Slovak University of Agriculture in Nitra

FACULTY OF AGROBIOLOGY AND FOOD RESOURCES

FACULTY OF BIOTECHNOLOGY AND FOOD SCIENCES

FACULTY OF HORICULTURE AND LANSCAPE ENGINEERING

Scientific Conference of PhD. Students of FAFR, FBFS and FHLE SUA in Nitra with international participation

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Proceedings of abstracts

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Content

Preface

Given the importance of science in agriculture in our daily lives around us, the importance of this new knowledge and its possible interconnection is also important.
Therefore, this conference Proceedings collected selected reviewed abstracts and provides an opportunity for students, scientists and other readers to engage with a selection of referred papers that were presented during the most comprehensive academic scientific conference of PhD. students hold on November 11, 2020 in Nitra, Slovak Republic. Submitted full scientific papers were reviewed and the best papers have been published in The Journal of Microbiology, Biotechnology and Food Sciences, Journal of Central European Agriculture, Slovak Journal of Food Sciences, Acta Fytotechnica et Zootechnica, Acta Horticulturae et Regiotecturae and Archives of Ecotoxicology.
The scientific Conference of PhD. students was organised on the occasion of the Science and Technology Week in the Slovak Republic at the Slovak University of Agriculture in Nitra under the auspices of doc. Ing. Peter Ondrišík, PhD. – dean of the Faculty of Agrobiology and Food Resources (FAFR), prof. Ing. Norbert Lukáč, PhD. – dean of the Faculty of Biotechnology and Food Sciences (FBFS) and prof. Ing. Dušan Igaz, PhD. – dean of Faculty of Horticulture and Landscape Engineering (FHLE).
The main aim of the Conference was to provide a platform for presentation of research findings, exchange of experiences and knowledge sharing. The abstracts were split equally among the eight conference areas:

- Biotechnology
- Animal production
- Applied and molecular biology
- Nutrition
- Multifunctional agriculture, environment, landscape architecture and rural development
- Plant production
- Technology, quality and safety of raw materials and foodstuffs of animal origin
- Technology, quality and safety of raw materials and foodstuffs of plant origin

There is no doubt that each our PhD. conference has encouraged the further advancement of interesting sources through fruitful discussions among students and other participants. Committees hope, that participants find valuable their engagement with various ideas in sustaining their own professional development and education; and that the scientific programme have contributed to increasing the knowledge, improving the future work and building new friendships between PhD. students from different countries as from the broader spectrum of biological sciences.

doc. Ing. Peter Ondrišík, PhD.
Dean of FAFR

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SECTION

Biotechnology

The impact of *Lonicera caerulea* berry extract on human ovarian cells in vitro

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Supervisor: prof. Ing. Adriana Kolesárová, PhD.

Phytochemicals present in functional foods offer great hope as an alternative therapy for many disorders. Blue honeysuckle berries (*Lonicera caerulea*) are a potential but relatively unknown rich source of bioactive substances, including anthocyanins and flavonols, which potentially contribute to their human health-promoting properties and anti-cancer, antioxidant, antibacterial, and anti-inflammatory activities. The aim of this *in vitro* study was to examine the effect of blue honeysuckle berry extract on ovarian cells using the immortalized human granulosa cell line HGL5 and ovarian carcinoma cell line OVCAR-3. The cell viability, the release of steroid hormones (17β-estradiol and progesterone), and the presence of apoptosis-associated proteins (p53 and caspase 3) after blue honeysuckle treatment at the concentrations 12.5, 25, 50, 100, and 200 μg/mL for 24 h were investigated. The ethanol extract from lyophilized berries *Lonicera caerulea var. kamtschatica* was prepared. Cell viability was determined by AlamarBlue™ cell viability assay. The release of 17β-estradiol and progesterone by the cells, and the presence of the human p53 tumor protein, and caspase-3 in the cell culture lysates were evaluated by ELISA method. The blue honeysuckle extract caused any significant ($P > 0.05$) changes in the viability of granulosa cells HGL5 and cancer cells OVCAR-3. Similarly, the release of progesterone and 17β-estradiol was not significantly ($P > 0.05$) affected by blue honeysuckle berry extract treatment. Evaluation of the presence of apoptotic markers p53 and caspase-3 did not show significant ($P > 0.05$) changes in granulosa cells HGL5. On the other hand, the presence of p53 protein was significantly ($P \leq 0.05$) increased at the highest concentration 200 μg/mL of blue honeysuckle berry extract in cancer cells OVCAR-3. Similarly, the significant increase of apoptotic marker caspase-3 at the concentration 50 and 100 μg/mL of the extract in cancer cells OVCAR-3 was detected. Our data show the potential involvement of phytochemicals from *Lonicera caerulea* in apoptosis signaling pathway through the regulation of markers p53 and caspase-3 in ovarian cancer cells *in vitro*.

Key words*: blue honeysuckle, ovarian cells, viability, steroid hormones, p53, caspase-3*

Acknowledgement: This work was supported by the Ministry of Education, Science, Research and Sport of the Slovak Republic projects APVV-18-0312, DS-FR-19-0049, VEGA 1/0266/20, The Excellent scientific team "Center of Animal Reproduction (CeRA)", the Operational Program Integrated Infrastructure within the project: Demand-driven research for the sustainable and inovative food, Drive4SIFood 313011V336, cofinanced by the European Regional Development Fund, and AgroBioTech Research Centre built in accordance with the project Building „AgroBioTech" Research Centre ITMS 26220220180.

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Justification of the use of thermomodified Baltic bream fabrics in the technology of snack products

Madina BAROTOVA

Supervisor: Olga Mezenova

Abstract. The research is aimed at increasing the complexity of the use of fish raw materials, expanding the range of fish snacks and improving their quality. Baltic bream was used as a raw material. The increase in the nutritional value of minced products such as dried snacks from bony Baltic bream was achieved due to its preliminary high-temperature processing and the use of softened bone tissue. Bream tissues without entrails and heads were previously heat treated in a thermoset at a temperature of 120°C and increased pressure 0.15 MPa, lasting 60 minutes, after which the muscle tissue was separated from the bones, it was crushed, and bones were finely ground to a powdery state and dried. The bone composition, together with flour and other food components, was added to the formulation of products based on minced bream muscle tissue. The resulting fish dough was thinly rolled out, molded into different shapes and brought to readiness by hot drying. Ready-made snacks had pleasant organoleptic properties. Bone inclusions and unpleasant flavors were not felt. The technology of snacks is proposed and the recipe based on thermomodified muscle tissues of the Baltic bream and a bone Supplement from its bones is justified. Finished products are recommended for a wide range of people. The practical significance of the work is to develop recommendations for the use of products. The quality indicators of the obtained snacks are justified, and the features of organoleptic indicators are characterized.

Keywords: *Baltic bream, thermomodification, bone powder, snack products.*

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Reutilization of enzymes in CMP-sialic acid (CMP-Neu5Ac) synthetic pathway using magnetics immobilization approach

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Supervisor: Ing. Jozef Nahálka, PhD.

Magnetization of insoluble enzymes is one of novel strategies in the field of saccharide biosynthesis. Amongst the main advantages of the insoluble state of enzyme (e.g. active inclusion bodies) are increased stability, greater recovery for reutilization and, in some cases, higher enzymatic activity. Therefore, magnetization of insoluble enzyme highly increases performance of biochemical reactions. However, it is challenging to find an operational conditions favorable for multiple insoluble enzymes during a single biochemical cascade reaction. CMP-Neu5Ac is a negatively charged member of the sialic acid family with many important biological functions. Successful synthesis of CMP-Neu5Ac is one of the key intermediate steps in further synthesis of sialyl glycoconjugates by sialyltransferases, where CMP-Neu5Ac serves as a main substrate. This experiment uses a magnetic-based approach of bounding insoluble enzymes in the form of active inclusion bodies on manganese or iron particles. Subsequently, enzymatic cascade consisted of four enzymes (polyphosphate kinase-PPK, cytidylate kinase -CMK, sialic acid aldolase- SAA and CMP-Neu5Ac synthetase-CSAS). Biochemical conditions were optimized in favor of all enzymes. The presence of synthetized CMP-Neu5Ac was observed by capillary electrophoresis. Experiment was split in three separate batches, where the first „one pot“ batch contained all four immobilized enzymes whereas the second batch used separated synthesis of CTP followed by CMP-Neu5Ac synthesis. In the third batch, PPK, the most sensitive enzyme, was optimized alone.
After several cycles of reutilization in the „one pot“ pathway, all enzymes retained their activity and CMP-Neu5Ac became synthetized. Nevertheless, the final concentration of CMP-Neu5Ac was low (5mM) and it kept decreasing by each cycle. Therefore, for higher final yield of CMP-Neu5Ac in „one pot“ synthesis, further optimization is required. Two step synthesis of CMP-Neu5Ac in second batch proved to be more efficient with final CMP-Neu5Ac concentration around 10mM in each of 10 cycles. In the third batch, magnetized PPK was recycled 20 times. After each cycle, the synthetized CTP was transformed to CMP-Neu5Ac by whole cells in separate reaction, CMP-Neu5Ac final concentration reached approximately 20mM.

Key words*:* *immobilization, magnetization, reutilization, active inclusion bodies, CMP-Neu5Ac*

Acknowledgement: Work was supported by the projects VEGA 2/0058/17 and APVV-18-0361; by the Research and Development Operational Programme, ITMS 26220120054

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The effect of cornelian cherry on glycaemia, feed and water intake in ZDF rats

Rudolf DUPÁK

Supervisor: prof. Ing. Marcela Capcarová, PhD.

Cornelian cherry (*Cornus mas* L.) is one of the traditional plants with delicious fruit having nutritional and therapeutic values. Several studies have shown that *C. mas* could be used in prevention of hyperglycaemia, reduction of fat accumulation, atherosclerosis or used in treatment of inflammatory, urinary tract infections, heat stroke and cancer. *C. mas* is characterized by antimicrobial, antiparasitic, anti-inflammatory, antioxidant and anticancer effects. The aim of the study was to observe the effects of *C. mas* pulp in Zucker diabetic fatty (ZDF) rats (*fa/fa*). Male ZDF rats (n=40) were divided to 4 groups, non-diabetic (lean) negative control (*fa*/+), diabetic positive control and two experimental groups. *C. mas* was applied orally using a gastric probe in two doses (E1=500 and E2=1000 mg/kg body weight) in the experimental groups. The study focused on observing the glycaemia, body weights, feed and water intake in ZDF rats, which are important indicators when examining type 2 diabetes. The feed, water intake and body weight were monitored once per week. Glucose was measured once per two week from one drop of blood, which was collected from the tail vein. Duration of the experiment was 10 weeks. Significantly higher values ($P < 0.05$) were found in E1 and E2 groups against the lean during the whole experiment when monitoring the body weights. Groups treated with *C. mas* developed obesity and their body weight rose uniformly, similarly as in the lean rats. The E2 group had significantly higher ($P < 0.05$) body weights against the control in 7th week and from both E1 and E2 groups in 8th week of the experiment. Feed intake in C, E1, E2 groups was significantly higher ($P < 0.05$) against the lean. Feed intake in the C group did not change ($P > 0.05$) when compared to E1 and E2 groups. Observation of water intake showed significantly lower ($P < 0.05$) levels in the experimental groups treated with *C. mas* when compared to the positive control. The results of glycaemia showed that the blood glucose level was supressed in the both experimental groups when compared to the C group during the whole experiment and significantly lower ($P < 0.05$) values were found in the 5th and 7th week of the experiment between E2 and C groups. Our results showed that regular consumption of cornelian cherry improved blood glucose levels; however duration of the experiment and dosing need further studies.

