -thick tissue sections of young (4–5 years,  $n=3$ ) and aged (15–16 years,  $n=5$ ) animals were analysed with SXR fluorescence and stained histologically for Fe. Results: High levels of Fe, Zn and Cu were found in the choroid and retinal pigment epithelium in the macular area and arachnoid layer in the retrobulbar optic nerve. In aged animals compared to young ones, there was an increase in Fe in the choroid with larger deposits and iron-loaded cellular structures. Conclusion: Iron-accumulates within cellular structures in the choroid with aging, which may contribute to reduced choroidal function with aging and age-related diseases.

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## O-4-008

**Efficiency of REC and molecular genetics of ATP7B gene in diagnosis of Wilson disease**Bost Muriel<sup>1,2,3</sup><sup>1</sup> Hereditary Diseases of Metabolism Genetics, CBPE, United Kingdom<sup>2</sup> Trace Element Analysis, CBAPS, United Kingdom<sup>3</sup> Reference Centre for WD, HFME, Lyon FranceE-mail address: [muriel.bost@chu-lyon.fr](mailto:muriel.bost@chu-lyon.fr).

Wilson disease (WD), a copper (Cu) disorder is due to mutations in ATP7B gene. Early diagnosis is critical because effective medical treatments are available. The aim of this study is to evaluate the efficiency of the combination of a recent biomarker [REC (ratio serum CuEXC/Total serum Cu)] (REC > 14% in WD) and molecular genetic analysis for WD diagnosis. In 100 unrelated WD patients (informed consent) whose diagnosis was based on hepatic or neurological symptoms, MRI imaging, a Kayser–Fleischer ring, decreased serum ceruloplasmin and Cu levels, raised 24 h-urinary Cu excretion, we performed serum exchangeable Cu (CuEXC) determination by ICP-MS with REC calculation and molecular genetic analysis by direct conventional Sanger sequencing and MLPA analysis. We found REC > 14% with two ATP7B mutations in 82 WD patients, REC > 14% with one or no mutation in 12 WD cases and REC < 14% with two ATP7B mutations in 6 cases. Based on the data of this study, the combination of REC determination and molecular genetic analysis lead to the diagnosis of 100% of patients affected of WD.

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## O-4-009

**Adipose tissue maintains copper status in rats with holo-ceruloplasmin deficiency**E.Y. Ilyechova<sup>1,2,\*</sup>, N.V. Tsybalenko<sup>1,2</sup>, L.V. Puchkova<sup>1,2</sup><sup>1</sup> ITMO University, St. Petersburg, Russia<sup>2</sup> Institute of Experimental Medicine, St. Petersburg, RussiaE-mail address: [ilichevaey@gmail.com](mailto:ilichevaey@gmail.com) (E.Y. Ilyechova).

We have shown that in rats with long-term holo-ceruloplasmin (Cp) deficiency, ectopic synthesis of holo-Cp, which restored copper status, was induced. The aim of this study was to identify the organ with ability to synthesize and secrete holo-Cp. In this study, samples from 20 rats fed for six month with AgCl (Ag-rats) and 20 control rats of the same age were analyzed for copper status, copper and silver distribution through body, expression level of copper metabolism genes, and in vitro synthesis and secretion of [<sup>14</sup>C]Cp. Only subcutaneous adipose tissues (SAT) of Ag-rats overexpressed Cp gene (mRNA of Cp and GPI-Cp) and genes participating in Cp metallation (CTR1, ATP7A/B, DMT1). Also SAT did not accumulate Ag. Moreover in SAT of Ag-rats, oxidase activity of GPI-Cp was found in the Golgi complex and plasma membranes. Also in vitro SAT synthesized secretory form of Cp. Thus SAT cells increased expression of Cp gene at all expression levels and so compensated for the lack of holo-Cp induced by Ag-diet. The work was supported by RFBR grants 16-34-60219, 15-04-06770.

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## O-4-010

**Precise diagnosis of presymptomatic Wilson disease by integrating synchrotron X-ray**

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While many effective treatments are available to prevent or reverse clinical manifestations of Wilson disease (WD), the diagnosis is still challenging especially for patients with the presymptomatic form presented with diverse symptoms and slight laboratory tests' abnormalities. ATP7B genotyping is very useful for the definite diagnosis when a large number of disease-causing variants (DV) deposited in the WD mutation database. However, we gradually notice that position and type of mutations are much more variable and widespread in the gene, and no DVs are detected in some cases. To improve the diagnostic ability, we established two-dimensional copper mapping technique for pathological examination using synchrotron-generated brilliant X-ray. We present the basic principle of synchrotron radiation X-ray fluorescence (SR-XRF), possible problems and examples of application. SR-XRF analysis of tissue sections was performed to evaluate copper status of WD and suspected cases. Integration of genotyping, biochemical copper measurement, and SR-XRF copper imaging provides precise diagnostic system for presymptomatic WD.

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## O-4-011

**Iron absorption and systemic utilization in tuberculosis: A human stable isotope study**C. Cercamondi<sup>1,\*</sup>, T. Zoller<sup>2</sup>, D. Moretti<sup>1</sup>, F. Mhimbira<sup>2</sup>, J. Hella<sup>2</sup>, L. Fenner<sup>3</sup>, M. Zimmermann<sup>1</sup><sup>1</sup> ETH Zurich, Switzerland<sup>2</sup> Ifakara Health Institute, Tanzania<sup>3</sup> University of Bern, SwitzerlandE-mail address: [ccolin@ethz.ch](mailto:ccolin@ethz.ch) (C. Cercamondi).

**Background:** Iron supplementation to treat anemia in tuberculosis (TB) patients is questioned as inflammation is likely the main cause and not dietary iron deficiency. Objective: To characterize iron balance by quantifying iron absorption and systemic utilization during TB treatment.

**Methods:** We included 18 adult TB patients from Tanzania (18–45 years; 17% women) who were studied at baseline, and after the first and second TB treatment phase (2 and 6 months). Iron absorption and utilization was determined using stable-isotope technique.

**Results:** TB treatment sharply increased iron absorption: at baseline, 0.9%; after 2 months, 8.0%; after 6 months, 15.6% (all at least  $P < 0.05$ ). Systemic iron utilization decreased: at baseline, 82.8%; after 2 months, 68.8% (although not significant;  $P = 0.25$ ); after 6 months, 67.6% ( $P < 0.05$ ).

**Conclusion:** Dietary iron absorption is substantially reduced during active TB. This may reflect a host mechanism for limiting iron supply to the mycobacterium; and therefore, iron supplementation during TB treatment is likely ineffective.

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## O-4-012

**Disposition of iron supplements before and after Roux-en-Y gastric bypass**

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**Background:** Obese and Roux-en-Y gastric bypass (RYGB) patients are predisposed to develop iron deficiency (ID).

**Objective:** Evaluate the disposition of iron supplements.

**Methods:** Absorption studies with iron(II)sulfate and iron bisglycinate supplements were performed in 6 subjects before RYGB and in 3 subjects at 1 month after RYGB. Before oral administration, blood samples were collected to determine serum iron concentration, iron-related markers, hepcidin and C-reactive protein (CRP). Nutritional properties were assessed by calculating the adjusted for baseline  $AUC_{0-5\text{ h}}$ ,  $C_{\text{max}}$  and  $T_{\text{max}}$ .

**Results:** Before RYGB, the  $AUC_{0-5\text{ h}}$  was significantly higher for iron(II)sulfate compared to iron bisglycinate ( $p = 0.03$ ). Post-RYGB, no significant changes were obtained for the iron-related markers or hepcidin. CRP was significantly decreased ( $p = 0.03$ ).

**Conclusion:** Before-RYGB, disposition of iron(II) sulfate is superior for ID treatment.

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## O-4-013

**Regulating iron intake in early postnatal life**

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**Objective:** To understand the regulation of intestinal iron absorption during suckling, we used mice to characterise the relationship between hepcidin, ferroportin (FPN) and absorption at this crucial life stage.

**Materials and methods:** Wild-type mice were studied at 15 (suckling) or 25 (weaned) days old. Mice were treated with iron dextran or LPS to increase hepcidin, and iron absorption and body iron status were assessed. Similar studies were carried out in Matriptase2 (constitutively high hepcidin) and FPN knockout mice.

**Results:** Iron absorption was very high during suckling and dropped to adult levels on weaning. Increasing hepcidin (by several methods) reduced absorption in 25d mice, but not in 15d suckling mice. Absorption was very low in 15d FPN knockouts, confirming that FPN was required for absorption at this time. FPN remained on the basolateral membrane of 15d enterocytes despite high hepcidin.

**Conclusions:** The high iron absorption of suckling is mediated by FPN, but enterocyte-specific alterations to FPN that prevent hepcidin binding at this time allow iron absorption to remain high regardless of hepcidin expression levels.

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## O-4-014

**The Wilson's disease as an inherited disorder of copper metabolism**

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Wilson's disease (WD) is a typical example of a metal metabolism disorder due to the mutations of the gene ATP7B, which encodes a transmembrane protein ATP-7B. This enzyme derives copper to the bile ducts and incorporates it into ceruloplasmin. Copper metabolism is closely associated with metabolism of other bivalent metals (Fe, Zn, Mg), as they engage in competitive interactions. Clinical-genetic database of the patients with orphan disease (WD) and their relatives was created in 2015 (100 patients). It includes clinical, laboratory, instrumental data and results of genetic analysis (targeted NGS of ATP7B gene). Information about long-term pharmacological effects of a chelation therapy is being accumulated. We use this information during clinical practice for prediction of WD severity, development of a personalized approach to treatment and diagnostic. Moreover, this data allows to evaluate quality of life of the WD patients.

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## O-4-015

**Boron and innate immunity: Implication in age-related susceptibility to infections**

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Innate immunity is the first line of defense against pathogens. A weak innate immune response is particularly important in age-related susceptibility to infection. Boron, a metalloid that typically occurs in nature as borate ( $\text{Na}_2\text{B}_4\text{O}_7$ ) hydrated with varying amount of water, plays an important role in inflammation and immunity. In this study, we envisaged the role of boron in innate immunity. Briefly, mice were administered with borax orally for 10 consecutive days, followed by the isolation of macrophages from the peritoneum. The isolated macrophages were challenged with LPS (1 ng/ml, 24 h) and used for the estimation of nitric oxide, tumor necrosis factor- $\alpha$ , interleukin-6 and  $1\beta$ . Boron increased the synthesis and secretion of these pro-inflammatory mediators in a dose-dependent manner, particularly at a dose of 4.6 mg/kg body weight. Results suggest the role of boron in augmenting the innate immunity by mediating the synthesis and secretion of pro-inflammatory mediators by the macrophages and implicate boron in fight against pathogens, particularly in age-related susceptibility to infection and sepsis.

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**O-4-016**

**Expression of TGF-Beta and  $\alpha$ -SMA in cholestatic rat treated by sodium molybdate**



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**Object:** The aim of this study was to investigate the effects of sodium molybdate on expression of TGF-Beta and  $\alpha$ -SMA as fibrogenic factor in cholestatic rat liver.

**Materials and methods:** After bile duct ligation (BDL), rats were given sodium molybdate (0.05, 0.1 and 0.2 g/kg) via intragastric gavage for 45 consecutive days. After 45 days, the rat was euthanized and hepatic tissue specimen fixed in 10% formalin solution and embedded in paraffin. The block was stained with mason's trichrome and immunohistochemistry (IHC) method by TGF-Beta and  $\alpha$ -SMA kit.

**Results:** Histopathology shows that sodium molybdate markedly attenuated the cholestatic liver injury and collagen deposition in BDL rats. Hepatic  $\alpha$ -SMA and TGF- $\beta$ 1 were also markedly decreased by sodium molybdate treatment.

**Conclusions:** Our data suggest that sodium molybdate may have antifibrotic properties via inhibition of expression of TGF- $\beta$ 1,  $\alpha$ -SMA and deposition of extracellular matrix in the rat model of BDL.

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**O-4-017**

**Silver nanoparticles induce apoptosis-like process in *E. coli* and interfere in mammalian copper metabolism**



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Silver nanoparticles (AgNPs) are one of the most popular modern nanomaterials due to the wide variety of their properties. However, their impact on living organisms, especially on mammals, has not been studied exhaustively. In these work we studied new AgNPs properties on the models of *E. coli* and laboratory mice. AgNPs were synthesized in  $\beta$ -cyclodextrin clathrates and had spherical form with an average diameter of 20 nm. AgNPs caused time- and dose-dependent death of *E. coli* cells which demonstrated apoptosis features, including initial externalization of phosphatidylserine and subsequent appearance of membrane permeability. After a few intraperitoneal injections of AgNPs oxidase activity of mice ceruloplasmin decreased to the 15% of initial value while its synthesis and secretion remained unviolated. AgNPs were accumulated mainly by liver (35%), spleen (15%), lungs (10%) and also formed encapsulated inclusions in adipose tissue. Summarizing, AgNPs demonstrate antibacterial activity and ability to integrate in mammalian copper metabolism (15-04-06770, 17-14-01117).

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**O-4-018**

**The levels of hemoglobin, ferritin, faecal iron in people with anemic syndrome in the Aral Sea area who take iron for a long time**



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The effectiveness of weekly intake of iron sulfate with folic acid for 28 weeks was studied in 317 women of the reproductive age. Hb levels increased in 58.6% of women on average by 1.69 (standard deviation 1.28) g/dl ( $p < 0.001$ ) whereas it decreased in 40.9% of women by 1.30 (standard deviation 0.94) g/dl ( $p < 0.001$ ). In 45.3% of women with low ferritin values of  $5.39 \pm 0.23$   $\mu$ g/l the rise to  $27.40 \pm 3.71$   $\mu$ g/l was observed with an average gain of 21.90 (standard deviation 28.99)  $\mu$ g/l ( $p < 0.001$ ). In 13.1% of the women with a high ferritin level of  $145.44 \pm 11.8$   $\mu$ g/l there was a decrease to  $31.18 \pm 7.23$   $\mu$ g/l with an average reduction of 103.19 (standard deviation 63.60)  $\mu$ g/l ( $p < 0.001$ ). Diet contained 10.6 mg per day iron, and 38.4 mg per day faecal iron was excreted, i.e. there was a threefold increase in iron excretion with direct dependency on the severity of anemia. The levels of lead and cadmium in feces were also high. As a result of the iron supplementation the fecal iron excretion dropped to 25.5 mg per day. This fact indicates an increase of the iron utilization in the body.

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**O-4-019**

**The effect of Cisplatin administration on some trace elements homeostasis in rats and the protective effect of siver birch (*Betula pendula*) sap**



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The study wants to emphasize the effect of cisplatin on some important trace elements in rats and the protective effect of silver birch sap. Wistar rats divided as: C received tap water, E1 – cisplatin 20 mg/kg i.p., E2 – cisplatin 20 mg/kg and silver birch sap, E3 – only silver birch sap. Blood samples were collected at the start of experiment, after 48 h and, at the end of experiment (7 days), blood and organs. Samples were digested in nitric acid by microwave digestion and were analyzed by flame spectroscopy. Rats exposed to cisplatin presented not significant ( $p > 0.05$ ) decrease of Zn and Mg, significantly ( $p < 0.05$ ) decrease of Cu at 48 h after administration, highly significant ( $p < 0.01$ ) decrease of Cu and Fe at 7 days after administration and not significant ( $p > 0.05$ ) increase of Mn. Silver birch sap administration was followed by restoration or even significantly ( $p < 0.05$ ) increase of studied trace elements offering protection against cisplatin trace elements homeostasis imbalance and side effects.

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O-4-020

### Effect of melatonin supplementation on the distribution of various elements in the serum of diabetic rats subjected to an acute swimming exercise



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The present study aims to examine the effect of supplementation of melatonin on the distribution of various elements in the sera of diabetic rats subjected to an acute swimming exercise. Animals were divided to 8 groups. Group 1, control. Group 2, melatonin-administered. Group 3, melatonin-administered diabetic. Group 4, swimming. Group 5, melatonin-administered swimming. Group 6, melatonin-administered diabetic swimming. Group 7, diabetic swimming. Group 8, diabetic group. These animals were administered 3 mg/kg/day intraperitoneal melatonin for 4 weeks. At the end of the 4-week study, and serum levels of elements were determined with atomic emission spectrometry. The lowest Mo, Cr, Cu, Fe, K, Mg, Na, P, Pb, Se, Zn values were in groups 7 and 8. These same parameters were higher in group 4. The results show that acute swimming exercise and diabetes affect the distribution of various elements, but melatonin supplementation can prevent changes associated with both exercise and diabetes.

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O-4-021

### Effect of chronic swimming exercise and vitamin E supplemented on element levels of bone tissues of rat with epilepsy



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This study was performed to assess the effect of chronic swimming exercise and vitamin E supplemented on element levels of bone tissues of rat with epilepsy. Animals were divided to 6 groups. 1 Control, 2 swimming, 3 swimming + vitamin E, 4 swimming + epileptic, 5 swimming + epilepsy + vitamin E, 6 epilepsy. Vitamin E was given by gavage every other day for 3 months as 500 mg/kg. 24 h after last vitamin E supplementation, animals were induced for epilepsy by a single microinjection of penicillin (500 units) into the left somatomotor cortex. Swimming exercise program lasted for 90 days (30 min/day). At the end of experiments bone tissue were analysed for elements levels using atomic emission spectrometry. In bone tissue of rats tissue of rats with epilepsy, Ca, Cr, Fe, Mg, Zn levels were significantly reduced compared to other groups. The findings of present study show that deteriorated elements metabolism in bone tissue are by vitamin E supplementation partially corrected.

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O-4-022

### Assessment of therapeutic potential of gold nanoparticles against acetaminophen induced hepatic injury: An emerging therapeutics



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This study was aimed to evaluate the protective effect of gold nanoparticles (AuNPs) on acetaminophen (APAP) induced hepatic damage in rats. Female albino rats were administered with APAP at a dose of 20 mg/kg p.o (5 days/week for 4 weeks) to induce hepatic injury. Animals were treated with AuNPs at a dose of 100 µg/kg p.o. or silymarin at a dose of 50 mg/kg p.o. for 2 days/week for 4 weeks. APAP induced a significant alteration in Liver Function Tests (LFTs) which indicated the hepatocellular damage. Toxicant administration caused oxidative stress and significantly declined the activities of antioxidant enzymes in liver. APAP exposure was also found to induce DNA damage and histological alterations in liver. Therapy of AuNPs significantly prevented the APAP induced oxidative DNA damage and histological alterations. Thus it is concluded that AuNPs showed remarkable protection against APAP induced toxicity and can be used in the development of drug against hepatic diseases, after further preclinical and clinical studies.

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P-001

### A missense mutation in selenocysteine synthase affects selenoprotein expression more profoundly in neurons than in astrocytes or hepatocytes



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Mutations in the gene encoding selenocysteine synthase (SEPSecs) lead to a syndrome now called pontocerebellar hypoplasia (PCH) type 1D. The neurological phenotypes of pediatric patients clearly demonstrate the importance of selenoproteins in the human brain. We have constructed a mouse model with a pathogenic mutation in selenocysteine synthase. Western blot analysis of selenoproteins in different tissues from homozygous mutant mice show reduction of selenoproteins to variable degrees. For example, selenoproteins in liver were hardly affected, while brain selenoproteins were most reduced among organs. Primary cultures demonstrated that neuronal selenoproteins were significantly reduced, while the effect was much smaller in astrocytes. These results explain why the phenotype of patients is dominated by neurodegeneration. At the same time, this is another example of an organ-specific phenotype caused by a germline mutation. Unlike the human patients, Sepsecs-mutant mice die after birth.

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## P-002

**Selenium fractions in two famous high-Se areas of China: Enshi, Hubei Province and Ziyang, Shaanxi Province**Huan Tian<sup>1</sup>, Zhengyu Bao<sup>2,3,\*</sup>, Hongyu Zhang<sup>1</sup><sup>1</sup> School of Earth Sciences, China University of Geosciences, Wuhan 430074, China<sup>2</sup> Faculty of Materials Science and Chemistry, China University of Geosciences, Wuhan 430074, China<sup>3</sup> Zhejiang Research Institute, China University of Geosciences, Hangzhou 311305, ChinaE-mail address: [zybao@cug.edu.cn](mailto:zybao@cug.edu.cn) (Z. Bao).

Selenium (Se) fractions of 31 rocks/soils (Enshi and Ziyang) were analysed for better understanding of Se biogeochemical cycling, assessing geological environment, utilizing Se sources and preventing Se poisoning. The Se content of Enshi rocks/soils are higher than those of Ziyang. Sulfide/selenide and elemental Se, base-soluble organic Se and residual Se are predominated in Ziyang carbonaceous slate, and the bioavailable Se is  $5.12 \pm 3.60\%$  ( $n=5$ ); base-soluble organic Se, sulfide/selenide and elemental Se, and ligand-exchangeable Se are the main fractions in Enshi carbonaceous shale, and the bioavailable Se is  $17.81 \pm 6.80\%$  ( $n=8$ ). The soil Se fractions present a high succession of the underlying strata. The soil bioavailable Se of Ziyang ( $4.17 \pm 3.35\%$ ,  $n=8$ ) is lower than that of Enshi ( $14.14 \pm 8.43\%$ ,  $n=10$ ). Thus, the Se bioavailability in geological samples is largely controlled by its fractions and species.

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## P-003

**Selenium regulates IL-10 mRNA expression of LPS induced-human periodontal ligament mesenchymal stem cells (hPDL-MSCs)**

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**Aim:** To explore whether seleno-methionine (S) alters *Porphyromonas gingivalis*-lipopolysaccharide (Pg-LPS) induced human periodontal ligament mesenchymal stem cells (hPDL-MSCs) response.

**Materials and methods:** Cells were treated with Pg-LPS to mimic periodontal disease and then S (1, 10, 100, 1000 ng/ml) was added to the culture conditions after 8 h LPS (1000 ng/ml) induction. Cell proliferation with the Pg-LPS and S was evaluated using RT-CA. RNA was isolated from hPDL-MSCs at 16, 24 and 72 h. Cytokines including IL-1 $\beta$ , IL-6, IL-8 and IL-10 were checked using qRT-PCR.

**Results:** LPS increased IL-1 $\beta$  and IL-6 mRNA expressions of hPDL-MSCs before S treatment. While 1-100 ng/ml concentration of Selenium did not change IL-1 $\beta$ , IL-6 and IL-8, S up-regulated IL-10 transcripts of LPS-induced hPDL-MSCs. Highest concentration of S increased IL-1 $\beta$ , IL-6, and IL-8 transcripts of hPDL-MSCs.

**Conclusion:** Results of this study demonstrated that S might have positive effects on the host regulation increasing IL-10 (This study was supported by Selcuk University Research Foundation).

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## P-004

**Does selenium supplementation prevent brain injury in chlorpyrifos-treated rat?**

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Chlorpyrifos (CPF) is a well-known organophosphate pesticide which is most commonly used in agriculture industry and domestic. This study is aimed at elucidating the possible protective effects of selenium (Se) in alleviating the neurotoxicity of CPF on brain in male rats. Sprague Dawley rats were divided into 5 groups of 6 animals each: control (deionized water), vehicle control (corn oil), group I [CPF (13.5 mg/kg)], group II [Se (3 mg/kg)] and group III (CPF + Se). The rats were treated by gavage 5 days a week for 6 weeks. At the end of the treatment period, the animals were sacrificed and brain tissues were collected. AChE activity was assayed in the tissue homogenate using kit procedure and trace elements such as Zn, Cu, etc. were analyzed by ICP-OES. As a result, it was determined that the body weights of the rats changed statistically between the groups. An increase in Silicon level was detected, while Boron level and AChE activity were decreased significantly in group I. Our findings revealed that Se may be beneficial for the neuroprotective effect against CPF induced neurological disorders.

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## P-005

**Role of selenium in mitigating the possible toxic effects of chlorpyrifos on hematological alterations and trace elements in rats**B. Ozturk Kurt<sup>1</sup>, D. Konukoglu<sup>2</sup>, S. Ozdemir<sup>1,\*</sup><sup>1</sup> Istanbul University Cerrahpasa Medical Faculty  
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Chlorpyrifos (CPF) is one of the most widely used organophosphate insecticides throughout the world. The aim of the study is to investigate the protective role of selenium (Se) on the possible toxic effect of CPF on the experimental model. 30 rats randomly distributed into 5 groups served as subjects. Animals were orally administered with distilled water, corn oil, Se (3 mg/kg), CPF (5.4 mg/kg) and Se + CPF 5 d/w for 6 weeks. After treatment, blood samples were taken from the heart. Hematological parameters were analyzed in blood; acetylcholinesterase activity, liver function tests and trace elements (Zn, Cu, etc.) were measured in serums. CPF led to an increase in red cell distribution width (RDW). There were no significant differences in alkaline phosphatase (ALP) and alanine aminotransferase (ALT). The levels of Cu, Mg and Se were increased in Se and Se + CPF groups according to control. As a result, we suggested that Se may help to reduce the effects caused by CPF.

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## P-006

**Impaired sperm quality was associated with decreased testicular transcription of nucleus form of glutathione reductase 4 in rats fed deficient and excessive dietary selenium**Ji-Chang Zhou<sup>1</sup>, Xin Gen Lei<sup>2,\*</sup>, Xiaoli Liu<sup>1</sup><sup>1</sup> Molecular Biology Laboratory, Shenzhen Center for Chronic Disease Control, Shenzhen, China<sup>2</sup> Department of Animal Science, Cornell University, Ithaca, NY, USAE-mail address: [XL20@cornell.edu](mailto:XL20@cornell.edu) (X.G. Lei).

To test the transcriptional responses of the two *Gpx4* variants in testis to the dietary Se concentrations and their associations with the sperm motility and morphology, four groups of weanling SD rats ( $n = 12$ ) were fed Se deficient basal diet (BD) for 5 wks and then supplemented with 0.0, 0.25, 3.0, and 5.0 mg Se/kg for another 4 wks before sacrifice. It was found that BD and/or BD plus 5.0 mg Se/kg significantly increased the plasma 8-OHdG concentration and decreased some of the sperm parameters and the testicular mRNA abundance of nucleus (minor) form ( $P < 0.05$ ) but not the cytosolic/mitochondrial (major) form ( $P > 0.05$ ) of *Gpx4*. Transcriptions of the two *Gpx4* variants in liver did not differ ( $P > 0.05$ ). Conclusively, the testicular nucleus *Gpx4* might be a sensitive marker representing the appropriate Se nutritional status for males.

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## P-007

**Dietary determinants of serum selenium species in Italian populations**Tommaso Filippini<sup>1,\*</sup>, Bernhard Michalke<sup>2</sup>, Chiara Salvia<sup>1</sup>, Carlotta Malagoli<sup>1</sup>, Marcella Malavolti<sup>1</sup>, Peter Grill<sup>2</sup>, Luciano Vescovi<sup>3</sup>, Sabina Sieri<sup>4</sup>, Vittorio Krogh<sup>4</sup>, Marco Vinceti<sup>1</sup><sup>1</sup> University of Modena and Reggio Emilia, Modena, Italy<sup>2</sup> Helmholtz Zentrum München, Neuherberg, Germany<sup>3</sup> IREN, Italy<sup>4</sup> Istituto Nazionale dei Tumori, Milan, ItalyE-mail address: [tommasso.filippini@unimore.it](mailto:tommasso.filippini@unimore.it) (T. Filippini).

We investigated the correlation between dietary habits with serum levels of selenium (Se) species collected from an Italian community. Consumption of food items was assessed using a food frequency questionnaire. Cereal intake showed a positive relation with total and organic Se, but null/negative with inorganic Se. Fish and seafood positively correlated with inorganic Se and negatively with organic Se. Correlations were generally negative/null in vegetables (only Se-Cys was positively correlated), while in fruits they were positive with organic species, mainly Se-Cys. Legumes showed inverse relation with overall organic Se, but positive with Se-Cys, Se-TrXr and inorganic Se. Correlation of potatoes intake was negative with Se forms, except a positive one with Se-Cys and selenate. Our results show highly specific associations between intake of selected foods and circulating Se species levels.

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## P-008

**Selenium Treatment and Chagasic Cardiopathy (STCC) clinical trial: First results on selenium levels at baseline**T.C. Araújo-Jorge<sup>1,\*</sup>, M.T. Holanda<sup>2</sup>, F.S. Pereira-Silva<sup>1</sup>, L.R. Garzoni<sup>1</sup>, L.O. Pimentel<sup>1</sup>, B.M.S. Gonzaga<sup>1</sup>, A.M. Hasslocher-Moreno<sup>2</sup>, S.S. Xavier<sup>2</sup>, G.M. Sperandio da Silva<sup>2</sup>, R.M. Saraiva<sup>2</sup>, C.S.A. Cardoso<sup>2</sup>, A.S. de Sousa<sup>2</sup>, M.F.F. Mediano<sup>2</sup>, P.E.A.A. do Brasil<sup>2</sup><sup>1</sup> LITEB, Oswaldo Cruz Institute, Brazil<sup>2</sup> Lapclin-Chagas, National Institute of Infectious Diseases, Oswaldo Cruz Foundation (Fiocruz), Rio de Janeiro BrazilE-mail address: [taniaaj@ioc.fiocruz.br](mailto:taniaaj@ioc.fiocruz.br) (T.C. Araújo-Jorge).

STCC is the first superiority, double-blind, placebo-controlled, randomized clinical trial of a micronutrient therapy for Chagas disease (Trials 6;15:388, 2014). Volunteers receive 100 µg of sodium selenite once daily for 365 consecutive days. The trial is still in the recruiting phase and the primary outcomes will not sort out before 2020. Plasma selenium baseline levels of a first group of patients measured by ICP-MS gave preliminary results as follows (in mg/L): median level = 70.25; minimum level = 51, maximum level = 131; first quartile (25%) = 59.25; third quartile (75%) = 82.75. If Se treatment reduces the progression of Chagas cardiopathy, the inclusion of this micronutrient in the daily diet could improve the therapeutic regimen for this neglected tropical disease at low cost.

