Session 3. DISTRIBUTION OF METAL IONS

COMPARATIVE WHOLE BLOOD AND GASTRIC TISSUE DISTRIBUTION OF SELENIUM IN PATIENTS WITH GASTRITIS AND *HELICOBACTER PYLORI* INFECTION

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The gastric tissue and whole blood Se levels were examined in 149 subjects with different types of gastritis and with or without the presence of *Helicobacter pylori* (HP) infection. The gastric and whole blood levels of Se in the subjects under study were 0.65 ± 0.52 mg g^{-1} and 136 ± 31 mg l^{-1}, respectively. HP was present in 100 subjects (48 males and 52 females) and it was absent in 49 patients (23 males and 26 females). The Se concentrations in gastric tissue was related with the kind of gastritis and the presence of HP infection and decreased in the different patients as follows: mild gastritis > erosive gastritis > chronic gastritis.

BLOOD LEAD (PB) AND SELENIUM (SE) IN RESPIRATORY DISEASES IN HUNGARIAN CHILDREN AND ADULTS

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Background: the trace element lead (Pb) is one of the most harmful pollutant in urban areas. Its adverse effects on health include upper and lower respiratory tract destruction since nearly 40% of Pb absorbs via lungs, Selenium (Se) is known to be involved in immune protection actions, and may protect against the toxic effects of Pb.

The aim of the study was to analyse the possible relations between the effects of the two trace elements in healthy children (n=62), healthy adults (n=57) as well as in patients with chronic rhinitis (n=15 children, n=31 adults), acute bronchitis (n=34 children, n=24 adults) and in chronic asthma (n=13 children, n=15 adults).

Methods: both trace elements were measured with atomic absorption spectrophotometry. Computing was performed by SPSS ™.

Results: in the healthy population blood Pb concentrations increased with age. Under twenty years, it was 5-7 μg/100 ml, above that levels doubled in average. Nearly 30 per cent of healthy people showed toxic Pb levels (above 10 μg/100 ml). Children in the capital had higher Pb levels than others from an industrial city, the lowest (4.1 ± 0.5 μg/100 ml) values observed in rural area. Children with chronic rhinitis, acute bronchitis or chronic asthma had similar Pb levels than the healty age and sex matched controls. Adults with bronchitis (15.2 ± 8 μg/100ml) or asthma (16.0 ± 7 μg/100 ml) had significantly higher Pb levels than the healthy group (8.9 ± 4 μg/100 ml, $p<0.001$). Se content and whole blood Pb concentrations showed a negative correlation in adult asthmatics ($r=0.7692$, $y=-16x+34$, $p<0.001$), but not in asthmatic children.

In conclusion: this observation indicates that the Se concentration did not protect Pb absorption in the adult group of patients, who were exposed to Pb inhalation longer than the young patients. Results also indicate, that air pollution connected with Pb inhalation could be associated with developing chronic asthma bronchiale.

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THE COPPER LEVELS IN THE PLASMA AND DOPAMINE BETA-HYDROXYLASE ACTIVITY IN A CHRONIC MILD STRESS MODEL OF DEPRESSION IN RATS

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Background: Dopamine β-hydroxylase (DBH) catalyzes the beta-hydroxylation of dopamine into norepinephrine. Its decreased activity has been reported in unipolar psychotic depression. DBH is known to use Cu

ions for catalytic activity.

The Aims: Our objective was to study the effect of chronic mild stress (CMS) in the rat model of depression on the content of Cu in the plasma and the DBH activity.

Material and Methods: DBH was isolated from blood plasma. It's activity was measured by the Nagatsu and Udenfriend method, modified by Grabowska and Gumicska, based on the oxidation of tyramine to octopamine. The octopamine was oxidized to p-hydroxybenzaldehyde. The absorbance of the second was measured spectrophotometrically at 330 nm. The Cu content in the plasma was measured by AAS method. The measurements were taken after 2 days from the beginning of the experiment and followed in the intervals 1, 2 and 5 weeks of undergoing stress. All procedures were conducted according to NIH Animal Care and use Committee guidelines.