Key words: *cornelian cherry, feed intake, glucose, water intake, ZDF rats*

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Isolation of a partial gene sequence encoding myrosinase gene from *Cardaria draba* (*Lepidium draba* L.)

Veronika MIKITOVÁ

Supervisor: Jana Libantová

Species of family Brassicaceae are a rich source of protective compounds glucosinolates, that convert into isothiocyanates (ITC) in the presence of a enzyme myrosinase. Under normal conditions, glucosinolates are being scattered in the vacuoles of most organs while the myrosinase occurs only in specific cells along the plant vascular system. Following physical damage of plant tissue, the glucosinolate–myrosinase tandem produces isothiocyanates - an efficient defense against herbivores and pathogens. For humans, isothiocynates are well known for their anti-carcinogenic, anti-inflammatory, immunomodulatory, anti-bacterial, cardio-protective, and central nervous system protective activities. Myrosinases (thioglucoside glucohydrolase, EC 3.2.3.147) in plants are encoded by a multigene family. Up to date, they have been isolated and characterized from more than 20 species of *Brassica* species. In *Arabidopsis thaliana* there were identified 6 genes for myrosinases; TGG1 and TGG2 genes with expression in above-ground tissues and TTG4, TGG5 genes with expression in roots. The TGG3 and TGG6 genes were identified as pseudogenes. Here we focus on the investigation of the occurence of genes for mysorinase in unexplored species *Cardaria draba* (syn. *Lepidium draba* (L). Link), which belongs to the family Brassicaceae. It is commonly known as whitetop or hoary cress. Although this perrennial herb is native to South Europe, currently is disseminating throughout most Europe, where grows on open places, in fields, meadows, and along roadsides. Numerous white flowers give the plant a white flat-topped appearance. To detect the presence of myrosinase genes in genomic DNA of *C. draba,* the polymerase chain reaction (PCR) approach and two sets degenerate primers were used. The former and latter set of primers were designed in conservative regions of TGG1, TGG2 and TGG4, TGG5 genes, respectively. The PCR on genomic DNA *C. draba* template resulted in the PCR products that were sequenced. *In silico* analysis of corresponding sequences (829 bp and 302 bp) revealed the presence of at least two myrosinase genes in genome of *C. draba.* They showed the highest similarity to TGG2 gene (E value $6e^{-62}$) and TGG4 (E value 0.007). These DNA sequences will be used ad a template for design of myrosinase specific primers and subsequent isolation of the complete DNA and cDNA sequences of correspnding myrosinase genes.

Key words*: Cardaria draba, gene isolation, glucosinolates, isothiocyanates, myrosinase*

Acknowledgement: The work was supported by APVV project 16-0439.
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Use of spectral methods for diagnostics of disorders of glycoconjugate metabolism

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Supervisor: Mgr. Stanislav Kozmon, PhD. and Mgr. Peter Baráth, PhD.

Metabolic disorders are group of inherited diseases with multiple organ involvement. The symptoms expressed vary with the type of disorder. However, their common feature is an accumulation of specific precursor and a lack of its metabolite. Identification of such precursors/substrates is suitable for diagnostics and monitoring of these diseases. Spectral methods, such as Mass Spectrometry (MS) and Nuclear Magnetic Resonance Spectroscopy (NMR), are often used for accurate diagnostics. Primary goal of our work is an identification of metabolites that can be considered as biomarkers with high specificity. Glycans, which can be found in increased concentration in urine or serum samples, are suitable biomarkers for a group of disorders of glycoconjugate metabolism. Series of urine samples as positive controls were analysed with Matrix-assisted laser desorption/ionization - Time of Flight (MALDI-TOF) and Two-dimensional NMR (2D-NMR) methods and further used for subsequent diagnostics. Advantage of urine analysis is a non-invasive sample collection and relatively fast sample preparation, especially for NMR experiments. In this work we present representative results from diagnostics of mucolipidosis (ML1, ML2) and mucopolysaccharidosis (MPS) IVA (Morquio A). Sample preparation for tandem MALDI TOF/TOF analysis included permethylation of urinary oligosaccharides. Permethylation is the most reliable derivatization method leading to an increased signal intensity and stabilization in the ion source. Samples were analysed in reflectron positive ion mode. Acquired spectra were interpreted with *GlycoWorkbench* (www.eurocarbdb.org) software. For NMR measurements, urine samples were freeze-dried. After dissolving in a buffer a series of selective One-dimensional NMR (1D-NMR) and 2D-NMR experiments were used for signals attribution. In MALDI-TOF spectra of urine sample from ML1/ML2 patients, characteristic signals of oligosaccharides of N-Acetylhexosamines, Hexoses and Sialic acid were obtained in increased intensities. ^{1}H- ^{13}C hetero-correlated Heteronuclear single quantum coherence (HSQC) NMR spectra confirmed the presence of mannose and N-Acetylglucosamine anomeric H1/C1 signals in oligosaccharides specific for ML1/ML2. Moreover, signals due to terminal (2-3) and (2-6) sialic acid were resolved and could be quantified. Comprehensive characterization of MALDI-TOF and NMR spectra enabled the determination of oligosaccharide fingerprint for each previously mentioned disease which can be used in the future diagnostic approach.

Key words: *metabolic disorders, Nuclear Magnetic Resonance, Mass Spectrometry*

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Changes in polyphenol content in white lupine induced by the addition of inoculant

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Supervisor: prof. RNDr. Alena Vollmannová, PhD.

This work was focused on changes in the total content of polyphenols and the change of total antioxidant capacity of white lupine seeds induced by the addition of inoculant. The evaluated material consisted of 11 varieties of white lupine which are foreign origins. Rizobine was used as an inoculant. Extracts from plant material were prepared using 80% methanol by Twisselmann extractor. Subsequently, we determined the total polyphenol content by a spectrophotometric method using a Folin-Ciocalteu agens according to Lachman (2003). From the measured values we found that the average total content of polyphenols (TPC) in the dry matter of white lupine seeds in the control variant A was 6683.84 mg. kg^{-1} and in the variant B with the addition of inoculant its content decreased to 6462.76 mg. kg^{-1}. The highest TPC content was recorded for the Satmarean variety (ROM) in both variants. The lowest TPC in A variant 4373.12 mg. $kg^{-1}$and in the B variant 5446.82 mg. kg^{-1} was found in the variety Nelly (HUN). There are no statistically significant differences between the pairs of means at the 95.0% confidence level in the comparison of the control A variant and the B variant with the addition of inoculant. The total antioxidant activity was determined by the method of Brand-Williams (1995). The total antioxidant activity (TAC) in investigated white lupine seeds ranged from 8.80% in variety WTD (POL) to 12.25% in the varieties Astra (CHL), R-993 (POL) 12.25% in the control A variant. By adding the inoculant, the TAC content varied between 8.73% in the variety Nelly (HUN) to 15.65% in the variety Solnecnyj (SUN). Based on our results it can be concluded that the inoculant has a statistically significant effect on the TAC in lupine seeds at a 95.0% confidence level.

Key words: *lupine, polyphenols, inoculation*

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SECTION

Animal Production

Differences and success in artificial insemination of goshawk in two different breeding centers

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Supervisor: doc. Mgr. Peter Juhás, PhD.

The article deals with the possibility of insemination of the goshawk in selected falconry centres in Slovakia (Falconry Kanát) and Italy (La corte dell´Astore). Most breeders, when rearing a goshawk, choose the insemination procedure instead of breeding in pairs. The reason is the frequent killing of the male by the female during the breeding season. The insemination process consists of two main parts, the semen collection and subsequent insemination. Both parts of the process can be carried out in a so-called non-forced or forced manner. In this paper we describe different methods of goshawk insemination according to available possibilities of breeders from two different countries and subsequent success of given methods. We can evaluate that in both observed falcontry centers the appropriate care for the birds of prey is in the first place. All centers meet and implement the recommended methods of prevention, which we point out in the theoretical basis of the work. The Italian centre used a non-compulsory method and kept all eggs under the female, the Slovak centre proceeded with forced insemination and placed certain eggs in the hatchery. By this method, the females induced the need for additional replacement laying and thus the probability for the production of more eggs has been increased. The female in Slovakia had 6 laid eggs and the female in Italy only 4. Based on the number of eggs laid and the subsequent successful rearing of chicks (3 chicks in Slovakia 2 chicks in Italy) we can evaluate that in both centres there is a directly proportional number of eggs laid with the number of reared chicks. From this view, we could assess that both centres had a 50% success rate and the centres were equally successful in 2018. However the decisive factor for us was the number of raised young birds and in 2018 the Slovak centre was more successful in this metric, having raised three young goshawks.

Key words: *goshawk, breeding birds of prey, falconry, semen collection, artificial insemination*

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The effect of different rabbit doe´s nutrition on the growth rate of rabbit pups during lactation

Mária KALÚZOVÁ, Branislav GÁLIK

Supervisor: prof. Ing. Branislav Gálik, PhD.

The aim of the research was to analyze the effect of nutritional different feed mixtures, intended for rabbit does nutrition, on changes in the live weight of rabbit pups during milk intake. While in small rabbit farming rabbits are most often fed with native feeds, intensive production systems feed rabbits with almost exclusively balanced feed mixtures to fulfill their nutritional requirements in order to optimize rabbit production and feeding technique. In this research, was focus on the change in growth rate of rabbit pups, which achieved through mothers milk by using two different feed mixtures in does feed ration. The feed ration of does consisted of feed mixtures with different composition and nutritional value (FM 1 and FM 2), barley and meadow hay. The nutrient composition of individual feeds used in the experiment using laboratory methods performed in the Laboratory of quality and nutritive value of feeds of the Department of Animal Nutrition, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra was analysed. The analysis showed that FM 1 had a higher fiber and fat content and lower ash content than FM 2. Then live weight of rabbit pups by weighing them at weekly intervals until the age of 22 days was observed. In the experiment, crossbreed of Nitra, Siamese and American Sable rabbits, specifically one buck and two doe´s were used. A total of 33 pups were weighed, of which 22 were from doe B and 11 from doe A. After the average litter weights comparison, a lower live weight in all weighings after the FM 2 feeding were found. On the other hand, the feeding of FM 1 did not prove a negative effect on the growth rate of the pups even in the case of the performed test.

Key words: *domestic rabbit, growth rate, feed mixtures*

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The effect of a new queen on the risk of bee colony winter losses

Ladislav KOHÚT

Supervisor: doc. Ing. Róbert Chlebo, PhD.

An increasing amount of honey bee colonies losses during the winter period is a worldwide problem affecting every beekeeping operation. The increase of the winter colony losses is caused by multiple factors, including pesticides, climatic changes, mutual effect of different pathogens and different beekeeping practices. In this study we decided to focus on one of the beekeepers practices, the effect of a queen replacement frequency. Data from Slovakian apiaries during 5 seasons (from 2019/2018 to 2015/2014) using 1719 datasets in total were analysed. Data were obtained from standardized COLOSS questionnaire.
Beekeepers who replaced more than 50% of queens annually faced lower bee colony losses comparing with those, who replaced lower percentage of queens or left colonies to change queens spontaneously. Apiaries where queen replacement share reached more than 50% faced 9.52% winter losses only comparing with 21.01% average winter losses on the apiaries with lower replacement frequency in the season 2019/2018. The same trend was confirmed in other seasons: 8.69% to 10.53% in 2018/2017; 12.83% versus 19.94% in 2017/2016; 6.31% versus 9.96% in 2016/2015 and 6.45% versus 11.79% in 2015/2014.According to these results, it is possible to say, that more than 50% of queen replacement leads to better wintering of the bee colonies. It is mostly caused by the ability of the young queen to provide enough amount of young bees required for successful wintering. Also, in colonies with the young queen, there is less level of infestation of the parasitic mite *Varroa destructor*, which can significantly affect the health and wintering of bee colonies.