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## P-009

**The effect of zinc supplementation on the zinc and selenium status in exercise**Andrey A. Skalny<sup>1,2,\*</sup>, Mikhail Yu. Karganov<sup>3</sup>, Anatoly V. Skalny<sup>4</sup>, Maria A. Fomina<sup>1</sup>, Alexander A. Nikonorov<sup>3,5</sup><sup>1</sup> Ryazan State Medical University Named After Academician IP Pavlov, Ryazan, Russia<sup>2</sup> RUDN University, Moscow, Russia<sup>3</sup> Laboratory of Physicochemical and Ecological Pathophysiology, Institute of General Pathology and Pathophysiology, Moscow, Russia<sup>4</sup> Trace Element Institute for UNESCO, Lyon, France<sup>5</sup> Orenburg State Medical University, Orenburg, RussiaE-mail address: [skalny.pfur@yandex.ru](mailto:skalny.pfur@yandex.ru) (A.A. Skalny).

**Objective:** Investigation of the effect of Zn supplementation on Zn and Se status in exercised rats.

**Methods:** 24 male Wistar were divided into 4 groups: control, exercised, Zn-supplemented, exercised Zn-supplemented. Zn was supplemented as Zn asparaginate. Tissue Zn and Se were estimated using ICP-MS.

**Results:** Exercise significantly decreased muscle, kidney and hair Zn; liver, heart, skeletal muscle and kidney Se levels. Exercise results in elevation of liver Zn; serum and hair Se content. Zn supplementation elevated liver, kidney, heart and hair Zn content in exercised rats. Zn supplementation increased Se stores in animals with high physical activity.

**Conclusions:** Effect of Zn supplementation in exercised organ-ism may be associated not only with modulation of Zn status but regulation of Se status.

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## P-010

**Prenatal mercury exposure from seafood. Does delay in language and communication development at 3 years persist at 5 years of age?**

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We previously found that prenatal exposure to methylmercury (MeHg) impaired language development as determined at three years in children in the Norwegian Mother and Child Cohort Study (MoBa). We investigated if this impairment also persisted at 5 years of age, in a study population of  $n = 38,581$  mother–child pairs. Total mercury (THg) in maternal blood was determined in a subgroup of  $n = 2239$ . Prenatal MeHg exposure was calculated from reported seafood consumption in mid-pregnancy. We examined associations between MeHg exposure from maternal blood and diet and impaired child's receptive language and expressive language from the ASQ screening tool. Median THg maternal blood levels were  $1.03 \mu\text{g/L}$  and MeHg exposure  $0.15 \mu\text{g/kg bw/week}$ . Mean maternal weekly seafood intake was 34 (range 0–267) g/week in the study population. We found no association between prenatal mercury exposure and language and communication development at 5 years of age. Hence, the observation seen at 3 years did not persist.

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## P-011

**Effects of chelating agents on the accumulation of cadmium and endogenous concentrations of some essential elements in muscles of Cd-exposed mice**

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Cadmium (Cd) is an environmental pollutant shown to induce multi organ dysfunction. In this study, we present novel data about the effects of 2,3-dimercaptosuccinic acid (DMSA), monensin and salinomycin on the accumulation of Cd in muscles of mice exposed to Cd (II) acetate treatment for 14 days. The impact of the chelating agents and Cd on the endogenous concentrations of calcium (Ca), copper (Cu), iron (Fe), magnesium (Mg), phosphorous (P), selenium (Se) and zinc (Zn) was also investigated. Subacute exposure of mice to Cd (II) acetate resulted in a significant accumulation of the toxic metal ion in the muscles compared to the untreated controls. Salinomycin most effectively mobilized Cd from the muscles compared to DMSA and monensin. The Cd-exposure and the tested chelating agents did not alter significantly the endogenous concentrations of the selected essential elements in mouse muscles.

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## P-012

**Bioavailability of silver nanoparticles (SNP)**

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Bioavailability of SNP fabricated by the method of chemical reduction of  $\text{Ag}^{1+}$  to  $\text{Ag}^0$  was studied. SNP antibacterial activity was tested on *E. coli* K802. Effect of SNP on mammalian was checked in mice. The SNP displayed dose- and time-dependent antimicrobial activity and low toxicity in mice. Ag from SNP was transported into the cells of prokaryotes and eukaryotes by  $\text{Cu}^{1+}$ -transporters. In mice, treated with SNP intraperitoneally, Ag was unevenly distributed in the body. Ag of injected SNP was entered in the bloodstream; it was taken up by hepatocytes and included into active centers of ceruloplasmin that then was secreted into blood. The bile was the main way of Ag excretion. After cancellation of the SNP injections, Ag concentration decline rapidly in extracellular fluids, but not in the liver. Thus, SNP interfere in mammalian copper metabolism and their ecotoxicity are discussed. The work was supported by grants 15-04-06770-a, 16-34-60219, 14.B25.31.0011, 6.1278.2014/K.

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## P-013

**The molecular forms of tyrosinase-like phenoloxidase in fresh-water mollusks *Planorbarius corneus* are differently sensitive to silver ions ( $\text{Ag}^{1+}$ ) and silver nanoparticles (SNP)**

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Comprising in active centers of cuproenzymes copper takes a part in many processes in all the organisms. There is at least one cuproenzyme that participates in the innate immune response against infection in mollusks: tyrosinase-like phenoloxidase of haemolymph. But its synthesis, processing and transport is studied insufficiently; the relation degree between this tyrosinase and tissue form of tyrosinase is not clear. The aim of this work was estimate sensitivity of different forms of mollusk tyrosinase to copper deficient. As model fresh-water mollusks *Planorbarius corneus* was used. To reach copper deficiency we applied  $\text{Ag}^{1+}$  and SNP, because  $\text{Ag}^{1+}$ , being isoelectronic to  $\text{Cu}^{1+}$ , can be transferred through copper metabolic system, displacing copper. According to FAAS  $\text{Ag}^{1+}$  and Ag from SNP can enter into mollusks. According to biochemical and histochemical analyses soluble tyrosinase loses activity, but tissue forms of enzyme keep it. Supported by RFBR 16-04-00793 A.

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## P-014

**Disrupting effect of aluminium sulphate on sexual hormones in female rats (suckling period exposure)**

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The study was carried out on 32 white adult Wistar female rats exposed to aluminium during suckling period. Rats were divided into four groups: three experimental (E) and one control group (C) and exposed to: E<sub>1</sub>: 200 ppb Al, E<sub>2</sub>: 400 ppb Al, E<sub>3</sub>: 1000 ppb Al. Levels of FSH, LH, estradiol, progesterone and testosterone were evaluated in the proestrus phase. The sexual hormones were determined by ELISA technique. Exposure to aluminium during suckling determined: FSH: significant increase compared with the C group and significantly directly correlated with exposure level; LH: significant increase, greater than physiological limits compared with the C group, directly correlated significantly to exposure level; estradiol: significant increase compared with the C group and directly correlated to exposure level; progesterone: significant decrease compared with C group, inverse correlation, with the significant level of exposure; testosterone: significant increase compared with the C group and directly correlated to exposure level.

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## P-015

**The outcome of hexavalent chromium exposure on adrenal gland morphology and protective role of *Aronia melanocarpa***

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The aim of this study was to assess whether hexavalent chromium induces morphological changes in adrenal glands and the possibility of *Aronia melanocarpa* (aqueous extract) to act as a protective antioxidant agent. After three months of Cr VI exposure vacuolar degenerations and apoptosis appeared. Similar lesions occurred, although in cluster-like arrangement, when Cr VI was administered simultaneously with *Aronia* for three months. However, Cr VI administration followed by one month of recovery period (distilled water) reduced incidence of degenerative lesions. When *Aronia* was administered in one-month recovery period diffuse hypertrophy and capillary dilation were observed but after three-months the gland presented normal histological structure. The results suggest that *Aronia melanocarpa* has antioxidant potential against Cr VI induced structural changes in adrenal glands. Financial support for this study was provided by BUASVMT project no. 2758.

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## P-016

**Effect of lead on some essential elements levels of laboratory animals**

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This study aimed to evaluate blood concentrations of several trace elements after lead intoxication modeling. For imitation of lead intoxication white rats were added to drinking water acetous lead daily during 7 weeks (preliminary dose was 60 mg/kg). The blood elements levels were determined by the atomic absorption spectrometer AADUO 240 Agilent Technologies. It was established that lead exposure is accompanied by significantly higher calcium content in blood (21.1 mg/L against 93.7 mg/L), significant increase of magnesium concentrations (6.1 mg/L compared to 16.8 mg/L) ( $p \leq 0.05$ ). On the contrary blood concentration of zinc and copper reduced in 30% and 20% accordingly ( $p \leq 0.05$ ) and selenium content decreased of from 92.1  $\mu\text{g/L}$  to 10.4  $\mu\text{g/L}$  ( $p \leq 0.01$ ) compared with the control group. The addition to lead exposure rats diet of taxifolin resulted in increase selenium blood concentration in 70% and returned magnesium and calcium concentrations to means of control group. Similar trends were not observed in the case of zinc and copper.

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## P-017

**Influence of gold on the reproductive system**

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Gold (Au) is used in the treatment of rheumatoid arthritis. The purpose of this work was to explore the impact of Au on the female reproductive system. After intraperitoneal administration of Au, ultrastructural investigations of ovary and uterus ultrathin sections of treated pregnant rats revealed the presence of numerous heterogeneous clusters with very electron dense inclusions in the lysosomes of granulosa, theca interna and externa cells. Cells vacuolization, expansion of the endoplasmic reticulum, mitochondrial alterations and necrosis foci were also highlighted. Moreover, huge phagolysosomes and high number of eosinophils as signs of inflammation produced by the damaged cells were also identified in endometrium and myometrium cells. Sections of control pregnant rats showed a normal ultrastructure. These results demonstrated the toxicity of Au and the role played by lysosomes in the sequestration of Au under insoluble form in all cells of studied tissues. We speculate that Au will be taken with all precaution.

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## P-018

**Manganese-peptide complexes involved in radioresistance in *Deinococcus radiodurans* bacterium**

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*Deinococcus radiodurans* (DR) is a bacterium extraordinary resistant to chronic  $\gamma$  radiation (50 Gy per hour) and acute doses (greater than 10 kGy). Although the biochemical basis of the radioprotective properties are still unknown, recent findings reported that Mn(II)-peptide complexes, isolated from DR cell-free extract, could act as scavenging agents by neutralizing ROS molecules induced through radiation exposure. Here we report the results of the interaction of Mn(II) and two peptides: DEHGTAVMLK and THMVLAKGED, as a model of the antioxidative mechanism in DR. The amino acid composition of the peptides was chosen randomly on the basis of their natural abundance in the DR cell-free extract. We have focused our attention on the coordination of Mn(II) with both peptides by using potentiometric titration and spectroscopic techniques (NMR, EPR and ESI-MS).

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## P-019

**Ni(II) interaction with a histidine-rich region of the human TLR4 protein involved in the activation of nickel contact allergy**

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Ni(II) stimulates innate immunity via the direct binding to human toll like receptor 4 (hTLR4), the bacterial lipopolysaccharide receptor. This interaction is specific for humans and causes nickel contact allergy. The protein sequence of hTLR4 revealed that the ectodomain, the region supposed to coordinate the metal ions, contains a histidine-rich motif that is not conserved among all organisms. To elucidate the role of each histidine on the protein–nickel binding, we investigated the Ni(II) interaction with the model peptide NH<sub>2</sub>-FQHSNRKQMSERSVFRSRRNRIYRDISHTHTR-COO<sup>-</sup>, which encompasses the sequence 429–460 of hTLR4. Potentiometric, UV–Vis, nuclear magnetic resonance and circular dichroism measurements demonstrate that the non-conserved histidine in the ectodomain cooperates in metal coordination and consequently enables the activation of the molecular mechanism involved in nickel hypersensitivity reaction.

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## P-020

**Ethylmercury, but not thimerosal, induces inflammatory cytokines from mouse cerebellar microglia cell line, C8-B4 cell**

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We observed that Ca<sup>2+</sup> was passed into the cell through P2X7 receptor by the addition of ethylmercury (EtH), but thimerosal did not. As the expression of cytokine is induced by the increase of intracellular Ca<sup>2+</sup>, the aim of this study is to find the different effect between EtHg and thimerosal on the expression of cytokines in microglia cells. The addition of 1.5  $\mu$ M of EtHg and thimerosal did not affect cell survival rates within four hours, and the expression of mRNAs of cytokines was observed at 2–4 h after the addition. The expression of mRNAs of TNF- $\alpha$  and IL1- $\beta$  significantly increases time-dependently when 1.5  $\mu$ M of EtHg is added to cells and IL10 mRNA is slightly increased four hours after the addition. On the contrary, we did not observe any difference in the expression of TNF- $\alpha$ , IL1- $\beta$ , and IL10 mRNAs between thimerosal-administered and control groups. It is suggested that EtHg probably stimulates Ca<sup>2+</sup> uptake, and then, microglia cells change resting form into activated form as well as inflammatory cytokines are induced in the cell.

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## P-021

**New experimental model of beryllium toxicity**

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Up-to-now the highest degree of attention was paid to the pathology of respiratory tract disorders, associated with human exposure to beryllium (Be). However, berylliosis as the most common pathology may be associated mostly with particles dispersity, whereas toxicity of Be<sup>2+</sup> ions itself is much less studied. The difficulties in studying of the latter are related to the high osmotic stress in case of parenteral injections and very low bioavailability for the gastrointestinal administration. The aim of the current study was to design a new experimental approach for the study of Be toxicity. Proposed model was based on intraperitoneal injection of Be chelates with neutralized pH. Proposed approach showed that lung tissue was not a primary target for Be<sup>2+</sup>. At the same time, high affinity of gonads and spleen tissues towards Be was observed. Also, a leading role of liver and kidneys in Be elimination was confirmed.

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## P-022

**Consumption of arsenic compounds from freshwater fish in Cambodia**

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Marine fish contain high amounts of arsenic (As), but the majority of As in marine fish is in the form of arsenobetaine, which is almost non-toxic. However, the chemical forms of As in freshwater fish remain unclear. In Cambodia, a large amount of freshwater fish derived from the Mekong River is consumed; more than 80% of animal protein intake are from freshwater fish. To assess the contribution of freshwater fish to As intake, we determined the concentrations of each form of As among 40 species of freshwater fish. The results showed that As concentrations in freshwater fish were very low primarily due to the lack of arsenobetaine. Speciation analysis revealed the existence of various forms of As including inorganic As in freshwater fish. The intake of inorganic As from each freshwater fish was estimated by multiplying the concentration with the amount of consumption of each fish, which was obtained by dietary survey among the residents. The total intake of inorganic As from freshwater fish was estimated to be around 10 µg/week/person, much less than those from water or rice.

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## P-023

**Effect of arsenic in rats caused by direct exposure and via parents**

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The effect of arsenic in rats caused by direct exposure and via parents was studied. Rats got water containing sodium arsenite at concentration 68 mg/L and 136 mg/L for 3 months. Our experiments reveal that these concentrations do not influence locomotor activity and anxiety behavior in adult rats, but it causes changes in their offspring, specifically the locomotion activity was significantly reduced in pups, they have a tendency to depression and also revealed reduced learning ability in Multi Branched Maze test compared to control ones. It was found that arsenic consumption at the same concentration induces memory deficits as in adult as well as in their offspring. The results of present study revealed that control rats clearly react to the object novelty by exploring the new object in contrast to arsenic exposed ones. Our studies for elucidation of arsenic exposure on cells of brain revealed that more vulnerable to this trace element were cells in motor cortex of offspring, from parents who received arsenic before, during pregnancy and lactation period.

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## P-024

**Assessing the impact of trace element, As in groundwater on public health**

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Groundwater is a major source of drinking water especially in rural areas. This study was intended to determine As in groundwater to assess its impact on public health. Here, we measured As concentration of groundwater in 722 sites covering all 6 major provincial areas of Korea. Groundwater was measured As concentration in two occasions (summer and winter) employing highly sensitive ICP-MS. Seasonal variation of As concentration in groundwater was minimal, while geographical difference, prominent. The concentrations of As in groundwater ranged from 0.1 to 48.4 µg/L and the majority displayed lower than 10 µg/L. However, some area exceeded 10.0 µg/L (2–5%) and most remarkably, the urinary excretion of As in the population around 3 groundwater with high arsenic levels was measured to be markedly higher with all stratified analysis yielding higher As levels compared to non-contaminated area (<5 µg/L). Especially, urinary As excretion of non-smokers was significantly higher in the contaminated area. These results suggest that more extensive monitoring for As in groundwater and examination of related health effects are necessary to protect public health from As exposure.

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## P-025

**Seafood arsenic is associated with an increase in TSH**

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Inorganic arsenic may increase thyroid-stimulating hormone (TSH). Increased TSH may be a result of suppressed thyroid hormone production. We investigated if high intake organic arsenicals (As) from seafood was associated with changes in thyroid hormones. Four groups, in total 38 healthy subjects, received daily 150 g portions of cod, salmon, blue mussels or potato (control) during 14 days. Plasma As, FT3, FT4, TSH and selenium, and urinary iodine were determined. Plasma TSH increased significantly in all seafood groups. Change in plasma As was together with a negative impact of selenium the dominant factors in the optimal multiple regression model for a positive change in TSH. Changes in thyroid hormones were compatible with an As related inhibition of T4 to T3 conversion. Organic seafood As, depending on seafood species and possibly species of As present, may influence thyroid metabolism.

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**P-026**

**Elemental mapping in rat bones treated with strontium ranelate and strontium citrate using  $\mu$ XRF**



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Strontium ranelate (SR) is reported to be beneficial in treating osteoporosis. In this study, the distribution of strontium in Spague-Dawley rat bones, following administration of strontium citrate (SC) and SR, were compared. Rats were dosed for ten weeks; the SR and SC group received 174 and 236 mg/kg/day of elemental Sr, respectively. A slice (~15  $\mu$ m) from each group was analyzed by scanning (step size: 50  $\mu$ m, time/point: 100 s) different regions of interest containing trabecular and cortical bone using a Rh anode tube (0.4 mA, 50 kV). Ca, Sr, P, S and Zn were detected. Calcium maps in both treated groups showed similar intensities, which would suggest similar levels of calcification. Strontium signals were detected in the two treated groups; while no detectable signal was observed in the control sample. Accumulation of strontium can be seen primarily in the trabecular or inner region of bones of treated groups. The 2D distribution of strontium and other elements will also be presented.

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**P-027**

**Quantifying trace-level gold nanoparticles in cancer cells**



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Recent developments in cancer treatment and diagnosis have been geared towards combining nanoparticles (NP) with conventional therapies. Among other nanoparticles, gold nanoparticles (GNPs) are being used in cancer therapy as radiation dose enhancers and drug carriers. Use of GNPs in cancer nanomedicine requires accurate quantification of NP in cancer cells. Thus, it is crucial to have an accurate and efficient method of quantification. We have developed and validated a total reflection X-ray fluorescence spectrometry (TXRF) based method for quantification of trace-level GNPs accumulated in breast cancer cells (MDA-MB-231) using small sample volumes (i.e. 5  $\mu$ L). The spectrometer (S2 PicoFox, Bruker-AXS, USA) utilizes a molybdenum target X-ray tube, silicon drift detector (SDD) and high purity siliconized quartz reflectors as sample carriers. The obtained recovery rates, sample preparation challenges and comparison with other methods will be presented.

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**P-028**

**Determining tungsten deposition and speciation in bone using X-ray spectroscopy**



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Though tungsten is increasingly used in a variety of applications, there is an alarming lack of toxicological data available due to a persisting belief in its innocuous nature. This gap in knowledge has been recently highlighted by several cases correlating high-level tungsten exposure to severe medical issues such as leukemia, stroke and seizure. Tungsten has been shown to accumulate in bone with studies suggesting that there may be detrimental effects on both bone structure and the immune cells produced in bone marrow. Using X-ray fluorescence spectroscopy, we have demonstrated unique heterogeneous tungsten accumulation within mouse long bone. X-ray absorption near edge spectroscopy measurements show that the tungsten species within the bone have a similar structure to phosphotungstate, indicating that its uptake mechanism may involve the condensation of tungsten into reactive polytungstate species followed by coordination to phosphate in bone, forming an insoluble species. These observations of tungsten speciation and specific localization in bone have serious implications about how tungsten accumulation gives rise to observed toxicity.

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**P-029**

**Arc atomic emission spectral analysis of human nails**



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Information about trace element composition can be obtained from different biological samples. Our goal is to use human nails for trace element analysis because they are easily obtained, stored and transported. To determine the elemental concentrations we used atomic emission spectral analysis with spectrum excitation of a dried residue. The optimal ratio of reagents for sample digestion is  $\approx$ 0.1 mg of sample, 1 ml HNO<sub>3</sub>, 0.2 ml H<sub>2</sub>O<sub>2</sub> with subsequent dilution to 2 ml by HNO<sub>3</sub> (1:1). Both hot plate and microwave oven are appropriate for digestion. Solutions can be stored at room temperature during at least 8 days. After statistical processing of obtained concentrations in nails samples ( $n=73$ ), we define that frequency distributions are subject to the normal or lognormal law (for different elements). That allows us to access correct average values and concentration ranges of Ag, Al, Ca, Cd, Cr, Cu, Fe, Mg, Mn, Ni, Pb and Zn. It was found that the average content of Cu in women nails (3.7  $\mu$ g/g) is statistically ( $p < 0.05$ ) higher than in men nails (2.7  $\mu$ g/g), Pb-concentration is associated with smoking. Inter-element correlations are also detected.

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## P-030

**Deuterium is an important element of biological kinetics processes control**

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Water represents as a stable isotope mixture ( $H_2O$ – $HDO$ – $D_2O$ ) with different mass. The content of specific isotopic composition of water is comparable to important trace elements in human plasma and seawater. Waters having different ratios of D/H possess dissimilar physical, chemical and spectral features. As it has been proved, deuterium depleted water (ddw) displays antidotal features under the individual and combined influence of active pharmaceutical ingredients (API) and it reduces the hazard of  $\gamma$ -ray radiation. We investigated the kinetics of ligand–receptor interaction pharmaceuticals and excipients by Spiritox-test in waters with varied quantity of hydrogen isotope  $^2H(D)$ : in ddw the toxicity decrease approximately in  $\sim 1.5$  times versus to MiliQ-water. Kinetic analysis by the LALLS-method has been used for investigation the API solubility depending on the content of  $^2H(D)$  in water. Rate constants of API solubility differ approximately in  $\sim 1.5$  times for ddw and MiliQ-water.

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## P-031

**Development of HPLC-ICP-MS method for determination of methylmercury in fish and seafood samples**

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Marine seafood is one of the major sources of mercury in the human food chain. Currently, there is no legally established limit for methyl mercury (MeHg) in food; thus, there is no standardized method for the determination of MeHg in fish and seafood in Russia. MeHg detection was performed using HPLC ICP-MS. Precision of the method was determined by calculation of the interlaboratory reproducibility by analysis of identical samples processed by different people using different batches of reagents on different days. Repeatability was evaluated by analysis of parallel samples using the same equipment and reagents on the same day. The relative standard deviation of repeatability (RSDr) ranged from 2.5 to 3.9%, while the relative standard deviation of reproducibility (RSDR) ranged from 4.9 to 7.7%. The measurement range for mass fraction of MeHg is 0.013–10.00 mg/kg. The wide range of marine tissues was used during the validation to ensure that the method will be applicable for measurements of MeHg in seafood matrices of all kinds.

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## P-032

**Sweat chloride quantification using inductively coupled plasma mass spectrometry (ICP-MS) as a reference method for the diagnosis of cystic fibrosis**

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Analysis of sweat Chloride (Cl) is a valuable tool in the diagnosis of cystic fibrosis (CF), where individuals with CF demonstrate a characteristic elevation in sweat Cl compared to those of “normal” individuals. Cl levels found in “normal” sweat are significantly lower than those seen in other sample types, introducing the requirement for a method capable of detection at this lower concentration range. Many of the methods available for Cl quantitation are based on extrapolation from a standard concentration curve, with no calibration point at this lower range. In 2008, the introduction of analysis of sweat Cl by ICP-MS provided a method capable of measuring the variation of Cl levels seen in “normal” and CF sweat. Analysis by ICP-MS provides the advantage of significantly lower volume requirements compared to previous methods for sweat analysis (ion selective electrode and flame photometer). ICP-MS methods allow for increased accuracy by allowing multiple assessments on the sample, use of an internal standard, and sensitivity at the parts per trillion level.

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## P-033

**Cholesterol derived carbon quantum dots as fluorescence probe for hemoglobin sensor**

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Hemoglobin (Hb) is vital to bring  $O_2$  and  $CO_2$  from the lungs to various parts and those parts to lungs respectively. The Hb level in blood is related to diseases like leukemia, anemia, heart diseases, etc. The normal Hb level in the male is 13.0–18.0 g/dL and female is 12.0–16.0 g/dL. So accurate quantification of Hb in blood is a key to controlling those diseases. Here, we developed a low-cost, simple and sensitive fluorometric way to detect Hb by carbon quantum dots (CQDs) synthesized from cholesterol under hydrothermal method at 180 °C for 8 h. The CQDs were characterized by UV–visible spectroscopy, photoluminescence spectroscopy, and transmission electron microscopy. The fluorescence of CQDs does not change in acidic or basic pH level, thus we can use this probe for any pH level. The commonly occurring interfering biomolecules in biofluids like vitamins, amino acids, carbohydrate (10  $\mu$ M) exhibit no significant interference. The lower detection limit is 12.4 nM with a linear range of 0.1–20  $\mu$ M, promising for real analysis from a drop blood.

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## P-034

**Salivary arsenic level as biomarker for inorganic arsenic exposure in a wafer fabrication facility**

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Arsenic exposure has been a concern for the maintenance engineers of wafer fabrication facility. Salivary arsenic level is considered an alternative biomarker for inorganic arsenic exposure. This study was therefore conducted in a light-emitting diode factory in 2015 to explore the association between engineers' salivary arsenic levels and arsenic exposure at work. Totally, 355 study subjects were recruited with their saliva samples and personal information being collected during the annual physical examination. Results show that average salivary arsenic level of the engineers with potential arsenic exposure at work was  $0.64 \pm 0.99 \mu\text{g/L}$ , while that for the controls was  $0.45 \pm 0.52 \mu\text{g/L}$ . Meanwhile, salivary arsenic level was positively correlated with work seniority ( $p = 0.0035$ ), but negatively associated with the engineers' education level ( $p = 0.0472$ ). These findings implied that salivary arsenic could be used in low level arsenic exposure monitoring and the occupational arsenic exposure among engineers in wafer fabrication facility is still detectable even at pretty low level.

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## P-035

**Assessment of Hg exposure risks for people living in typical Hg polluted areas in China**

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The cereal and aquatic products consumption are the dominant pathway of Hg exposure for most Chinese people. In this work, we assessed the Hg exposure risks for Chinese residents of Hg polluted areas and fishermen in the coastal regions of China. The results demonstrated that the concentrations of Hg in inland China residents was in general at a low level, although Hg concentration in human hair of approximate 3% investigated people exceeds the Hg threshold limit value ( $1.9 \text{ mg/kg}$ ) recommended by WHO and 17.5% exceeds the Hg value in common people hair ( $1 \text{ mg/kg}$ ) promulgated by EPA. However, Hg in hair of above 40% of the fishermen living in the coastal and inland lakes areas exceeds the EPA recommended safety value (RSV). For another, Hg in urine of about 45% investigated Chinese people exceeds the WHO RSV ( $4 \mu\text{g/L}$ ), about 5% exceeds the China's health industry standard value ( $10 \mu\text{g/L}$ ). In general, the lower Hg content in hair but higher Hg content in urine implied a lower methylmercury exposure level but a higher inorganic Hg exposure level for Chinese people.

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## P-036

**Assessing the human lithium environmental exposure**N. Mimica<sup>1</sup>, J. Prejac<sup>2,\*</sup>, B. Momčilović<sup>3</sup><sup>1</sup> *University Psychiatric Hospital Vrapče, Bolnička cesta 12, Croatia*<sup>2</sup> *University Hospital Centre Zagreb, Kišpatičeva 13, Croatia*<sup>3</sup> *Institute for Research and Development of Sustainable Eco Systems, 10000 Zagreb, Croatia*  
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The aim of this study was to assess the human environmental Li exposure by studying Li frequency distribution in the hair (H-Li) and whole blood (WB-Li). Hair (H) was collected in 1073 healthy adult subjects (339 ♂ and 734 ♀); blood Li (B-Li) was analyzed in the sub-population of 91 ♂ and 143 ♀. Samples were analyzed for Li with the ICP-MS at the CBM, Moscow, Russia. The frequency distribution of H-Li and B-Li WB-Li was analyzed with the median derivative bioassay method. The H-Li bioassay sigmoid curve was linear (adequate) for the range of ( $\mu\text{g/g}$ ) 0.014–0.086 and 0.016–0.100 in ♂ and ♀, respectively. The WB-Li medians were 3.45–5.48 for ♂ and 3.24–5.64 in ♂ and ♀ respectively. The H-Li below 0.014 for ♀ and 0.015  $\mu\text{g/g}$  for ♂ are Li deficient, and those above 0.086 in ♀ and 0.100 in ♂ as Li excessive: B-Li conc's below 3.45 and 3.24 are regarded as Li deficient and those above 5.48 and 5.63 as Li excessive in ♂ and ♀, respectively.

**Conclusions:** (B-Li) > (H-Li) is good long term biological indicator for assessing the Li exposure.<http://dx.doi.org/10.1016/j.jtemb.2017.03.192>

## P-037

**Assessing the human boron nutritional status/exposure**J. Prejac<sup>1</sup>, N. Mimica<sup>2,\*</sup>, B. Momčilović<sup>3</sup><sup>1</sup> *University Hospital Centre Zagreb, Kišpatičeva 13, Croatia*<sup>2</sup> *University Psychiatric Hospital Vrapče, Bolnička cesta 12, Croatia*<sup>3</sup> *Institute for Research and Development of Sustainable Eco Systems, 10000 Zagreb, Croatia*

The aim of this study was to assess human boron (B) nutritional status. Hair (H) (samples were analyzed in 707 healthy adult subjects in (263 ♂ and 464 ♀) with the ICP-MS at the CBM, Moscow, Russia. Whole blood (WB) B was assessed in the population subsample of 80 men and 152 women. The frequency distribution of B in the respective H and WB samples was analyzed with the median derivative method. The bioassay sigmoid curve for H B is characterized by a linear response range (adequate B) status, of ( $\mu\text{g/g}$ ) 0.771–6.510 and 0.472–3.389, for ♂ and ♀, respectively; ♂ retained distinctly more B than ♀. Hair B concentrations below that level indicate low and that above it the B excessive exposure. There were no differences in the short term biological indicator of WB B linear range of concentrations between ♂ and ♀; ♂ 0.020–0.078 and ♀ 0.019–0.062 ( $\mu\text{g/g}$ ).