Results: Results of the study are presented in the following table:

Duration of time	Cu content in the plasma [mg/L]		DBH activity in the plasma	
	Control	CMS	Control	CMS
2 days	0.84±0.13	0.87±0.90	58.75±13.74	39.70±8.08*
1 week	0.99±0.12	0.90±0.08	58.87±22.72	73.14±15.05
2 weeks	0.99±0.12	0.90±0.08	53.49±7.81	60.24±9.40
5 weeks	1.01±0.25	1.11±0.10	54.61±21.20	22.84±9.82*

* $p<0.5$ – significant difference vs. control

Conclusions: The Cu content in the plasma in the chronic mild stress of the rat's depression model remains stable, whereas the DBH activity is altered. There exists a negative significant correlation between the content of Cu in the plasma and the activity of DBH in the rats subjected to CMS ($r=-0.48$, $p<0.05$).

HEPATIC DEPOSITION OF BUTYLTIN IN HUMANS

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Health effects following exposure to butyltin compounds have focussed on effects on the immune system, but endocrine effects of butyltin have been documented in a variety of marine species. The information on human exposure to butyltin compounds and hepatic deposition is limited. Intake of marine food is the main source of butyltin exposure to humans and recent data indicate that butyltin concentrations in marine food may exceed 400 ng/g. The present study includes 18 consecutively sampled human livers analysed for butyltin compounds. Dibutyltin (DBT) concentrations varied between 0.8 ng/g and 28.3 ng/g with a mean concentration of 9.0 ng/g. Significantly lower concentrations of mono butyltin (MBT) was observed ranging from 0.3 ng/g to 4.7 ng/g with a mean value of 1.6 ng/g. Age and DBT/MBT ratio were significantly associated. We conclude that younger men have more recent exposures or have a lower capacity to debutylate DBT than older men and would therefore potentially be more susceptible to butyltin toxicity. Given the inter-person variability observed in our limited group of men, we can not exclude that thresholds for either immunotoxicity or effects on the endocrine system may occur due to exposure to butyltin compounds alone or in combination with other environmental toxicants with similar target organs.

EFFECT OF MAGNESIUM SUPPLEMENTATION ON MAGNESIUM, CALCIUM, ZINC, IRON AND COPPER BALANCE IN RATS

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Background: Dietary imbalance of minerals, especially magnesium has been frequently described in the literature. The simplest solution is to correct a slight magnesium deficiency with an appropriate diet, but often used method is to supplement the deficiency by using pharmaceutical products containing magnesium.

Aim: The aim of the study was to investigate the balance of magnesium, calcium, zinc, iron and cooper in rats which diet had been supplemented with magnesium carbonate and after its discontinuation.

Materials and methods: Male Wistar rats, aged 4–5 weeks were given LSM laboratory chow and deionized water ad libitum. Magnesium carbonate suspended in 2% arabic gum was administered for 4 weeks to the experimental groups by gavage in doses of: 2.5 mg; 5.0 mg; 10,0 mg and 20.0 mg Mg/kg b. w./24h and for another 4 weeks the magnesium supplementation was discontinued. A control group was given 2% arabic gum. During the experiment the animals were four times placed in metabolic cages for 2, 4, 6 and 8 weeks for determination of minerals balance. The balance was calculated as the retention coefficient. The results were statistically evaluated.

Results: It was shown that after two weeks of magnesium supplementation in a dose of 2.5 mg Mg/kg b. w./24h there were no significant differences in the coefficient of apparent retention for all estimated minerals.

The higher doses influenced the balance of magnesium and zinc which was increased and the balance of iron and cooper which was decreased. Supplementation with magnesium (for 4 weeks) caused the changes in apparent retention of iron (marked reduction) and zinc (increase). After 4 weeks of discontinuations of magnesium supplementation reduction of the coefficients of apparent retention for iron, cooper and calcium in all experimental groups was noted.

Conclusions: The results obtained in this study show that oral supplementation of magnesium in doses of 2.5 mg; 5.0 mg; 10.0 mg and 20.0 mg Mg/kg b. w./24h during 4 weeks causes the changes of the balance for iron, cooper and calcium in rats.