Key words*: queen replacement, winter losses*

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Effect of birth season, birthweight and preweaning weight gain of calves on their first lactation milk yield

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The aim of the study was to investigate the effect of calves' birth season, birth weight and preweaning weight gain on their first lactation milk yield, as some authors assign their impact to the mechanisms of epigenetics. The examined animals, 116 records, were from the farm located in Lower Váh region (Western Slovakia). The examined data were collected in years 2015 – 2017. The herd consisted of Slovak spotted breed. The calves were housed in individual calf hutches (for 80 days). For the first 5 days they were fed with colostrum and subsequently by whole milk, until they were 21 days old. Later the calves were offered milk replacer (util 80 days of age). The average first lactation 305-d milk yield in the observed herd was 7585 ± 1124 kg. In the study, the factor of birth season was divided into four categories: winter (December to February), spring (March to May), summer (June to August), autumn (September to November). Concerning the birthweight four groups were set up (low: 30-36 kg; medium: 37 – 40 kg; high: 41 – 42 kg; highest: 43 and more kg), as well as regarding weight gain (low: 0.2-0.54 kg/day; medium: 0.55 – 0.64 kg/day; high: 0.65 – 0.74 kg/day; highest: 0.75 and more kg/day). The average age of calves at weighting was 55.7 ± 4.7 days. The effect of birth season, birth weight and the weight gain until the first weighting on the 305-d milk yield were found to be insignificant ($P > 0.16$; $P > 0.52$; $P > 2.0$; resp.). Nevertheless, we observed that calves born in summer had the numerically lowest milk yields during first lactation (7332 ± 251 kg) as compared to calves born in winter (7896 ± 215 kg). Moreover, calves with the lowest birth weight were characterized by the numerically lowest milk production at their first lactation (7303 ± 213 kg), with more than 400 kg lower milk yield compared to the category of the heaviest calves (7743 ± 221 kg). Moreover, calves with the highest weight gains were also numerically the most productive at their first lactation (7921 ± 203 kg), compared to all other examined categories (low: 7293 ± 226 kg; medium: 7567 ± 225 kg; higher: 7475 ± 214 kg). To conclude, although our results did not reach statistical significance they may point out to the relation between early life environment of born heifers and their future performance as dairy cows.

Key words: *season of birth, birth weight, weight gain, calves, milk yield, preweaning, first lactation*

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Changes in locomotion activity and rumination of dairy cows during estrus

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Supervisor: prof. Ing. Peter Strapák, PhD.

The aim of the experiment was to analyse changes of locomotion activity and rumination time in dairy cows by using the Heatime RuminAct technical equipment. Basic measurements of locomotion activity and rumination time of cows were performed at the dairy farm in University of Agriculture in Nitra, where a comprehensive technological device Heatime RuminAct with DataFlowTMII software is installed. We evaluated the effect of estrus in activity in 24 hours on the basis of background data of 423 estrus cycles of Holstein dairy cows during the reference period of 3 days before estrus, 3 days after estrus and on the day of the estrus occurrence. Locomotion activity of dairy cows was expressed in units of locomotion activity in 24 hours and we evaluated the rumination on the basis of the total rumination time in 24 hours. An average locomotion activity on the 3rd day before the estrus was 508 u.24h^{-1}, 523 u.24h^{-1} on the 2nd day before estrus and on the 1st day before the estrus there was a more significant increase in the locomotion activity to 590 u.24h^{-1}, which was probably due to the onset of estrus and the gradual increase in the estrogen level in the blood. Due to the onset of a full-fledged estrus, there was a significant increase in the locomotion activity of the dairy cows to 820 u.24h^{-1} on the day of the estrus, which represented an increase of + 39 % (+230 u.24h^{-1}) compared to the values of locomotion activity recorded one day before estrus. After the end of the estrus, we observed an immediate significant decrease in the locomotion activity of the dairy cows to 518 u.24h^{-1} already one day after the end of the estrus. On the 2nd day after the estrus we recorded the value of locomotion activity 508 u.24h^{-1} and on the 3rd day after the estrus 510 u.24h^{-1}. In the evaluation of the impact of estrus on changes in the rumination time of dairy cows, we found an average value of 476 min.24h^{-1} on the 3rd day before the estrus, 475 min.24h^{-1} on the 2nd day before estrus and 469 min.24h^{-1} one day before estrus. On the day of the peak of the estrus, the total time of rumination of dairy cows was reduced to 466 min.24h^{-1}. After the end of the estrus, we recorded an increase in the time of rumination of dairy cows from 466 min.24h^{-1} to 471 min.24h^{-1} on the 1st day after the estrus. The values of rumination of the dairy cows acquired relatively balanced values after the end of the estrus, namely 470 min.24h^{-1} on the 2nd day after the estrus and 469 min.24h^{-1} on the 3rd day after the end of the estrus. The results of the experiment confirmed a significant increase in locomotion activity and a decrease in rumination time of cows during estrus. Based on this, we recommend the use of the Heatime RuminAct device to increase the reliability of searching for cows in estrus on dairy farms.

Key words: *dairy cows, Holstein, estrus, rumination, locomotion activity, Heatime RuminAct*

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SECTION

Applied and molecular biology

The *in vitro* impact of linoleic acid on the endocrine function of rabbit testicular tissue

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Supervisor: prof. Ing. Norbert Lukáč, PhD.
Specialist: Ing. Eva Tvrdá, PhD.

The application of natural substances in the field of reproductive biology has become more popular in recent years. Their positive properties could affect the production of male reproductive hormones in the testicular tissue. The objective of our experiment was to assess the effect of linoleic acid (LA) on the endocrine function of rabbit testicular tissue under *in vitro* conditions. LA is a polyunsaturated essential fatty acid found especially in plant oils, nuts and seeds. It is a colorless white oil insoluble in water. LA is commonly found in the lipids of cell membranes and plays a main role in the metabolism of lipid radicals. In this study we used testes from sexually mature Hyla Hyplus rabbits (n = 3). The testes were removed by opening the abdominal cavity and pulling out of the scrotum. Then, cut into smaller testicular fragments by using scalpel and cultivated in the D-MEM medium enriched with different concentration of LA (1000; 500; 100; 50 and 10 μmol/L) at 37°C (5% CO_2) for 24 hours. After cultivation the medium was separated and the level of cholesterol (CHOL) was measured spectrophotometrically. The concentrations of male reproductive hormones (testosterone – TEST; dehydroepiandrosterone – DHEA; androstenedione – ANDRO) were quantified using the ELISA method and commercial kits. The evaluation of the results showed a slight increase of steroid biomolecules in the groups supplemented with 100, 50 and 10 μmol/L of LA, but none was significant against the control group. Based on our results we may conclude, that LA does not have any negative or side effects on the endocrine function of rabbit testicular tissue and does not affect the concentrations of male steroid biomolecules under *in vitro* conditions. For future experiments, we would like to analyse the effects of different concentrations of LA on a different cell or tissue model.

Key words: *linoleic acid, rabbit, testicular tissue, male hormones*

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Preparation of glycan surfaces and their application

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Glycans belong to the basic cellular molecules. Glycosylation is a post-translational enzymatic modification of proteins and lipids. Changes in the glycosylation process suggest a pathological condition in the cell. The presence of aberrant glycans (GalNAcal-O-Ser / Thr – Tn antigen, Neu5Acα2-6GalNAcα-O-Ser / Thr – sialyl-Tn antigen, Galβ1-3GalNAcα1-O-Ser / Thr – T antigen) has been demonstrated in many cancers (prostate, stomach, colon, lungs, oesophagus etc.) and aberrant antigens (Tn, T, sTn) are usually associated with a poor prognosis and a reduced overall survival. By detecting autoantibodies, generated by the immune system against aberrant glycans, which take place in the body before the first effects of the disease, it is possible to predict the development of the disease. The earlier the diagnosis, the sooner it is possible to intervene and thus increases the chances of survival.
Biosensors are devices which use a biological recognition element retained in a direct spatial contact with a transduction system. According to IUPAC definitions, a biosensor analytical device that needs to be funded with specific quantitative or semi-quantitative analytical information. The biosensor contains a sensitive element of biological origin (bioelement) or a receptor, which is either part of or in close contact with the physicochemical transducer. Electrochemically activated surfaces of electrodes with oxygen functional groups were used for covalent immobilization of human serum albumin (HSA) and the glycan – Tn antigen. We detected antibody and lectins by applying electrochemical methods. We monitored the electrochemical behaviour and various surfaces treated by cyclic voltammetry (CV) under different conditions. Differential pulse voltammetry (DPV) was used to investigate the interactions between the aberrant glycan and the antibody, respectively between glycan and lectin. The developed biosensor has detected analytics with high selectivity and sensitivity down to the atomic level. Finally, we studied the interactions and kinetics of glycan-protein interaction using surface plasmon resonance (SPR). After fitting SPR data, we obtained various kinetic constants - the dissociation constant of a complex, and moreover the kinetic constants of its formation and decay. In conclusion, the developed biosensor has detected analytics with high selectivity and sensitivity down to the attomolar level.

Key words: *antibodies; antigens; biosensors; cancer diagnostics; electrochemistry; glycans;*

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Antimicrobial and cytotoxic activity of essential oils on different cell models

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Majority of people have been using natural plant substances in everyday life. Even as food supplement, in cosmetics or to increase a health condition. Essential oils are extendedly used because of their broad-spectral properties. Health benefits are known for centuries, but with increasing scientific possibilities, the interest about specific bioactive compounds contained in specific plants started to grow. Potential therapeutic effects could have important role in suppression of the growth pathogenic microorganism and also in inhibition of cancer cells proliferation. Four essential oils were chosen for testing of potential antimicrobial and cytotoxic activity. The Basil (*Ocimum basilicum*), Eucalyptus (*Eucalyptus globulus*), the Silver fir (*Abies alba*), and the Thyme (*Thymus zygis*) essential oil. Inhibitory activity of essential oils was determined by two methods. Disk diffusion method was used for testing of antimicrobial activity of chosen pathogenic microorganisms: gram-negative (*Salmonella enterica* subsp. *enterica* CCM 3807, *Pseudomonas aeruginosa* CCM 1960, *Yersinia enterocolitica* CCM 5671), gram-positive *(Staphylococcus aureus* subsp. *aureus* CCM 2461, *Clostridium perfringens* CCM 4435, *Listeria monocytogenes* CCM 4699), and yeasts (*Candida albicans* CCM 8186, *Candida krusei* CCM 8271, *Candida tropicalis* CCM 8223). Cytotoxic effect of essential oils on three cancer cell lines (HeLa (ATCC® CCL-2 ™), PANC-1 (ATCC® CRL-1469™), and MDA-MB-231 (ATCC® HTB-26™)) was determined by MTT test. Cells were incubated with concentration range 12,5–200 μg/mL of each essential oil and IC_{50} was calculated. The strongest antimicrobial activity was observed against *Clostridium perfringens*, the common gram-positive human pathogen. All four essential oils showed antimicrobial activity especially against gram-positive organisms, but also against gram-negative. Inhibitive activity against yeast was mild compared to bacteria. MTT test showed that concentration that inhibited the 50% of cancer cells ranged from 32.6 to 46.8 μg/ml. All of the essential oils were effective against selected three types of cancer cell lines.