**Conclusions:** Hair is a non-invasive long term biological indicator tissue of choice for the human B nutritional status assessment/environmental exposure (body burden).<http://dx.doi.org/10.1016/j.jtemb.2017.03.193>

P-038

**Indirect toxicity information in humans through canine tissue biomonitoring**Vázquez Cristina<sup>1,2,\*</sup>, C. Rodríguez Castro María<sup>2</sup>, Boeykens Susana<sup>3</sup><sup>1</sup> Universidad de Buenos Aires, Facultad de Ingeniería, Buenos Aires, Argentina<sup>2</sup> Comisión Nacional de Energía Atómica, Sede Constituyentes, Buenos Aires, Argentina<sup>3</sup> Universidad de Luján, Luján, ArgentinaE-mail address: [vazquezcristi@gmail.com](mailto:vazquezcristi@gmail.com) (V. Cristina).

Biomonitoring gives a full view of an internal or absorbed dose of a chemical in an organism. Animal testing have often been used for obtaining toxicity information in humans and for assessing the extent the environmental contamination. Since mammals share physiological and biochemical characteristics with men, metals could have a similar impact on them, acting as targets of contamination. Dogs have long been an important research model and a promising tool as a target for metal contamination. This is due to the fact that dogs share the same environment as humans. They ingest waters from different sources, dogs consume only tap water from their surroundings. Blood and hair particularly appear as interesting monitoring tools for exposure risk assessment. The aim of this work was to evaluate the potentialities of whole blood and hair tests in domestic dogs as indicator for exposure to toxic elements. Total reflection X-ray fluorescence (TXRF) is used for the analysis of toxic elements in these tissues.

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P-039

**Association of heavy metals with abundance of pathogenic *Acanthamoeba* in wastewater**Ching-Wen Chang<sup>1,\*</sup>, Kai-Wen Ming<sup>1</sup>, Yaw-Huei Hwang<sup>2</sup>, Cheng-Chi Liao<sup>2</sup><sup>1</sup> Institute of Environmental Health, National Taiwan University, Taiwan<sup>2</sup> Institute of Occupational Medicine and Industrial Hygiene, National Taiwan University, TaiwanE-mail address: [chingwenchang@ntu.edu.tw](mailto:chingwenchang@ntu.edu.tw) (C.-W. Chang).

Metallic elements in wastewater could affect *Acanthamoeba*, known as pathogens of human meningoencephalitis. The study aims were to quantify *Acanthamoeba*, 15 heavy metals and physiochemical parameters in wastewater and to assess their association. *Acanthamoeba* and metals were respectively quantified by PCR and ICP-MS. Results showed Mn, Al, Zn and Ba ranked as the highest constituents, followed by Cu, Ni, Cr, As, V, Pb, Th, Sb, Co, Cd and Be in influent sewage. Following sedimentation, biodegradation and clarification, 87.3% of Al and 38.2% of Mn was removed. Mn level was further reduced after chlorination while Al was increased. Univariate statistical analyses indicate Ni, Be, Al, Cr, Cd, Ba, Pb, Zn, pH, water temperature, conductivity, dissolved organic compounds, total bacteria and free chlorine (FC) were significant factors ( $p < 0.05$ ). Further multivariate analyses reveal *Acanthamoeba* abundance was negatively affected by Ni, Ba and FC but positively related to Pb and conductivity ( $p < 0.05$ ).

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P-040

**Determination of heavy metals in *Mytilus galloprovincialis* along the Boka Kotorska Bay, Montenegro Coast**D. Joksimović<sup>1,\*</sup>, A. Perošević<sup>2</sup>, D. Djurović<sup>3</sup>, S. Stanković<sup>4</sup><sup>1</sup> Institute of Marine Biology, Kotor, Montenegro<sup>2</sup> Centre of Excellence in Bioinformatics, Podgorica, Montenegro<sup>3</sup> Institute of Public Health of Montenegro, Podgorica, Montenegro<sup>4</sup> Faculty of Technology and Metallurgy, Belgrade, SerbiaE-mail address: [danijela.j@ac.me](mailto:danijela.j@ac.me) (D. Joksimović).

Mussel (*Mytilus galloprovincialis*) is a species of shellfish living attached to the sea bottom near the shore. Due to its specific way of feeding it represents a natural filter that perfectly contains all the harmful substances present in water and in the tiny water organisms. As it is intensively used in human diet, the possibly present harmful and dangerous substances are directly influencing human health. The aim of this paper was to determine content of heavy metals Pb, Cd, Cu and Zn in mussel. In order to determine the microelements in mussel we used the GF AAS. The content of measured elements (up to for Pb: 83.5; Cd: 0.3; Cu: 58.8; Zn: 148 mg/kg) in samples was compared to the localities open sea–Boka Kotorska Bay.

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P-041

**Human exposure to Cd via consumption of mussels *Mytilus galloprovincialis* in Boka Kotorska Bay, Montenegro coast**A. Perošević<sup>1,\*</sup>, D. Joksimović<sup>2</sup>, D. Đurović<sup>3</sup>, I. Milašević<sup>1</sup>, S. Stanković<sup>4</sup><sup>1</sup> BIO-ICT Centre of Excellence in Bioinformatics, Podgorica, Montenegro<sup>2</sup> Institute of Marine Biology, University of Montenegro, Kotor, Montenegro<sup>3</sup> Institute of Public Health of Montenegro, Podgorica, Montenegro<sup>4</sup> Faculty of Technology and Metallurgy, University of Belgrade, SerbiaE-mail address: [anap@ac.me](mailto:anap@ac.me) (A. Perošević).

The aim of this study was to determine Cd contents in mussels collected in Boka Kotorska Bay and to assess possible human health risk via their consumption. Cd contents in samples collected during the period of one year were determined by ICP-OES. According to provisional tolerable monthly intake (PTMI) for Cd, its concentrations were recognized as the limiting factor for the consumption of these mussels. Considering PTMI<sub>Cd</sub> and mean value of Cd contents during this period, the maximum amount of mussels which can be consumed per month during the lifetime is limited at 6.52 kg, for a person weighting 60 kg. However, since Cd can enter into human body through other sources, this data requires more attention.

**Acknowledgment:** This work has been supported by the Ministry of Science of Montenegro and HERIC project through the BIO-ICT Centre of Excellence (Contract No. 01-1001).

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**P-042**

**Levels of essential macro- and trace elements in oily and lean fish species from the eastern Adriatic Sea**



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Fish is a rich source of many nutritious elements. According to its fat content, it is often categorized as lean and oily fish; the latter is the commonly consumed seafood in Croatia. We determined the levels of essential macro- and trace elements (K, Na, S, Mg, Ca, Fe, Cu, Zn, Mn, Se) in edible tissue of eight fish species typical for Croatian coastal area diet: chub mackerel, Atlantic horse mackerel, European anchovy, and European pilchard (oily fish) and bogue, blotched picarel, European hake, and red mullet (lean fish). All samples (in total  $n = 323$ ) were collected in the eastern Adriatic Sea during 2014. After freeze-drying and homogenization, samples were wet digested and analyzed by ICP-MS. We found lower S and higher K, Mg, Zn, Fe and Cu levels in oily than in lean fish, with the highest levels in pilchards. Our results indicate that besides omega-3 fatty acids, small oily fish is also a valuable source of essential trace elements and a healthy food choice.

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**P-043**

**Bioelemental status of indigenous people North Eastern Russia**



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The purpose of the article is the study features bioelement status of indigenous groups of the NorthEast of Russia and establishment of the main factors ensuring the mineral metabolism. The levels of bioelements in the Koryak, Chukchi and Evens have been studied. The research was performed by ICP-AES/ICP-MS methods. It is shown that the common elements in the Koryak and Chukchi are the Na, K, Fe, Cr, I. The ethnic group of Chukchi–Evens has been combined by levels Cu and Si. The content of most investigated elements has been comparable in the Koryak and Chukchi and significantly different from their levels in the Evens. It has been indicating the presence of the common features of the mineral metabolism in the Koryak and Chukchi. The ethnically Chukchi and Koryak were single arctic race. At the present stage the historical community can determine the similarity of physiological parameters in the Koryak and Chukchi, that confirmed by their bioelement status. Considering that investigated people have lived in one biogeochemical territory, it has been suggested that features of the mineral metabolism in

indigenous ethnic groups of the NorthEast of Russia are genetically determined.

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**P-044**

**The content of heavy metals in the hair of the children of different ages living in an industrial region**



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The assessment of the condition of children's organisms is an actual scientific and practical task. The pollution of the urban environment by industrial emissions, including heavy metals is harmful to the health of the children living in the urbanized territories. The analysis of the soil of  $3 \times 5$  km in size in the places of residence of the children and the analysis of the hair of the school students living in this territory were carried out. We determined content of Cr, Mn, Fe, Co, Ni, Cu, Zn, Ag, Cd, Pb by means of the method of nuclear and absorption spectrometry. The children's health was determined by methods of computer spirometry and rhythmic cardiography. It is established that with the age and with the increase of functional reserves of the cardio respiratory system the content of Cu and Pb in children's hair is decreased by 20–25% at the permanent content of these elements in the environment. It is shown that the increase of the content of heavy metals in the soil has a greater influence on the condition of lungs than on the condition of the cardiovascular system.

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**P-045**

**The composition of trace elements in the hair of inhabitants of India, after 4 years of training in Moscow**



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The influence of various trace elements on the ability of an organism to adaptation is an actual scientific task. It is important for persons moving to other natural and climatic conditions. The analysis of the soil tests in the place of residence of students from India and the analysis of the hair for the content of some trace elements was done by the method of atomic absorption spectrometry. Functional reserves of the organism were determined by the computer spirometry and heart rate variability. It is shown that at the 4th year of residence in Moscow the content of Cr, Co, Ni, Zn, Ag and Cd in the hair was decreased. It is shown that the content of heavy metals in students hair and the state of cardio respiratory system is closely connected. It is established that the persons having disturbance of the function of lungs have higher content of lead  $43 \pm 7$  mg/kg and the content of copper  $38 \pm 5$  mg/kg which exceeds the normal level. During 4 years the human organism is capable to successfully adapt itself in the changed natural and ecological conditions.

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P-046

**The elemental status of temporary teeth and whole saliva of children**I.V. Radysh\*, T.N. Umnova, V.I. Torshin,  
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The objective was to study the element content of the temporary teeth and whole saliva in almost healthy children living in different regions of Russia. 126 children (4–6 y.o.) living in Moscow and 135 children from Orenburg were examined. Assessment of sample element content has been carried out using ICP-AES and ICP-MS methods. The highest content of Be, Hg, Li, Se, Si, Sr, Zn and the lowest of Ca, Mg, P, K, Na, Cu, Mn, Pb, As and Ni in temporary teeth of the children from Moscow has been revealed. The maximal salivary concentration of K, Na, P, Si, Ti, Ca, Cr, Be, Li and minimal of Zn and Pb was revealed in these children. The children from Orenburg are characterized by a relatively high content of As, Cd, Cr, Fe, Mo and Ni, and lower level of Se, Ti, Sn, Hg in the teeth. In their saliva we revealed lower concentration of Ca, P, K, Cu, Fe, Na, Mn, Mo, Pb, As and higher Mg level. Therefore, comparative analysis of the temporary teeth and whole saliva element content in children is indicative of specificity of element homeostasis, emerged during adaptation to different climatic, geographic, and social conditions.

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P-047

**Age features of elemental status of whole saliva in children**R.A. Terushkin\*, V.I. Torshin, T.N. Umnova,  
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The objective was to study the element content of whole saliva in 167 healthy children (4–10 y.o.) living in Moscow (85 girls and 82 boys) of different age groups: (1) 88 children aged 4–6 years (45 girls and 43 boys); (2) 79 children aged 7–10 years (40 girls and 39 boys). Assessment of salivary element content was carried out using ICP-AES and ICP-MS. The salivary concentration of Al, Ca, K, Mn, Mg, Na, P, Se, Si, Sr and Zn was significantly higher in 4–6 y. o. girls, whereas Cu, Fe, Mn and Pb – in the boys ( $p < 0.05$ ). The maximal salivary levels of Al, Cu, Fe, K, Mg, Se, Sn, Pb were observed in the group of 7–10 y. o. girls, whereas Ca, Fe, Na, P, Si, Sr, Mn and Zn – in the boys of the same age. The salivary concentration of Al, Ca, Cu, Fe, K, Mg, Mn, Na, P, Pb, Se, Sr, Sn was significantly higher in the elder children, and Zn – in the youngest ones. Therefore, the state of mineral metabolism in different periods of development of the organism, indicates the formation of biochemical prerequisites of chronic pathologies associated with the metabolism of macro- and micronutrients.

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P-048

**Parameter for evaluation Al influence on human organism**A. Skarabhatava<sup>1,\*</sup>, N. Gres<sup>2</sup>, L. Lukyanenko<sup>1</sup>,  
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In this work attempt to elucidate the link between processes happened in erythrocytes under chronical accumulation Al in organism and concentrations of Al and Ca in hairs was made.

Study group consisted of 27 almost healthy donors. Elements content in hairs were determined using inductive coupled plasma spectroscopy. Evaluation of physical and chemical state erythrocytes membrane conducted with the help of lipophilic fluorescent probes. Using criteria of standardize content Al in hair (10 µg/g) we divided our group on subgroups: 1 subgroup – mean value  $7.7 \pm 0.35$  µg/g, 2 subgroup – mean value  $14.4 \pm 0.76$  µg/g. The level of Ca concentration in hairs in both subgroups was almost the same. It was shown that parameter Ca/Al was significantly lower in 2 subgroup than in 1 subgroup. Correlation analysis of Ca/Al parameter and degree of polarization of laurdan showed significant correlation for subjects with Ca/Al value lower physiologically normal state. Thus, parameter Ca/Al for hair could be prognostic index for evaluation of toxic Al influence on human organism.

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P-049

**Increased serum magnesium after weight loss in non-diabetic and diabetic obese patients**S. Meyer Mikalsen<sup>1,\*</sup>, A.-L. Bjørke-Monsen<sup>2</sup>,  
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Weight loss is reported to decrease HbA1c and increase magnesium (Mg) levels. We have investigated biochemical changes from inclusion, after nutritional counseling (8 weeks), and after laparoscopic gastric bypass (6 and 12 months) in 73 non-diabetic and 20 diabetic patients (mean body mass index 42.6 (SD 4.1). Mean weightloss after nutritional counseling, 6 and 12 months after surgery was 9.5 (SD 4.6), 25.4 (7.9) and 6.3 (6.8) kg. HbA1c decreased significantly after 8 weeks and the first 6 months after surgery (mean difference 0.26 vs. 0.71) in non-diabetics and diabetics, but no significant changes were seen thereafter. Serum Mg was higher in non-diabetics compared to diabetics at inclusion (mean 0.84 vs. 0.78 mmol/L,  $p = 0.003$ ), but not after bariatric surgery. Serum Mg increased significantly only during the first 8 weeks. In conclusion, serum Mg increased after moderate weightloss in non-diabetics and diabetics.

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## P-050

**Dual role of a rhenium-diselenium compound in cancer treatment**

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The rhenium(I)-diselenoether compound is amphiphilic and may be administered by a daily oral route with a good diffusion of the rhenium (Re) metal and of the selenium (Se) element in tissues. This will allow the effect of Re and Se on their respective targets. 3 experiments were performed in models of MDA-MB231 transplanted tumors in nude mice, at the dose of 10 mg/kg/24 h of Re-diSe for 4 weeks. No sign of toxicity was observed. In the first one, a complete tumour growth inhibition was noted. In the second one, the tumor growth was facilitated by the use of matrigel. A statistically significant decrease of the tumor volumes was still observed versus controls. In the third one, a whole-body irradiation was applied to all mice before the transplantation of the tumor cells and the Re-diSe drug favoured the tumor growth. In conclusion, the Re-diSe compound may either fight or favour the cancer. These opposite results may perhaps be explained by the expected role of the two components, Re and Se on the redox potential of the cancer cells. Se is mainly known as anti-oxidant, but it is as pro-oxidant that its anticancer effect was demonstrated.

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## P-051

**Hair multielement content as an indicator of the longevity of a population: A comparison between citizens of Taiwan and Moscow**Cheng-Chi Wu<sup>1</sup>, O.A. Skalnaya<sup>2,\*</sup>,  
Pai-Tsang Huang<sup>3</sup>, A.V. Skalny<sup>4</sup><sup>1</sup> *Neomedi Clinic, Taipei, Taiwan, ROC*<sup>2</sup> *National Taiwan University, Business Administration, Taipei, Taiwan, ROC*<sup>3</sup> *Wan Fang Medical Center, Taipei, Taiwan, ROC*<sup>4</sup> *RUDN University, Moscow, Russia**E-mail address: taurus14@gmail.com (O.A. Skalnaya).*

A positive correlation between trace element content and different demographic indices in Russians was discussed earlier (A.V. Skalny: TEMA 15, 2014). In this study the connection between such demographic aspect as life expectancy and hair mineral test results in a population was investigated using the comparison of hair mineral tests data obtained from citizens of Taiwan (average life expectancy is 80.2 years) and Moscow (average life expectancy is 72.1 years). Totally, 426 samples of Taiwanese residents and 440,000 samples of Muscovites were analyzed by ICP-MS. It was found that less prominent deficiencies of K, Ca, Mg, Cu, Zn, Mn were identified in hair of Taiwanese women in comparison to female population from Moscow. For males, lower rates of deficiency in Se, Mg, K, Na, I and Co were identified in men from Taiwan in comparison to Muscovites. Interestingly, for both genders element excesses were more frequent for Muscovites.

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## P-052

**Personalized approach to trace element status evaluation for treatment of cerebral palsy and epilepsy in children**A.A. Skalnaya<sup>1,\*</sup>, M.S. Uzhentseva<sup>2</sup><sup>1</sup> *Lomonosov Moscow State University, Department of Medicine, Moscow, Russia*<sup>2</sup> *Novosibirsk State Medical University, Novosibirsk, Russia**E-mail address: skalnaya.a@mail.ru (A.A. Skalnaya).*

Totally 412 children (3–15 y.o.) were enrolled: 45 patients (27 ♂, 18 ♀) with spastic cerebral palsy (Gr.1), 132 ones (72 ♂, 60 ♀) with other types of cerebral palsy (Gr.2), 235 ones (133 ♂, 102 ♀) with epilepsy (Gr.3) and 1594 healthy children (840 ♂, 754 ♀) (control group, Gr.C). The hair analyses were carried out by ICP-MS. The study revealed significant ( $p < 0.05$ ) and numerous differences in the hair TE content between groups. E.g., we found the significantly lower hair Se level at all pathological conditions (Me of Gr.1, 2, 3 respectively in ♂ and ♀ 0.26, 0.30, 0.35 and 0.28, 0.35, 0.34 ppm) vs control (0.43 and 0.42 ppm). Among ♂ patients from Gr.1–3 hair Cr (0.16, 0.45, 0.46 ppm) and Cu (9.50, 10.77, 10.37 ppm) were significantly lower vs Gr.C (0.59 and 11.58 ppm). ♀ hair Cr levels were decreased in Gr.1 (0.21 ppm) and Gr.3 (0.36 ppm). Hair I was decreased in Gr.3. So, the personalized evaluation correction of the Se and other TE status in cerebral palsy and epilepsy should be included to the national guidelines.

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## P-0053

**Background for trace elements analyses using hair**

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**Objective:** To compare the differences in element levels for patients with numerous diseases using hair and serum analysis. We suppose that while serum levels of trace elements are homeostatically controlled, more changes associated with diseases may be found in hair.

**Materials and methods:** Data were collected for 40 elements from hair, and 30 elements from serum. A total of 1463 analyses were divided into the following groups: controls (H+S+, 340 patients) with no current severe diseases, group with changes in serum only (H+S–, 68 patients), in hair only (H–S+, 321 patients) and both in serum and in hair (H–S–, 656 patients). Statistics was made using R-language for Wilcoxon test using  $p$  adjustment with FDR.

**Results:** For H–S– group the number of changed elements is 15 in hair, macroelements – 2, essential trace – 5, toxic – 4, other – 4; 4 in serum, macro – 1, trace – 2, toxic – 1; H–S+ is 5 in hair, 1 is macro, 4 is toxic; 0 in serum, both trace; H+S– 0 in hair, 5 in serum, macro – 1, trace – 2.

**Conclusions:** It was shown that for H+S-group we have less changes in elements (5) than for group H–S+ (7), that allows us to continue usage of hair as a primary source of information for diagnosis of trace element disorders.

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## P-054

**Concentration of trace elements in the hair of patients diagnosed with schizophrenia compared to patients with major depressive disorder; A cross sectional study in Croatia**

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Differing concentrations of trace elements (TE) may play a role in the pathogenesis of schizophrenia and major depressive disorder (MDD). The aim of this study was to compare such differences. This cross-sectional study was conducted in 2015 at the psychiatric hospitals Sveti Ivan and Vrapče in Zagreb, Croatia, on a consecutive sample of 75 patients diagnosed with schizophrenia (ICD-10 F20) and 32 patients with MDD without psychotic symptoms (ICD-10 F33). The analysis showed the concentration of 34 TE. The samples were analysed with inductively coupled plasma mass spectrometry (ICP-MS). After the adjustment of sex and age, results showed a significantly lower TE concentration in the samples taken from patients with schizophrenia, particularly in the concentration of silicon 100%, calcium 96% and sodium 92%.

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## P-055

**Influence of anticoagulants on detected level of Zn in plasma**

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The aim of this study was to check the influence of anticoagulants on detected level of Zn in plasma and compare it with detected level of Zn in serum. For that purpose blood samples from the same blood donor ( $n = 10$ ) were sampled on various anticoagulants and to obtain serum, no anticoagulant was used. In plasma or serum samples Zn level was determined by flame atomic-absorption spectrometer. The level of Zn in plasma collected on different anticoagulants and in serum were in reference range (0.7–1.5  $\mu\text{g/ml}$ ) and did not differ ( $p = 0.079$ ) indicating that anticoagulant do not have impact on detected level of Zn in plasma or serum. However, correlation was observed only between Zn level in plasma samples collected by use of citrate and heparin ( $r_s = 0.723$ ) and citrate and Zn level in serum ( $r_s = 0.764$ ). Although our results indicate that anticoagulant do not have effect on the detected level of Zn in plasma/serum sample, nevertheless the impact of anticoagulant cannot be overlooked when comparing results of Zn level in plasma from various studies.

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## P-056

**Metallothionein (MT) expression and trace elements (TE) concentration in rat liver and kidney tissues; Sex differences and effect of gonadectomy**

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MT can bind essential (Zn, Fe, Cu, Co) and toxic (Cd, Hg) TE with different affinities. Sex-related expression of MT in specific organs and correlation with tissue concentration of TE have not been investigated. Here we studied in the liver (LV) and kidney (KD) tissues from adult sham-operated and gonadectomized male (M) and female (F) rats the expression of MT mRNA by RT-PCR and MT protein by immunochemical methods, and concentrations of the above-indicated TE. In both organs, MT mRNA and protein expression was strongly sex-related ( $F > M$ ), weakly upregulated by castration, and strongly downregulated by ovariectomy. In control rats, similar pattern of sex-related TE concentrations ( $F > M$ ) was found in LV for Cu, Fe, Cd, and in KD for Zn, Cu, Co, Fe, Hg, Cd, while Zn in LV was  $F < M$ . In gonadectomized rats, however, the pattern of TE concentrations in both organs was variable and poorly related to MT expression. Supported by HRZZ grant IP-11-2013-1481.

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## P-057

**The effects of vitamin D and surgical stress on Ca and P**

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The most important effects of vitamin D is on calcium (Ca) and phosphorus (P) metabolism, and on bone health, which also helps in regulating the ratio of Ca&P. In our study, we aimed to investigate the effects of vitamin D and minor surgical stress on especially Ca and P levels in liver, kidney and serum in 24 New Zealand rabbits with cartilage defects. The experimental groups are Group 1 (applied microfracture surgery that is an articular cartilage repair surgical technique), Group 2 (given orally vitamin D a daily 1000 IU/kg during 16 weeks) and Group 3 (microfracture and vitamin D). The levels of Ca and P were measured in blood, liver and kidney by ICP-OES. The kidney Ca/P ratio was lower and the serum Ca/P ratio was higher in Group 3 than control. The serum P levels showed a significant decrease in Group 1–3 as compared with control. As we could reach this is a scare study due to microfracture surgery and the relationship between Ca and P. Consequently, we speculate that the Ca/P ratio can indicate an ideal balance between them as well as adequacy of vitamin D.

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## P-058

**The concentration of selenium in the serum of patients with Parkinson disease and their dietary habits**

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The objective of this study was to estimate the influence of their dietary habits on concentration of selenium (Se) in the serum of patients with Parkinson disease (PD). 93 patients with PD (aged 47–86 years), as well as control group of 43 healthy people (aged 42–83 years) were studied. Food-frequency questionnaires were implemented to collect the dietary data. Se concentration in the serum was determined by electrothermal atomic absorption spectrometry method. The concentration of Se in patients with PD ( $69.16 \pm 18.48 \mu\text{g/L}$ ) was significantly lower ( $p < 0.004$ ) than in healthy people ( $79.98 \pm 22.23 \mu\text{g/L}$ ). Stepwise regression analysis showed that the dietary habits in 25% may have influence on serum Se concentration in examined patients. The modification of diet may improve Se status of patients with PD disease.

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## P-059

**The concentration of lead and antioxidant mineral components in blood of people with Multiple Sclerosis (MS)**

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The aim of this study was to evaluate the concentration of Pb in and its ratio to antioxidants such as Se, Zn and Cu in the blood people with MS and healthy volunteers. 101 patients with relapsing-remitting MS, as well as control group of 70 healthy people were studied. The concentration Pb in whole blood and Se, Zn, Cu in the serum was measured by atomic absorption spectrometry method. The molar ratios of Se/Pb, Zn/Pb, Cu/Pb were calculated. The results of the MS patients shown that the Pb concentration is higher and Se, Cu and Zn lower than in the control group ( $p < 0.05$ ). The molar ratios of Se/Pb, Zn/Pb, Cu/Pb were significantly higher in volunteers than in the MS group. The impaired proportion between

antioxidant minerals and Pb in the blood may be prognostic factor in the case of SM.

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## P-060

**Shifted trace element levels in adolescents with osteopenic syndrome**

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Boron, copper, manganese and zinc provision of adolescents with decreased bone mineral density (BMD) on the background of various pathological conditions was studied. The study involved 102 adolescents of both genders 11–17 y/o including 30 patients with chronic gastritis or gastroduodenitis outside exacerbations, 31 with syndrome of undifferentiated connective tissue dysplasia (UCTD), 41 with mild hypertension developed on the background of vegetative dysregulation. All patients were divided in 2 groups: osteopenic (OP,  $n = 47$ ) and with normal BMD (NN,  $n = 55$ ). Both groups were matched by pathology, gender and age. BMD was determined by dual energy X-ray absorptiometry of lumbar spine, trace elements (TE) were determined in hair by ICP mass spectrometry. It was found that only 1.9% of adolescents had normal TE levels. OP patients had lowered Mn, B content and elevated Cu, Zn ( $p < 0.05$ ); NN patients had similar shifts tendlike ( $p > 0.05$ ). Correlations between BMD and TE levels were detected as  $r = 0.45$  for B, 0.48 for Mn,  $-0.47$  for Zn and  $-0.34$  for Cu ( $p < 0.001$  in all cases). TE imbalance was most pronounced in patients with UCTD.

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## P-061

**Serum selenium in children with gastrointestinal diseases and healthy controls**

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**Objective:** Children are the most affected by the risk of selenium (Se) deficiency. The purpose of the study was to establish the serum Se level in children with gastrointestinal diseases and in healthy controls.

**Material and methods:** The concentration of serum Se was determined by atomic spectrophotometry in the group of children with celiac disease ( $N = 18$ ), liver diseases ( $N = 14$ ), acute diarrhea ( $N = 20$ ; 10 with rotavirus diarrhea and 10 without established etiological agents) as well as in the control group ( $N = 20$ ).

**Results:** The serum Se in children with celiac disease was  $74.2 \pm 6.9 \mu\text{g/l}$ . In the group with rotavirus diarrhea serum Se was  $72.3 \pm 14.7 \mu\text{g/l}$  and in the group with acute diarrhea without established etiological agents it was  $77.9 \pm 6.7 \mu\text{g/l}$ . The group of children with liver diseases had Se level similar to controls ( $90.9 \pm 11.3$  and  $94.7 \pm 7.4 \mu\text{g/l}$ ).

**Conclusion:** Children with celiac disease and acute diarrhoea had a poorer Se status than healthy children. However, we must bear in mind that despite the fact that a lower serum Se level does not constitute a major problem, it may under certain circumstances mean an additional health hazard.

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## P-062

**Effects of laparoscopic sleeve gastrectomy on trace elements in morbid obesity**

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It's known that obesity causes several diseases. There may be alteration in absorption of trace elements and it may be risk factor for some disorders in obesity. Laparoscopic sleeve gastrectomy-LSG is an effective surgical method in obesity treatment. In this study, it was aimed to investigate the effect of LSG on the absorption of trace elements. For this purpose, zinc-Zn, copper-Cu, selenium-Se, iron-Fe and magnesium-Mg levels in serum of healthy control group ( $n=30$ ) and morbid obese patients ( $n=30$ ) who had undergone LSG procedure were measured. Post-op 1 month Zn level showed decrease compared to pre-op. Pre-op Cu level was observed higher than control, whereas it was indicated that post-op 1 and 12 month Cu levels were lower than pre-op. Pre-op Se, Fe and Mg levels were lower than control. Post-op 1 and 12 month Se, Fe and Mg levels were higher than pre-op. These findings indicate that LSG may have important role on regulation of trace elements metabolism disrupted in obesity.