INTRAMUSCULAR INJECTION OF DESFERRIOXAMINE LOWERS BRAIN ALUMINIUM CONCENTRATION IN ALZHEIMER DISEASE

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While genetic risk factors are involved in the expression of Alzheimer disease, there also are strong indications that environmental aluminium (Al) plays an active role in the pathogenesis of AD. Based on the hypothesis that Al may act as a toxic factor, we tested the effectiveness of the trivalent metal chelator, desferrioxamine (DFO) in removing Al from the brains of elderly patients with advanced AD. Patients were injected intramuscularly with a twice daily dose of 500 mg DFO, 5 days per week. Autopsy brains became available from 6 patients who died from causes unrelated to drug administration. These were examined for Al content. Three brains were from subjects who had received less than 7 DFO injections (minimally treated), and 3 were from subjects who had received 47, 76 and 108 DFO injections (DFO treated). Samples from minimally treated patients had an average value of 4.04 :g Al/g dry weight for 21 neocortical regions in each brain and samples from DFO treated patients had an average value of 2.67 :g Al/g for the same 21 brain regions. The difference between the mean Al levels of the two groups was statically significant ($P < 0.001$). There was no difference between the mean Al level of the minimally treated group and that of a group of 7 untreated AD patients. This association study, although small, supports the hypothesis that DFO treatment can reduce the concentration of Al in the AD brain. Because the muscular injection of 125 mg of DFO twice daily for 5 days a week over a 24 month period was found in an independent phase I clinical trial to reduce the rate of mental deterioration in DFO treated patients in excess of 50% over the 24 month trial period compared to patients not treated with DFO (Crapper-McLachlan et al., Lancet, 337: 1304–1308, 1991), the results of the present study suggest that the favourable response to DFO treatment in the clinical trial may have resulted, at least in part, from reduction of the level of brain Al.

SEX AND AGE RELATED CALCIUM-PHOSPHORUS RATIO IN TRABECULAR BONE OF HUMAN FEMORAL NECK

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Background: A new method was demonstrated recently for assessing the skeletal Ca/P ratio *in vivo*, using photon absorptiometry.

Aims: In the present *in vitro* study trabecular bone of human femoral neck was analyzed with two objectives. One of the objectives was to use intact bones for Ca/P ratio measurements and as a consequence these data to be used as basis for *in vivo* studies. The second objective was to perform measurements on bone kind mostly affected by osteoporosis.

Materials and method: Concentrations of Ca and P as well as Ca/P ratio were estimated in intact trabecular bone samples of femoral neck from healthy humans, 34 women and 44 men, aged from 15 to 55 years. For Ca and P concentration measurements, instrumental neutron activation analysis was used.

Results: Mean values (M ± S.D.) for the investigated parameters (on dry weight basis) for female and male were: 12.1 ± 3.0%, 5.94 ± 1.71%, 2.07 ± 0.25 and 10.9 ± 2.5%, 5.30 ± 1.23%, 2.07 ± 0.22 respectively. Statistically significant ($p<0.05$) decrease of calcium concentration with age was found for male, but not for female. Phosphorus concentration and Ca/P ratio were not affected by age. No statistically significant differences of all parameters studied were observed related to sex. The mean values for Ca, P and Ca/P ratio were within a very wide range of reference data and close to their median.

Conclusions: The individual variation for Ca/P ratio in trabecular bone of femoral neck from healthy humans was lower than those for Ca and P concentrations separately. This means that specificity of Ca/P ratio is better than those of Ca and P concentrations and may be more reliable for diagnosis of bone disorders.