Key words: *essential oils, antimicrobial activity, cytotoxic activity*

Acknowledgement: Work was supported by the grants VEGA 1/0180/20 Study of the properties and biological activity of essential oils in the cell model.

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Staphylococcus-induced bacteriospermia and its effects on bovine spermatozoa

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Previous studies on bacterial load in bovine semen showed the prevalence of *Staphylococcus* species. Therefore, the present study is focused on the effect of induced bacteriospermia by selected 7 *Staphylococcus* species on selected structural and functional alterations on spermatozoa. Isolates of *S. haemolyticus*, *S. warneri*, *S. lentus*, *S. epidermidis*, *S. kloosii*, *S. cohnii* and *S. aureus* were selected based on previous studies. Bovine semen samples came from breeding bulls kept in a breeding centre (Slovak Biological Services, a.s., Lužianky). Immediately, samples were subjected to density gradient separation using Percoll PLUS to separate seminal plasma along with seminal bacteriocenoses. Bacterial species isolated from bovine semen samples were diluted to 0.5 McF and co-incubated with spermatozoa, while held at 37°C during 4 hours. Subsequently, sperm motility, reactive oxygen species (ROS) production, DNA fragmentation, mitochondrial membrane potential, concentration of Magnesium (Mg) and Calcium (Ca) ions were measured. One-way ANOVA followed by Dunnett's comparison test were used to express arithmetic mean ± standard error of mean of obtained data. Spermatozoa motility significantly decreased in all groups treated with bacteria. On the other hand, ROS production significantly increased in all experimental groups when compared to the control group. The highest increase of sperm DNA fragmentation was observed in the group with *S. aureus*. On the contrary, the lowest mitochondrial membrane potential ($P<0.001$) and Mg concentration ($P<0.001$) was detected in the group treated with *S. cohnii*. Ca concentration significantly ($P<0.001$) decreased in the presence of *S. kloosii* and *S. epidermidis*. In conclusion, bovine spermatozoa exposed to increased concentrations of *Staphylococcus* species face structural alterations due to the milieu changes which lead to a decreased fertility.

Key words: *bovine spermatozoa, bacteria, Staphylococcus, Percoll PLUS, ROS production*

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Changes in inflammatory markers production by HUVEC cells after treatment with zymosan and amygdalin

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Supervisor: prof. Ing. Norbert Lukáč, PhD.

Amygdalin is a cyanogenic glycoside, naturally occurring mainly in the kernels of many plants, including almonds with a bitter-flavored phenotype or apricots. Many studies describe the effect of amygdalin on cancer cells and tissue. However, since the direct effect of amygdalin on healthy endothelium and its effects in the inflammatory response of the body are not sufficiently documented, in the present research we focused on this issue and tried to clarify aspects of the anti-inflammatory effect of this organic glycoside. In the experimental part, we first induced the inflammatory process with zymosan, applied *in vitro* on model human umbilical vein endothelial cells (HUVECs). Subsequently, we monitored changes in the production of selected cytokines by biochip analysis and ELISA method at various concentrations of amygdalin (1; 5; 7.5 and 10 $mg.ml^{-1}$) in combination with 0.01 $mg.ml^{-1}$ of zymosan. We selected IL-1α, IL-1β, IL-6 and MCP-1 for this experiment as characteristic molecular markers of inflammation secreted by vascular endothelial cells. The production of the given pro-inflammatory molecules had a decreasing tendency, depending on the exposure dose of the test substance. IL-1β and MCP-1 reached the values of the control group at the highest selected concentration of amygdalin, but also the viability of the model cells was reduced in this case. Following the results of the MTT test of cell viability as a very important factor, we concluded that the introduction of additional gradients in the range of selected concentrations of 7.5 and 10 $mg.ml^{-1}$ in the following studies could achieve an effective dose of amygdalin without signs of cytotoxicity. The addition of the scale between specific concentrations of amygdalin is explained by the fact that in our conditions it proved its anti-inflammatory character in some cytokines, such as IL-1α, already in a gradient of 7.5 $mg.ml^{-1}$, while the viability of intravascular cells was not endangered.

Key words*: amygdalin, HUVEC cells, zymosan, inflammation, interleukins*

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Ovarian hormones and their influence on gut barrier markers and antibody response against intestinal commensals

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Supervisor: MUDr. Miloslav Kverka, Ph.D.

The hormonal system affects the reactivity of the immune system and the integrity of epithelia. In this study we analyzed the effect of loss of ovarian hormones or their supplementation on biomarkers of intestinal barrier function and antibody response against intestinal commensal bacteria. We collected blood samples from 20 patients before and 6 months after bilateral adnexectomy (BAE) to study the effect of loss of natural hormonal regulation on barrier function of the gut. The effect of hormonal therapy (HT) was examined by comparing the group of patients long time after BAE and 6 months after the initiation of HT with the group of patients short time after BAE and without hormonal therapy. Biomarker analyzes were performed on a serum samples using commercially available sandwich ELISA kits. For the analysis of anti-commensal antibody response, we used an in house developed indirect ELISA method. After the analysis of the data we found out that BAE led to a significant reduction in serum MMP-9, which was not further altered by HT. In contrast, HT led to a significant increase in TFF-3 marker and significant decrease in CD14. None of the monitored interventions (BAE and HT) led to a change in the response against commensal microbes in the IgA or IgM isotype. However, HT led to a reduction in the antibody response in the IgG isotype against the genera *Blautia, Eubacterium* and *Escherichia*. Our conclusions show that hormonal therapy increases the serum biomarker of the intestinal barrier integrity TFF-3 and decreases the serum level of the inflammatory biomarker CD14 and also decreases the intensity of responses against some of the intestinal commensals in the IgG class. From the results so far, we can conclude that HT improves gut barrier function and reduces the readiness for inflammation. Furthermore, it is apparent that neither BAE nor HT lead to an alteration of the antibody response against intestinal commensal bacteria in the IgA or IgM isotype, but BAE causes significant reduction in levels of MMP-9 in serum.

Key words: *biomarkers, antibody response, ELISA, bilateral adnexectomy, hormonal therapy, gut barrier, commensal bacteria*

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Glycomic analysis of children serum samples with ADHD disorder using lectin-based microarray and MALDI-TOF-MS methods

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Supervisor: Ing. Jaroslav Katrlík, PhD.

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder that manifests in patients with signs of inattention, impulsivity, and hyperactivity. Glycosylation is characterized as posttranslational modification of proteins. Changes in glycosylation are associated with the onset and development of many disorders and their monitoring is important in terms of the development of new approaches for research and diagnostics of neurodevelopmental disorders. We focused on glycomic analysis of samples from patients with ADHD. We compare the glycan profile of serum samples from patients with ADHD (n = 10) and the control group (n = 10) in 3 types of samples. After using the depletion kit for preparing the sera, we obtained depleted sera samples (without IgG and albumin); after using column with Protein A, we obtained second type of sample: IgGs (Immunoglobulin G). The third type of sample was whole serum. Lectins are a family of proteins that bind specifically to certain glycans. We used this type of biorecognition in the analysis of patient serum samples by a microarray method based on lectins. We prepared a glycoprotein microarray biochip by application of the samples, incubated it with a set of biotinylated lectins, and then with a fluorescent marker conjugated to streptavidin. Mass spectrometry (MS) is a standard method used in glycomic analysis. Samples, which we adjusted according to the protocol (release, purification and derivatization) before the MS measurement itself, were analyzed by the MALDI-TOF MS method in positive-ion reflectron mode. Conclusions drawn from the analysis of both methods are mutually consistent, they also coincide with the conclusion of the work devoted to similar research. Glycomic analysis is one of approaches that can significantly help in the research, effective diagnostics and also treatment of this disorder. The microrray method also enables high-throughput screening of potential biomarkers.

Key words: *lectin, microarray, MALDI-TOF MS, ADHD*

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Evaluation of the dose-dependent activity of bisphenol F on viability parameters and steroidogenesis in H295R cells

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Supervisor: prof. Ing. Norbert Lukáč, PhD.

Increasing concern over bisphenol A (BPA) as an endocrine-disrupting chemical and recent imposition of restriction on the use of BPA paved the way for entry of its analogues in the market. Bisphenol F is one of the major analogues of commercial value. Thus, its increasing production and application makes it vulnerable to human exposure. Although much information on the endocrine activity of BPA is available, a proper human hazard assessment of analogues that are believed to have a less harmful toxicity profile is lacking. The aim of our in vitro study was to assess the potential effect of BPF on H295R cells mitochondrial activity, metabolic activity, membrane integrity, lysosomal function and testosterone synthesis. Mitochondrial activity was evaluated using MTT test, triple assay was used in order to assess cell viability parameters, and quantification of testosterone was performed by the enzyme- linked immunosorbent assay. Adrenocortical carcinoma cells were cultivated during 24 h in the presence of BPF (0.1, 0.5, 1, 10, 25, 50, 75, 100, 300, 500 μM). Exposure doses of BPF caused a significant decrease of mitochondrial activity from 10 μM (10 μM = 93.64 ± 0.46 %; 25 μM = 93.64 ± 0.46 %; 50 μM = 93.64 ± 0.46 %; 75 μM = 93.64 ± 0.46 %; 100 μM = 93.64 ± 0.46 %; 300 μM = 93.64 ± 0.46 %; 500 μM = 93.64 ± 0.46 %), we observed a slight increase in esterase activity at the lowest concentration (0.1 μM). Metabolic activity decreased with increasing dose of BPF - from 10 μM (10 μM = 84.33 ± 4.31 %; 25 μM = 83.01 ± 2.23 %; 50 μM = 77.72 ± 2.80 %; 75 μM = 71.60 ± 3.59 %; 100 μM = 72.80 ± 1.52 %; 300 μM = 87.32 ± 2.67 %; 500 μM = 43.87 ± 2.87 %). A significant increase in metabolic activity after 24 hours of exposure was observed after cultivation with 0.1 μM BPF (111.50 ± 3.89 %) and a slight was observed after cultivation with 1 μM BPF (101,70 ± 1.61 %). We observed a slight increase in lysosomal function and membrane integrity after cultivation with 0.1 and 1 μM, higher exposure doses (25 – 500 μM) caused significant decrease in membrane integrity and lysosomal function. Lowest exposure dose of BPF (0.1 μM) caused a significant increase of testosterone synthesis - 111.80 ± 1.79 %, higher exposure doses (50 – 500 μM) caused significant decrease of testosterone production (50 μM = 87.98 ± 1.29 %; 75 μM = 72.01 ± 0.98 %; 100 μM = 65.25 ± 2.22 %; 300 μM = 63.33 ± 1.20 %; 500 μM = 56.22 ± 0.80 %). The obtained results confirmed that BPF at higher concentrations caused cytotoxicity. A substitution of BPA by BPF should be thus considered with caution.

Key words: *BPF, H295R, mitochondrial activity, metabolic activity, lysosomal activity, membrane integrity, testosterone*

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Detection of the effect of ellagic acid on the selected parameters of rats spermatozoa

Ján KOVÁČ

Supervisor: Ing. Eva Tvrdá, PhD.