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## P-063

**Plasma level and dietary sources of silicon in patients with rheumatoid arthritis**

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Silicon level in blood may depend on health condition. The data on Si content in body fluids of patients with rheumatoid arthritis (RA) are scarcely available. The aim of this study was to investigate fasting plasma Si concentration and to evaluate dietary sources of this element in 66 patients with RA and 74 healthy subjects. Plasma Si was determined using GF-AAS method. Dietary Si sources were assessed using validated questionnaire and 3-day food records. Median of the plasma Si level in RA patients was significantly higher (139.6  $\mu\text{g/L}$ , range 19.8–408.3) than in the control group (108.0  $\mu\text{g/L}$ , range 99.8–322.0,  $p=0.028$ ). Cereal products were the main source of dietary Si in both groups. Positive correlation between the plasma Si level and the consumption of tea and coffee was found in RA patients, while in the control group the cereals consumption positively correlated with the plasma concentration of Si. In conclusion, Si level in plasma of RA patients may depend on diet, however other factors related to the disease course or therapy may be relevant.

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## P-064

**Blood Zn, Cu, Mn profile and relation to redox status in lung cancer**

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This study evaluated the association between redox status and Zn, Cu and Mn levels in the blood of lung cancer (LC) patients. Forty-four LC patients was sex- and age-matched with healthy control (HC) group ( $n=44$ ). AAS technique was used to determine whole blood levels of Zn (F-AAS), Cu and Mn (GF-AAS). Redox status was evaluated based on total antioxidant status (TAS), total oxidant status (TOS) and oxidative stress index (OSI). LC patients had lower blood Zn and Mn levels compared to HC group. Blood Cu level significantly increased between LC patients stage I–II and stage III–IV. Among redox status parameters, TAS was decreased, TOS and OSI – increased in LC compared to HC group. Negative correlations were found between Mn and TAS in whole LC group, Mn and TAS, Zn and TOS in LC group stage I–II. No relation was found between trace elements and redox status in HC group. We concluded that lung cancer patients have altered redox status which may be related to disruption of trace element levels.

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## P-065

**Blood Zn, Cu and Mn level and its relation to the activity of SOD and CAT in lung cancer**

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This study evaluated the association between Zn, Cu and Mn levels and SOD, CAT activities in blood of lung cancer (LC) patients. Forty-four LC patients was sex- and age-matched with healthy control (HC) group ( $n=44$ ). AAS technique was used to determine whole blood levels of Zn (F-AAS), Cu and Mn (GF-AAS). SOD and CAT activities were measured with commercial kits (Cayman Chemicals, USA). LC patients had lower blood Zn and Mn levels compared to HC group. Blood Cu concentration was similar in LC and HC group however we observed significant increase in Cu level according to disease stage. Blood SOD activity was significantly lower in LC compared to HC group while CAT activity tended to be lower in LC compared to HC group. Positive correlations were found between Cu/Zn and SOD as well as Mn and SOD in LC group. No relationship was found between trace elements and enzyme activities in HC group. We concluded that lung cancer patients have altered trace element status which may contributed to changes in SOD and CAT activity.

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## P-066

**The relationship between zinc and copper levels of aorta/left internal mammary artery and oxidative stress in atherosclerosis**A.M. Ercan<sup>1,\*</sup>, D. Karis<sup>1</sup>, D. Tarhan<sup>1</sup>, K. Boyacioglu<sup>2</sup>, C. Koksai<sup>3</sup><sup>1</sup> Biophysics Department, Cerrahpasa Medical Faculty, Turkey<sup>2</sup> Bagcilar, Istanbul, Turkey<sup>3</sup> Kartal Kosuyolu State Hospital, Istanbul TurkeyE-mail address: [meltem@istanbul.edu.tr](mailto:meltem@istanbul.edu.tr) (A.M. Ercan).

Aorta faces with high pressure variations with its largest diameter. Left internal mammary artery (LIMA) is an elastic artery nourished by intraluminal diffusion. Malondialdehyde (MDA) an endogenous genotoxic product and antioxidant enzymes like glutathione peroxidase (GSH-Px) are crucial in atherosclerosis. Zinc (Zn) is a cofactor for antioxidant enzymes, besides copper (Cu) induces oxidation of low-density lipoprotein initiating atherosclerosis. We aimed to evaluate Zn and Cu levels with GSH-Px and MDA in aorta/LIMA tissues in 33 atherosclerotic patients underwent coronary artery by-pass graft operation (CBAG). Aorta/LIMA Zn, Cu and GSH-Px, MDA were measured by spectrophotometer and commercial kits, respectively. GSH-Px and MDA levels were lower in aorta than LIMA. As a result, aortic tissue is predisposed to atherosclerosis due to its poor bioavailability using Zn. LIMA is a potential graft for CBAG with its specific endothelial function. Zn might be used to activate defence mechanism in atherosclerosis.

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## P-067

**Personalized assessment of ecological toxicants impact on the human body by the elemental analysis of hair**

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The aim of this research is measuring of chemical elements (CE), including heavy metals (HM) in the hair and assessment of megapolis ecological safety.

**Materials:** Research was conducted by the method of atomic emission spectrometry with inductively coupled argon plasma and mass spectrometry with inductively coupled plasma. The object of research was the hair of 53 students (27 male/26 female) of the Asfendiyarov Kazakh National Medical University.

**Results:** More than half of investigated individuals have a normal level of HM in the hair. 30% of investigated have light multidirectional changes relatively to reference data. More specific changes of Cobalt, Zinc and Copper were observed with upward tendency and there was a downward trend of Silicon. The content of Cobalt was under the reference intervals at about 1/3 of investigated.

**Conclusion:** Constant level of CE in the body is the important factor of cell homeostasis. The individual submissions of CE could help in diagnosing of microelementoses and be the valid test for ecological assessment of megapolis.

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## P-068

**Assessment of the zinc in children from Eastern Siberia, Russia**

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East Siberian region is characterized by large variety of natural and anthropogenic conditions; this may induce different disbalance of trace elements. The aim of this study was to investigate level of Zn in hair in 747 preschool-age children from Eastern Siberia. The levels of Zn were determined by an atomic absorption spectrometer. Zn contents are varied very largely. The least quantity was indexed in children hair of southern industrial towns (25th quartile–75th quartile was 70.98–164.94 µg/g). 53% children had Zn level under Absolute Norm (AN), 25% children had Zn level under Biological Tolerance Value (BTV). At the same time, the concentration of Zn in the hair 86% of urban children from the central regions had mean 118.36–180.31 µg/g. 93% rural children had contents of Zn on BTV level (25th quartile–75th quartile was 123.1–168.61 µg/g). Only 6% of children was characterized by Zn content under AN and BTV. The highest Zn level was indexed in children from rural northern and mountainous regions (25th quartile–75th quartile was 125.97–270.34 µg/g). 92% children had Zn level above AN, 73% children had Zn level above BTV.

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## P-069

**Features of the elemental composition, and some indicators of cytokine status of patients with rosacea**

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The aim of presented research was to study the elemental composition of hair, some indicators of the status of the cytokine (VEGF, IL-8) in rosacea patients and evaluate the possible relationship between these parameters. In the course of study by means of X-ray fluorescence spectroscopy in biosubstrate (hair) with a diagnosis of rosacea, 28 chemical elements – essential and conditionally essential and toxic were measured simultaneously. Assessment of the relationship between the elemental composition of the hair and the state of the cytokine status revealed a positive correlation between the concentration of VEGF, IL-8 and vanadium content. Along with a decrease of essential elements in hair of all observed patients, they had also elevated levels of toxic elements such as Pb, Hg. Prospective purposeful study of trace elements in the hair of patients with rosacea will allow to form the correct approach to understanding the mechanisms of occurrence of this disease and to develop effective methods for its treatment.

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P-070

### Assessment of some trace elements levels in hair and serum samples of autistic children in Delta Egypt



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**Objective:** To assess the levels of trace elements like copper (Cu), zinc (Zn) and selenium (Se) and toxic elements like mercury (Hg), and lead (Pb) in the hair and serum samples of autistic children and to evaluate whether the level of these elements could be correlated with the severity of autism.

**Methods:** The subjects of the study were 50 autistic children (4–12 y.o., boys:girls ratio – 4:1) with different grades of severity according to Childhood Autism Rating Scale and 50 healthy children (age and sex matched) at. The serum and hair samples were analyzed by ICP-MS.

**Results:** The current study showed significantly higher levels of copper, mercury and lead in autistic spectrum disorders as compared to the control children. Moreover, serum and hair samples from children with autistic spectrum disorders contained significantly lower concentration of selenium as compared to normal children.

**Conclusion:** Children with autistic spectrum disorders might benefit from chelating therapy for heavy metals poisoning and supplementation of essential trace elements.

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P-071

### A prospective study on the behavior of the transmission of specific elements of the food to human milk associated with a diet of Egyptian mothers during the first ten days of lactation



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**Objectives:** To evaluate the correlation of trace element levels in human milk with the maternal nutritional status, quality of lactation and child growth, by measuring the transfer factors (TF) of Cr, Cu, Fe, Mn, Zn and Se from food to milk in nursing mothers.

**Methods:** Food and milk samples from 120 mothers were analyzed using ICP-MS. TF was calculated the ratio between food (g/kg) and milk (g/L) trace element concentrations.

**Results:** The calculated TF were 11.85, 12.70 and 14.56 for Cr to lactating high, middle and low-income women, respectively, 5.55, 6.02, 5.88 for Cu, 102.90, 118.75, 121.50 for Fe, 62.53, 56.72, 46.11 for Mn, 29, 34.76, 50.95 for Zn, 67.76, 50.96, 48.66 for Se. Factors differed significantly across individuals and days after birth.

**Conclusion:** There is a lack of correlation between the diet body composition and composition of the milk in Tanta. The study suggests that milk composition may temporarily be against fluctuations in dietary intake of the mother or the nutritional status.

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P-072

### Plasma copper and zinc concentrations in Tunisian patients with lung cancer



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The aim of this study was to investigate plasma Copper (Cu) and Zinc (Zn) concentrations and Cu/Zn ratio in Tunisian Lung cancer. In total, 58 patients with lung cancer (LC) and 81 healthy controls were assessed. Lung cancer patients were divided into those with early stage or advanced stage disease. Plasma concentrations Cu and Zn were measured by atomic absorption spectrometry. The results showed that the plasma concentrations of Cu ( $\mu\text{mol/l}$ ) in patients with LC ( $19.69 \pm 3.27$ ,  $p < 0.001$ ) were significantly higher than in controls ( $16.80 \pm 3.59$ ) and plasma concentrations of Zn ( $\mu\text{mol/l}$ ) were significantly lower ( $9.54 \pm 2.27$ ,  $p < 0.001$ ) compared to controls ( $11.73 \pm 1.75$ ). The Cu/Zn ratio was also significantly higher in patients with LC ( $2.19 \pm 0.68$ ,  $p < 0.001$ ) than controls ( $1.46 \pm 0.37$ ). Patients with advanced stage disease (stage III and IV) had higher Cu/Zn ratio than patients in stages I and II ( $2.32 \pm 0.71$  versus  $1.84 \pm 0.42$ ,  $p < 0.05$ ). These findings suggest that Cu/Zn ratio may be used as a diagnostic test in LC patients.

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P-073

### Dose–response relationship between dietary magnesium intake, serum magnesium concentration and risk of hypertension: A systematic review and meta-analysis of prospective cohort studies



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There is limited evidence regarding the association between dietary magnesium intake and serum magnesium concentration and the risk of hypertension. Prospective cohort studies reporting effect estimates for hypertension of dietary magnesium intake and/or serum magnesium concentrations were reviewed. Random-effects models were used to combine the estimated effects. Nine articles were eligible for meta-analysis. We found a reverse association between dietary magnesium intake and the risk of hypertension. A 100 mg/d increment in magnesium intake was associated with a 5% reduction in the risk of hypertension (RR=0.95; 95% CI: 0.90, 1.00). The reverse association of serum magnesium concentration with the risk of hypertension was marginally significant (RR=0.91; 95% CI: 0.80, 1.02). Current evidence supports the reverse dose-response relationship of hypertension with dietary magnesium intake and but not with serum magnesium concentration.

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## P-074

**Iodine content in hair of children with enlarged thyroid gland in the West Kazakhstan region of the Republic of Kazakhstan**

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The aim of research is to determine the iodine content in hair of children with enlarged thyroid gland living in the West Kazakhstan region of the Republic of Kazakhstan. The content of trace elements in hair of 159 children aged 6–12 years was determined using ICP-MS. Ultrasonography was used in line with WHO recommendations (2007) for measuring the thyroid volume. The obtained data (median (q25–q75)) showed no significant difference ( $p = 0.1$ ) in the content of I in hair of group with goiter 0.57 (0.38–0.92)  $\mu\text{g/g}$  and control group 0.55 (0.39–1.04)  $\mu\text{g/g}$ . Correlation analysis between the content of I in hair and other elements showed weak relations with Hg ( $r = 0.3$ ,  $p < 0.05$ ), K ( $r = 0.2$ ;  $p < 0.05$ ), Li ( $r = 0.16$ ;  $p < 0.05$ ). Therefore, hair I content in children is directly associated with Hg, K, Li content.

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## P-075

**Heavy metals content in the children's hair and soil samples of the Yamalo-Nenets Autonomous District**

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Heavy metals (Fe, Cu, Zn, Pb, As, Mn, Cr, Cd, Hg) content in the children's hair and soil samples of the Yamalo-Nenets Autonomous District have been studied in this project. Metals content in above mentioned samples were analyzed using Duo Atomic Absorption Spectrophotometer Agilent AA DUO 240FS/240Z/UltrAA. 10 soil and 30 children's hair samples for analysing were obtained during field surveys. Heavy metal levels in the determined soil samples were not higher than permissible concentration. Study of the metal accumulation in the hair is indicated that Pb, Mn, Hg, Cd, As content were also within the permissible levels. But at the same time an excess of zinc (Zn) and copper (Cu) in 10% and 20% hair samples was detected, respectively; high concentration of iron (Fe) and chromium (Cr) in 100% and 83.3% samples were found, respectively. Studies of the metal content in the children's hair are quite informative and can be used as an additional evaluation method of the current environmental situation.

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## P-076

**Selenium (Se) in the multivariate pathogenesis of ischemic stroke. Gerontology aspect**

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The objective of this study was to analyze the role of Se in ischemic stroke pathogenesis. Blood serum Se concentrations were evaluated using ICP-MS. Neurospecific NR2 antibodies (NR2Ab) levels were determined by enzyme immunoassay. Mann-Whitney *U*-test revealed a significant ( $p = 0.005$ ) reduction in the concentration of selenium in the oldest age group (over 60 years), which indicates that the depletion of glutathione-dependent antioxidant enzymes with the advanced age. Method of optimal valid partitioning (OVP) indicated that a high value corresponds to a low concentration of selenium to the NR2Ab and vice versa. Correlation analysis revealed a significant association between selenium concentration and NR2Ab, which suggests the possibility of using multi-level set of these indicators as biomarkers of cerebral inflammation and ischemia.

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## P-077

**The impact of long-term lithium treatment on renal function in patients with bipolar disorder**

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**Objective:** The aim of this study was to evaluate the association of lithium carbonate treatment with renal function changes in patients with bipolar disorder.

**Materials and methods:** Patients with bipolar disorder were separated in groups based on lithium and non-lithium treatment. The total of 100 patients comprised of 70 receiving lithium for 1–38 (mean 16) years and 30 who have never been exposed to it. We compared kidney function of both groups using novel markers of kidney damage such as plasma neutrophil gelatinase associated lipocain (NGAL), Cystatin C, eGFR (CKD EPI), serum and urinary osmolality.

**Results:** Patients treated with lithium had significantly decreased eGFR value, urine osmolality and U/S osmolality ratio ( $p < 0.01$ ). The NGAL and Cystatin C values were significantly increased ( $p < 0.01$ ).

**Conclusions:** Both patient groups showed significant difference in the monitored parameters and were more prominent in patients



treated with lithium for more than 2 years. Supported by MH CZ – DRO (FNBr, 65269705).

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P-078

### Nanostructure to assess trace elements in yeast as supplements in nutrition: An African perspective review



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Malnutrition with reference to trace element deficiency is a global predicament. This might escalate in developing countries to major nutrition related deceases and mortality in children and adults. Developed countries can accommodate this quandary by the intake of chemically prepared supplements. It is not a quick resolve as rivaling research of chemical supplements versus natural nutritional value-added food sources is still inconclusive. Furthermore, to supply such expensive gratuitous treatment in any developing country is not really an economically viable solution. This review covers a summary of some literature about trace element supplements and preliminary experiments to incorporate and localise Zn and S as trace element examples in yeast cells. Yeast organisms are researched as a natural occurrence in leavened bread and indigenous beverages. Natural beer and milk related brewed products using wheat, maize, cassava and other fermentable products may already contain natural concentrations of trace elements. Specific strains can be exposed and introduced to enhance food preparation in communities to increase nutritional value.

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P-079

### The adverse effects of iodine excess on children: Safe upper intake level of iodine



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Excessive iodine intake has adverse effects. This study enrolled 2224 children from Shandong, where the iodine concentration in drinking water was 181 (67–402) µg/L, to explore the upper safe intake level (UL) of iodine for children. The habitual daily iodine intake of children estimated by multiple urine was 298 (186–437) µg/d. 237 (11.5%) children were diagnosed with subclinical hypothyroidism (SCH) and total goiter rate (TGR) was 9.7%. TSH was positively correlated with iodine intake, while the incidence of SCH was ≈10% in children with iodine intake of 200–299 µg/d. Tvol and TGR increased as the increase of iodine intake, and TGR was ≈5% when children with iodine intake of 200–299 µg/d. In addition, the risk of Tg > 40 µg/l began to increase as iodine intake over 200 µg/d. In conclusion, our findings suggest

UL of iodine for children should be in the range of 200–299 µg/d. Grant NO. 81330064, 14ZCZDSY00022.

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P-080

### Fast determination of iodine content in food, water, salt, serum, urine, breast milk, feces and saliva samples by ICP-MS



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**Background:** Inductively Coupled Plasma Mass Spectrometry (ICP-MS) prevails in determining elements as its rapidity, low detection limits and minimal sample amount needed for analysis.

**Objective:** To develop a fast and simple method to determine iodine in samples was developed.

**Method:** After shredded and digested with 1% tetramethylammonium hydroxide (TMAH) at 90 °C for 24 h for food and feces samples and then centrifuged and diluted with 7 mmol/L ammonia, digested with 0.5% ammonia at 90 °C for 3 h for breast milk samples and then centrifuged and diluted with 7 mmol/L ammonia, directly diluted with 7 mmol/L ammonia for water, salt, serum, urine, and saliva samples, the dilution can be directly injected into ICP-MS for analysing.

**Results:** The results of precision (RSD: 2.65–8.85%) and recovery rate (88.08–115.04%) were satisfactory. Conclusion: These sample treatments make large number of samples' iodine determination fast and simple. Grant NO. 81330064, 14ZCZDSY00022, 15KPxM01SF037.

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P-081

### The association study between gene polymorphism (SNPs) and hypothyroidism in Tianjin



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**Objective:** To explore the relationship between SNPs of thyroid hormone (TH) synthesis and the hypothyroidism (HT) susceptibility in Chinese.

**Materials and methods:** 347 patients with HT and 337 healthy people were analyzed in the study. Systematical screening was made for the tag-SNPs of SLC5A5, TSHR, TPO, TG and DUOX2. The differences of alleles and genotypes frequency for each genetic locus were compared. The association between the genotypes of candidate SNPs and the level of TH was analyzed.

**Results:** TG-rs2741202 and TG-rs3739266 were associated with the susceptibility of HT. The mutant genotype of TG-rs3739266 was more susceptible to HT than wild genotype. SLC5A5-rs11672428 correlated with the levels of serum FT4. TG-rs3739266 was correlated with the levels of serum TSH for the females.

**Conclusions:** The polymorphism of TG, TSHR and SLC5A5 might increase the risk of HT. They may be valuable biomarkers for the screen of the susceptible population. Grant NO. 81330064, 31340033 and 14ZCZDSY00022.

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#### P-082

### Iodized salt helps to achieve adequate iodine intake in pregnancy



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Nutritional iodine deficiency can be addressed by adding iodine to edible salt. We evaluated urine iodine concentration (UIC) in pregnant women using either fine iodized salt (FIS) or coarse non-iodized salt (CNIS). We studied 197 women in the first, second or third trimester of pregnancy:  $n = 118$  reported consuming FIS, while  $n = 79$  reported consuming CNIS. We measured UIC and thyrotropin (TSH) levels. Analysis was done with the Kruskal–Wallis test and Spearman's rank correlation. Women using FIS had higher UIC ( $\mu\text{g/L}$ ) (Q1: 106.7/Q2: 143.0/Q3: 214.3) compared to women using CNIS (Q1: 82.5/Q2: 121.9/Q3: 184.8) ( $p = 0.04$ ). Sixty percent of women using FIS had adequate iodine intake according to the World Health Organization (WHO), while only 40% of women using CNIS met the WHO criteria. TSH remained within normal levels (Q1: 1.2/Q2: 1.56/Q3: 2.0  $\mu\text{IU/mL}$ ). The consumption of FIS helps women attain the UIC levels in pregnancy recommended by WHO, and should be encouraged. This is important, since previous research has suggested that Greek pregnant women are at risk of iodine deficiency.

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#### P-083

### Use of iodine supplements in pregnancy and lactation: Results of an online survey of New Zealand women



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In 2010, the New Zealand (NZ) Ministry of Health recommended that all women planning a pregnancy, pregnant, or breastfeeding take an iodine supplement containing 150  $\mu\text{g/day}$ . From Dec 2016–Feb 2017 we conducted an online national survey to evaluate the use of maternal supplements including iodine. Most women ( $n = 525$ ) who took part in the survey were of European ethnicity (83%) and had a tertiary or post-graduate qualification (81%). Thirty two % of respondents were currently pregnant and 67% had been pregnant in the past 2 years. Over half (60%) of the women surveyed took a maternal supplement before pregnancy, 90% took a maternal supplement during pregnancy, and 59% did or planned to take a maternal supplement during lactation. Only 44% of women took an iodine-containing maternal supplement throughout pregnancy. Within a NZ context, despite being well educated and highly motivated, the majority of respondents are not currently following the government guidelines regarding the

use of an iodine-containing maternal supplement for pregnancy and lactation.

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#### P-084

### Consumption of selected minerals and bone mineral content in young women



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**Introduction:** Improperly balanced diet may lead to bone damage.

**Aim:** The aim was to assess the consumption of dietary components that affect bone mineralization.

**Materials and methods:** The analysis included 200 young women. 3-day dietary interviews to assess the intake of phosphorus (P), magnesium (Mg), potassium (K), sodium (Na) and calcium (Ca) were collected.

**Results:** Among all women, 12% were characterized by a very low bone mineral content. The percentage of people with insufficient intake was 74% of the Ca, Mg – 47%, while for P only 2%. Sufficient intake of K was characterized by only 4% of young women. Very high positive correlation ( $R = 0.81$ ) between the consumption of Ca and P was shown.

**Conclusion:** It is recommended to modify the diet of young women in the direction of reducing the intake of Na and P, and increasing the consumption of Ca, Mg and K in the prevention of bone disorders.

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#### P-085

### Dietary intake of minerals, vitamins and trace elements among geriatric population in India



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A community based cross-sectional study was conducted during 2015–2016 in India. 255 geriatric subjects were enrolled from 30 villages. Data were collected on socio demographic profile and dietary intake of essential micronutrients from all the geriatric subjects.

**Results:** A high percentage of geriatric subjects did not consume the recommended daily intake for essential micronutrients such as energy (78%), protein (78%), zinc (98%), calcium (51%), thiamine (33%), riboflavin (88%), niacin (42%), vitamin C (72%), iron (72%), folic acid (48%), magnesium (81%), zinc (98%) and copper (89%) adequately. Food groups rich in essential micronutrients such as pulses, green leafy vegetables, roots and tubers, other vegetables, fruits, non-vegetarian food items and milk and milk products were consumed irregularly by the subjects.

**Conclusion:** The overall intake of energy and essential micronutrients was inadequate amongst the geriatric population in India, possibly due to poor quality and quantity of the diet consumed.

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P-086

### Iron status correlates with free thyroxine in goiter



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Several trace elements such as iodine, iron, selenium, and zinc are essential for normal thyroid function. Iodine has an important role in the synthesis of thyroid hormones; selenium is a component of the deiodinases that convert T<sub>4</sub> to T<sub>3</sub> and also protects the thyroid from damage by excessive iodide exposure. Zinc is involved in thyroid hormone nucleus receptor structure. In addition low iron, or more specifically, low ferritin, is one of the most underestimated causes of thyroid dysfunction. A total of 45 patients with goiter in mild iodine deficiency region of South Ural were included in the study. Iron status and thyroid function were assessed. 16% of patients had hypothyroidism. While decreased levels of Hb were established in 75% hypothyroid patients, low concentrations of ferritin were revealed only in 17% cases. Significant positive relationship between levels of Hb and fT<sub>4</sub> was detected ( $r=0.82$ , at  $p<0.05$ ). Negative correlation between erythrocyte count and fT<sub>3</sub> level is unclear. However, no association between amount of ferritin and thyroid status was found.

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P-087

### Iron bioavailability in rats fed fermented quinoa diet



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Quinoa, (*Chenopodium quinoa*) a nutrient-rich pseudocereal contains relatively high levels of iron; however, its bioavailability is affected by presence of phytic acid. The study aim was to investigate the iron bioavailability in rats fed non-fermented and fermented quinoa diet. Quinoa flour was fermented with *Lactobacillus plantarum* 299v<sup>®</sup> for 24 h. The animal study was conducted in Wistar rats fed non-fermented and fermented quinoa diet, *ad libitum* during 30 days. Iron was analyzed in liver and femur of rats as marker of iron bioavailability. During fermentation, a reduction of 82% of phytic acid was found. The food intake was similar for both groups, but the feed efficiency ratio and femur weight were lower ( $p<0.05$ ) after fermented diet. There was an effect ( $p<0.05$ ) of the fermented diet on iron concentration in femur (1.16 mg/g) compared with non-fermented diet (0.09 mg/g). There was no significant difference in iron concentration in liver. The iron retention in femur of rats fed fermented diet was significantly higher than

non-fermented diet, due to the positive effect of phytic acid reduction during fermentation.

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P-088

### Iron supplementation is better than zinc and iron/zinc for the bioavailability of provitamin A carotenoids from papaya



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**Objectives:** The study aimed at determining the bioavailability of 3 provitamin A carotenoids in young adult men, after a vitamin A deficient diet and zinc, iron or iron/zinc supplementation.

**Materials and methods:** Twelve healthy participants divided into 3 groups were supplemented with iron, zinc or iron + zinc over 2 weeks under a vitamin A deficient diet. Participants consumed a test meal containing 0.55 kg of fresh peeled papaya. Four blood samples were successively taken for various analyses.

**Results:** Iron supplementation led to the highest retinol levels in the serum. Zinc and iron/zinc were best to improve serum levels of  $\alpha$ -carotene and  $\beta$ -carotene. Iron/zinc was the best supplement for better  $\beta$ -kryptoxanthin absorption.

**Conclusion:** Supplementation with iron is the best for the bioavailability of provitamins A from local papaya and should be considered for use in populations suffering of vitamin A deficiency and iron deficiency anemia.

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P-089

### Selenium, zinc and copper content of foods consumed in an Italian community



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This study aimed to determine the concentrations of selenium, zinc and copper in foods generally composing the diet of Northern Italy population in order to implement a database of the quantitative content for each of the three trace elements, according to food category intake. Food samples were collected from (small to large) distribution markets in triplicates and trace elements determination was performed with ICP-MS after sample mineralization. We found the highest levels of selenium in meat (202  $\mu\text{g}/\text{kg}$ ), fish and seafood (489), dry fruits (314) and legumes (220). The level of zinc was higher in cereal products (11.7 mg/kg), meat (28.4), dairy products (18.8), legumes (21.2) and dry fruits (37.8). Finally, the highest concentration of copper was found in dry fruits (14.9 mg/kg), legumes (6.2), sweets (4.1) and meat (3.7). Our findings will allow to estimate dietary trace elements exposure which could be useful for both toxicological and epidemiological studies.

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## P-090

**Cultivations of Se-enriched *L. casei* subsp. *rhamnosus* for using as Se-supplement diet**

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The *L. casei* subsp. *rhamnosus* strain was selected for producing Se-enriched probiotics. Se-enriched *L. casei* subsp. *rhamnosus* cultivation was studied. The results showed that selenocysteine, Se-methylselenocysteine and selenomethionine were obtained in the cells extract. The cultivation of Se-enriched *L. casei* subsp. *rhamnosus* was achieved by uptaking of 2.5 mg Se L<sup>-1</sup> from SeO<sub>3</sub><sup>2-</sup> into the culture medium at the end point of lag phase of *L. casei* subsp. *rhamnosus*. Hence, it indicated that SeO<sub>3</sub><sup>2-</sup> ion could be absorbed and synthesized to be selenoamino acids though the biosynthetic pathway. The optimum Se-supplemented concentration in MRS broth was greater than or equal to 4 mg Se L<sup>-1</sup>. The detoxification of Se was also occurred when SeO<sub>3</sub><sup>2-</sup> ion was added at lag phase of cultivation. Therefore, *L. casei* subsp. *rhamnosus* is a potential probiotic bacteria which could be produced as Se-enriched supplement for human.

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## P-091

**Evaluation of extracellular selenium speciation in *Lactobacillus***

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Evaluation of extracellular Se species in the cell culture supernatant of Se-enriched *L. casei* subsp. *rhamnosus* culture was carried out by HPLC-ICP-MS. The result showed that Se(IV) and selenocysteine (SeC) species were synthesized and excreted into the cell culture supernatant. The presence of SeC and Se(IV) species could be defined as a free amino acid and non-transformed Se(IV), respectively. Moreover, SeC concentration was higher when the cell culture supernatant was hydrolyzed with protease XIV before determining in the chromatographic system. Therefore, Se(IV) is transported into *L. casei* subsp. *rhamnosus* cells, and synthesized to be SeC as a primary organic Se-compound. SeC was not only incorporated into selenoproteins, but also accumulated as an intracellular Se specie in *L. casei* subsp. *rhamnosus* cells. Meanwhile, SeC was also exported as a free amino acid and the selenoprotein existing in the extracellular cell culture.