TRACE ELEMENT LEVELS IN HUMAN SEMINAL PLASMA

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Several trace elements have been linked with male infertility, *e.g.* an excess of aluminium causes decreased sperm motility, a deficiency of zinc causes impaired spermatogenesis and testosterone production, reduced sperm density and motility and a deficiency in selenium causes reduced sperm production and breakage of the spermatozoa tail (mid-piece) *etc.* Literature values for some trace elements are very sceptical due to the wide range presented, for example, numerous papers have reported zinc in seminal plasma for "control" individuals over the range 18–301 μg/mL. An evaluation into the importance of sample collection was therefore undertaken. Seminal plasma samples were centrifuged at 1, 10, 30 and 60 minutes after sample collection. Analysis was undertaken by ICP-MS for Fe, Cu, Zn, Se, Cd and Pb. The time factor appears to be critical for Zn and Se in particular, as the concentration decreases from 156 to 84 μg/mL and 63 to 40 μg/L respectively over the time periods 1 and 60 minutes. This data shows that the sample collection procedure for seminal plasma is imperative if accurate trace element levels are to be determined in this media. This specific sample collection procedure (avoid ejaculation for between two and three days prior to semen collection, wash hands with soap and plenty of warm water, deliver sample directly into polyethylene specimen container, separate semen samples by centrifugation at 13 000 rpm within one minute and immediately store samples at –20 °C) was used in a study to evaluate the trace element levels in infertile and fertile males.

REGIONAL DISTRIBUTION OF ALUMINIUM IN THE RAT BRAIN: INFLUENCE OF VITAMIN E

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We have investigated the effects of the antioxidant vitamin E on the regional accumulation of aluminium (Al) in the rat brain. Al was administered i.p. as aluminium lactate at a dose of 10 mg Al/Kg body weight, 5 times a week for 4 weeks. Male Wistar albino rats were either treated with aluminium alone, or together with a dietary supplement of 5, 15, and 20 mg/g, of vitamin E (n=5 per group) of rats (n=5 per group). Further groups received 20 mg/g vitamin E supplemented diet or normal chow alone. Animals were killed by anaesthetic overdose, the brain removed and dissected into identifiable regional segments, namely cortex, cerebellum, medulla, hippocampus, striatum and hypothalamus, for measurements of Al by atomic absorption spectrometry.

Al was found to be increased in various regions of the brain of Al-treated rats compared to the control. The accumulation of Al in the various regions of the brain were significantly higher ($P<0.01$) in the rats receiving Al in the decreasing order; cerebellum > cortex > hippocampus > medulla > striatum. Concomitant dietary vitamin E significantly reduced ($P<0.01$) the Al accumulation in the various regions of the brain. These results suggest that vitamin E may influence the regional accumulation of Al in the brain. If Al-induced neurotoxicity is mediated by pro-oxidant events, vitamin E may offer some protection.

HELYCOBACTER PYLORI RELATED TO WHOLE BLOOD AND GASTRIC TISSUES BISMUTH LEVELS IN PATIENTS WITH DIFFERENT TYPES OF GASTRITIS

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Background: Bismuth (Bi) and its salts belong to basic drugs for the eradication of Helicobacter Pylori (HP), a microorganism which is postulated to participate in ethiopathogenesis of duodenal ulcers. As a result of its abundance and wide use in medicine, Bi is found in small amounts in biological and environmental samples. Given the analytical difficulties in determining minutes amounts of Bi in such complex matrixes, only few

papers deal with its determination in biological samples obtained from patients without Bi-based treatment.

Aims: The main concern in developing this work was to evaluate the basic concentrations of Bi in whole blood and gastric tissues from patients suffering different types of gastritis without any Bi-related treatment and to correlate it to the presence of HP.

Methods: Urease test and atomic absorption spectrometry with electrothermal atomization was used to determine HP and Bi, respectively. During endoscopy, small samples of the stomach lining (biopsies) were obtained and used for Bi determinations. The statistical evaluation of the results was carried out with SAS (Statistical Analysis System) software version 6.12 under UNIX. The statistical significance was accepted for 95 % confidence level ($p = 0.05$).

Results: This study involved 67 subjects (38 female and 29 male) with ages between 14 and 80 years (43.51±17.04) suffering different types of gastritis (mild (MG): n = 22; erosive (EG): n = 33; and chronic (CG): n = 12). Positive HP appeared in 44 of the subjects; 10 with MG, 27 with EG and 7 with CG. Bi global levels were 10.25±6.15 $\mu g\, l^{-1}$ and 0.34±0.18 $\mu g\, g^{-1}$ in blood and gastric tissue, respectively. Bi concentrations in both samples were significantly lower in CG when compared to the other types of gastritis ($p = 0.002$). In all cases there was a slight decrease of the Bi levels in gastric tissue with age ($r = –0.20$). There was no relationship between the Bi concentration in either matrix nor between the prevalence of HP and the sex.