For many decades, most of diseases have been effectively treated by using synthetic chemicals, such as drugs. Naturally, from ancient to modern history plant based medicines have an important role in health care. Phytochemicals are natural bioactive compounds found in fruits, vegetables, leaves, flowersm roots, aromatic plants and medicinal plants and generally play a role during plant growth or defense against competitors, pathogens or predators. Ellagic acid is a natural dietary polyphenol known for its beneficial effect in a variety of diseases shown in epidemiological and experimental studies involve anticarcinogenesis, anti-angiogenesis, anti-inflamation, anti-oxidation and anti-proliferation properties. The objective of the present work is to estimate the impact of three different concentrations (10 μmol/L; 25 μmol/L; 50 μmol/L) of ellagic acid on the seleted quality parameters of spermatozoa collected from rats after *in vitro* culture. The motility of the spermatozoa was evaluated using the Computer-assisted sperm analysis (CASA) system. The reactive oxygen species (ROS) generation was evaluated by chemiluminescence analysis using the Glomax Multi^{+} luminometer. The functional integrity of the sperm membrane was assessed using the eosin – nigrosin staining method and the acrosomal integrity was evaluated following the fast green – rose bengal staining protocol. Finally, we used the JC-1 staining method to monitor the mitochondrial membrane potenrial. Our results showed, that the lowest added dose significantly increased the motility ($p > 0.01$), acrosome integrity, mitochondrial membrane potential, and membrane integrity ($p > 0.05$), also the ROS generation assessment revealed significantly lower levels ($p > 0.001$). The second amount (25 μmol/L) of these substance significantly raised the motility as well as the acrosome integrity ($p > 0.05$). The ROS production showed decreasing results ($p > 0.001$) after the middle and the highest administered dose. We may conclude, that phytochemicals as a natural bioactive compound of plants, can positively affect the regulation of male reproductive cells during *in vitro* incubation.

Key words: *phytochemicals, ellagic acid, rats, spermatozoa*

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Nature's response to the formation of *Ambrosia artemisiifolia* L. allergenic pollen and seed viability

Patrícia MÁČAJOVÁ, Peter TÓTH

Supervisor: Assoc. Prof. Peter Tóth, PhD.

Common ragweed (*Ambrosia artemisiifolia* L., Asteraceae) is an invasive alien species indigenous to North America. It has a negative impact on agriculture, biodiversity, and human health in Europe. The plant emits huge amount of pollen with the substantial allergenic potential, what is the cause of bigger losses as an economic damage to the agriculture. Ragweed's dominate in disturbed habitats and tends to spread rapidly and negatively affect populations of indigenous plants within ecosystems. The main goal of this study was to evaluate pollen production and seed viability of symptomatic ragweed plants. Plant scouting of suspicious ragweed was realized in southwestern and southeastern Slovakia (locations Balvany, Malá nad Hronom, Tekovské Nemce, Veľký Horeš) and northwestern Hungary (location Kiscsősz) in 2019 – 2020. Presence of phytoplasmas was detected by extraction of DNA and subsequent PCR. Investigation of potential phytoplasma vectors was done by sweeping net (100 sweeps/site/date) over ragweed in July (1x) and August (2x) at three localities, Balvany, Malá nad Hronom, and Veľký Horeš. Symptomatic plants were screened also by microscope. Seeds viability was tested in the laboratory by simple crush test. Suspicious plants showed typical symptoms, young tissues were pale green/yellow, proliferation, malformation and virescence of male inflorescence, witches' broom, phyllody and plant´s stunting, but plants still stayed green/alive. The deformed male inflorescence forming "seeds" instead of pollen and whole plants were sterile. Production of allergenic pollen by symptomatic plants was assessed in the field. Based on a survey of 300 ragweed plants we can say that these plants produce no pollen. Seeds of symptomatic ragweed plants were collected at Malá nad Hronom, Balvany, Kiscsősz, and from one site without symptomatic plants, Tekovské Nemce. Altogether 870 seeds of symptomatic and 220 seeds of healthy plants were tested. 52,8 % seeds of symptomatic and 41,36% of healthy plants were viable. Testing of the seed germination is under way. Extraction of DNA and preliminary PCR of the symptomatic plants confirmed presence of phytoplasmas (*Candidatus* genus *Phytoplasma*). One Eriophyoid mite from genera *Aceria* was determined within malformed generative organs. As mites were recorded only from symptomatic plants, we hypothesize that there is some interrelationship between mites and phytoplasmas. To have a preliminary shot to elucidate the bionomy of the Eriophyoid mites and phytoplasma, 12 symptomatic and 5 healthy plants were transplanted to the pots in 2019 and pots were let to overwinter under field conditions. After hibernation, some new *Ambrosia* plants grew up from the seedbank in the pots. Surprisingly, some of them had the symptoms like the previous ones. Literature claims that phytoplasmas cannot be transmitted by seeds. Therefore, it remains a question how these organisms could survive and spread. Sweeping of ragweed revealed some potential vectors of phytoplasmas, especially cicadas and bugs. Our results indicate that by looking deep into nature we could find the answers. All these results will be discussed, and ecological implications highlighted.

Key words: *eryophyoid mites, excessive branching, male flower malformation, phyllody, phytoplasma, sterile plants, Witches' Broom*

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Application of lectin-based microarray and MALDI-MS technique for glycosylation analysis of recombinant monoclonal IgA antibodies

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Glycosylation of therapeutic proteins is one of the most important and common posttranslational modification, which influence protein properties, such as solubility, thermostability, immunogenicity and efficiency, which makes glycosylation an essential parameter effecting quality and efficacy of therapeutic proteins. In fact, partially glycosylated proteins have shorter lifetime in comparison with fully glycosylated ones. Glycosylation of recombinant proteins depends on cultivation conditions, such as media composition, pH and temperature. Immunoglobulines are produced by specific part of immune system in order of identification and neutralization extraneous antigens and patogens, which human body is exposed to. Therapeutic antibodies are mostly produced in mammal cells, which leads to glycosylation pattern similar to glycosylation in human cells. The most common used therapeutic antibodies are IgGs, but demand for recombinant IgAs is fastly increasing according to their important role in mucosal surface protection. Recombinant IgAs play key role against many air born diseases (flu, rotaviruses, measles) and provide the first defense line during immunological response. The aim of this work was to analyse N-glycan profile of IgA antibodies, which were produced in CHO (Chinese hamster ovary cells) under different conditions. Profile of biologically accessible glycans was determined by lectin based microarray. Samples were applied in form of spots (nL volumes) on epoxy microarray substrates, incubated with 16 biotinylated lectins with different glycan specificity and with fluorescent conjugate of streptavidine, followed by detection by microarray scanner. All N-glycans present in the samples were after cleavage analysed by MALDI-MS and selected glycan structures were further analysed by MS-MS. Results from both methods correlated and these methods appear to be suitable for analysing of glycosylation and its changes in IgA samples as well as in other therapeutic proteins.

Key words*: glycoprotein, therapeutic protein, IgA, lectin, microarray, MALDI-MS*

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Protein glycoprofiling as advanced tool for breast cancer diagnostics

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Breast cancer (BC) has been considered the most frequent type of cancer disease worldwide among women, impacting 2.1 million women each year. The probability of the disease to develop within a woman's lifetime has grown over the past few decades from 1 in 11 in 1975 to 1 in 8 in 2016. Despite wide use of mammography, less than 50 % of breast cancer cases are localized at the time of diagnosis. To avoid development of disease into advanced stages there is a need for early diagnostics. Biomarker is a characteristic indicator of normal biological processes or pathogenic processes. BC biomarkers can be classified as biomolecule based biomarkers (MUC1, HER2, CEA, EGFR – glycoproteins, BRCA1, BRCA2 – DNA, microRNA) and cancer stage based biomarkers (HER2, *BRCA1*, Ki-67, OPN, MAM, CA15-3, CA 27-29, CTC, CEA, miRNA) what are further divided into prognostic, therapeutic biomarkers and biomarkers for monitoring of disease treatment. Glycans (complex carbohydrates covalently bound to proteins) control and support cellular interactions, host-pathogen interactions, cell signalling, disease progression and metastasis. Aberrant glycosylation affect malignant transformation and tumour progression. Alterations in glycosylation structures could serve as important diagnostic markers. Surface Plasmon Resonance (SPR) is an optical method which is applied for detection of interactions between an analyte and a ligand immobilized on a chip surface at nanomolar level. Lectins are carbohydrate binding proteins which are highly specific for glycans. Glycoprofiling of chosen biomarkers was determined using SPR involving lectins with their binding interactions expressed through kinetic constants. In pilot studies, we investigated the interactions between biomarkers CA 15-3, Mamaglobin A and various lectins using SPR and microarray. Protein microarray is also one of the methods for studying the interactions of molecules on the chip surface. We used biochip techniques and a wide range of lectins to determine the glycosylation profile of potential biomarkers of BC - CA 15-3 and Mamaglobin A.

Key words: *breast cancer, glycosylation, lectins, microarray, surface plasmon resonance*

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Study of osteoclastogenic potential of monocytes in patients with axial spondyloarthritis under in vitro conditions

Eva ŠEBOVÁ

Supervisor: RNDr. Pavlína Daňková, Ph.D.

Axial spondyloarthritis (axSpA) is a progressive rheumatic disease that has a prevalence of up to 1.4% in Europe. It is a chronic disease characterized by severe inflammation. Inflammation and its consequences in the area of the axial skeleton can cause structural damage, leading to restricted mobility. This disease is a unique model of bone remodeling disorders, because two opposing pathological processes take place at the same time – site-specific new bone formation and systemic bone resorption. Osteoclasts, cells capable of bone resorption, are formed in the process of osteoclastogenesis by fusion of monocytes from the bone marrow or blood in the presence of two key cytokines: Receptor activator of nuclear factor kappa-B ligand (RANKL) and macrophage colony-stimulating factor (M-CSF) that are responsible for osteoclastogenesis. Multinucleated osteoclasts produce specific enzymes tartrate-resistant acid phosphatase (TRAP) and cathepsin K (CTSK), which are capable of reducing bone. According to many studies, inflammation has a significant effect on osteoclast differentiation. Thus, the increased risk of osteoporosis detected in axSpA patients may be due to the chronic inflammation present in their body. This study examines the effect of inflammatory environment represented by axSpA patients' blood serum on the *in vitro* formation of osteoclasts from the axSpA monocytes compared to the environment of serum from healthy controls. Monocytes separated from the peripheral blood of 9 patients with axSpA were cultured for 14 days in medium (DMEM, L-glutamine, penicillin/streptomycin) under the influence of cytokines RANKL, M-CSF and stimulated with serum of 5 axSpA patients and in parallel with serum derived from 5 age- and sex-matched healthy donors. Osteoclasts were evaluated as TRAP positive cells with at least 3 nuclei. Their numbers were statistically processed in GraphPad Prism 8 using one-way ANOVA and Tukey's multiple comparisons test. The osteoclastogenic potential of the inflammatory serum of axSpA patients was 1.68 times higher ($P < 0.05$) compared to serum of healthy subjects. The results of the study suggest that the presence of inflammatory agents in the serum of patients has a significant effect on the osteoclastogenesis process.