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## P-092

**Evaluation of antioxidant activity of Se-enriched kale seedling using DPPH radical scavenging and ferric thiocyanate methods**

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The antioxidant activity of Se-enriched kale seedling (SeKS) was tested by DPPH radical scavenging and FTC methods. The kale seeds (*Brassica oleraceavar. alboglabra* L.) were grown in Hoagland's solution added with 5, 10, 15, and 30 µgSe (IV) mL<sup>-1</sup> from SeO<sub>3</sub><sup>2-</sup> for 15 d and harvested every 5 d. The predominant forms of organic Se were selenomethionine and Se-methylselenocysteine. The results of antioxidant activity showed that the radical scavenging ability of SeKS increased with increasing levels of Se-supplement and cultivation time. The highest inhibition percentage of 77.42 were obtained in ethanolic extracts of SeKS which grown in the solution added with 30 µg Se (IV) mL<sup>-1</sup> for 15 days. The antioxidant activities from FTC method showed almost the same patterns of activities as the DPPH method. The results showed that SeKS had a good potential of antioxidant activity.

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## P-093

**Nutraceutical benefits of trace metals in chia seeds (*Salvia hispanica* L) wild plant**

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Chia seeds wild plant played an important role in nutrition of different ethnic group's diet at prehispanic time. Nowadays plant is domesticated and cultivated in several states of Mexico, due to population high request; nevertheless seeds are not part of the Mexican average diet. The aim of this research was to assess chia seed's trace elements and promote consumption among population to decrease mineral deficiency malnutrition. Chia seeds collected at Puebla State (2016) to analyze Iron, Zinc, Copper and Magnesium content by atomic absorption spectroscopy. Data obtained (mg/100 g dry basis) were: Iron 7.5; Zinc 4.1; Copper 1.53 and Magnesium 345. Nutraceutical is a term defined as food or food components that provide health or medical benefits, including prevention or treatment of disease in humans. Metals analyzed play important functions in human metabolism. Data obtained from metals analyzed in chia seeds show that they are a good source of metals requested in human health.

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## P-094

**Maternal diet, levels of selected elements and fatty acid composition in maternal milk from two different areas in Slovenia**

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As the content of  $\omega$ -6 and  $\omega$ -3 polyunsaturated fatty acids (PUFAs) can influence growth and development of babies, associations between maternal diet, environment, concentration of trace elements, fatty acid (FA) composition and their stable isotopes in human milk were investigated. Questionnaire data and analysis of milk samples of 74 mother-child pairs from coastal and inland areas of Slovenia were used. Associations between those areas and (a) predictors obtained through questionnaires and (b) levels of selected elements, FA composition and stable isotopes of individual FA in maternal milk samples were tested using univariate and multiple linear regression. Levels of selected elements did not represent any health risk for the mother-child pairs. Levels of As and Hg in milk were statistically higher in the coastal area, so where the levels of saturated and monounsaturated FA, whereas PUFAs,  $\omega$ -3,  $\omega$ -6 levels were lower in that area in compare to inland.

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## P-095

**Reference values of 14 serum trace elements for pregnant women in the China Nutrition and Health Survey (CNHS) 2010–2012**

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**Objective:** To establish the 14 serum trace element reference values for Chinese pregnant women.

**Materials and methods:** A total of 1400 pregnant women were randomly selected in China derived from the CNHS 2010–2012. 14 trace elements in serum were determined by HR-ICP-MS.

**Results:** The reference value of serum trace element was 131.5 (55.8–265.0  $\mu$ g/dL for Fe, 195.5 (107.0–362.4)  $\mu$ g/dL, 74.0 (51.8–111.3)  $\mu$ g/dL for Zn, 22.3 (14.0–62.0)  $\mu$ g/dL for Rb, 72.2 (39.9–111.6)  $\mu$ g/L for Se, 45.9 (23.8–104.3)  $\mu$ g/L for Sr, 1.8 (1.2–3.6)  $\mu$ g/L for Mo, 2.4 (1.2–8.4)  $\mu$ g/L for Mn, 1.9 (0.6–9.0) for Pb, 1.1 (0.3–5.6) for As, 835.6 (219.8–4287.7) ng/L for Cr, 337.9 (57.0–1130.0) ng/L for Co, 193.2 (23.6–2323.1) ng/L for V, and 133.7 (72.1–595.1) ng/L for Cd. Significant differences in serum concentrations were observed in age intervals, residences, anthropometric status and pregnancy. Serum Fe, Zn and Se levels significantly decreased, whereas serum Cu and Co elevated progressively with advance anthropometric status and pregnancy. The established reference values could play a key role in the assessment of trace elements nutritional status and health risks to environmental metal exposure.

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## P-096

**Zinc concentration and *in vitro* bioavailability of winter wheat grains as affected by zinc biofortification and different levels of nitrogen fertilization**

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The objectives were to examine efficiency of Zn biofortification and *in vitro* bioavailability of wheat grain under different levels of N fertilization and foliar Zn application. Foliar Zn was applied as ZnSO<sub>4</sub> (0 and 1.5 kg/ha Zn) and N fertilization was carried out with four levels (0, 110, 145 and 180 kg/ha) growing two winter wheat cultivars (Srpanjka and Renata) under field conditions. Among all examined sources of variation in this trial (cultivar, N, foliar Zn and their interactions), foliar Zn application had highest effect on whole grain Zn concentration (23.3–32.7 mg/kg;  $F = 106.03$ ;  $p < 0.01$ ) and Zn concentration after *in vitro* digestion (4.1–5.4 mg/kg;  $F = 45.86$ ;  $p < 0.01$ ) while percentage of bioavailability was under highest effect of cultivar ( $F = 42.63$ ;  $p < 0.01$ ). Results indicating that biofortification is an effective approach to increase a whole grain Zn concentration as well as Zn bioavailability.

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## P-097

**Response of chicory to foliar spraying of selenium and iodine in different forms**

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Selenium (Se) and iodine (I) are essential elements for humans and animals, but not confirmed for plants yet. There are scarce information about the response of plants to simultaneous addition of Se and I, so the effect of foliar application of both elements on chicory (*Cichorium intybus*) was studied. Seedlings were transplanted on field and foliarly sprayed with 10 mg/L of Se(IV) or Se(VI) and 1000 mg/L of I(-I) or I(V) at the beginning of head formatting. Different treatments did not significantly affect yield and mass of chicory heads. Se and I content were enhanced up to 8-fold in comparison with control plants containing 26 ng Se/g DW and 113 ng I/g DW. Lower amount of chlorophyll *a*, carotenoids and anthocyanins indicated possible presence of stress in plants, treated with I(V) solution. However, potential photochemical efficiency of photosystem II showed good condition of treated plants with both elements.

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## P-098

**New microelement compositions to increase wheat nitrogen and phosphorous nutrition**

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Ukrainian scientists have created trace element complex "Avatar-2" for agriculture on the base of citochelate of 12 biogenic metals (Zn, Cu, Fe, Mn, Mo, Co, La, Ge, V, Ni, Ti, Mg) including Se, I, S. This complex has growth-stimulating, stress-protective and antioxidant action, significantly increases acidifying activity of wheat root system, exudation of organic acids and acid phosphatases. The results of five-year field trials of Avatar-2 of soft winter wheat sort Smuglianka, Legend Mironovskaia and other sorts ensure field germination of seeds for 9–11%, protein content in grain from 10.9–11.0 to 13.2–14.2%. The protein nitrogen yield of grain exceeds control for 55–60% and more, phosphorous yield for 28–37%. It can be explained by plant more effective usage of nitrogen and phosphorous from fertilizers and also low-soluble nitrogen and phosphorous compounds in soil, activation of processes for biological nitrogen fixation in rhizosphere. On the base of Avatar-2 there was elaborated a range of compositional products for different types of crops.

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## P-099

**Possible causes and correction of an outbreak of anaemia at a goat farm in East Trinidad**

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This study investigated the occurrence of anaemia in goats from a farm in East Trinidad. From two groups ( $n = 27$ ) ( $n = 24$ ) of goats, blood was collected to determine Packed cell Volume (PCV), and caeruloplasmin (EC 1.16.3.1) activity, by microhaematocrit and change in optical density per unit time of substrate. 69% and 70%, of animals were classed as anaemic, based on high conjunctival grades (FAMACHA 4 and 5) and low PCV. Animals were treated intramuscularly at day 7 either with Iron Dextran or a Multi B Vitamin injectable. Subsequently, treated goats displayed lowered incidences of anaemia of 25% and 19%, respectively. 84% and 90% of pre and post treated goats also displayed low caeruloplasmin activity, suggestive of Cu deficiency. The reduction of anaemia was associated with administering Fe and B vitamins.

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## P-100

**miR-200a induce cardiac muscle necroptosis in selenium deficiency chicken by regulating RNF11**

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We found necroptosis may play a key role in heart disease, and additionally with the selenium. Hence, we choose miR-200a for our study and explore the role of miR-200a in selenium-deficient myocardial necroptosis. We selected miR-200a and its target genes RNF11 based on differentially expressed in tissues. We found the expression of miR-200a significantly increased in selenium deficiency myocardium, while the expression of RNF11 significantly decreased compared with normal chicken cardiac tissue. We examined the expression of necroptosis related genes and inflammation related genes in myocardial induced by selenium deficiency and myocardial cells transfected miR-200a mimic and inhibitor by quantitative real-time PCR. We confirmed that selenium deficiency and miR-200a mimics can lead to myocardial necroptosis in chicken. We hypothesized that miR-200a may suppress RNF11 to induce necroptosis in selenium deficiency cardiac muscle.

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## P-101

**Inflammatory response happened in broiler chick vein when treated with selenium deficiency diet**

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A few studies indicated that Selenium deficiency can induce the vascular diseases. In the present study, we investigated the effect of Se deficiency on vascular. A total of 60 male broilers were randomly divided into 2 groups. The control group was fed a basic diet. The Se-deficient group was fed a Se-deficient corn-soy basic diet. The changes of the inflammatory factors and inflammation-related cytokines were examined. Our results indicated that the levels of inflammatory factors and inflammation-related cytokines in the Se-deficiency group were significantly changed in the vein. In addition, principal component analysis was used to define the most important parameters that could be used as key factors. The in vitro experiments also demonstrated Se can enhance the anti-inflammatory ability of vein endothelial cells. In conclusion, Se deficiency induced inflammatory response by modulating inflammatory factors and inflammation-related cytokines.

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## P-102

**Rare earth elements (REE) in beef cattle feeding and the transfer into the food of animal origin**

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REE represent 17 transition metals of the third subgroup of the periodic system. Fourteen elements following lanthanum belong to lanthanides. REE occur naturally in the environment. At present, China is the dominant provider of REE. REE are used for electrical industries, as fertilizers in plant production and also as feed additives in animal nutrition. Results from experiments with different livestock species performed in Asian countries indicate positive effects on weight gain and feed conversion. Experiments carried out under European conditions testing mainly lanthanum and cerium confirmed these findings to some extent. Moreover, recently, the European Food Safety Authority (EFSA) has focused on the potential use of REE as feed additive. Following the recommendations of EFSA, aspects of consumer safety and feed efficiency are discussed based on results from experiments with growing cattle.

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## P-103

**Mineral contribution of donkey (*Equus asinus*) meat**

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Donkey (*Equus asinus*) domesticated animal, is neglected as an object of scientific study. In countries where donkeys are used for work, they are slaughtered at the end of their useful working life and meat is destined for human consumption. This study was carried out to evaluate the mineral composition of donkey carcass meat and inform population benefits that intake can provide to void mineral deficiency diseases in human health. Meat obtained in Donkey Fair 2016 at Mexico State, minerals were analyzed by Atomic Absorption Spectrophotometry, Ca, Na, K, Fe, Zn and Cu, and P content by colorimetry. Data obtained: (mg/100 g) Ca, 7.95; Na, 48.75; K, 353; Fe, 3.95; Zn, 3.17; Cu, 0.19 and P, 227. Analysis revealed that donkey meat is low in Ca, good in P and K, average in Sodium, it has a ratio in Fe–Zn–Cu, important since excess of any of them can inhibit absorption of the others. In conclusion donkey meat is a good source of minerals requested for human health.

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## P-104

**Role of selenium in iodine deficiency**

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Many people worldwide suffer from goiter, cretinism and intellectual deficit due to Iodine deficiency by absence of this element in diets that leads to impaired function of the thyroid gland, delay in growth and severe mental retardation. Selenium is essential in the metabolism of the iodothyronine, to convert the prohormone tetraiodothyronine to the active form triiodothyronine. The seleno-cysteine protects the thyroid hormone synthesis. Jumil *Euchistus sulfultus* S forest bug consumed in Mexico has both elements. The aim of this paper is to analyze iodine and selenium in this insect, captured at Guerrero State (2016) and profile samples of iodine by titration with thiosulfate and selenium by Atomic Absorption Spectrophotometer. Data obtained were Iodine 0.72 µg/100 g and selenium 57 µg/g. In conclusion, thyroid disease and severe mental retardation caused by iodine deficiency can be prevented by intake of two or three insects a day.

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## P-105

**Maternal nutrition during the first 50 d of gestation alters expression of metal-binding genes in fetal cerebrum**

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We hypothesized that maternal nutrition during the first 50 d of gestation would alter the metal-binding transcriptome of the developing cerebrum. 14 beef heifers were estrus synchronized and assigned to 2 treatments at breeding (CON-100% of requirements; RES-60% of CON). Heifers were ovariectomized on d 50 of gestation and fetal cerebrum were dissected, flash frozen, RNA extracted, and RNA-Sequencing conducted. Transcriptome analysis was run via the Tuxedo Suite in collaboration with USDA-ARS-MARC and gene clusters were examined with DAVID 6.8. 151 genes were utilized for cluster analysis ( $P < 0.01$ ;  $29 q < 0.10$ ). The metal-binding cluster contained 24 genes (Enrichment Score 1.01;  $P = 0.006$ ; Benjamini = 0.047), 4-Fe, 10-Zn, 2-Cu, and 8 for other metal binding genes. 23 metal-binding genes were upregulated in RES (Min = 2.26, Max = 46.29; Avg = 8.28-fold greater), and 1 in CON (3.51-fold greater). Thus, maternal nutrition during the first 50 days of gestation impacted expression of metal-binding genes in bovine fetal cerebrum. USDA is an equal opportunity provider and employer.

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## P-106

**Dietary Cu<sub>2</sub>O and CuSO<sub>4</sub> stimulate growth performance in pigs**P. Bikker<sup>1,\*</sup>, S. Durosoy<sup>2</sup>, A. Romeo<sup>2</sup>, J. van Baal<sup>1</sup><sup>1</sup> Wageningen University & Research, Wageningen, The Netherlands<sup>2</sup> Animine, Sillingy, France

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**Introduction:** CuSO<sub>4</sub> is commonly used as Cu source in pigs diets, both at nutritional and pharmacological levels, but CuO has been demonstrated to be ineffective as Cu source. Here, we determined the biological availability and efficacy of monovalent Cu<sub>2</sub>O (CoRouge®) and interactions with other trace elements, in comparison to CuSO<sub>4</sub>.

**Methods:** A 2 × 3 factorial arrangement with Cu-source (CuSO<sub>4</sub> and Cu<sub>2</sub>O) and supplementation (15, 80 or 160 mg Cu/kg diet) as factors in 600 weaned pigs during 5 weeks. On day 35, blood and gut tissues of 8 pigs/treatment were harvested for trace element content, enzyme activity and gene expression.

**Results:** CuSO<sub>4</sub> and Cu<sub>2</sub>O enhanced feed intake, feed efficiency and growth rate, with a final BW of 18.2 and 21.2 kg for 15 and 160 mg Cu/kg, respectively. Cu<sub>2</sub>O tended to enhance body gain compared to CuSO<sub>4</sub>. Indicators of Cu, Zn and Fe status of pigs and expression of genes related to their homeostasis are determined by RT-qPCR.

**Conclusion:** Unlike earlier results with CuO, the efficacy of Cu<sub>2</sub>O in promoting growth was equal to CuSO<sub>4</sub>. Molecular data will be available and presented at the symposium.

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## P-107

**Biologic action of citrates of the trace elements in melliferous bees in different periods of their lives**

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The influence of citrates Co, Ni, Cr, Se, Ag, Cu and Ge obtained by nanotechnology method on the indices of mineral and lipid metabolism in the organism of the melliferous bees and their production level was investigated. Adding citrates of these mineral elements to the components of artificial feeding causes their correcting influence on the content of trace elements and macroelements, crude lipids and their classes in the tissues of separate anatomic parts and the entire organism of bees and their production. The stimulating action of citrates of these elements was established on the intensity of egg laying by bee queens, that is more expressed for Co and Ni in the spring period of life. On the basis of the obtained results of the research the recommendations were issued on using aquananocitrates in feeding the melliferous bees and improving their vital activity, productivity and egg laying intensity by the bee queens and also biologic value and quality of the bee production.

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## P-108

**Forage mineral survey: Impacts of farm proximity to coal-powered electricity plants in the Transvaal Highveld region of Mpumalanga, South Africa**J.D. Arthington<sup>1,\*</sup>, J.G. Myburgh<sup>2</sup><sup>1</sup> University of Florida, Range Cattle Research and Education Center, Ona, USA<sup>2</sup> University of Pretoria, Onderstepoort, South Africa  
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Over 75% of South Africa's electricity is generated from coal-powered plants primarily located near large coal deposits in the north and east portions of the country. The Transvaal Highveld region of Mpumalanga province is one of these regions and is characterized by large commercial agricultural enterprises dispersed among multiple coal-powered electricity-producing plants. Sulfur dioxide emissions from these plants result in dilute acid precipitation which increases plant S accumulation and reduces soil pH. These ecosystem alterations have been implicated in both plant and livestock mineral imbalances. This survey evaluated the mineral status of forages (predominantly *Eragrostis plana*) grown on beef cattle farms in Mpumalanga province. Location of farm had no impact on forage S concentrations. Concentrations of P, K, Zn, and Se were greatest on Impacted vs. Non-Impacted farms. These initial data suggest that farm location, relative to coal-powered electricity plants, impacts forage mineral characteristics.

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## P-109

**Effect of zinc dietary sources on mineral and antioxidant status of lambs**

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The aim was to compare the effect of three dietary Zn sources on the mineral deposition and antioxidant enzyme activities in tissues of lambs fed diets supplemented with zinc (total 80 mg Zn/kg) either from ZnSO<sub>4</sub> or organic sources Zn-chelate of glycine hydrate (Zn-Gly) and Zn-chelate of protein hydrolysates (Zn-Pro). The 4-month feeding period increased Zn levels in liver of lambs from ZnSO<sub>4</sub> group and Zn plasma levels of lambs given Zn-Gly. Strong positive correlation was determinate between plasma Zn and pancreas ( $R=0.63$ ), liver and kidney (both  $R=0.52$ ) Zn levels. Intake of a diet with Zn-Pro decreased Cu and metallothionein levels (Zn-MT1) in plasma as well as SOD activity and lymphocytes (%) in blood, although the highest Zn content was measured in kidney and urine. Dietary Zn source had no effect on the antioxidant (glutathione peroxidase-GPx, malondialdehyde-MDA) and mineral status (Fe, Mn, Cu) in the lambs. Our results indicate that there are some differences in Zn and Cu tissue distribution from the chelated Zn proteinate. This study was supported by the Slovak Research and Development Support Agency APVV-0667-12.

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## P-110

**Effect of dietary zinc on mineral deposition and activity of zinc-containing enzymes in the intestinal mucosa of broilers**

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The objective of this study was to compare the effect of different levels of dietary zinc (total 60 or 100 mg Zn/kg) from its inorganic (ZnSO<sub>4</sub>) or organic source (Zn chelate of glycine) on concentration of Zn, Cu, Mn and Fe in small intestinal mucosa of broilers. Activity of Cu/Zn superoxide dismutase (Cu/Zn SOD) and alkaline phosphatase (APL) was determined too. Zinc concentration in duodenal, jejunal and ileal mucosa was significantly increased in all supplemented groups. Neither source nor level of dietary Zn affected concentration of Mn, Cu and Fe in intestinal mucosa. Activity of Cu/Zn SOD in jejunal mucosa was decreased in birds supplemented with lower dose of Zn sulphate. Intake of the organic Zn resulted in higher ALP activity in duodenal enterocytes. In conclusion, no differences in mineral concentration were found due to the source or dose of Zn supplemented, however, intake of organic Zn increased activity of Zn containing enzymes in small intestine of broilers. This work was supported by the Slovak Research and Development Agency APVV-0667-12.

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## P-111

**Element exchange in the organism of broiler chicken after introduction of nanoparticles**

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The purpose of the current study to evaluate the influence of new preparation containing iron and cobalt alloy on growth and metabolism of the chemical elements in chicken. The research project also demonstrated the relatively high bioavailability of elements from nanoparticles introduced per os. At the end of the experiment, the average Fe in body of chicken in Group II (Fe 7 mg/kg and Co 3 mg/kg with salts of FeSO<sub>4</sub> × 7H<sub>2</sub>O and CoCl<sub>2</sub>) was 35.8 ± 1.4 mg, Co 77.9 ± 8.8 mcg, in Group III (FeCo nanoparticles) Fe 50.7 ± 2.8 mg and Co 99.5 ± 7.4 mcg. Fe in chicken from I (control) group was 29.4 ± 3.41 mg, Co 62.4 ± 5.8 mcg. Taking into account the deposits of Fe 15.9 mg, Co 5.1 mcg in the body of control chickens for 28 days, the deposition of elements from the injected products was Fe 5.9 mg, Co 14.7 mcg in Group II, in Group III-Fe 20.8 mg and Co 36.7 mcg. The retention of iron (endogenous losses not included) from nanoparticles (Group III) was 73.9% and that from ferric sulfate (Group II) was 20.7% or by 53.2% less.

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## P-112

**Physicochemical characterization of feed grade zinc oxide sources**

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This project aims to characterize different sources of feed grade zinc oxide (ZnO) to better understand their fate in the digestive tract and differences in bioavailability. More than 25 ZnO samples have been collected from the feed industry worldwide. Physical characteristics of 4 representative samples were assessed using low-angle light scattering, electron microscopy (SEM and TEM) and BET nitrogen adsorption isotherms. SEM suggested that ZnO-1, ZnO-2 and ZnO-3 were grinded dense materials, while HiZox<sup>®</sup> (Animine) showed aggregates having a porous internal structure. TEM demonstrated ZnO-1 and ZnO-2 were made of platelets, not forming aggregates. ZnO-3 presented rod-like crystals forming aggregates. HiZox<sup>®</sup> showed platelets forming aggregates. Light scattering provided the size distributions of aggregates and agglomerates. The high specific area combined to large agglomerate sizes of HiZox<sup>®</sup> makes this feed additive different from standard ZnO. ZnO sources have different characteristics which can affect their in vivo solubility and bioavailability. Further studies are being developed to understand this relationship.

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## P-113

**Endoparasite infection in Santa Ines ewes supplemented with increasing doses of chromium picolinate**

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The aim was evaluate the endoparasites infection in ewes supplemented with Chromium picolinate (CrPic). The experiment was conducted at CENA – USP and approved by the Ethics Committee (007-2016). 32 multiparous ewes (BW: 55.3 ± 8.0 kg) were randomly assigned in control, 0.15, 0.30 and 0.45 mg of CrPic/animal/d. The diet was formulated based on the American feed systems. The CrPic was provided in pills 5 times a week. For eggs per gram (EPG) analysis, two grams of feces collected from rectum were mixed to 28 mL of saturated salt solution, the mixture was sifted and pipetted in a MacMaster chamber and read in a 10× lens microscope. The statistical design was a CRD with repeated measures. The EPG was converted (Log<sub>x</sub>+10) and tested by Tukey (*P*<0.05). The EPG results show no effect of treatment (*P*>0.05) nor interaction treatment and time (*P*>0.90), but an increase in EPG after birth (*P*<0.01), as expected. Thus, CrPic did not control or affect endoparasites infection during pregnancy.

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## P-114

**The effect of inorganic selenium on the quality of minks' coat under the cage housing**

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The lack of trace elements, including selenium, affects the metabolism of minks and the process of forming high-quality coat.

**Aim:** To identify the relationship between metabolic processes and formation of coat by application of selenium preparations of inorganic nature in minks.

**Methods:** The study was carried out from July to October on the *Mustela vison* Schr. The control and experimental groups consisted of 25 2-month old animals. Animals were fed 2 times a day, water was given ad libitum. Animals from the experimental group additionally received sodium Selenite ( $\text{Na}_2\text{SeO}_3$ ) with fodder within 60 days with an interval of 10 days, dose-0.2 mg/head.

**Results:** Application of sodium Selenite recorded significantly increased levels of total protein (average 7.6%), the amount of glucose (22.5%), decrease in urea level (15.7%) and cholesterol (15.5%). Compared with the beginning of the experiment, after the prophylactic use of the drug content of lymphocytes and monocytes in the blood of the burrows of the experimental group decreased by 54.5.

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## P-115

**Effect of *in ovo* injection of copper nanoparticle on embryo mortality, and immune system of broiler chicken**

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In this study, the effects of *in ovo* injection of nano copper (CuNano) in broiler breeder eggs on hatchability, embryo mortality, and immune and blood parameters of broiler chicken were investigated. 320 fertilized eggs were randomly assigned into four treatment groups. CuNano was injected into the eggs' air sac of three groups, in the amount of 50, 75, or 100 ppm. The fourth group received distilled water injection and served as the control. The eggs that were fed 50 ppm CuNano showed the highest hatchability and lowest embryo mortality during 0–10th day of incubation ( $p < 0.05$ ). However, CuNano did not influence embryo mortality from the 11th day to the end of incubation time. The 50 ppm group of chickens showed significantly lower total white blood cells compared to the other groups, but CuNano made no change in antibody levels against influenza and Newcastle disease. Furthermore, feeding *in ovo* CuNano reduced significantly the level of haematocrit ( $p < 0.05$ ). Overall, *in ovo* injection of CuNano during embryonic development may reduce early embryo mortality and improve hatchability of chickens.

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## P-116

**Effects of tribasic zinc sulfate on growth performance, intestinal morphology and expression of zinc transporters in pigs**

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To investigate the effects of tribasic zinc sulfate (TBZ) as dietary zinc source on growth performance, serum superoxide dismutase (SOD) level, intestinal morphology and mRNA expression of zinc transporters, a total of 168 Duroc × Landrace × Yorkshire pigs (about 10 kg body weight) were fed basal diet with 0 mg/kg (control), 100 mg/kg (LTBZ) and 1000 mg/kg Zn (HTBZ) from TBZ for 28 days. The results showed that pigs fed LTBZ had higher average daily weight gain and feed intake ( $P < 0.05$ ) than pigs fed HTBZ and control pigs. Pigs fed either LTBZ or HTBZ had higher CuZn-SOD level ( $P < 0.05$ ) in serum than control pigs. Pigs fed LTBZ had higher villus height and villus height: crypt depth ratio ( $P < 0.05$ ) than pigs fed HTBZ and control pigs. Moreover, pigs fed LTBZ had higher mRNA expression of the zinc influx transporter ZIP4 and lower mRNA expression of the zinc efflux transporters ZnT1 and ZnT2 than pigs fed HTBZ. In all, TBZ had the potential to be used as a dietary zinc source for pigs as it had beneficial effects on growth performance, intestinal morphology and zinc uptake.

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## P-117

**The copper availability as function of the feed type, pH, and copper concentration**

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The objective was to evaluate the influence of feed type, pH, and copper (Cu) concentration on Cu availability after *in vitro* incubation in water with varying feedstuffs: wheat straw, grass hay, corn silage, dried distillers grains with solubles (DDGS), ground corn, and soybean meal were incubated with ultrapure water (pH ≈ 6.4) with Cu concentrations: 0.0, 5.0, 10.0, 15.0, 20.0, 30.0 and 40.0 mg Cu/kg of DM for 48 h. This experiment was repeated, however, following the 48 h incubation in ultrapure (pH ≈ 6.4) samples were incubated for an additional hour (pH ≈ 2.3). Following incubation, the indigestible residue was analyzed for Cu. Regression analysis was performed on all data. Based on confidence intervals comparisons, grass hay (pH ≈ 6.4) and DDGS (pH ≈ 2.3) had similar cubic regression models. All other models/equations were different, indicating that the coefficient of copper binding was different between all remaining feedstuffs. It shows that retention of copper by feedstuffs can vary in intensity, accordingly with the chemical properties of feedstuff, such as lignin, cellulose, hemicellulose, starch and protein content.

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## P-118

**The zinc availability as function of the feed type, pH, and zinc concentration**

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It was evaluated the influence of feed type, pH, and zinc concentration on Zn availability after in vitro incubation in water with varying feedstuffs: wheat straw, grass hay, corn silage, dried distillers grains with solubles, ground corn, and soybean meal were incubated with ultrapure water (pH ≈ 6.4) with Zn concentrations: 0.0, 15.0, 30.0, 45.0, 60.0, 90.0, and 120 mg Zn/kg of DM for 48 h. It was repeated, however, following the 48 h incubation in water (pH ≈ 6.4) samples were incubated for an additional hour (pH ≈ 2.3). Following incubation the indigestible residue was analyzed for Zn. Regression analysis was performed on all data. Based on confidence intervals comparisons, wheat straw (pH ≈ 2.3) and grass hay (pH ≈ 2.3) had similar linear models as did the quadratic models for corn silage (pH ≈ 6.4) and DDGS (pH ≈ 2.3). All other models/equations were considered different, indicating that the coefficient of zinc binding was different between all remaining feedstuffs. It shows that zinc retention by feedstuffs can vary in intensity, accordingly with the chemical properties of feedstuffs.

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## P-119

**The effect of injectable trace minerals on semen quality of bulls**

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**Objective:** Evaluating injectable Zn, Cu, Mn, Se (Multimin Cattle) on semen quality.

**Materials and methods:** Ten disease-free bulls, body condition score (3.5–4), body weight (420–750 kg) on a trace mineral supplemented ration from day 60 to end of the study period were allocated to treated and control groups. Semen collected twice weekly for 3 months, analysed by Computer-assisted semen analysis. The ejaculate act as statistical unit, and significance threshold was 0.05.