Conclusions: Bi concentration seem to be related to the severity of the inflammation process, being lower where the tissue is damaged most (CG). There is also certain association between the presence of HP and the evolution of the illness. The clinical significance of Bi concentrations in blood and gastric tissue related to different degree of damaged gastric mucosa deserves further investigation.

SERUM SELENIUM CONCENTRATIONS IN CHILDREN WITH COELIAC DISEASE

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Background: An important role for free radicals in a number of gastrointestinal disease has been demonstrated. Selenium is the component of the glutation peroxidase one of the most important enzymes in the antioxidant protection of the organism. Many studies relate a deficit of selenium in patients with celiac disease, compared with the healthy population. Dietary supplementation with antioxidant molecules may offer some benefit and deserves further investigation.

Objective: To investigate the relationship between celiac disease and serum selenium levels.

Patients and Methods: Selenium levels were evaluated in the serum of 6 children with celiac disease and in a 28 age-matched healthy controls (2–10 years).

Serum selenium levels were measured by atomic absorption spectrophotometry (AAS) with a graphite furnace and Zeeman background corrector (*Perkin Elmer 4110 ZL*), using $Pd(NO_3)_2$ solution as matrix modifier.

The statistical calculations were carried out using SPSS statistics program. The statistical test used, was the Mann-Whitney U test for two independent samples.

Results: The concentrations of serum selenium were significantly ($p<0.05$) lower in patients (64.05 μg/l) compared with controls (75.74 μg/l).

Conclusions: Serum selenium in CD patients is decreased. In patients at free diet the deficit of selenium can be attributed to malabsorption, while in patients at gluten-free diet it may be due to the diet itself.

These findings seem to suggest that, besides the adoption of a strictly gluten-free diet, the possibility for an adjuvant therapy with selenium may be considered for celiac disease patients.

SERUM SELENIUM IN HEMODIALYSIS PATIENTS

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Background: The mechanisms that could modify selenium status may, therefore, be of particular interest in hemodialysis patients, considering their high cancer mortality rates. In the bibliografy, some studies show lower selenium levels in patients on regular hemodialysis treatment compared to healthy controls. There are some positive data regarding the use of moderate and safe selenium supplementation in hemodialysis patients.

Objectives: To investigate the existence of an altered selenium balance in patients on regular hemodialysis treatment.

Patients and Methods: 466 chronically dialyzed patients and 256 age-matched healthy controls were enrolled in the study. All patients were divided into 3

groups: 1) patients treated by 1–24 months hemodialysis, 2) patients treated by 25–49 months hemodialysis, and, 3) patients treated by 50 months or more.

Serum selenium levels were measured by atomic absorption spectrophotometry (AAS) with a graphite furnace and Zeeman background corrector, using $Pd(NO_3)_2$ solution as matrix modifier.

The statistical calculations were carried out using SPSS statistics program. The statistical test used has been the analysis of variance (ANOVA).

Results: In all patients groups, selenium concentrations were significantly lower (group 1 = 57.04 μg/l; group 2 = 56.11 μg/l; group 3 = 52.90 μg/l) than in healthy subjets group (75.02 μg/l).

The differences between group 1 and group 3 was statistically significant.

Conclusions: The findings of this study suggest that selenium levels in hemodialysis patients in lower than healthy population, and serum selenium decrease during hemodialysis. Supplementation with a trace element may be indicated when its depletion was unequivocally documented and when there is evidence of the positive effects of this element on the quality of life of the hemodialyzed patients.