Key words: *inflammation, monocyte, axial spondyloarthritis, osteoclastogenesis, osteoporosis*

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The of vasorelaxant effects of the alkaloid F-18 on isolated rat thoracic aorta

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Supervisor: PhD of Biological Sciences, Adilbay T. Esimbetov

The development of new medicine for the treatment of cardiovascular disease is highly relevant nowadays. Our research deals with isoquinoline alkaloids isolated are compounds with a wide range of bioactivity, which are considerable interest in the search for new lead compounds for developing new drugs for the treatment of cardiovascular diseases. Therefore, the objective of the present study was characterized the effects of 1- (2′-bromine-4′,5′-dimethoxyphenyl) - 6,7- dimethoxy-1,2,3,4-tetrahydroisoquinoline (F-18) on the contraction of rat aortic rings and to investigate its possible mechanism of vasorelaxant action. The experiments were performed in preparations, which are ~3–4 mm wide rings isolated from aortic albino rats (~200–250 g) and placed in a special chamber (5 mL) was perfused with solution Krebs–Henseleit following composition (mmol/L): NaCl – 118.6; KCl – 4.8; $CaCl_2$ – 2.5; $MgSO_4$ – 1.2; KH_2PO_4 – 1.2; $NaHCO_3$ – 20, glucose – 10 (pH = 7.4). During the experiments, while working with experimental animals, International principles of The Council for International Organizations of Medical Sciences and the rules of human attitudes towards animals were completely followed (2012). Force contraction was recorded using an FT.03 (Grass–Telefactor, USA). To characterize the vasorelaxant effect of F-18, in the first the concentration-response curves were determined in rat aortic rings precontracted with KCl (50 mM) or phenylephrine (1 μM). F-18 in a concentration-dependent manner relaxed KCl -induced contractions of aortic rings. The maximal relaxation (Emax) of 89.5 ± 3,4% (n = 6) was obtained when the aortic ring was treated with 150 μM of F-18. The IC_{50} (the concentration to produce a 50% maximal relaxation) value for F-18 obtained in these experimental conditions was 26.4 μM. Similarly, F-18 also in a concentration-dependent manner relaxed phenylephrine-induced contractions of aortic rings with a maximal effect of 78.2 ± 3.2% and an IC_{50} value of 49.2 μM. It was established that the relaxant effectively of F–18, an isoquinoline alkaloid in conditions of KCl– and phenylephrine-induced contraction was related to the inhibition of the influx of Ca^{2+} ions through the voltage-dependent and receptor-operated Ca^{2+}–channels SMC.

Keywords: isoquinoline alkaloid, rat aorta, vasorelaxant effect, Ca^{2+}–channels

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SECTION

Nutrition

Content of aluminum, silver, and zinc in wild edible mushroom *Macrolepiota procera*

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Supervisor: prof. Ing. Janette Musilová, PhD.

Monitoring the occurrence and concentration of risk elements in wild edible mushrooms is very important. It is generally known that mushrooms have an ability to bioaccumulate risk elements and even in unpolluted areas they can be also contaminated. Information on the content of risk elements in wild edible mushrooms is important not only in terms of determining the degree of environmental pollution, but especially as a warning to consumers against the collection of mushrooms from sites with a high incidence of risk elements in wild edible mushrooms. This work is focused on monitoring of the content of risk elements (Al, Ag, and Zn) in wild edible Parasol mushroom (*Macrolepiota procera* Scop. Singer). The samples of Parasol mushroom were collected from five sites in Slovakia – Lazy pod Makytou, Lozorno, Nemečky, Tesáre and Zbyňov. The selected locations belong to popular mushrooming sites and represent localities with different levels of contamination by the monitored elements. The analysis of monitored elements in the Parasol mushroom samples was performed using ICP-OES method. Depending on the locality and the individual morphological part (cap and stem) of *M. procera* the concentrations of the observed elements varied. In caps the concentration of monitored elements ranged from 16.6 to 113 mg kg^{-1} DW (Al), from 0.41 to 3.23 mg kg^{-1} DW (Ag) and from 73.4 to 111 mg kg^{-1} DW (Zn). Subsequently, the obtained data of the monitored elements content were used to evaluate the risks arising from regular and long-term consumption of *M. procera* caps from selected localities. The determined values of Provisional Tolerable Weekly Intake (PTWI) and Recommended Daily Allowance (RDA) were used as a reference. These values were not exceeded in any sample of *M. procera* caps. Therefore, regular and long-term consumption of *M. procera* from monitored localities does not cause any health risk to the consumer.

Key words*: Parasol mushroom, risk elements, health risk, contamination*

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Milk Consumption in Childhood and Adulthood and its Effect on Body Composition

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Supervisor: doc. Ing. Marta Habánová, PhD.

During life, people are exposed to many different types of milk. First is breast milk if infants are breastfed or special formula on base of cow's milk with modified composition. Later in life humans are recommended to consume milk of other mammals as a source of highly valuable protein, calcium and phosphorus. The aim of the work was to evaluate effects of methods and duration of feeding in infancy, and consumption of milk or milk alternatives in adulthood on body composition. We used a questionnaire of 21 specific questions to obtain information on breastfeeding and milk consumption. All 84 participants (18 men, 66 women; age 23.26 ± 1.36) underwent measurement of body composition, using BIA method (InBody 720). Comparison of the information from the questionnaire with the information from the body composition measurement was made. Significant differences were spotted in visceral far area (p = 0.048) and waist-to-hip ratio (p = 0.022) according to duration of breastfeeding. Participants fed for less than 1 year of age (12 months) with formula showed higher percentage of body fat (p = 0.047). Fat percentage of milk was a significant factor for waist-to-hip ratio (p = 0.026). Participants consuming plant-based milk alternatives showed significant differences in waist-to-hip ratio (p = 0.031) and body mass index (p = 0.015) and highly significant differences in weight (p < 0.001) and fat-free mass (p < 0.001). In conclusion, results show duration of breastfeeding may prevent development of overweight and eventually obesity. Usage of infant formulas as an alternative to breast milk should be limited to those who are unable to breastfeed. Current consumption of milk points to benefits of whole milk in the diet, but also shows increasing interest in plant-based milk positives.

Key words: *milk, breastfeeding, plant-based milk, body composition, milk fat percentage*

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Is pumpkin an important source of vitamin C? How does storage affect vitamin C?

Adriána MAŤOVÁ, Alžbeta HEGEDŰSOVÁ

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One of the most commonly grown pumpkin species is *Cucurbita moschata* Duch. ex. Poir. All anatomical parts of the plant, including flowers, are edible, which makes it very attractive. The nutritional composition reveals the presence of a variety of phytochemicals, vitamins, minerals, polyphenols and carotenoids. Vitamin C is an essential substance for proper functioning of the human body. It is recommended to take 50 to 80 mg of vitamin C daily. This vitamin is very thermolabile, sensitive to pH, oxidized by atmospheric oxygen. The stability of vitamin C decreases with increasing temperature and pH, during storage the content gradually decreases, especially at temperatures above 0°C. Various methods of treatment of fruits containing vitamin C also reduce its level. For example, abrasions, peeling, cutting into pieces and exposure to air contribute to this. Most of the documented data indicate that *Cucurbita moschata* is an important source of vitamin C. However, the lack of scientific publications on this issue suggests that this claim must be properly investigated and substantiated. In this work, we focused on determining the content of vitamin C in fresh pumpkin pulp before and after storage. The content of vitamin C in the samples was analyzed by HPLC and evaluated by the calibration method of an external standard, STAR software directly evaluating the chromatogram in concentration units. The content of vitamin C and its development during 120 days of storage in samples of 6 varieties (Liscia, Matilda, Orange, Serpentine, UG 205 F1, Waltham) of *Cucurbita moschata* was monitored. The range of vitamin C values in the fresh fruit pulp was from 5.50 $mg.100g^{-1}$ FM (Serpentine) to 12.00 $mg.100g^{-1}$ FM (Matilda). After 60 days of storage, the values ranged from 5.20 $mg.100g^{-1}$ FM (Serpentine) to 8.30 $mg.100g^{-1}$ FM (UG 205 F1, Matilda). After 120 days of storage, we observed further degradation of vitamin C, during which the values ranged from 4.50 $mg.100g^{-1}$ FM (Liscia) to 6.60 $mg.100g^{-1}$ FM (Orange). According to our results, *Cucurbita moschata* cannot be considered a significant source of vitamin C. In terms of changes in the content of vitamin C, it does not make much sense to store this crop, as storage leads to a gradual degradation of this vitamin.

Key words: *vitamin C, Cucurbita moschata Duch. ex. Poir., storage*

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Feeding dried grape pomace and their influence on the energy profile of sows in commercial breeding

Eva MIXTAJOVÁ, Michal ROLINEC

Supervisor: doc. Ing. Michal Rolinec, PhD.

The grape pomace (GP) is by-product produced nowadays in large amounts. However, GP is a suitable source of nutrients and biologically active substances supporting the health of an individual, which suggests that by feeding to livestock is possible to support their health. To prove these effects, the biochemical parameters of the blood of gestating and lactating sows were observed. The farrowing and the first days after that are risky for sows and also for piglets. In this work, only partial results of serum biochemical parameters are published. Therefore, only partial evaluation of the energy profile, namely glucose, cholesterol and triglyceride were presented. The experiment was carried out at the Pigfarm Dubovany (SPD Veselé, Slovakia), where 14 sows (LxBU) at late gestation were randomly divided into two groups. The experiment started 7 days before expected farrowing. The first control group (CON) and the second experimental group (DGP) which was fed dried grape pomace in amount of 1% of diet. The control group received a diet consisted only from complete feed mixture for lactating sows. Blood samples were taken 7 days before the expected farrowing ($CON_{before,}$ DGP_{before}) and during first day after farrowing ($CON_{after,}$ DGP_{after}). Blood serum was gained and stored at -18°C until analyses. Serum concentration of glucose, cholesterol and triglyceride were determined using the Labkit and according to manufacturer instructions (Chemelex S.A., Barcelona ESP). Gained results were statistically processed (ANOVA, mean, S.D., SEM) using IBM SPSS v. 26.0. The differences between groups (CON_{before}, CON_{after}, DGP_{before}, DGP_{after}) were tested with Tukey HSD test. From all samples, the average cholesterol concentration was from 1.03 ± 0.12 to 1.62 ± 0.25 mmol.l^{-1}, significant difference was detected between DGP_{before} and DGP_{after} ($P < 0.05$). Serum cholesterol content of all analyzed samples was under physiological range for pigs. Average concentration of glucose was from 4.21 ± 0.84 to 4.48 ± 1.18 mmol.l^{-1} and triglyceride from 0.56 ± 0.24 to 0.74 ± 0.28 mmol.l^{-1}. For glucose and triglyceride no significant difference between groups was detected. Serum content of glucose and triglyceride was within the reference values published for pigs. According to these results, it can be concluded, that addition of dried grape pomace did not affect the monitored parameters of the energy profile of sows at time near farrowing. However, further studies are needed to confirm these results.

Key words: *sow, grape pomace, serum energy profile*

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Investigation the effects of cornelian cherry (*Cornus mas* L.) on haematological parameters of ZDF rats

Nikoleta ŠIMONOVÁ

Supervisor: doc. Ing. Anna Kalafová, PhD.