**Results:** Mean spermatozoa (SPZ) concentration, proportion of ejaculates with >50% SPZ with progressive motility was significant higher, proportion of ejaculates with >1% SPZ with nuclear defects was numerically lower, total SPZ collected was numerically higher in treated bulls.

**Conclusions:** Multimin supplementation improves semen quality.

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## P-120

**Serum mineral levels in sheep of various physiological stages in the dry and wet seasons in Central Trinidad**

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In Trinidad, cases of milk fever and Cu deficiency have been identified in ewes and newborn lambs. Therefore, serum mineral concentrations regarding season, and physiological stage were determined for prones to these disorders and limitations to animal performance. Mineral levels were determined by Atomic Absorption, but P calorimetrically. Lower serum P ( $P < 0.001$ ) was found in the dry than the wet season, whereas Mg ( $P < 0.001$ ) and Zn ( $P < 0.01$ ) were lower in the wet season with higher Cu ( $P < 0.001$ ) observed in the wet season. Based on low mineral levels, in the dry season, the order of minerals likely to limit production ( $P < 0.001$ ) was P, Mg, C and Zn. The low serum mineral concentrations probably of physiological importance were Mg and Cu in growing lambs; Ca, P, Cu and Mg in pregnant and lactating sheep. In both the dry and wet seasons, the order of forage minerals probably limiting production was Na, Cu, Mg and Zn. Levels of mineral deficiencies implied that optimal performance of sheep was being compromised.

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## P-121

**The Selenium status of fresh cows in Isfahan dairy herds**

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For detection of Selenium in fresh dairy cows, in a 17 dairy farm in the different parts of Isfahan province (Iran) blood samples were taken from tail of fresh cows and blood Selenium concentration was determined indirectly via *Glutathione peroxidase* (GPx) activity. The mean Selenium concentration ( $n = 60$ ) was determined  $0.18 \pm 0.07$  mg/L that was in normal range, and the Selenium concentration in summer was ( $n = 31$ )  $0.16 \pm 0.07$  and in winter ( $n = 29$ ) was  $0.17 \pm 0.07$  mg/L that showed season has any significant effect ( $P < 0.05$ ) on Selenium concentration according the t student statistical test. According these data the Selenium supplement was not recommended in dairy farms of Isfahan province.

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## P-122

**The effect of *in ovo* supplementation of nano zinc particles on hatchability and post-hatch immune system of broiler chicken**

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The aim of this research was to study the effect of *in ovo* administration of nano zinc in broiler chicken. Nano forms of zinc at 50, 75, and 100 ppm/egg were *in ovo* supplemented at 4th day of incubation in the air cell of the fertile eggs. A control group was also *in ovo* injected with distilled water. Each treatment had 80 replicates. Parameters such as hatchability, and immune factors were studied. *In ovo* feeding of nano zinc at 50 and 75 ppm/egg decreased embryo mortality at 0–11 day of incubation period, however, at 11–18 day of incubation, 100 ppm nano zinc/egg increased embryo mortality compared to the control group. Nano zinc did not influence the hatchability. Significantly less antibody titer against Newcastle disease virus and more total white blood cell content were observed in the Nano Zn injected eggs compared to the control eggs. There was no distinct difference in the Hematocrite percent among the experimental groups. The results suggest that *in ovo* feeding of nano form of zinc does not harm developing embryo, and increase white blood cells in hatched chicks.

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## P-123

**Effects of dietary consumption of protected conjugated linoleic acid (CLA) and different levels of nano-selenium on performance, biometric and blood parameters of male lambs**

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Thirty six Moghani male lambs, in a factorial design with 6 lambs in each treatment, were used to evaluate the effects of the different nano-selenium levels and protected conjugated linoleic acid (CLA) on performance, biometric and blood parameters of the lambs. The lambs were divided into six groups and each was fed according to the following diets: 1) control diet without nano-Se and CLA, 2) 1 mg nano-Se/kg dry matter (DM), 3) 2 mg nano-Se/kg DM, 4) 15 g CLA/kg DM, 5) 15 g CLA + 1 mg nano-Se/kg DM, 6) 15 g CLA + 2 mg nano-Se/kg DM. The experimental diets had no effect on biometric and carcass parameters. Some blood parameters such as HDL, LDL, T4, T3 and Glutathione peroxidase were affected by dietary nano-Se supplementation ( $P > 0.05$ ). The results show that although the nano-Se and protected CLA had no effect on weight gain and the other biometric parameters, based on hematological parameters, dietary consumption of nano-Se and protected CLA together can improve animal health.

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## P-124

**Effect of zinc oxide and chlortetracycline on antibiotic resistance development in piglets**Stéphane Durosoy<sup>1,\*</sup>, Agathe Romeo<sup>1</sup>, Wilfried Vahjen<sup>2</sup>, Jürgen Zentek<sup>2</sup><sup>1</sup> Animine, Sillingy, France<sup>2</sup> Freie Universität Berlin, Berlin, GermanyE-mail address: [sdurosoy@animine.eu](mailto:sdurosoy@animine.eu) (S. Durosoy).

Chlortetracycline (CTC) and zinc oxide (ZnO) at pharmacological dosage are commonly supplemented in piglet diets in order to reduce diarrhea and to improve growth performance. However, there is a risk of bacterial resistance development. In this trial, CTC and ZnO were used to evaluate their effects on antibiotic resistance genes. The experiment was performed with 4 diets: 2400 ppm of Zn from standard ZnO vs. 110 ppm of Zn from a potentiated ZnO source (HiZox<sup>®</sup>), with or without 300 ppm of CTC. Each treatment consisted of 10 piglets weaned at 25 days. DNA was extracted from feces (0, 2, 4, 7, 14 d), in order to quantify by qPCR some antibiotic resistance genes and related genes. CTC increased numerically the development of various genes (tetA, bacA) after 6 days; without CTC, there were numerical (tetA) or significant (bacA, zinT) differences between the group fed 2400 ppm of Zn from standard ZnO and the group fed 110 ppm of Zn from potentiated ZnO. Both ZnO at high level and CTC increase the development of antibiotic resistance genes, and may have an additive effect on these genes.

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## P-125

**Effect of microRNA-210 is induced by deferoxamine on modulating the cellular iron homeostasis and protect stressed cell against death in rat L6 myotube**

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The upregulation of microRNA-210 (miR-210) can suppress the scaffold protein for iron-sulfur cluster biosynthesis iron sulfur cluster U (IscU) expression, which results in dysregulated of mitochondrial energy metabolism and iron homeostasis in high-proliferative cancer cells. After anti-miR-210 transfection, the expression of miR-210 levels was decreased about 50% in without deferoxamine (DFO)-treated myotube compared with anti-scramble-treated myotube. The cytosolic aconitase activity, mitochondrial IscU and H-ferritin protein, the mitochondrial reactive oxygen species (ROS) and apoptotic marker caspase 3 protein levels were also increased in anti-miR-210 without DFO-treated myotube. In contrast, overexpression of anti-miR-210 mitigated that the decreased expression of IscU and H-ferritin levels were caused by DFO treatment. In summary, our data show that the miR-210 is normally expressed in non-proliferative myotube, which is required for maintaining cellular iron homeostasis and protect stressed cell against cell death.

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## P-126

**Japan clinical practice guideline for Wilson disease**

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Practice guidelines on Wilson disease (WD) have been reported in U.S.A. and Europe. We present the Japan practice guideline for WD approved by Japanese Society for Pediatric Gastroenterology, Hepatology and Nutrition (JSPGHAN), other 7 academic societies and Japanese WD patient's association. This guideline was published in JSPGHAN 29, 2015, and includes diagnostic scoring system consisting of 8 items and diagnostic algorithms to provide a good diagnostic accuracy, which are different from those of Europe and U.S.A. This guideline also shows how to treat each type of patients with WD. In addition, treatment targets, monitoring of treatment and adherence of treatment were described.

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## P-127

**Assessment of iron accumulation in the liver by a noncontact magnetometric method under cholestasis in the experiment**

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As a result of inside or extrahepatic causes cholestasis always lipid peroxidation activated, that leads to biliary cirrhosis. Purpose was to study ability of iron accumulation in liver on an experimental model of mechanical jaundice, using method of noncontact investigation of the magnetic field in rats' liver with SQUID (superconducting quantum interference device) magnetometer system. Common bile duct of main group of rats was ligated. In two weeks the magnetic field in projection of the rat's liver was measured using SQUID magnetometer system. Iron content in liver by cholestasis rats

increased more than 3 times. Histological studies also showed iron accumulation in liver. Magnetic signal over the liver of rats with cholestasis were much higher than of control group. SQUID method required further investigation in experimental and clinic conditions as a method for diagnostics of iron overload in cholestasis.

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## P-128

**Morphological and functional assessment of the heart and liver under iron oxide nanoparticles exposed (experimental data)**

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Nano-sized particles of iron oxides may be present in urban air (smog), breathing area workers of many trades. Purpose of this article was to study heart and liver ability to accumulate iron, to assess changes in blood biochemical indices and organ morphology after administration of different size (19, 75 and 400 nm) particles (NP) Fe<sub>2</sub>O<sub>3</sub>. NP were administered rats by intraperitoneal 1 ml colloidal solutions injection (iron content 1.56 mg/100 g body weight) 5 times/week, control group – 1 ml 0.1% stabilizing gelatine solution. Evaluation was carried right after 30 injections and 30 days post experimental period (PEP). Iron content in liver and heart exposed rats increased, especially in group 19 nm NP and even more in PEP. Enzymes activity, indices of oxidative stress, contents uric acid in serum and other indicators antioxidant defense increased. Degenerative changes heart and liver, blood capillaries were found in rats not depending on size of particles but smaller NP had greater potency.

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## P-129

**Iron deficient anaemic patients in Sudan lack nutritional zinc**

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**Objective:** Assessment of zinc status in blood of iron deficient anaemic patients in Sudan and compared them with those of Dutch anaemic patients.

**Material and method:** Fe and Zn were measured in whole blood with instrumental neutron activation analysis (INAA) in 22 Sudanese anaemic patients and 4 controls as well as in 17 Dutch anaemic patients and 4 controls.

**Results and conclusion:** In the Sudanese patients very low concentrations of both Fe and Zn were measured, with averages of 190 ± 50 mg/L and 3 ± 1 mg/L respectively compared to control group (Fe 440 ± 20, Zn 5 ± 1 mg/L), while the Dutch patients had low iron (300 ± 40 mg/L), but normal zinc levels (5 ± 1 mg/L). A positive correlation was observed between Fe and Zn in blood of the Sudanese subjects ( $r=0.654$ ). While there is a very weak relation between Fe and Zn in blood of the Dutch group ( $r=0.08$ ). The low level of Fe and Zn for the Sudanese group might be ascribed to the poor intake of these two nutrients with the main dietary food (cereals) in this area. In iron deficiency anaemia in Sudanese

patients, a deficiency of zinc should be taken into account in case of supplementation.

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P-130

**Extracellular domain of human high affinity copper transporter (hNdcTR1), synthesized by *E. coli* cells, chelates silver and copper ions *in vivo***



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In this study, a recombinant fusion protein for expression in *E. coli* cells was constructed from glutathione-S-transferase (GST) and the N-terminal domain (ectodomain) of human high affinity copper transporter CTR1 (hNdcTR1). Several biological properties of the GST-NdcTR1 fusion protein were assessed. It was demonstrated that the protein was localized in cytoplasm, displayed no toxicity, was prone to oligomerization and formed inclusion bodies. Specific GST activity was significantly decreased in the oligomeric species. Treatment of *E. coli* cells with silver and copper ions reduced cell viability in a dose- and time-dependent manner. Cells expressing GST-NdcTR1 protein demonstrated resistance to metal treatment. The possibility for the fusion protein carrying extracellular metal binding motifs to integrate into the cell's copper metabolism and its chelating properties is discussed. The work was supported by grants RFBR 15-04-06770 and RSF 17-14-01117.

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P-131

**Stable isotope dimethyl-labeling based quantitative proteomic analysis identify a set differentially expressed proteins related to ribosome biogenesis and protein synthesis is regulated by iron depletion in human breast cancer cells**



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Perturbation of ribosome biogenesis has been shown to activate p53 expression and cause translational arrest, inhibition of cell growth and induction of apoptosis. In this study, we identified most of the up-regulated proteins in nuclear fraction are involved in pre-rRNA modification and processing and ribosomal assembly, while most of the down-regulated proteins are involved in energy metabolism, protein metabolic process, cell cycle, and cell proliferation in iron chelator deferoxamine (DFO)-treated nuclear fraction for 48 h by using stable isotope dimethyl-labeling coupled with quantitative proteomic analysis. In addition, DFO treatment led to a reduction in the fractions of ribosomes that are engaged in polysomic fraction, and concomitant decreased the efficiency of protein synthesis. In summary, perturbation of ribosome biogenesis by iron chelator, thereby suggesting that inhibition of protein synthesis and cell growth.

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P-132

**Effect of microRNA-210 is induced by deferoxamine on modulating the cellular iron homeostasis and protect stressed cell against death in rat L6 myotube**



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The upregulation of microRNA-210 (miR-210) can suppress the scaffold protein for iron-sulfur cluster biosynthesis iron sulfur cluster U (IscU) expression, which results in dysregulated of mitochondrial energy metabolism and iron homeostasis in high-proliferative cancer cells. After anti-miR-210 transfection, the expression of miR-210 levels was decreased about 50% in without deferoxamine (DFO)-treated myotube compared with anti-scramble-treated myotube. The cytosolic aconitase activity, mitochondrial IscU and H-ferritin protein, the mitochondrial reactive oxygen species (ROS) and apoptotic marker caspase 3 protein levels were also increased in anti-miR-210 without DFO-treated myotube. In contrast, overexpression of anti-miR-210 mitigated that the decreased expression of IscU and H-ferritin levels were caused by DFO treatment. In summary, our data show that the miR-210 is normally expressed in non-proliferative myotube, which is required for maintaining cellular iron homeostasis and protect stressed cell against cell death.

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P-133

**Effect of vanadium citrate on oxidative stress in the blood of rats with experimentally induced diabetes**



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The subject of study is the effect of nanosynthesized vanadium citrate on oxidative stress in rats with induced diabetes. The study was held on 5 rat groups: I – control group, II–V – research groups. Rats from III–V groups consumed water with 0.125, 0.5 and 2.0 μV/ml solutions of vanadium citrate for 1 month. Experimental diabetes was induced in all research groups by injection of 5% alloxan monohydrate (150 mg/kg b.w.). The rats were put to death on the 40th day of study. The study revealed that high level of glucose (9 mmol/l) in rats' blood from II group inhibits the activity of glucose-6-phosphate dehydrogenase, the activity of glutathione reductase, amount of restored glutathione, and increasing of the oxidative stress. This is confirmed by an increased amount of lipid hydroperoxides and TBA-active products. The studied indexes are normalized by vanadium compounds. It's evident that being insulin-mimetic and antioxidant, vanadium can act as an acceptor of free radicals and lower the oxidative stress in rat blood.

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## P-134

**The effect of resveratrol supplementation on element metabolism in bone tissue of rats with acute swimming exercise**

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The aim of the present study was to investigate how affect resveratrol supplementation element metabolism in bone tissue of rats with acute swimming exercise. Animals were divided to 4 groups. 1. Control, 2. Swimming; rats were fed by standart rat food and exposed to 30 min swimming exercise at the end of study. 3. Resveratrol: animals were fed by standard rat food plus resveratrol for 4 weeks (10 mg/kg/day) by drinking water. 4. Resveratrol+Swimming: Animals were fed by standard rat food plus resveratrol (10 mg/kg/day) by drinking water for 4 weeks and exposed to swimming exercise for 30 min at the end of study. The end of 4 weeks study, bone tissue samples analyzed at the Atomic Emission (mg/L). The findings of the study show that resveratrol supplementation increased zinc, calcium, phosphorus, magnesium and boron levels in bone tissue independently from exercise. One of the main findings of study was that resveratrol supplementation has protective and/or regulator activity in bone tissue independently from exercise and may be consider.

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## P-135

**Effect of pinealectomy and melatonin supplementation on metallothionein, zinc transport protein levels in the small intestine sections of the rat**

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The objective of the present study is to explore the relationship between levels of metallothionein, zinc transport protein levels, which comprise a basic mechanism in the absorption of zinc, in the parts of the small intestines, of rats whose pineal glands were removed, which were supplemented with melatonin after pinealectomy, and which were supplemented with melatonin without touching the pineal gland. The study was carried out at the Wistar type adult male rats. Group 1, Control, Group 2, Pinealectomy, Group 3, Pinealectomy + Melatonin, Group 4, Melatonin. The percentages of ZnT2, ZIP2, ZIP4 and metallothionein were determined using the immunohistochemical method. The results of the study indicate that reduced levels of ZnT2, ZIP-2, ZIP-4, and metallothionein, especially in the duodenum after pinealectomy are almost restored to control values after melatonin supplementation.

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## P-136

**Reproductive system of animals with magnesium deficiency and its pharmacological correction**

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In the course of “Russian Magnesium” program VolgSMU and BIOAMID have developed bischofite based drugs: standardized bischofite mineral (SBM), Magnevitol, and MagneB6.

**Objective:** Evaluate the correction of reproductiveness in male rats with alimentary hypomagnesemia with SBM, Magnevitol, and MagneB6.

**Methods:** Adult male rats with moderate hypomagnesemia (plasma Mg<sup>2+</sup> levels <0.6 mM, erythrocytes levels <1.6 mM) were dosed p.o. with SBM, Magnevitol, or MagneB6 for 2 months. Treated animals were compared to the control and intact groups.

**Results:** Administration of drugs markedly improved fertility, spermatogenesis, total sperm count and mobility, and reduced the number of pathological forms. These effects were more significant in Magnevitol than in MagneB6 group. Fertilization of females was deferred, but the male copulatory was not compromised. Male fertility index, quality of conception in females, and postnatal survival of offspring were improved in treated groups.

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## P-137

**The effects of zinc and melatonin on muscle ischemia–reperfusion damage in rat**

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Ischemia–reperfusion leads to damage in cell or tissue due to insufficient blood flow stream. The aim of present study was to determine the effect of zinc, melatonin and zinc+melatonin supplementation for 3 weeks on muscle tissue malondialdehyde (MDA) and glutathione (GSH) levels and muscle histology. This study was performed on 38 male Wistar-Albino rats. Experiments groups were designed as sham-control, ischemia–reperfusion (I/R), zinc+I/R, melatonin+I/R and zinc+melatonin+I/R. Ischemia–reperfusion was induced by left femoral artery occlusion (1 h) and reopening (1 h). At the end of experiments tissue samples were analysed for MDA and GSH. MDA levels in I/R groups increased significantly. Zinc and melatonin supplementation reduced MDA, however increased GSH levels. There was no histological alteration in muscle. The results of present study show that increased lipid peroxidation in muscle tissue by ischemia–reperfusion may be prevented by zinc and melatonin supplementation.

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## P-138

**Evaluation of tissue trace element content in the rat models of obesity**

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The aim of the study was to assess the impact of high-fat (HFD, 31.6% from fat) and high-fat high-carbohydrate (HFHCD, 60% from fat and 10% sucrose solution) diets on tissue trace elements (TE) content in rats. HFD resulted in excessive adiposity with the absence of insulin resistance and proatherogenic changes. HFD decreased hepatic Cu, I, Mn, Se, and Zn content; Cr, V, Co, Cu, Fe, and I levels in adipose tissue. Only serum Cu level was reduced. HFHCD resulted in obesity, insulin resistance, proatherogenic changes and fatty liver. HFHCD lowered total hepatic Co, Cu, I, Li, Mn, Se, Zn, whereas only hepatic Mn and Se remained reduced after adjustment for total protein. Serum I, Li, and Mn were decreased in HFHCD-rats, whereas Co, Se, V, and Sr were elevated. It is proposed that TE imbalance may precede obesity-associated disorders.

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## P-139

**Protective effect of zinc supplementation against diet-induced non-alcoholic fatty liver disease**

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The aim of the study was to assess the influence of zinc supplementation on metabolic parameters of rats with diet-induced non-alcoholic fatty liver disease (NAFLD). 24 female Wistar rats were divided into 4 equal groups: STD-control group (standard diet, 10% from fat), HFHCD-control (high-fat high-carbohydrate diet, 60% from fat and 10% sucrose solution), STD-Zn-supplemented (227 mg/l in drinking water) and HFHCD-Zn-supplemented groups. The obtained data show that HFHCD led to obesity, insulin resistance and hepatic steatosis. Zinc treatment resulted in significant 12% ( $p=0.036$ ) decrease in liver weight and degree of steatosis. Generally, Zn supplementation has beneficial effects on liver metabolism in diet-induced NAFLD.

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## P-140

**Effects of smoking on zinc, plasma viscosity, plasma osmolality and red blood cell deformability**

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Smoking is accepted as a source of oxidants and toxic chemicals on hemorheological parameters (red blood cell-RBC, RBC deformability-Tk, plasma viscosity-PV and plasma osmolality-PO) and respiratory diseases. Zinc (Zn) is an essential element for cellular growth, biomolecule metabolism, membrane stability and metalloenzyme functions. The main objective is to investigate the effect of smoking on Zn levels and hemorheological parameters. Zn levels, PO, PV and Tk were determined by spectrophotometer, freezing point method, capillary viscometer and Dintenfuss' formula; respectively. PV, PO and fibrinogen were significantly higher in current and ex-smokers than controls. Tk<sub>45</sub> was significantly lower in current-smokers than controls. Consequently, PV and PO increase with any Zn alterations in smokers might be related with high content of plasma, thus deformability feature of RBC have just initiated within the blood flow. We emphasize that Zn values, PV, Tk and PO are useful markers in monitoring of smokers. (Istanbul University, Research Fund-ID No: 15364).

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## P-141

**Chromium picolinate reduces morphine-dependence in rats and increases brain serotonin**

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**Objective:** To test chromium picolinate (CrPi) effect on morphine (M) dependence in rats.

**Materials and methods:** Group 1 received saline and group 2 received CrPi, 10 µg/kg/day (10 days). In groups 3, 4 and 5 M-dependence was induced with increased M doses, from 5 – day 1 to 90 mg/kg/day – day 10; in day 11, naloxone, 2 mg/kg was administered to precipitate withdrawal, which was assessed by Gellert-Holtzmann score (GHWS). Group 3 received only M, groups 4 & 5 received CrPi, 5 and 10 µg/kg/day, during dependence induction. At the end, brain serotonin (5HT) and serum and brain Cr were assessed.

**Results:** GHWS was significantly reduced by CrPi: from  $132.4 \pm 9.87$  (g3) to  $124.1 \pm 8.41$  (g4,  $p < 0.05$ ) and  $122.2 \pm 6.47$  (g5,  $p < 0.01$ ), but withdrawal symptoms were unequally lowered. CrPi increased brain 5HT in both dependent and non-dependent rats, mainly in the prefrontal cortex ( $646.3 \pm 8.51$  – group 3 vs.  $661.5 \pm 14.63$  – group 5,  $p < 0.01$ ).

**Conclusions:** CrPi significantly lowered M-dependence and increased brain 5HT; this is in accordance with Cr anti-depressant effect evidences and the 5HT-mediated mechanisms involvement in it.

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## P-142

**Long-term effects of exercise on zinc homeostasis**

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Long-term impact of exercise on zinc status is unclear. We conducted a systematic review of articles published up to 28th January 2016 to identify studies that investigated the zinc status of trained populations, compared to untrained controls, using one or more zinc biomarkers. Six interventional studies ( $n=89$  exercise, 86 controls) and 16 cross-sectional studies ( $n=1374$  athletes, 670 controls) were eligible for inclusion. In cross-sectional studies, the majority of athletes displayed lower serum zinc concentrations and higher dietary zinc intakes, compared to controls. Interventional studies provided inconclusive results on differences in zinc biomarkers between exercise and control groups. Further investigations are required to determine zinc requirements for athletes and exercise-induced changes in zinc homeostasis. The limited evidence suggests that those who regularly exercise have lower serum zinc levels, which appear to be independent of dietary zinc intake.

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## P-143

**Chronobiological activity of extract *Filipendula ulmaria* with high lithium content**

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The purpose of this study to evaluate the chronobiological activity of an aqueous extract of *Filipendula ulmaria*, containing of high concentrations of lithium (Li 20  $\mu$ /g). The rhythmic organization of body temperature and behavioral activity of rats was evaluated on day 6–8 daily oral administration of the extract in the morning. Control rats were administered the extract of *Filipendula vulgaris* (Li 3  $\mu$ /g) or water in equivalent amounts. Statistical analysis of variance, cosinor and spectral analyzes was carried. It was shown that during the summer and winter solstices in intact rats there was a lack of rhythms of the investigated indicators. In the control rats treated with water there was 24 h rhythm of body temperature. In rats treated with the extract of *F. vulgaris* (Li 26  $\mu$ /g) in the spectrum rhythms of behavioral activity 7 circadian harmonics appeared (20–26 h). In rats treated with the extract of *F. ulmaria* (Li 90  $\mu$ /g) there were 3 circadian rhythms (21–23 h) of behavioral activity and 2 harmonics (20, 21 h) of body temperature.

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## P-144

**Oral supplementation with low strontium doses improve bone quality in adult rats**

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Strontium (Sr) ranelate is a potent drug for osteoporosis treatment. But Sr is also part of our diet. In a dose response study, we have supplemented the feed of male, healthy rats (6–8 months;  $n=20$  per group) with Sr lactate for 24 wks (0, 35, 70 and 150 mg Sr/kg body weight per day). Tibiae and vertebrae were harvested after sacrifice. Sr concentration in serum and bone increased linearly with dose and was deposited mainly in newly formed bone but also in old bone. Sr was found to exert a positive effect on bone at doses as low as 16% of the effective therapeutic Sr dose of the drug in rats (increased trabecular thickness, osteoid thickness, trabecular volume, bone formation rate and mineral apposition rate obtained from histomorphometric measurements, and increased modulus and hardness measured by nanoindentation test,  $p<0.05$ ). Our finding indicates that low Sr doses could serve as a cost-effective strategy for osteoporosis prevention during adulthood.

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## P-145

**Red meat consumption triggers serum non-transferrin bound iron (NTBI) formation in humans**

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Iron (Fe) can catalyse formation of hydroxyl radicals in the body. A mechanism that has been linked to various degenerative disorders. Transferrin acts not only as the main Fe transport protein in serum but also shields Fe from reaction. Using stable isotope techniques, we developed a novel assay for analysis of non-transferrin bound iron (NTBI) in serum. By preserving NTBI at the time of blood sampling and correction of Fe leakage from transferrin into serum during analysis, we achieved a higher accuracy as in previous assays. Serum NTBI has been reported so far in response to Fe supplement intake but not for regular meals. Here, we have measured the effect of a standardized meal high in bioavailable iron (beef stew and rice) on serum NTBI concentration in apparently healthy, male Chinese ( $24.4 \pm 4.0$  a;  $n=11$ ) after an overnight fast. Serum NTBI was  $0.03 \pm 0.15$   $\mu$ mol/L before meal intake and increased to an average of  $0.14 \pm 0.24$   $\mu$ mol/L two hours after test meal intake ( $p<0.05$ ). Possible risks associated with high meat consumption as a trigger of iron induced oxidative stress demand further investigations.

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## E-001

**Determination and forecasting of content of heavy metals in natural, industrial waste water, drinking water, milk and blood serum**

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Heavy metals have been assayed in multicomponent environmental and biological systems such as natural and drinking water, milk and blood serum samples. Bioaffinity method of the determination of heavy metals based on the amperometric DNA-based biosensor with immobilized single-stranded DNA (ssDNA) has been developed. The study of heavy metals adsorption on ssDNA modified NC-membranes was carried out. The method of determination of heavy metals based on biospecific preconcentration of metal ions on the biosensor followed by the destruction of DNA-metal complexes and voltammogram recording has been proposed. The study of seasonal and annual changes of color and turbidity of natural and industrial waste water was carried out. This became a basis for found correlation between those characteristics and copper, zinc, iron and manganese ions level in water and for the development of cost-effective and fast method for water ecological monitoring and forecasting of heavy metals level.

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## E-002

**The evaluation of mineral concentrations in amniotic fluid and maternal serum at birth**

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The aim of the study was to determine Cu, Zn, Mn and Se concentration in amniotic fluid (AF) and maternal serum (MS) during delivery. The study population consisted of 175 examined deliveries of healthy Caucasian women at 29.5 ± 4.6 years in 38–42 weeks of gestation. AF and MS were collected at the same time at birth. An inductively coupled plasma mass spectrometry (ICP-MS) was used to determine the mineral levels in materials. It was found that the mean concentration of minerals was significantly higher in MS than AF (Cu: 2.1 ± 0.4 vs 0.07 ± 0.02 µg/ml; Zn: 1.0 ± 0.3 vs 0.5 ± 0.3 µg/ml; Mn: 12.0 ± 7.4 vs 5.8 ± 2.8 µg/L; Se: 54.7 ± 14.3 vs 4.2 ± 2.7 µg/L). Cu level in MS significantly correlated with Cu in AF. Age of mother positively correlated with Cu concentration in AF and with Se level in AF and in MS. In conclusion, age of mother is associated with Cu and Se levels in AF and MS.

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## E-003

**Copper content in hair, bristle and feather in different species reared in Western Siberia**

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The purpose of this study was firstly to determine copper contents in hair and other derivatives of the skin in different species of farm animals bred in Western Siberia for food production and secondly to determine reference values of copper contents for subsequent long-term monitoring of the elemental composition. Analysis of copper content was performed by atomic absorption spectrometry. The copper concentration in the skin derivatives could be placed among the animal species in the following order: pigs = cattle > rabbits = sheep > poultry > fish (pike-perch) in the ratio 9.2:9.1:6.6:6.5:3.7:1.1 respectively. The reported reference ranges of the copper content for different species of farm animals could serve as useful tool for veterinary medicine and environmental monitoring populations to describe the physiological status and phenofund of various breeds. The research was supported by the Russian Science Foundation (project № 15-16-30003).