ON THE DISTRIBUTION OF SOME MINERAL LEVELS IN THE DIABETES RATS (GK-RATS)

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To observe the distribution of mineral concentration in the several organs for diabetes, we analyzed the concentration of Ca, Mn, Mg, Zn, Cu, and Fe in the blood, urine and organs (cerebrum, cerebellum, lung, heart, liver, pancreas, spleen, kidney, testis, prostate, muscle and fat) in the control and GK (Gotho-Kawasaki)-rats, and compared with the data of these two groups. The concentration of Mg and Mn were not significant differences between the controls and the GK rats in the blood. However, in the urine, GK-rats of these minerals were significant higher than those of the controls. Moreover, in the pancreas, Zn levels of GK rats was higher than that of controls, and in the kidney, testis, and intracutaneous fat, this levels of GK rats were lower than those of controls. In the Ca levels, cerebrum, lung, kidney, testis and muscle of GK-rats were significantly higher than those of the controls. In the Mn levels, cerebrum, pancreas and prostate in GK-rats were higher than those of controls. Moreover, another many interesting differences were observed between these two groups. From these results, it is indicate that many mineral distribution was disturbed with a body in the diabetes. It is necessary to control the mineral distribution in a body by the nutrition or drug at the treatment procedure of diabetes patients.

INFLUENCE OF ZINC, COPPER AND MAGNESIUM INTAKE WITH DIET ON THESE ELEMENTS LEVEL IN THE BLOOD SERUM OF YOUNG MEN DOING MILITARY SERVICE IN POLISH ARMY

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Young men beginning military service are the men aged 20–21, coming from different social environments. Nutrition habits at their homes are not always in accordance to proper nutrition principles. Therefore fundamental task of their nutrition during military service is to ensure diet of standard value guaranteeing meeting the requirements of young organism exposed to stress and huge physical load.

The aim of the work was estimation of zinc, copper and magnesium content in food ration that is the base for nutrition planning for most men serving in Polish Army. Level of zinc, copper and magnesium was estimated in blood serum of soldiers fed this diet as well. Content of m/a elopements in basic food ration was calculated using calculation software FOOD 2. Level of zinc, copper and magnesium in blood serum was estimated by atomic absorption spectrophotometry method. Obtained results were compared to obligatory in Poland norms.

It was found that content of examined elements in food ration, including technological losses occurring during food processing, was for zinc 18.9 mg, copper 1.93 mg and for magnesium 590.4 mg. They met the recommended requirements in 118.1%, for zinc, from 77.0% to 96.3% for copper and 159.4% for magnesium. Average zinc content in blood serum of examined people was 10.95±1.7 μmol/l. This value is included in norm limits of 8–23 μmol/l. Copper level in blood serum was 13.26±2.87 μmol/l and reached lower norm's limit (13–22 μmol/l). Average magnesium content was 0.82±0.54 mmol/l and was included in the norm's limits of 0.7–1.1 mmol/l.

Low copper content found in daily food ration may be one of the reasons of its low level in blood serum of examined men.

METAL ACCUMULATION BY *BETULA PENDULA* ROTH. LEAVES UNDER CONDITIONS OF THE STERLITAMAK INDUSTRIAL CENTER

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Unsufficient catching and clearing of industrial enterprises emissions can result to significant environment pollution. The Sterlitamak industrial center (The Preural region, Russia) is characterized by a high concentration of chemical manufactures. The "Soda" enterprise, the "Kaustik" joint-stock company, the Sterlitamak heating plant, and other enterprises of Sterlitamak city throw out to environment a plenty of toxicants — 146.8 thousand ton annually (State report..., 1998).

The researches were carried out in *Betula pendula* Roth. stands (age 35–40 years), located on various distance from the Sterlitamak industrial center. The relative life status of stands was determined by a standard technique (Alekseev, 1990). The content of Cu, Mn, Fe, Pb, and Ca in *B.pendula* leaves was defined by the atomic-absorption method.

The relative life status of *B. pendula* stands is estimated as "weakened". The damage of a birch leaves (chlorosis and necrosis) were found out. The area of chlorosis and necrosis on leaves was 30–40 %.

Some features in accumulation and distribution of metals in *B. pendula* leaves are revealed. The metal content in samples which taken at various height of a crone and a trunk was unequal.