The aim of our thesis was to investigate the effect of cornelian cherry (*Cornus mas* L.) on haematological parameters of ZDF rats. Cornus mas L. is a berry fruit which contains a high amount of bioactive compounds, which can positively affect not only compensation, but also prevention of diabetes mellitus. To explore the impact of cornelian cherry on diabetes mellitus type 2 we used male Zucker Diabetic Fatty rats (n = 30), thanks to similar onset and demonstrations of symptoms of this disease, compared to human kind. Rats were devided into five groups: healthy, thin control, Lean (n = 6) and ZDF diabetic control, C (n = 6) was given water for 12 weeks, experimental group K (n = 6) was given cornelian cherry´s stone a dose of 250 $mg.kg^{-1}$, group D was given cornelian cherry´s pulp a dose of 1500 $mg.kg^{-1}$ and group DD was given pulp a dose of 2000 $mg.kg^{-1}$. The blood was analyzed by automatic haematological analyzator Abacus Junior Vet (Diatron ®, Vienna, Austria) and were statistically evaluated. In experimental groups D, DD with addition of cornelian cherry´s pulp was within diabetic changes observed inconclusive decrease the overall count of white blood cells 2.542 x $10^9.l^{-1}$ a 2.682 x $10^9.l^{-1}$. In treated group DD with addition of cornelian cherry´s pulp we found slightly inconclusive ($P > 0.05$) increase of heamoglobin 163.500 $g.l^{-1}$ and haematocrit 52.802 % compared to treated group K, to which was given cherry´s stone, but inconclusively ($P > 0.05$). In treated group K with addition of cherry´s stone we noticed slightly inconclusive decrease in number of red blood cells 9.153 x $10^{12}.l^{-1}$ and also inconclusive ($P > 0.05$) rise in number of thrombocytes 994.167 x $10^9.l^{-1}$ compared to treated group DD, whose have been given cornelian cherry´s pulp. Number of thrombocytes was inconclusively lower ($P > 0.05$) in treated group D with addition of cherry´s pulp (1500 $mg.kg^{-1}$) 860.000 x $10^9.l^{-1}$ compared to group K, with addition of cherry´s bone. In conclusion, from our data collected in this study we can deduce, that cornelian cherry did not improve selected haematological parameters statistically significantly, but monitoring of these parameters is needed from the long time perspective to be able to capture and potentionally avoid or reduce risk of developing degenerative complications connected with diabetes mellitus.

Key words: *diabetes mellitus type 2, cornellian cherry, Zucker Diabetic Fatty (ZDF) rats, haematological parameters*

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Flax lignans as potential source of plant protection substances and functional food supplements

Angéla VARGAOVÁ

Supervisor: prof. Ing. Katarína Ražná, PhD.

Flax is a multi-purpose plant with a long history of use. Flaxseed is an important source of three main medicinal components: omega-3 fatty acids, lignans and fibre. Flax has a beneficial effect on cardiovascular disease and consumption of ground or partially defatted flaxseed lowers total blood cholesterol. It acts as an excellent antidote to inflammatory diseases of the respiratory tract and its consumption facilitates the course of bronchitis. Flaxseed oil has a healing effect on the condition of the liver. Current knowledge about the presence of pharmacologically and nutritionally interesting polyphenols offers new perspectives of flax as a functional food or nutraceutical. Naturally occurring plant lignans are present in vegetables, fruits and whole grains. Flaxseed is the richest source of this phytoestrogens. The lignans are involved in plant defence mechanisms through their antioxidant, antiviral, antibacterial and fungicidal properties. Most important, the flax lignan secoisolariciresinol diglucoside (SDG) provides health benefits exhibiting antioxidant and anti-inflammatory properties. In addition to antioxidant effects, lignans significantly affect the metabolism and function of the hormone estrogen, thereby reducing the growth of breast cancer cells and also have a positive effect on colon, prostate and ovarian cancer. Interestingly, the lignan content may be affected by a variety of factors, as geographic location, environmental conditions, plant maturity and storage conditions. As the demand for nutritional supplements is constantly increasing, research into lignans focuses, not only to understanding the mechanisms of their action, but also on the external stimulation of lignan synthesis by various elicitors under *in vitro* conditions. Research is focused on genomic and transcriptomic screening of oilseed flax genotypes with a focus on lignans as substances with antioxidant potential that contribute to the adaptability of the flax genome, as well as in the context of lignans nutraceutical potential.

Key words: *Linum usitatissimum* L., *flaxseed, lignans, nutrition*

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SECTION

Multifunctional agriculture, environment, landscape architecture and rural development

Assessment of fallow lands' ecosystem services for landscape planning

Daria ANPILOGOVA

Supervisor: Alla Pakina, PhD

Abandonment of agricultural land is a worldwide land use trend of the last few decades mainly driven either by intensification of agriculture or crisis events in the agricultural sector. In Russia massive withdrawal of arable land from agricultural use took place in 1990s following the decline of Soviet system. Although national and regional agriculture development programs facilitated the return of abandoned fields to agricultural use the proportion of unused cropland still measures up to 44% (Russian agricultural census, 2016). One year after abandon formerly ploughed lands transform into fallows where vegetation and soil recovery processes come through different stages of secondary succession. Understanding not only the problems but also the opportunities related to abandonment is vital for landscape planning and land management. This study aims to consider abandoned agricultural land in relation to environmental benefits that it delivers. The area in Kashira district located at the South-East of the Moscow region was selected for the field study. Effects of agricultural abandonment on the environmental side were analyzed through the assessment of ecosystem services provided by fallows. Four classes of ecosystem services from the category "Regulation and maintenance" were assessed withing the study (based on CICES version 5.1 typology) – regulation of chemical composition of atmosphere, control of erosion rates, effect of decomposition and fixing processes soil quality and pollination. Each individual ecosystem service was assessed qualitatively for different types of land cover – forest land, cropland and fallows on three stages of plant succession present in study area: ruderal stage, grassland and small-leaved forest. The assessment scale reached from 0 (no capacity to provide service) to 5 (very high capacity), the grades were assigned to different land cover types based on the results of research conducted in similar soil and climate areas. Grades for individual ecosystem services were put in assessment matrix (instrument developed by B. Burkhard, 2009) and summed up to the total regulating services result of each land cover type. Finally, spatial distribution of ecosystem services was reflected on the land cover map. The results of the conducted assessment revealed a correlation between the age of the fallow and the volume of provided regulating ecosystem services. The recovery of natural vegetation leads to higher levels of carbon sequestration, more effective hydrological regulation and erosion mitigation, soil recovery, higher decomposer activity and biodiversity increase. In terms of provided regulating services fallows on small-leaved stage are comparable to the lands covered by mature forest. At the same time cropland was proven to be rather a recipient of the services provided by the natural ecosystems – forests and fallows. Thus, the return of all the uncultivated fields to the agricultural use will cause substantial decrease of ecological value of the study area. The ecological outcomes generated by fallows should be considered by decision-makers when deciding which land management strategy to implement on the abandoned agricultural land – renewal of cultivation, active reforestation or passive revegetation.

Key words: *ecosystem services, land-use change, revegetation, soil, agriculture, abandoned land, secondary succession*

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Fortified sacral areas of the microregions of the Little Carpathians

Denis BECHERA

Supervisor: doc. Ing. Gabriel Kuczman, PhD.

The territory of Slovakia has undergone many geopolitical, urban and natural changes in the past. These interventions shaped the landscape and the current state of landscape architecture not only in terms of ownership, power and functional classification of buildings and spaces, but also in terms of proportionality, structure and overall functional and aesthetic expression of buildings, areas and spaces in the landscape. The changes that took place in society, politics and the church in the past, in the period from the 17th century, also shaped and shaped the view of the modernization and modification of buildings of secular and ecclesiastical significance. Buildings, objects and landscape elements changed the overall visual and aesthetic effect of the landscape's identity. Dealing with the reconstruction and modification of church grounds and buildings in the context of landscape architecture is justified, as church buildings are the centers of rural settlements, they form a dominant not only in close relation to the settlement but are a significant identifier in the landscape structure. Fortified churches and areas occur in several regions of Slovakia, where they have different historical context and background. One of the localities that is the subject of the contribution, mapping and research is the Lesser Carpathian region between Čachtice castle - from the first half of the 13th century and the Katarínka monastery complex from the first half of the 15th century. The foothill trade route, which led from Bratislava to the areas of middle Považie, was of great importance as part of the region's urban and landscape structure. The use and significance of this route, on which there are fortified churches in greater concentration than in other parts of the region, is not only from the ecclesiastical but also secular point of view, as the route of the castle with adjacent areas Červený Kameň. The subject of the mapping is not only the verification of the correlation between the localities of selected rural settlements and buildings, structures and areas with fortifications within the selected region, but also the relationships between significant building landmarks in the country. At the same time, the subject of research is also the relationship of greenery to buildings in terms of location, architectural and horticultural arrangement in relation to the fortified area and the relationship of greenery around the fortified area as part of Non-forest woody vegetation, residential greenery and landscape structure.

Key words: *landscape structure, rural settlement, sacral architecture, residential greenery, historical development*

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Influence of land use on selected physical properties of soil

Nikola BENKOVÁ

Supervisor: doc. Ing. Radoslava Kanianska, CSc.

The physical condition of the soil depends on the way the land is used. Improper land use can lead to deterioration of physical soil properties. As part of the research, we focused on the soil situated near the flow of the Orava river in the north of Slovakia. In October 2019, we took samples from 13 localities from depths of 0 – 10 and 20 – 30 cm, of which 11 were Fluvisols, 1 Cambisol and 1 Technosol (developed on environmental burden). Arable land was characterized by intensive cultivation with deep plowing. Soil texture ranged from sandy to loamy. The dominant arable crops were Z*ea mays* and *Triticum aestivum*. We determined the particle density (ρs), bulk density (ρd), porosity (P) and air capacity (AC). The average value of ρs was higher in the first monitored depth (2.35 $g.cm^{-3}$) compared to the second (2.31 $g.cm^{-3}$). In contrast, ρd reached a higher average value at the second depth (1.45 $g.cm^{-3}$) compared to the first (1.38 $g.cm^{-3}$). In the first depth, the values of ρs ranged from 2.20 to 2.68 $g.cm^{-3}$, in the second depth from 2.20 to 2.43 $g.cm^{-3}$. The ρd values ranged from 1.21 to 1.60 $g.cm^{-3}$ at the first depth and from 1.30 to 1.58 $g.cm^{-3}$ at the second depth. In the first depth, we found an average value of total porosity (Pc) of 34.12 % for arable lands, and 42.88 % for soils used as grasslands. In the second depth, the average Pc value was 34.16 % for arable lands and 35.07 % for grasslands. The soil porosity was significantly affected by the land use and indicated soil compaction at arable land. The values of air capacity reflected the state of soil porosity and compaction. In most cases of arable land, the limit values of the monitored physical characteristics indicated soil compaction and are close to the critical limit values in accordance with the Decree of the Ministry of Agriculture and Rural Development of the Slovak Republic no. 59/2013 Coll., which indicates their compaction. Compaction is negative environmental problem leading to reducing the permeability of soil to water and air and subsequently to the overall deterioration of the performance of other soil functions and services. This indicates the need to apply conservation technologies in tillage.