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## E-004

**Selenium yeast normalizes male rats from glutamate-induced Kiss/GPR54 abnormality in brain and testis**

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Kiss/GPR54 play significant roles in regulating reproductive activity. This study aimed to study the effects of Selenium Yeast (SY, Se 2000 ppm) on glutamate-induced Kiss/GPR54 abnormalities in male rats. A total of 15 rats (11 wk old) were arranged into 3 groups: control, GLU (+10 g/kg Glutamate) and GLU + Se (+GLU 10 g/kg + SY 0.3 g/kg) groups. After 3 wk, sperm, testis and brain samples were obtained for analyses. The results showed that compared with the control group, GLU treatment decreased sperm motility ( $P < 0.05$ ), and increased mRNA expression of Kiss1 and GPR54 in both brain and testis; while compared with the GLU group, Se increased sperm motility ( $P < 0.05$ ) and Kiss1 mRNA expression in both brain and testis ( $P < 0.05$ ). Western-blot results showed that GLU increased both expression of KiSS1 and GPR54 protein ( $P < 0.01$ ), while Se decreased both expression of KiSS1 and GPR54 protein ( $P < 0.05$ ). These results indicated that Se normalized the glutamate-induced abnormality of kisspeptin and GPR54 in the brain and testis which involved in controlling reproductive events in male rats.

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## E-005

**Tissue essential trace element levels in a streptozotocin model of diabetes**

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The objective was to assess the level of trace elements in different tissues in diabetic rats. Diabetes was induced by a single intraperitoneal injection of streptozotocin (45 or 55 mg/kg in physiological saline). Control animals were injected with pure NaCl 0.9%. Streptozotocin injection resulted in reduced weight gain, increased food and water consumption, elevated blood glucose and HbA1c levels at 28 day. In a general sample of diabetic animals, serum Co (–25%), Cu (–20%), Li (–32%), Mo (–33%), and V (4-fold) were significantly decreased, whereas Se levels were 17% higher. In contrast, hepatic Cu, Mn, Mo, and Se levels exceeded the control values by 55%, 76%, 56%, and 33%, respectively. Streptozotocin injection affected the level of certain trace elements in a dose dependent manner. Therefore, modulation of trace element status may be interrelated with diabetogenic effect of streptozotocin.

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## E-006

**Serum zinc concentration was affected by dynamic feeding schedule with low and high Ca diets in laying hens**

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This study was conducted to determine the effects of dynamic feeding low- and high-calcium (Ca) diets on zinc (Zn) concentration in serum and tibia of hens. A total of 180 Brown Hy-line laying hens (41 w old) were divided into 3 groups based on the egg production ( $n = 6$ ): control group received control diet (contained 3.4% Ca) at both 07:30 and 15:30, LH group received low Ca diet (contained 3.2% Ca) and high Ca diet (contained 3.6% Ca), while HL group received high Ca and low Ca diet at 07:30 and 15:30, for 10 w. Blood samples were collected 4 h intervals with initial starting at 07:30 before feeding. The results showed that serum Zn level valley's time point of HL group was the peak's time point of the control and LH groups during the day and night, and serum Zn of the HL group were higher at 19:30 than the control and LH groups ( $P < 0.05$ ). It is demonstrated that circadian variation of serum Zn was affected by dynamic feeding Ca in hens.

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## E-007

**The contents of selenium and zinc in the environment and food in Orenburg region**

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It was established that in the Orenburg region selenium content in the soil is 216–290  $\mu\text{g}/\text{kg}$ , and for zinc from 2.4 to 7 mg/kg. The average selenium content in underground waters of Russia is 1  $\mu\text{g}/\text{l}$ , and in underground waters of the Orenburg region in all of 2 mg/l. Minimal concentration of zinc founded in the groundwater of the Western and Central areas of Orenburg region and is 2–1.4 mg/l, respectively. Our research shows a relatively low micronutrient accumulation wheat: selenium 57–187  $\mu\text{g}/\text{kg}$ ; zinc 10–39 mg/kg. The selenium content in the meat of pigs is 345  $\mu\text{g}/\text{kg}$ , in beef is 176  $\mu\text{g}/\text{kg}$ , in chicken is 146  $\mu\text{g}/\text{kg}$ . The selenium content in milk and cottage cheese from the north regions almost in 20% ( $p < 0.05$ ) higher than that of products from the southern and central areas. Perhaps, it is bound to a bioregulation of animals' organism of as the similar situation is observed in hair of the examined population. Food has a decisive influence on the accumulation of selenium and zinc in the hair that is confirmed by significant interrelations. It confirms the idea that in hair accumulates selenium in organic form, typical for foodstuff.

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## E-008

**A trace element and hormonal markers using in clinical laboratory analytic for stress diagnosis at extreme professional workers**

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**Background:** The problem of endemic diseases that depends from trace element imbalance is an actual human issue. Multiple investigations have demonstrated the impact of trace elements on metabolic disturbances, especially in endocrine system.

**Materials:** We examined extreme professional workers that undergo psychological stress.

**Results:** A strong correlation between trace element changes in organism (increasing or decreasing from physiological limits) and hormonal secretion type (thyroid, sex, adrenal) has been revealed. The observed changes are more serious than in moderate professions. Therefore, trace element imbalance is a one-ranked pathognomonic marker for diagnostic of stress excluding the extreme professional groups. It can be recommended for clinical laboratory analysis to reveal premorbidity and permit previous measures against serious complications. It improves a life safety indexes.

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## E-009

**Synthesis, characterization and interaction with DNA of a copper complex with N-carbamylglutamate**

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The aim of this study is to synthesize a copper complex and in particular to gain interaction mechanism of this complex with DNA. The copper complex with N-carbamylglutamate was synthesized and fully characterized by IR, thermogravimetry and elemental analysis. In addition, the binding of the complex of calf-thymus (CT) DNA was monitored by UV-vis spectroscopy and DNA-viscosity measurements and indirectly by competitive studies with ethidium bromide (EB). The DNA band centered at  $\lambda_{\max} = 258$  nm exhibits a light hypochromism, the addition of the complex in the EB-DNA solution resulted in a significant quenching of the DNA-EB emission, and the DNA-viscosity exhibited a decrease in the presence of increasing amounts of the complex. The experimental results showed that partial intercalation was the most possible interaction mode of this complex with CT DNA.

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## E-010

**The supply of nutritional iodine and iodine content of hair from respondents in Kazakhstan**

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Iodine deficiency is a typical nutritional disease. Normally, about 95% of iodine is provided by food. Data analysis of the nutrition study done by 24-h dietary recall showed that iodine intake in 1961 individuals older than 40 years was deficient – only 41.6–44.3  $\mu\text{g}$  per day when the need is 150  $\mu\text{g}$  per day. At the same time the iodine content of hair from the respondents was examined using mass spectrometry (Center for Biotic Medicine, Moscow). The average iodine content of hair in Kazakhstan was  $5.87 \pm 0.50$   $\mu\text{g/g}$  and  $4.64 \pm 1.33$   $\mu\text{g/g}$  in women and men respectively (reference values of 0.3–10.0  $\mu\text{g/g}$ ). The highest average hair iodine levels were found in South Kazakhstan oblast ( $10.9 \pm 3.4$   $\mu\text{g/g}$ ), and the lowest – in North Kazakhstan oblast ( $2.7 \pm 0.4$   $\mu\text{g/g}$ ). These results show the inverse relationship between the hair iodine level and the high prevalence of iodine deficiency diseases in South Kazakhstan.

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## E-011

**Lead and cadmium contents in the raw materials of *Asparagus racemosus***

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*Asparagus racemosus* (roots) are included in the Ayurvedic Pharmacopoeia of India. They contain steroidal saponins, which have beneficial effects on the female reproductive system. In addition to the basic quality control parameters of phytomedicine, there is a need for the safety evaluation. The aim of this study is to determine the contents of lead and cadmium in raw materials of *A. racemosus*. The objects of the study were: *A. racemosus* root's powders and dried roots from India (Hyderabad, Varanasi, Mumbai) and roots grown in the Kaluga Region of Russia. The heavy metals determination in the objects was carried out by atomic absorption spectrometry with electrothermal atomization according to the Russian State Pharmacopoeia (RSP) XIII. Lead content in the objects was 0.147–0.454 mg/kg, cadmium – 0.008–0.059 mg/kg. The lead concentration in the roots grown in the Kaluga Region was lower (0.147 mg/kg) than in India (0.163–0.454 mg/kg). Cadmium content didn't differ considerably. Concentrations of the metals in all samples didn't exceed the standards regulated by RSP.

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## E-012

**Calcium homeostasis dysregulation and endoplasmic reticulum stress mediated-apoptosis in chicken myoblasts induced by Selenoprotein K silencing**

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There is an increasing evidence that selenoproteins, which located in endoplasmic reticulum (ER) play a central role in the control of calcium and ER homeostasis. However, the precise contribution of Selenoprotein K (Selk) in the control of these homeostasis in chicken myoblasts is still elusive. In this study, the specific small interfering RNA (siRNA) for Selk gene was designed and transfected into chicken myoblasts. Afterwards, the expression levels of related genes involving in calcium channels, ER stress and apoptosis were examined at various time periods 24 and 72 h after transfection. The results showed that the mRNA and protein expressions of SERCA, PMCA, GRP78, GRP94, PERK, CHOP, XBP1, Bax and caspase12 were significantly increased ( $p < 0.05$ ), but that of Bcl-2 was significantly decreased ( $p < 0.05$ ) at 24 h and 72 h. These results indicated that the Selk silencing induced calcium homeostasis dysregulation and ER stress to promote apoptosis in chicken myoblasts.

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E-013

**Methodological substantiation of primary atherosclerosis prevention technology**

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Impact of risk factors for atherosclerosis depends on their combination with other factors, including environmental-biogeochemical ones. Scientific search methods for primary atherosclerosis prevention have been based on the principle of ecological and biogeochemical zoning of the Chuvash Republic territory. With ecological and biogeochemical positions atherosclerosis is considered as one of the symptoms of the human disadaptation to conditions of the increased silicon intake, combined with a high content of fluorine, calcium, manganese, nitrates, sulfates, chlorides, and low magnesium content in the biogeochemical food chain. In the future, violations of elastase-inhibitor, sodium-potassium-chloride and trace elements' balance by lowering the intestinal ATP-ase activity are possible. Magnesium deficiency contributes to the progression of vascular sclerotic lesions. Control over the optimal level of macro- and trace elements in water and food rations is necessary.

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E-014

**Dietary selenium attenuate NF-κB pathway activation induced by lead exposure via increasing selenoproteins expression in neutrophils of chicken**

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The aim of this study was to evaluate interaction mechanism of selenium (Se) and lead (Pb) in neutrophils of chicken. In this study, we established Se and Pb interaction chicken models, determined expressions levels of selenoproteins and inflammatory-related genes in Se and/or Pb treatment. The results showed that Pb treatment increased expression of selenoproteins and inflammatory-related genes. Co-treatment of Se significantly further increases selenoprotein gene expression and alleviated inflammatory-related genes expression. In summary, we speculated that Pb exposure trigger activation of NF-κB pathway, and dietary Se supplement could attenuate activation of NF-κB pathway induced by Pb exposure via increasing selenoproteins gene expression in neutrophils of chicken.

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E-015

**Use of chromium for treatment of metabolic syndrome**

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**Object:** To study the effect of chromium on patients with metabolic syndrome (MS).

**Materials and methods:** We examined 48 patients with MS (for the IDF criteria, adapted accordingly to ATP-III). We also measured the level of insulin, leptin, glucose, chromium in the blood. Patients were divided into two groups: 1 group – consumed Metformin on the background of correction of nutrition and physical activity increasing, 2 group – consumed also chromium beside everything mentioned above. Chromium Picolinate was prescribed to patients 200 µg with meals during 1 month.

**Results:** The therapy showed positive dynamic, patients' health, clinical and biochemical indicators were approved. 2 group patients noted that their appetences for sweets were lost and the desires of constant eating were reduced. The level of leptin decreased in 33.3% of patients in the group 2 and in 12.5% of patients in the group 1. The use of Chromium Picolinate and Metformin gave the opportunity to take off insulin resistance in 37.5% of patients.

**Conclusions:** The prescription of Chromium Picolinate preparations is recommended for patients with metabolic syndrome.

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E-016

**The impact of the imbalance of certain trace elements in the carbohydrate metabolism**

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**Objective:** To study the effect of some trace elements in the carbohydrate metabolism.

**Materials and methods:** 70 people are tested. 2 groups: experimental and control. The diet – identical. The difference between the two groups: accommodation in contrasting ecological and biogeochemical zones (distress, optimum). Experiment duration – 4 months. In blood serum, we evaluated: the levels of trace elements (Cu, Si, Se, Mn, Ca, Cr, Y, F), leptin, fasting glucose; body mass index.

**Results of the study:** Found: serum investigated experimental group differed from the control: (1) Si level is 1.5-fold higher, Cr level is 3.5-fold lower; (2) the fasting glucose is above 15%; (3) the leptin level increased by a factor of 2. The body mass index of the disaster area persons increased by 10% with respect to the parameters of the optimum zone persons.

**Conclusion:** Rising level Si and decrease level Cr in the blood serum are connected with the development of disorders of carbohydrate metabolism in the form of increased fasting glucose, rising leptin level and increase of body mass index. The dependence was proved.

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## E-017

**Density affects serum and liver trace mineral elements deposition of fattening pigs**

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Trace minerals are important for a balanced nutrition to keep pigs going. To study the effects of density on serum and liver trace mineral elements deposition of fattening pigs, a total of 288 conventional pigs (Duroc × Landrace × Large) were grouped into 3 different densities randomly: low-, mid- and high-density (8, 16 and 24 pigs/pen, with the pen (5.2 m × 3.8 m),  $n=6$ ). On d 30, 1 pig per pen was selected, blood and liver samples were obtained for mineral determination. The results showed that compared with the low-density group, both the mid- and high-density decreased serum Ca, Fe and Zn ( $P<0.05$ ), and liver Ca also tended to decreased in the high-density group; interestingly, compared with the low-density group, high-density increased liver Fe content ( $P<0.05$ ), and both the mid- and high-density increased liver Fe and Mn content ( $P<0.05$ ) of pigs during the fattening period. These results indicated that density affected the trace mineral elements deposition under the studied conditions of pig fattening.

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## E-018

**Elemental status of sledge hockey players**

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The objective is to study specific characteristics of the elemental status of sledge hockey players.

**Material and method:** The subjects of research were male athletes ( $n=15$ ) with different levels of lower limb amputation. Hair chemical composition and blood serum were measured by ICP-AES and ICP-MS.

**Results:** Hair test revealed the reduced concentrations of Ca, Co, Cr and Se compared to the recommended levels (Skalny A.V., 2003). 30% of the athletes had a deficiency in I and Fe. At the same time the excessive concentration of Na, K, P and Zn was detected. The blood serum of athletes had a high content of K, Ca, Fe and total deficiency of Se.

**Conclusions:** Our results correlate to the earlier data about the influence of intensive physical activity on the electrolyte (Wang, 2012) and several essential micronutrients metabolism. Low hair and serum selenium levels are typical for Orenburg region residents regardless of their activity and physical condition. Hair chemical composition change is an early diagnostic sign of the diselementosis and requires the correction of disability athletes' nutrition. Supported by the RHSF and the Government of the Orenburg region within the scientific project No. 17-16-56-005.

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## E-019

**The biogenous macroelements and trace elements in the time of formation of malignant neoplasm in women of an industrial region**

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**Objectives:** To estimate of the biogenous elements in the time of formation of malignant neoplasm in patients.

**Methods:** Research was based on the inspection of somatic healthy women ( $n=18$ ), of women with benign breast tumor classified as mammary gland fibroadenoma ( $n=19$ ) and women with breast cancer ( $n=20$ ).

**Results:** It was found that women had the hypoglycemia and lower contents of total protein and albumin during disease of fibroadenoma and breast cancer. The content of the essential elements in women with breast cancer cases compared to the control was lower: Ca – 70%, Cu – 73% ( $p=0.005$ ). Concentration of Fe has increased by 6.4 times, Zn by 2.2 times ( $p=0.003$ ). The Cd and the Pb levels in the blood increased by 2 times, the Sr level increased by 3 times ( $p<0.05$ ) compared to the somatically healthy women.

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## E-020

**Iodine content in hair: Sign of human individualization**

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Hair iodine contents data as well as that of in urine are used just only for epidemiological investigations because of individual variability of iodine concentration. This variation may be an advantage for personality identification in forensic medicine. The aim: to define hair and urine availability of iodine status determining. Populations of coastal (50 subjects) and continental (100 subjects) territories in Europe and North Asia were investigated. The iodine-deficiency indexes were analyzed by determining of iodine in urine and hair (ICP-MS). As result iodine hair concentrations proved to correlate well with mean concentrations on each territory. In continental territories the concentrations are 0.15–2.43  $\mu\text{g/g}$  ( $\text{CV}=122\%$ ), but in coastal territories those are 0.15–7.67  $\mu\text{g/g}$  ( $\text{CV}=232\%$ ). Thus, iodine status of a human reflects his place of living. In addition, high variability of microelements in hair considered to be useful for personality identification.

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## E-021

**Mineral composition of *Eisenia fetida* tissues in presence of MoO<sub>3</sub> nanoparticles**S.V. Lebedev<sup>1,2</sup>, I.A. Gavrish<sup>1,\*</sup><sup>1</sup> Orenburg State University, Orenburg, Russia<sup>2</sup> All-Russian Research Institute of Beef Cattle Breeding, Orenburg, RussiaE-mail address: [gavrish.irina.ogu@gmail.com](mailto:gavrish.irina.ogu@gmail.com) (I.A. Gavrish).

Use of nanoparticles (NPs) requires an overall assessment of their toxicity in living systems. We investigated accumulation of MoO<sub>3</sub> NPs at a dose of 10, 40, 500 mg/kg of dry soil in tissues of *E. fetida*. We used two substrates: MCC (A) and artificial soil (B). Degree of Mo accumulation in worm tissues depended on the dose and substrate. Increasing MoO<sub>3</sub> concentrations, 2–7 mg/kg of Mo were accumulated in substrate A, Mo content in substrate B was up to 15 mg/kg. When we decreased Mo concentration at doses of 40 mg/kg and 500 mg/kg on day 14, Mo concentration in substrate A and B decreased by 64.8% and 57.4%, respectively. Using the results, we can assume that high degree of Mo accumulation in tissues (substrate A) is associated with passive process, due to available Mo concentrations in substrate but not active processes of worms. Assessing total mineral composition, the deficiency of many elements was observed. Co, Cu, P, Zn were the most stable elements under the influence of the studied factors. Research was done with financial support of RSF #14-36-00023.

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## E-022

**Specific features of the nutrition status and gestation course in overweight women**

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The problem of rational nutrition of a pregnant woman remains the subject of focus of obstetricians–gynecologists and neonatologists.

**Materials and methods:** There were examined 200 pregnant women with overweight and eutrophia on 2–3rd trimester of pregnancy. BMI was assessed using Luft classification (2002): study group – 52 pregnant women with BMI >25; control group – 148 pregnant women with BMI of 19–25. 34% pregnant women were subject to in-depth study of the actual food ration by means of “Aspon-nutrition” computer program.

**Findings:** The most significant deficiency was observed on the following positions, depending on the pregnant women nutritional status with: eutrophia were diagnosed apparent egg-white injury syndrome (66.7%), deficiency of iron (37.5%), K (31.3%), Ca (12.5%), Mg (18.8%), iodine (64.6%), linolenic acid (33.3%); hypernutrition were diagnosed apparent egg-white injury syndrome (90%), deficiency of iron (20%), Ca (30%), Mg (20%), iodine (70%), linolenic acid (40%).

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## E-023

**The biosynthesis and application of nano-selenium**Xu-Gang Shu<sup>1,\*</sup>, Feng-Zhan<sup>2</sup>, Guo-jie Wu<sup>1</sup>, Meng Zhou<sup>1</sup>, Xin-Hua Zhou<sup>1</sup>, Guixiong Qiu<sup>3</sup><sup>1</sup> College of Chemistry and Chemical Engineering, Zhongkai University of Agriculture and Engineering, Guangzhou, China<sup>2</sup> Light Industry Institute of Chemical Industry, Guangdong University of Technology, Guangzhou, China<sup>3</sup> Guangzhou Tanke Biological Technology Co., Ltd, Guangzhou, ChinaE-mail address: [xgshu@21cn.com](mailto:xgshu@21cn.com) (X.-G. Shu).

The nanoselenium biosynthesis by yeast mud’s fermentation. The results show that at least 70% sodium selenite can be biological to nanoselenium exist in yeast cells just in 3 h. Under the optimum conditions, the highest selenium content could reach to 11470 ppm and it has a close relationship to GSH which drops rapidly from 2252.9 μM to 123.6 μM in 3 h and then flattens out in yeast cells. Through application in mouse. At the same level, nanoselenium has a better effect with sodium selenite on increasing serum glutathione peroxidase activities and selenium content ( $P < 0.05$ ). Compare to blank group, nanoselenium, yeast selenium, sodium selenite can significantly increase the activity of glutathione peroxidase and nanoselenium has the highest increase ( $P < 0.01$ ), up to 49.6%. This method of biosynthesis has a feature which is short time, high activity.

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## E-024

**Elemental status of suckling calves in the selenium-deficient region**A.V. Nikulina<sup>1,\*</sup>, A.A. Shukanov<sup>2</sup><sup>1</sup> Chuvash State Agricultural Academy, Cheboksary, Russia<sup>2</sup> Branch of the Saint-Petersburg State Economic University, Cheboksary, RussiaE-mail address: [panianna@list.ru](mailto:panianna@list.ru) (A.V. Nikulina).

The main goal of this work is to study the characteristics of the element status of young cattle in the Chuvash Republic. Material of the study is hair samples from clinically healthy calves of black-motley breed grown up in the selenium-deficient biogeochemical province. Hair samples (25 items) were performed in the accredited test laboratory ANO “Center for biotic medicine”, Russia by methods of mass-spectrometry with inductively coupled argon plasma using Nexion 300D (USA). Statistical processing of the obtained results was carried out by nonparametric methods in the program Statistica 6.0. Comparing with quartile ranges obtained by Miroshnikov S.A. and coauthors (2016) for *Bos Taurus* we revealed higher concentration (mg/g) of macroelements Ca (1766.75–3914.25), K (4559.25–7021.75), Na (4051.5–5376.0), P (276–388); essential trace elements Se (0.4425–0.5255), Si (49.088–65.925) in the studied region. The low levels in hair of toxic trace elements Cd and Pb was also noted. The obtained results are coordinated with the results of similar studies in neighbouring regions.

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## E-025

**Examination of the content of heavy metals in children of Bashkir Trans-Urals**

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The objectives of the study included research the biogeochemical characteristics of the background and the changes of trace-element composition of the environment in the vicinity of the abandoned quarries in the territory of Bashkir Trans-Urals; determining the degree of correlation between the content of heavy metals in the soil and the hair of children living in this area. Evaluation of metals in soils was carried out in accordance with standard techniques. Analytical work to determine the levels of heavy metals in hair was carried out by the methods of atomic emission and mass spectrometry with inductively coupled argon plasma (ICP-AES, ICP-MS). The local biogeochemical background differs from the mean global values in the higher concentrations of Cu, Zn, Fe. The content of toxic element Cd in the hair has a high degree of correlation with its concentration in the soil. The results of this study can be used in the planning of activities to address the imbalance of trace elements in the human body in order to prevent eco-dependent diseases of the population of the territories abandoned quarries.

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## E-026

**Modern approaches to the study of functional iron deficiency in pathologic conditions**

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The purpose of the work was to study the development of anemia syndrome in patients with chronic inflammatory diseases of pelvic organs. The complex analysis of clinical and laboratory parameters was performed in 102 women of reproductive age with chronic inflammatory diseases of pelvic organs, complicated by anemia; parameters of serum iron, ferritin and hepcidin were assessed. The analysis of the results showed that in 92.2% of patients the moderate normochromic and normocytic anemia was detected, the levels of serum iron were within the limits of physiological fluctuations which are typical for healthy women. In the same time there was a considerable increase in levels of ferritin, limiting iron usage by erythroid cells, and of hepcidin, providing a blocking action on iron transport in different compartments of organism. The collected data demonstrate the potential development of functional iron deficiency in patients with chronic inflammatory diseases of pelvic organs that proves a need to design the new approaches to the therapy of the pathology, considering the detected problems.

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## E-027

**Cd-, Pb-, As-determination in medicinal raw plant materials with means of ETAAS**

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Quality of medicinal vegetable raw materials is defined by many factors, in particular, the content of such toxic metals as lead, cadmium, arsenic must be considered. One of the methods is the atomic absorption spectrometry with electrothermal atomization (ETAAS). In the present work, the raw materials most often used in Russia are analysed and the content of lead, cadmium, arsenic in the medicinal vegetable raw materials is determined. Samples are decomposed by concentrated nitric acid and concentrated hydrogen peroxide solution. For decomposition MW-oven is used. The analytes determination in the obtained solutions is carried out by ETAAS. The highest contents of cadmium (23.6 ng/g) and an arsenic (8.14 µg/g) are found in the *Laminaria thallus*. In common balm and marjoram herbs, Senna leaves, oak bark, garden burnet roots and rhizomes lead is found in the quantities 262, 125, 170, 129, 140 ng/g correspondingly. The greatest quantity of cadmium and arsenic can be explained by the fact that the water organism expanding, as a rule, in coastal ocean water, apparently, is an efficient natural geochemical barrier.

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## E-028

**Geochemical risk factors of magnesium deficiency**

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**Purpose:** The definition of Mg status in children in natural and anthropogenic zones of the Lake Baikal.

**Results:** The hair of children (3–7 years of age) from the Island of Olkhon (Lake Baikal) was found to contain  $41.4 \pm 4.69$  ppm of Mg; 30% of the children had Mg deficiency. At the same time, Mg content in the hair of children (3–7 years of age) from the geochemically contrasting settlement of Kachuk, with elevated amounts of Ca, Mg, and Cu in both soil and water, was  $72.7 \pm 4.98$  ppm. Mg deficiency was not found in these children. In the industrially impacted conditions of the urban environment in the vicinity of the Shelekhov aluminum smelter, Al, Be, Cd, F, Pb, Si concentrations in higher plants are at abnormal levels. The Mg content in children's hair is  $8.6 \pm 1.6$  ppm, and 68% of the children had profound Mg deficiency, with an average deviation of 5.7 times. Analysis of Mg in diets showed that children of Olkhon receive 215 mg of Mg per day, in Kachug – 260 mg, and in Shelekhov – 350 mg, with an established rate of 300 mg for children under 3–7 years old.

**Conclusion:** The development of Mg deficiency is influenced by geochemical factors.

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## E-029

**The absorption and utilization of iron II complex with N-carbamyl glycinate**

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The absorption and utilization of the third generation of iron supplementation is higher. In order to demonstrate the effect of iron supplementation with iron II complex with N-carbamyl glycinate, the comparison test with ferric glycine. The content and color of mouse feces in iron II complex with N-carbamyl glycinate group was the lowest (0.178 mg/g, yellow). The iron content of the tissues of mice treated with iron II complex with N-carbamyl glycinate was higher than that of ferric glycine complex (increased by 15.8%,  $P < 0.01$ ). The content of iron in blood and serum was higher than that of ferric glycine group. The increased content of ceruloplasmin favored iron transport and absorption. The results showed that the absorption and utilization of iron II complex with N-carbamyl glycinate was the highest.

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## E-030

**Iron-deficiency anemia of pregnant adolescents**

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**Urgency of the issue:** It is required to pay great attention to pregnancy among young women.

**Materials and methods:** Differences in somatic status of pregnant adolescents (680), pregnant women of older reproductive age (250) were analyzed.

**Results:** Anemia of pregnant adolescents was identified in 2 times more often than in the comparison group,  $p < 0.05$ . The comparison of given values with hemoglobin level in the older age group revealed the statistically significant differences,  $p < 0.05$ . Anemia was diagnosed among 317 young women, which was 46.6%, in the group of women of older reproductive age, this pathology was found in 23.2% of cases.

**Conclusions:** The most frequent disease accompanying pregnancy of young women is iron-deficiency anemia significantly exceeding the similar indicator among women of the control group. Iron-deficiency anemia necessitates additional administration of iron supplements throughout pregnancy along with vitamin C, B<sub>9</sub>, B<sub>12</sub>.

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## E-031

**The influence of trace element status on functional status of the children**

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**Aim:** To define the influence of trace element status of children on the functional indicators.

**Methods:** The analysis of hair from 93 children from Republic Sakha was made with the use of AES, ICP-MS and microwave decomposition system. The indicators of muscle power were also analyzed.

**Results:** The statistically significant differences ( $p < 0.05$ ) of the average calcium content were received in children with high muscle power group (HMP) ( $261.28 \pm 20.4$  mg/kg) and average muscle power group (AMP) ( $209.84 \pm 13.5$  mg/kg). Correlation relationships were related with muscle power and calcium content ( $R = 0.42$ ;  $p < 0.05$ ). Children with HMP had higher magnesium content. The level of zinc in group with HMP was normal ( $129.8 \pm 13.8$  mg/kg), but in the average and the low groups the level of zinc was lower ( $90.1 \pm 7.6$ ;  $96.8 \pm 8.9$  mg/kg).

**Conclusions:** Nutrient deficiency can be the reason of the reduced muscle power. The recovery of microelement status of children can improve the functional reserves restoration of reduced functional parameters.

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## E-032

**Molecular and membrane effects of aluminum ions influence on blood cells**

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**The aim of the work:** To identify mechanisms of aluminum ions toxic influence on structures of membrane and cell components in erythrocytes and lymphocytes of human blood. It was shown that human erythrocytes and lymphocytes could accumulate aluminum ions in dose-dependent way. Increasing of intracellular aluminum concentration in erythrocytes and lymphocytes leads to substantial aggravating reactive oxygen species generation and stimulates lipid peroxidation. Simultaneous with it activity of antioxidant enzyme decreased which reduce protective cells possibilities. Aggravating of oxidative process in blood cells leads to changes in structural state of erythrocytes and lymphocytes membrane lipid bilayer. Using atomic-force microscopy it was established that erythrocytes preloaded with 27 mg/l of AlCl<sub>3</sub> undergo smoothing of external erythrocytes surface without changing their shape. Aluminum chloride influence on lymphocytes produces moderate DNA disruption. Obtained results are a background for developing cells test-system for evaluation aluminum toxic influence on human organism.