The content of Mn (918 mg/kg), and Fe (10170 mg/kg) in leaves from the average part of a crone is higher, than in leaves from the bottom and top part of a crone. In leaves from the bottom and top parts of a crone the Mn (in 9.7 times), and Fe (in 17.5 times) content are more than in leaves from average part of a crone.

In *B.pendula* leaves from the bottom part of a crone the Cu (14 mg/kg) and Cd (0.3 mg/kg) content are unsignificant, their quantity in 1,4 times is higher, than in leaves from the average and top parts of a crone. In the bottom part of a crone the Ca content makes 41600 mg/kg, that was more in 8.6 times in comparison with leaves from the average and top parts of a crone. In the bottom part of a crone the average content of Pb makes 0.9 mg/kg, in the top part — 1.6 mg/kg.

Despite of a leaves defeat and significant weakened of trees the *B. pendula* stands it is necessary to consider as the biological filter for metal accumulation.

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PLASMA COPPER AND ZINC CONTENT IN PATIENTS WITH CHRONIC RENAL INSUFFICIENCY: INFLUENCE OF DIET

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Alterations of trace element metabolism in chronic renal failure (CRF) has been reported, but the mechanisms responsible for these changes are poorly understood. Changes in plasma concentration of copper and zinc in patients with CRF were studied before dialysis. The patients were given nutritional therapy consisting of a balanced diet adjusted to their needs, or prepared from manufactured (Sanavi®) low-protein dietary products (LPDP). Forty-two patients with CRF were included in the study on the basis of the following criteria: blood creatinine >3 mg/dL, creatinine clearance < 20 min, and stable clinical condition. The patients were divided into three groups of 14 patients each. In Group1 (G1) patients consumed their regular diet, those in G2 consumed a balanced diet adjusted to their needs, and those in G3 consumed a balanced diet consisting of LPDP. Copper and zinc concentrations were measured by atomic absorption spectrometry. At the beginning of the study (day zero), mean plasma concentrations were higher than 1.70 mg Cu/L and lower than 1.50 mg Zn/L, in three groups. After 6 months, plasma Cu concentration was lower in patients who consumed LPDP ($p<0.05$), but no significant change was seen in G1 or G2. Plasma Zn concentration showed a tendency to decrease in three groups, becoming significant in G2 ($p<0.05$).

EFFECTS OF ALUMINUM ADMINISTRATION IN RENAL FAILURE RATS

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Background: Physiological roles of aluminum (Al) remain unclear since this element is not recognized as an essential metal in animals. However, it occurs in microquantities in blood, brain, muscle and other tissues, while such disease states as encephalopathy, osteomalacia and anemia have been suggested to be associated with renal failure. We investigated Al bioaccumulation in organs of renal failure rats receiving Al preparations and its metabolic relations to calcium and phosphorus.

Methods: Forty male Wistar rats were randomized into two groups of equal numbers; one group was 5/6-nephrectomized and subjected to experiments at 2 months post-operation. They received either 5% Al potassium sulfate in diet or Al potassium sulfate solution parenterally. The other group, serving as untreated controls, received a standard rodent diet and parenteral physiological saline instead. After 3 to 6 months of the treatment, the animals were euthanatized/laparotomized under anesthesia and specimens were collected and submitted for ICP analysis, etc.

Results: Al was detected, in microquantities, in blood cells, brain, bones, etc. There was no significant difference in serum Al level between the nephrectomized and control groups at 3 months of treatment, while the parental Al-treated rats exhibited marked Al increases in blood, liver, kidneys and bones. At 6 months with oral or parenteral Al, rats showed an increase in serum Al concentration but no distribution/accumulation in the brain. Al accumulation was more noticeable in the tibia and femur of parenterally treated rats and nephrectomized rats at 6 months, compared to 3 months.

Conclusion: In renal failure rats, chronic administration of Al resulted in an increase in blood Al level and marked Al increases in liver, kidneys and pancreas, and a marked accumulation in bones. There was no obvious distribution into brain. The trend to bioaccumulation was conspicuous in parenterally treated animals.