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## E-033

**Bioregulatory and sanogenic effects of dinitrosyl iron complexes with glutathione ligands at experimental thermal trauma**A.K. Martusevich<sup>1,2,\*</sup>, A.G. Soloveva<sup>1</sup>,  
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The aim of this study is estimation of action of glutathione-containing dinitrosyl iron complexes (DNIC) on rat's blood metabolism at experimental thermal trauma. We studied 30 Wistar rats, divided into intact ( $n=10$ ), control ( $n=10$ ) and main ( $n=10$ ) group. We modeled combined trauma (skin burn + thermoinhalation damage) in animals of control and main groups. Rats of control group got infusions of sodium chloride solution ( $n=10$ ) every day. Rats of main group got infusions of DNIC solution in sodium chloride. It was shown that DNIC administration leads to oxidative stress correction. This effect included inhibition of lipid peroxidation with elevation of antioxidant potential of blood plasma and erythrocytes. It was also stated that DNIC normalizes erythrocytes energy metabolism from the third day after trauma. In addition, DNIC infusions caused marked stimulation of catalytic activity of aldehyde dehydrogenase.

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## E-034

**Proadaptive effect of glutathione-containing dinitrosyl iron complexes**A.K. Martusevich<sup>1,2,\*</sup>, A.V. Razumovsky<sup>3</sup><sup>1</sup> Privolzhsky Federal Medical Research Center,  
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The aim of this study is a complex analysis of physiological activity of glutathione-containing dinitrosyl iron complexes (DNIC) in healthy rats. Our experiment was carried out on 60 healthy Wistar rats, divided into 6 equal groups. First group was intact (without any manipulations), and rats of second group got 10 intraperitoneal infusion of saline (1 ml) every day. Animals of other groups got infusions of saline with DNIC (dose – 0.15; 0.30; 0.45 and 0.60 mM respectively). It was stated that course of DNIC infusions causes non-linear dose-dependent metabolic and hemodynamics response. Metabolic changes included stimulation of total antioxidant and crystallogenic activity of blood plasma, intensification of energy metabolism in erythrocytes and activation of aldehyde dehydrogenase. Hemodynamic response on DNIC realized in stimulation of microcirculation with prevalent activation of endothelial component of its regulation. These trends were most pronounced with the administration of 0.3 and 0.45 mM of DNIC.

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## E-035

**Effects of selenium and cadmium on alterations of mineral elements in chicken brain and kidney**Jianhong Li<sup>1,\*</sup>, Runxiang Zhang<sup>2</sup><sup>1</sup> College of Life Science, Northeast Agricultural  
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The aim of the study was to investigate the ameliorative effects of selenium (Se) against cadmium (Cd) induced toxicity in chicken. Based on the model of chicken fed a diet supplemented with Se, Cd or Se + Cd in combination for 90 days, the concentrations of 28 elements were detected using ICP-MS. Cd exposure caused ion profile disorders, including increased concentrations of Cd, Li, Sn and Sb, and decreased K in brain, meanwhile, increased concentrations of Cd, Si, Cu, Li and Sb and reduced V, Cr, Mn, Mo, As, Ba, Hg, Ti, and Pb in kidney. Moreover, Se increased the concentrations of Cr, Mn, Zn, and Se, and decreased those of Li and Pb, which in contrast were induced by Cd in kidney. The content of Se in brain was not altered by Se supplementation. Complex interactions between elements showed that both positive and negative correlations presented. The present study indicated that Se can help against the negative effects of Cd and may be related to the homeostasis of the trace elements in chicken kidney and brain.

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## E-036

**Cumulation of trace and macroelements of alimentary canal of the inhabitants of Astrakhan region**

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The object of the research was the investigation of the levels of content of some elements in the tissue of stomach, small intestine and large intestine of the inhabitants of Astrakhan region. The samples were of the research was the fragments of the tissue of stomach ( $n=25$ ), small intestine ( $n=25$ ) and large intestine ( $n=25$ ). The study of peculiarities of cumulative distribution of the elements was conducted by means of the method of atomic absorbing spectrography. The results were expressed in mg/kg of dry matter. As a result of the research it was found out that the similar variations of cumulation of these elements were obtained in the tissues of stomach, small intestine and large intestine that were identical in morphological structure. The tissue of stomach cumulates more elements than the small and large intestines' tissue does. The differences of cumulation depending on sex were discovered. The average concentration of the elements in the stomach tissues and intestines tissues of male's organism was rather higher (1.3 times) than of female's organism.

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E-037

**The association of calcium and cAMP levels in seminal plasma with semen quality in idiopathic infertility**

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The purpose of this study was to assess the relationship of calcium and cAMP levels in seminal plasma with the quality of the ejaculate in cases of idiopathic infertility. 39 infertile and 25 fertile men aged 23–35 years were examined. Analysis of ejaculate was performed according to WHO protocol (2010). The calcium content in the seminal plasma was determined by atomic absorption spectroscopy, cAMP levels – by ELISA. In the seminal plasma of infertile men the significant reduction in calcium and cAMP, which are triggers of phosphorylation reactions of gamete flagellar proteins, is revealed. cAMP level was significantly correlated with the proportion of progressively motile spermatozoa ( $p < 0.01$ ), but not with the number of pathological forms. Also, a positive correlation between the concentration of cAMP and Ca ( $p < 0.005$ ) was found in all samples of sperm. Thus, the pronounced changes in the concentration of second messengers in the seminal fluid, which can act as a prerequisite for the development of infertility of unknown etiology, are identified.

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E-038

**The contents of trace elements in lung tissue in fetuses with developmental abnormality**

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The research of the concentration of trace elements has been carried out in the lung tissues of the dead fetuses with the developmental anomaly of lung and tissue dysplasia ( $n = 24$ ) and without developmental abnormalities ( $n = 9$ ) using atomic absorption analysis. Ni has been detected in 2 cases of lung tissue research (8.3%), and Co was detected in the lungs of 16 fetuses (66.7%) of the main group, while they were absent in the control group. Cu has been detected in all cases 100%, there has been no differences with the control group. It has been revealed that 22 fetuses have got the concentration of Mn in lung tissue (91.7%) with the developmental anomaly have 7.7-fold higher lung Mg content than in the control group ( $p < 0.001$ ). Pb has been detected in 9 cases (37.5%), and there has been 1 case (11.1%) in the control group. Cd has been detected in lung tissue of 1 fetus with the developmental anomaly (4.2%). Thus, heavy metals and higher content of Co and Mn have been detected in the examined lung samples of fetuses with the developmental anomaly of lung than in the control group.

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E-039

**Evaluation of elements' accumulation in the North indigenous ethnic groups' hair**

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The object of the research is the Magadan inhabitants belonging to various ethnic groups (the Evens, the Koryaks, and the Chukchi). The rank correlations analysis has shown that there are statistically reliable distinctions in some elements' content among the Koryaks, the Evens, and the Chukchi. Thus, in the Evens' hair the accumulation of K, Na, I, Cr, Cd, Pb is greater if to compare with the Chukchi and the Koryaks. The content of Si, Sn, and Al is larger in the Chukchi's hair than in the Evens' and the Koryaks' hair. However, the variations in the Ca, Mg, Mn, Co, Fe, P, Se, Zn, Li, As, Hg content have not been discovered in the groups examined. Low accumulation of toxic elements (Cd, Pb, Al) for the Koryaks, the Evens, the Chukchi has been noted as opposed to the reference values. High linear correlation coefficients of absolute values have been discovered for the following couples of elements: for the Evens – Cr-V (0.72), Na-K (0.92), for the Koryaks – K-Na (0.76), for the Chukchi – Cr-V (0.74), Na-K (0.80), K-Pb (0.76), V-I (0.71). Thus, the examined element status of indigenous ethnic groups has certain genetic features and reflects geochemical environment.

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E-040

**Role of autophagy and apoptosis in damaged cardiomyocytes caused by thioredoxin (Txn) knock down in chicken**

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Thioredoxin (Txn) acts as an antioxidant in cells, but the exact mechanism about how its functions exerted in damaged cardiomyocytes in chicken remains unclear.

**Methods:** We use gene knockdown technology make a model of Txn knock down. Cells were divided into C (control) and KD (knock down), the activities of reactive oxygen species (ROS), electron microscope, autophagy- apoptosis- and insulin-related genes were detected.

**Results:** In KD group, activities of ROS increased ( $P < 0.05$ ), typical autophagy features were observed, the mRNA levels of Bcl-2, Caspase6-9 Beclin-1, LC3-1 2, Dynein, ATG3 5 6 9, P-Akt, FOX, JNK increased, Bax Caspase3 Fas, mTOR, PI3K, Akt, P-FOX, IGF1-2, IGFBP2-4, GLUT1 3 8 were decreased ( $P < 0.05$ ). WB results showed that the expression of Caspase3, mTOR, PI3K, Akt, P-FOX, GLUT, IGFBP2 decreased, Bcl-2, Beclin-1, P-Akt, FOX, JNK IGF, IGFBP3 4 increased ( $P < 0.05$ ).

**Conclusions:** Txn knock down can cause myocardial injury by increasing the autophagy through classical pathway of PI3K-Akt-mTOR and inhibiting the apoptosis use Fas-Caspase3 and IGFBP3-IGF pathway.

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## E-041

**Effects of Selenium Yeast in the setting of glutamate-induced Kiss/GPR54 normalizes in ovary of pregnant rats**

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Kiss/GPR54 play significant roles in regulating reproductive activity. Dietary selenium alters specific aspects of maternal endocrine status during pregnancy. This study aimed to study the effects of Selenium Yeast (SY, Se 2000 ppm) in the setting of glutamate-induced Kiss/GPR54 normalizes in pregnant rats. A total of 21 rats (11 wk) were arranged into 3 groups: control, GLU (+10 g/kg glutamate) and GLU+Se (+10 g/kg GLU+0.3 g/kg SY) groups on 13 d of pregnancy. On 21 d of postpartum, ovary sample was obtained for qRT-PCR and western blot analyses. The results showed that compared with the control group, GLU treatment decreased Kiss1 and increased GPR54 mRNA in ovary ( $P < 0.05$ ); while compared with the GLU group, Se increased Kiss1 and decreased GPR54 mRNA ( $P < 0.05$ ). Interestingly, Western-blot results also showed that GLU decreased both KISS1 and GPR54 protein ( $P < 0.05$ ), while Se increased both KISS1 and GPR54 protein ( $P < 0.05$ ). In conclusion, the results indicated that SY normalized the decreasing both Kiss1 and GPR54 in the ovary inducing by dietary glutamate in pregnant rats.

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## E-042

**Urinary iodine concentrations in children in the Irkutsk region**

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Determining of urinary iodine excretion is one of the most informative methods for diagnosis of the iodine-deficiency states. Iodine is in small quantity in the soil, superficial water reservoirs and local food in the Irkutsk region, therefore water and food do not provide the iodine necessity in children of the region. The purpose of the study – assessment of iodine status among children in the Irkutsk region. 1359 children (age 4–17) were involved in this study. Criteria for evaluation of iodine deficiency are recommended by WHO: severe iodine deficiency is diagnosed in case urinary iodine excretion is below 20  $\mu\text{g/L}$ , moderate – 20–49  $\mu\text{g/L}$ , easy – 50–100  $\mu\text{g/L}$ , physiological standard –  $>100 \mu\text{g/L}$ . Average urinary iodine concentration in children was from 0.23 to 0.46  $\mu\text{g/L}$  indicates that moderate iodine deficiency. It is noted, urinary iodine content among the city children is higher than in the village children (38 vs. 28  $\mu\text{g/L}$ ,  $p < 0.01$ ). The study suggests that the iodine deficiency risk among the children is maintained in the Irkutsk region, especially in its rural areas.

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## E-043

**Iodine-induced diseases in birds**

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**Objective:** The aim of the study was to establish correlation between iodine supplementation and endocrine status in head-reared birds.

**Method:** The objects of the study were 24 hand-reared budgerigars, divided into 3 groups: adequate iodine-fed group, excess iodine-fed group and iodine-free group. The methods included full clinical examination, especially endocrine organs, growth characteristics.

**Results:** The obtained results showed that iodine supplementation influences on functioning of thyroid gland. Iodine deficiency resulted in goiter with subsequent death of 3 birds because of aspiration of vomitus, other birds presented clinical signs as lethargy, wheezing respiration, depressed growth rate. Excess iodine diet also resulted in goiter, all birds alive with growth retardation. Adequate iodine feeding resulted in normal endocrine homeostasis and good growth characteristics.

**Conclusion:** Both iodine deficiency and excess can result in goiter in hand-reared budgerigars. The death of affected birds can be because of aspiration of vomitus, dyspnea, convulsions and sudden death, heart failure.

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## E-044

**Selenium as an immunomodulator in avian species**

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**Objective:** The aim of the study was to establish correlation between selenium supplementation and immune system status in avian species.

**Method:** The objects of the study were 20 chickens, 20 pigeons and 12 ducks, divided into 2 groups: selenium-fed group and selenium-free group. The methods included antibody response, examination of lymphoid organs, organs weight to body weight ratio and growth characteristics.

**Results:** The obtained results show that selenium supplementation influences on microbial and viral infections resistance by stimulation antibody production and proliferation of T and B lymphocytes. Selenium deficiency leads to elimination of lymphocytes and degeneration of epithelium of bursa of Fabricius and thymus. The main lymphoid organs improved their weight to whole body weight ratio in birds with additional selenium feed supplementation. Improvement of body weight and better feed-conversion efficiency were observed in birds with selenium-fed diets.

**Conclusion:** Increased selenium supplementation stimulates antibody production, increases antibody titre and improves immune response in most avian species.

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## E-045

**Screening level biomonitoring data of the child population in a risk-based context**

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Human biological monitoring (HBM) of Biomonitoring Equivalents can be used as tools to help interpret HBM data in a health risk context at a population level (WHO, 2015). The studies carried out on the territories (zones) in the city of Kazan included analysis of heavy metals in the hair and urine of children aged 8–12 years old. Chemicals in children hair were determined by means of ICP-AES and ICP-MS at ANO “Center for Biotic Medicine”. The examined children included the groups of practically healthy children and those with chronic diseases: of the upper respiratory tract, the gastrointestinal tract, the genito-urinary system. The concentrations of Pb, Cd, Ni, Cr, Mn were higher in children living in industrial zones ( $p < 0.05$ ;  $< 0.001$ ), and those of Zn and Cu were lower as in the hair of ill children ( $p < 0.05$ ). The centile method of assessment allowed rationalizing the notion of “norm” with the account of regional peculiarities (25th–75th Perc) and carrying out a correct selection of children into the groups with risk of developing diseases associated with deficiency or excess of trace elements.

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## E-046

**The effects of cadmium on TLR3 expression in chicken peripheral blood lymphocytes and spleen**

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In this study, we investigated the protein expression of toll-like receptor 3 (TLR3), as one of pattern recognition receptors, of peripheral blood lymphocytes (PBLs) and spleen of chicken infected with cadmium (Cd). Western blot results showed that TLR3 rarely expressed in PBLs and spleen of normal group, but the TLR3 expression was significantly increased in the Cd group compared to the control group. Flow cytometry assay showed that the proportion of TLR3 positive fluorescent cells in PBLs of Cd group did not increase, but the total and single cell fluorescence intensity significantly increased compared to control group. Indirect immunofluorescence results showed that the amount of TLR3 positive cells in spleen of Cd group increased and strong positive cells mainly expressed in marginal zone of red pulp and white pulp and in the junction between the splenic cord and the splenic sinusoid. Our study demonstrated that Cd increased the TLR3 expression in chicken PBLs and spleen.

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## E-047

**Age features of exchange element at women with wedge-shaped defects teeth**

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The aim was to study age characteristics of the element status of the whole saliva at women with wedge-shaped defects teeth of a reproductive age. 183 women with the wedge-shaped defects teeth aged 18–45 years are examined. Analytical determination of the content of chemical elements in the whole saliva has been carried out using ICP-AES and ICP-MS methods. Statistically significant ( $p < 0.01$ ) increase of salivary concentration of Ca, Fe, K, Ni, Pb and decrease of Cu, Mg Mn, Na, P, Se, Si and Zn at the women with age. The Spearman correlation analysis showed an inverse correlation between the serum estradiol levels and salivary ratio Ca/Mg of ( $r = -0.55$ ;  $p < 0.001$ ); and the inverse correlation of the serum levels of calcitonin and salivary ratio Ca/P ( $r = -0.63$ ;  $p < 0.001$ ). Increased serum levels of parathyroid hormone with age at the patients with wedge-shaped defects teeth correlated with salivary ratio Ca/B ( $r = 0.68$ ;  $p < 0.001$ ). Thus, the imbalance of chemical elements in the whole saliva lead to increase in the prevalence and intensity of destructive processes at the women with wedge-shaped defects teeth with age.

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## E-048

**Main principles of environmental and biogeochemical evaluation of chemical elements composition in the system soil–plant–animal**

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1. In connection with biogeochemical heterogeneity of environmental conditions, beings related to natural heterogeneity, and caused by techno genesis as well, it is important to define element status wider spectrum of chemical elements on each territory. 2. Eco-system approach is needed including producers, consumers and decomposers and allowing natural ecosystems to support their stable conditions for uncertainly long time, without problems of exhausted resources and waste disposal. 3. Apart from property description of some components (soil–plants–animals) it is necessary to study ecosystem as a functioning whole where the soil cover represents the interrelations knot on each territory. 4. Taking into account geographical features of a territory it is necessary to establish normal levels of chemical elements containing in soil, plants, water, bio-substrates of animals and human beings. 5. As an express method of environmental and biogeochemical evaluation of agro landscape territory we prefer to use chemical element analysis of cattle scalp hair fed with forage, grown up only within studied territory.

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## E-049

**The dynamics of dose-dependent excretion of cadmium from the body with urine**

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This research discusses the dynamics of excretion of inorganic eco toxicants of cadmium (Cd) (i.m. – of 0.3; 1.0 and 3.0 mg/kg) in rats urine. Method GFAAS used for Cd content measurement. The relationship between Cd concentration and total volume of excreted urine is formulated by the equation ( $R^2 = 0.8$ ). Measurements over a period of three weeks show non-linear correlation between Cd and time. Amount of Cd excreted is in a negative correlation with dose of originally administrated Cd – the lower original dose corresponds with a greater amount of excreted Cd, which could be explained by the kidneys functional response to the presence of toxic metal. Calculations show that in two weeks during the experiments approximately 7.5% (dose of 3.0 mg/kg) and 25% (dose of 0.3 mg/kg) of administrated Cd is excreted through rat urine.

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## E-050

**The level of lead in hair of respondents in Kazakhstan**

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We studied lead (Pb) content in hair of respondents (984 samples) in Kazakhstan using mass spectrometry technique (Center for Biotic Medicine, Moscow). The average hair Pb content was  $5.4 \pm 1.04 \mu\text{g/g}$  in general population ( $4.9 \pm 0.88 \mu\text{g/g}$  and  $8.9 \pm 5.5 \mu\text{g/g}$  in women and men respectively). According to the Center the reference values of Pb in hair is considered to be  $0\text{--}3.0 \mu\text{g/g}$ . Hair Pb content varied significantly in different areas of the country ( $p < 0.001$ ). Taking into account that the maximum acceptable level of hair lead is  $8\text{--}9 \mu\text{g/g}$ , the highest average level of hair Pb ( $15.12 \pm 7.7 \mu\text{g/g}$ ) was observed in South Kazakhstan oblast, the lowest ( $2.08 \pm 0.48 \mu\text{g/g}$ ) – in Akmola oblast. The level of hair lead can determine the accumulation of this element over the several years in this area, therefore we can come to the conclusion that the environmental lead pollution in the country is high.

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## E-051

**Association of trace element and mineral status with functional reserves of the organism in physically active men**

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The objective of the study was to assess the association between trace element and mineral levels in serum and hair of physically active men ( $n=36$ ) and functional parameters of the organism. The majority of positive correlations were observed for Ca, Mg, and P. In particular, higher functional parameters were associated with lower hair Ca, Mg, and P content. In particular, both serum K ( $r = -0.52$ ) and hair Ca ( $r = -0.59$ ), Mg ( $r = -0.54$ ), K ( $r = -0.58$ ), Na ( $r = -0.58$ ), P ( $r = -0.60$ ), and Be ( $r = -0.63$ ) were inversely associated with palmar strength index. Parameters of functional adaptation were also associated with hair and serum K and Zn levels. A negative association with functional parameters of the organism was revealed for toxic trace elements including cadmium, nickel, and especially arsenic, whereas selenium positively correlated with functional reserves of the physically active men. Therefore, modulation of mineral homeostasis may be used to improve performance in athletes.

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## E-052

**Cadmium induced apoptosis in chicken spleen via Nrf2/HO-1 pathway and ameliorative effect by selenium**

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To explore the mechanism of selenium attenuating spleen toxicity induced by cadmium in chickens, cadmium chloride ( $\text{CdCl}_2$ , 150 mg/kg) and sodium selenite ( $\text{Na}_2\text{SeO}_3$ , 2 mg/kg) were co-administrated or individually administered in the diet of chickens for 90 days. The results showed that Cd increased nuclear accumulation of Nrf2, the expression of heme oxygenase-1 (HO-1), the level of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) and malondialdehyde (MDA), decreased the antioxidant enzyme (superoxide dismutase (SOD), glutathione peroxidase (Gpx), total antioxidative capacity (T-AOC), catalase (CAT)) activities and the expression of Kelch-like ECH-associated protein (keap1), Gpx-1 and thioredoxin reductase-1 (TrxR1), accompanied the induction of apoptosis. Concurrent treatment with Se ameliorated the Cd-induced spleen oxidative stress, activation of Nrf2 and apoptosis, suggesting the mechanism for attenuation of Cd-induced spleen damage by Se supplementation via inhibiting Nrf2/HO-1 signaling pathway.

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## E-053

**Assessment of heavy metal content in *Tanacetum vulgare* L. growing near the copper smelter**

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The objective was to assess the level heavy metals in raw materials of *Tanacetum vulgare* L. growing in the area of Mednogorsk copper smelter using atomic absorption spectrometry. The samples were collected in two equidistant from the smelter points: plain (1) and floodplain of Blyava river (2). The obtained data demonstrate that the levels of metal in points 1 and 2 exceeded the maximal permissible concentrations for lead (Pb) by a factor of 5.8 ( $2.92 \pm 0.01$  mg/kg) and 2.5 ( $1.24 \pm 0.01$  mg/kg), for cadmium (Cd) by a factor of 3 ( $0.09 \pm 0.001$  mg/kg) and 2.7 ( $0.08 \pm 0.001$  mg/kg), for copper (Cu) by a factor of 1.5 ( $7.74 \pm 0.01$  mg/kg) and 1.4 ( $7.14 \pm 0.01$  mg/kg), and for zinc (Zn) by a factor of 1.4 ( $13.17 \pm 0.01$  mg/kg) and 1.3 ( $12.70 \pm 0.01$  mg/kg). Hypothetically, the plants cumulated metals from soils contaminated by the smelter emissions. The raw materials of medicinal plants growing in the area of copper smelter are unacceptable for collection and using in medicine.

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## E-054

**The antagonistic mechanisms of selenium on cadmium-induced apoptosis by regulating mitochondrial dynamics and energy metabolism in the chicken spleen**

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The aim of this study was to investigate the mechanisms of Cd-induced apoptosis by regulating mitochondrial dynamics and energy metabolism in chicken spleen and the antagonistic effects of Se. We duplicated the Se and Cd interaction model. The results showed that in Cd treatment group, the expressions of mitochondrial fission-related genes were significantly increased and that of mitochondrial fusion and energy metabolism-related genes were markedly decreased, activating the mitochondrial apoptosis pathway. The expressions of IL-1 $\beta$  and TNF- $\alpha$  were enhanced and that of IL-2 and IFN- $\gamma$  were reduced. However, Se co-treatment markedly antagonized those effects. In conclusion, we demonstrated that Cd treatment could induce apoptosis by regulating mitochondrial dynamics and energy metabolism, and Se co-treatment significantly reduced the Cd-induced apoptosis in the chicken spleen.

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## E-055

**Biomonitoring of aluminium plant workers exposure to heavy metals using scalp hair**

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The objective of the present study was to assess the level of Al and toxic metals in hair of persons occupationally exposed to Al using ICP-MS. The obtained data demonstrate that aluminium plant workers had nearly 4- and 2-fold higher levels of hair Al and Pb than the controls, respectively. Hair As and Cd content in the occupationally exposed group exceeded the respective control values by 36% and 62%. Further analysis demonstrated that persons involved in different technological processes are characterized by distinct hair metal profiles. Thus, hair Al, As, Cd, Pb, and Sn levels in sintering unit workers exceeded the respective control values. In turn, workers of the hydrometallurgical unit were characterized by significantly higher levels of Al and Cd in hair. The results of the present study demonstrate that workers occupationally exposed to Al have an increased risk of toxic influence of Al and other metals like As, Cd, Pb, and Sn.

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## E-056

**The effects of *Agaricus blazei* murill polysaccharides (ABP) on cadmium-induced oxidant stress in chicken livers**

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The study aimed to assess the effects of ABP on cadmium (Cd)-induced damage in chicken livers. 80 Hy-Line laying chickens (7 days old) were randomly divided into 4 groups ( $n=20$ ). Group I and group IV were fed with a basic diet, while group II and group III were fed with a basic diet with 140 mg/kg CdCl<sub>2</sub>. Meanwhile, group I and group II were supplied with 0.2 ml saline, while group III and group IV were supplied with 0.2 ml ABP solution (30 mg/ml) per day via oral gavage. The contents of Cd and MDA, the activities of SOD and GSH-PX, the mRNA and protein levels of heat shock proteins (HSPs) in livers were detected on days 20, 40, and 60. The results showed that ABP supplementation during dietary exposure to Cd could ameliorate the inhibited activities of SOD and GSH-PX, and the increased contents of MDA and Cd, the mRNA levels of HSPs (HSP27, 40, 60, 70, and 90) and the protein levels of HSPs (HSP60, 70, and 90) caused by Cd exposure. The results indicated that ABP could partly ameliorate the toxic effects of Cd on chicken livers.

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## E-057

**Apoptosis of lens epithelial cells induced by sodium selenite and its pathway**Hongjie Chen<sup>1,2,\*</sup>, Kaixun Huang<sup>2</sup><sup>1</sup> Wuhan Technology and Business University, Wuhan 430065, PR China<sup>2</sup> Huazhong University of Science and Technology, Wuhan 430074, PR ChinaE-mail address: [hongjie6666@sina.com](mailto:hongjie6666@sina.com) (H. Chen).

Apoptosis of lens epithelial cells is an early event of cataract formation. In order to study the mechanism of cataract formation induced by sodium selenite, we investigated apoptosis of human lens epithelial (hLE) cells SRA01/04 induced by sodium selenite and its pathway. The data showed that, the survival rate of hLE cell by MTT method showed a decrease to the increasing concentration of selenite, while apoptosis rate by flow cytometry analysis increased gradually. This result is coincident with the qualitative result of Hoechst 33258 staining. Caspase-3 activity in hLE cells increased remarkably after selenite treatment. Correspondingly, level of ROS and content of MDA increased significantly, and the mitochondrial membrane potential is greatly decreased. Thus, apoptosis of hLE cells SRA01/04 induced by sodium selenite, is closely related to mitochondrial apoptotic pathway mediated by generated ROS. This work was supported by grants from the NSFC (Project No. 30870555, 21271077).

<http://dx.doi.org/10.1016/j.jtemb.2017.03.358>**Cu and Zn in dry dog foods measured by INAA**C. Elias<sup>1,\*</sup>, E.A.N. Fernandes<sup>1</sup>, M.A. Bacchi<sup>1</sup>, P. Bode<sup>2</sup>, T.F.C.F. Assis<sup>1</sup><sup>1</sup> Nuclear Energy Center for Agriculture, University of São Paulo, Piracicaba, SP, Brazil<sup>2</sup> Delft University of Technology, Delft, The NetherlandsE-mail address: [celias@cena.usp.br](mailto:celias@cena.usp.br) (C. Elias).

Accumulation of Cu in the liver leads to hepatitis and eventually cirrhosis of the hepatic parenchyma of dogs. Supplementation of Zn has been recommended for the treatment of such liver disease. Dog foods are an important diet source of those elements

for animals. Thereby a comprehensive sampling of dry dog food for puppies and adults of various brands was performed. Samples were analyzed by instrumental neutron activation analysis (INAA), with both short and long irradiations carried out respectively for Cu and Zn measurements. Results were compared to reference values from the European Pet Food Industry (FEDIAF). For Cu, ten samples of adult and nine of puppy dog food presented values higher than the recommended maximum limit (28 mg/kg). Zn was above the maximum limit (284 mg/kg) in ten samples of puppy and nineteen samples of adult dog foods. No relation was observed between Cu and Zn contents in the dog food, implying that a high Cu content does not reflect a high Zn content, which may be an aggravating factor for dog breeds with Cu storage disease.

<http://dx.doi.org/10.1016/j.jtemb.2017.03.360>**Ferroptosis Induction in Breast Cancer Cell line MDA-MB-231 by Sulfasalazine and Ferric Ammonium Citrate**Ning-Sing Shaw<sup>\*</sup>, Ya-Wei Lin

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Ferroptosis is newly discovered iron-dependent and intracellular signaling-regulated cell death. The study investigates the potential effect of the cancer drug sulfasalazine (SAS) in induction of ferroptosis in the triple-negative breast cancer cell line MDA-MB-231. We detect ferroptosis molecular characteristics, and the effects is blocked by specific inhibitors ferrostatin-1 and analyze iron-related antioxidant proteins NRF2, HO-1 and ferritin (FTH) protein expression and assess the impact of the antioxidant mineral selenium and zinc compound in ferroptosis. The results show that combined group (SAS + iron) induce MDA-MB-231 cells ferroptosis, and ferrostatin-1 inhibit cell death. In addition, ROS and LROS are increased before cell death. The NRF2 and FTH protein expression levels are increased in a combined group dose-dependent manner. We found selenium can inhibit ferroptosis, and the mechanism may be through increasing the GPX4 protein expression. Zinc increases cell death in combined group and enhance Zn-MT protein expression, but Zn-MT does not contribute to prevent cell death.

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