Key words: *soil physical properties, particle density, bulk density, porosity, air capacity*

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The importance of the location of campuses within urban structures

Miroslav ČIBIK

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Development in the city center evokes different feelings and opinions in society. But instead of a comprehensive urbanistic view of developing a city in a broader context, many people disagree with it and have an isolated view of the thing. They often argue that the city is significantly densifying at the expense of greenery and public spaces. However, they are often unaware of the significant societal implications given the current massive construction in various forms on the outskirts of cities in relation to sustainability, ecology, transport and public finances. They also do not realize that in the case of larger, more complex areas, such as urban (unused) spaces, are these areas often replaced by better, more aesthetic spaces and areas that create new functions in the city and are open and accessible to its inhabitants. In other words, these spaces perform the functions of a semi-public or even public spaces. The urban structure of the city creates its streets, public spaces, courtyards and generally places where people spend their free time. Life has disappeared from the streets and it can only be returned by gradually transforming defunct buildings, brownfields and public spaces into meaningful structures. The presented article thematically focuses on the issue of campuses, as well as the search for their interconnection with urban structures with the intention of preserving the idea of a sustainable multifunctional part of the urbanized space. For the purpose of understanding these connections, it is necessary to describe the individual attributes that form this relationship in detail. The paper further compares the urban area with the area on the outskirts of the city and describes the advantages and disadvantages of the location within the city and the differences, in terms of total area, density, walking distance, ecology and economy. If the individual capacities of campuses still proved insufficient, the free space around them allowed them to expand. With their own urbanization, they have often conditioned the urbanization of the city itself, and together with new buildings, they paved the way to creation of new housing estates for families with children, parks, schools, kindergartens and other services or institutions. In cities, they are often conceived on their borders, where they form a separate unit. At their borders, they create their own ecosystem and their impact on functioning, sustainability, green and blue infrastructure, and the overall appearance of the city is smaller compared to campuses that are located in urbanized city structures, where they play their role more prominently. A campus located in the center of urban structures and not on their edge has a greater impact, whether positive or negative, on the functioning, appearance and functions of the city than the university campus which is located on its borders. The paper graphically presents the differences between two similarly sized and differently located areas within the city and compares their impact on the city.

Key words: *campus, urban structure, city, sustainability, development*

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Proposal of erosion control measures to reduce the impact of water erosion on landscape

Dávid DEŽERICKÝ

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The General Principle of the Functional Rearrangement of the Territory undoubtedly form the framework of land consolidation in terms of the optimal way of management, rearrangement and functional use of the land. Management and frequent changes in land use increase the probability in negative surface runoff which can result in water erosion. In order to prevent water erosion and in particular the formation of surface runoff, it is necessary to propose erosion control measures – a set of complex organizational, agrotechnical and technical measures which mutually respect and follow condition of agriculture. The universal soil loss equation (USLE) based on geographic information systems GIS is one of the most widely used methods for determining erosion due to its simple application to multiple topographic reliefs with minimal data requirements and relatively accurate water erosion prediction models. The purpose of this paper was to evaluate water erosion based on the current land use and then to propose erosion measures within functional rearrangement of the territory. The USLE model (G = R.K.LS.C.P) was applied to the cadastral area of Veľké Janíkovce, Slovakia. Where value of G is average annual soil loss caused by water erosion ($t.ha^{-1}.year^{-1}$), the value of the R factor represent the rainfall erosivity and it was taken from the ombrographic station Nitra where R = 24.62 $MJ.ha^{-1}.r^{-1}$. The K factor the soil erodibility was derived from the main soil units with values ranging from 0.25 – 0.72 $t.MJ^{-1}$. The topographic factor LS was calculated based on digital elevation model (DEM) in which we incorporated barriers in the form of vegetation, watercourses and built-up areas. The value of the topographic factor LS ranges from 0 – 194.95. The land cover C factor was derived from cultivated crops in land block in the range of values from 0.15-0.60. The support practice factor P was set to value of 1 because in area were not any registered erosion control measures. Substituting the variables into the USLE equation, we calculated the potential intensity of water erosion which was estimated 5 $t.ha^{-1}.year^{-1}$, while at the calculated intensity of water erosion the average value of erosion ratio decreased to 0.30 $t.ha^{-1}.year^{-1}$. According to the SEOP index, which represents the division of the calculated erosion and acceptable erosion according to STN 75 4501, the area was evaluated as not endangered up to slightly endangered by water erosion. By proposing erosion control measures we divided the soil units on slopes above 12 ° into permanent grasslands and recommended a contour method of land management. From the technical measures, field roads were designed in order to interrupt the slope length. By incorporating the proposed erosion control measures into the USLE model erosion activity was reduced by half where annual yield is 0.15 $t.ha^{1}.year^{-1}$.

Key words: *USLE, GIS, water erosion, control measures*

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Utilisation of repellents for the control of Western corn rootworm (*Diabrotica virgifera virgifera*)

Miroslava FUSKOVÁ

Supervisor: prof. Ing. Ľudovít Cagáň, CSc.

The present study investigated the potential repellency of two chemical substances DEET, 2-undecanone, and essential oils (EOs) *Allium sativum* and Eucalyptus oil. The most effective and most known insect repellents currently on the market are DEET (N, N-diethyl-3-methylbenzamide) and 2-Undecanone. Essential oils of aromatic plants are effective natural products as contact and fumigant insecticides and as repellents against insects. The aim of our study was to find the level of repellent effect of the chemicals, and essential oils on the Western corn rootworm, *Diabrotica virgifera virgifera*. To identify how strong is the repellent impact of DEET, 2-Undecanone, and selected essential oils from plants to *Diabrotica v. virgifera* adults. *Diabrotica v. virgifera* is one of the most destructive pests of maize in Europe, and it causes primary damage to a maize plant by chewing and boring through the rootstock in the soil. The flight of the *Diabrotica. v. virgifera* adults started at the beginning of July and the trial begun at the beginning of August. Repellents were used in the area of 5 x 4 meters with four replications. The repellents were applied as a solution of 700 µl chemical/ essential oil in one liter of water. TWEEN 80 was used as a solvent. After 24 and 48 hours, the repellent effect was checked by visual observation. After 48 hours, yellow sticky traps were used for the detection of the occurrence of adult beetles. The average number of adults per one plant counted after 24 hours depended on the variant, and it was as follows: Undecanone 1.93; DEET 2.42; Garlic 4.42; Eucalyptus 4.65 and the control 4.72. It was found a significant repellent effect of Undecanone, and DEET compared to Garlic, Eucalyptus, and control variant (ANOVA, LSD multiple range test at 95.0% level). After 48 hours, the average number of beetles was in Undecanone 2.9; Eucalyptus 4.22; DEET 2.9; Garlic 3.77 and 6.02 in the control variant. It was found a significant effect of DEET compared to the control variant (ANOVA, LSD multiple range test at 95.0% level). The average number of beetles captured in yellow sticky traps after 48 hours depended on the variant, and it was as follows: Undecanone 16.5; Eucalyptus 17.25; DEET 16.5; Garlic 18.25 and 22.25 in the control variant. It was not found a significant effect among the variants (ANOVA, LSD multiple range test at 95.0 % level). Our results indicate that repellent substances influence the number of the *D. v. virgifera* adults in the maize field. This effect can be significant, but only during a short time of nearly 24 – 48 hours.

Key words: *DEET, 2-Undecanone, Alium sativum, Eucalyptus oil, Diabrotica virgifera virgifera*

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Use of the Web GIS tools for publishing water reservoir data

Richard HANZLÍK, Jakub FUSKA

Supervisor: prof. Ing. Ľuboš Jurík, PhD.

One of the biggest obstacles to the automation of data processing, with measurable hydrological, climatic and other indicators on small water reservoirs, is the high financial costs. Mainly for software licenses, operation and maintenance of either software equipment or instrumentation. The aim of our research was to develope an alternative solution to this problem with rapidly lower costs for the necessary equipment and with the use of freely available software. We were provided with the basic parameters processed in the desktop application ArcMap 10.1. as three files of measured points. Each point had the exact coordinates of the Global Positioning System (GPS) recorded, according to S-JTSK, the altitude and the distance from the sonar to the ground of the water reservoir. The interpolation of the points led to the creation of a digital relief model, which ultimately represented the course of the water reservoir ground relief, from which, by subtracting the maximum and minimum ground dimensions, a map of the water depth in the water reservoir at the operating level was created. Modeled level changes of ± 5 centimeters were subtracted from it and water depth maps were created in case of possible fluctuations of the water level in real time. By modifying their coordinate system to WGS 84, we have achieved compatibility with the web interface of the open layer display. Using the File Transfer Protocol (FTP) service and the open source FileZilla application, we upload data to an online server with storage for map outputs - Geoserver in GeoTIFF format, which the server can identify within the Web Map Service (WMS). By creating the website http://diplomovkarha.000webhostapp.com we have made all data about Jelenec reservoir available online. It contains, among other things, a digital map consisting of two map layers – the underlying open street map and the current map of water depth in the water reservoir as an open layer stretched from Geoserver , with the relevant parameters according to the World Geodetical System (WGS 84), defined by the European Petroleum Survey Group (EPSG: 4326), the water depth attribute and the display style defined by the Styled Layer Descriptor (SLD) code, which exactly defined the web interface of the displayed data. The current display of the water depth map in the water reservoir on the website is provided by a programmed Arduino Mega 2560 board, in the Leaflet Javascript library, to which a module for measuring distance (from the sensor to the current water level in a reservoir) is connected, using an ultrasonic waterproof, sensor JSN-SR04T and a General Packet Radio Service (GPRS) module SIM900 for wireless transmission of measured data to a database on a website server. In the backend, the process of evaluating the last measured value and assigning the current water depth map is running, based on the recalculation of the current geodetic heights. In the frontend, it is displayed on our website as an output, respectively an open layer map with an open street map background, and we observe a visible change in the water level during its decreases and increases in real time online.

Key words: *small water reservoir, digital relief model, Jelenec, water depth map*

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Study of the influence of *Asclepias syriaca* on soil nematofauna communities

Michaela JAKUBCSIKOVÁ, Marek RENČO

Supervisor: Ing. Andrea Čerevková, PhD.

In our study, we investigated the impact of invasive plant Common milkweed (*Asclepias syriaca*) on soil nematofauna, a specific group of soil organisms which has excellent bioindication of soil function. We focused on change in their occurrence, abundance, number of species, species diversity and trophic structure of their community. The research was realized in 2018 and 2019 in the ecosystem of permanent grassland in Laborec river basin, situated in the south-eastern Slovakia. We found totally 64 species of free-living and parasitic nematodes in studied ecosystem. The overall structure of nematofauna, the composition of trophic groups and the number of species in areas with *A. syriaca* were similar to those we found in native vegetation which was without any plant invasion during two-year study (control). The most dominant trophic groups in our samples were bacterivores nematodes, especially species *Acrobeloides nanus*, herbivores (*Helicotylenchus digonicus*, *Pratylenchus pratensis*) followed by fungivores (*Aphelenchus avenae*) and omnivores (*Eudorylaimus carteri*). The analysis of the structure of food webs by Enrichment and Structure indices has shown that both type of the ecosystem was little disturbed with balanced nutrient supply. In the decomposition of organic matter were involved bacterivores and fungivores nematodes in equal ratio and the food web was mature. Based on our results, we can state that the invasion of *A. syriaca* into the grassland ecosystem had no significant impact on soil nematofauna.

Key words: *non-native plant species, Common milkweed, soil nematofauna, diversity, ecology*

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Genetic structure and diversity of hybrid swarms of Scots pine and mountain dwarf pine in northern Slovakia

Miroslav KLOBUČNÍK

Supervisor: RNDr. Andrej Kormuťák, DrSc.

Pinus mugo complex, obviously the most challenging group of European pines, is relevant taxonomic problem for its high morphological variability. Besides the phenomenon known as phenotypic plasticity, this variation may also be ascribed to introgressive hybridization and formation of hybrid swarms. Such populations are typical of unsteady phenotypic traits and a variable degree of genetic differentiation, which poses difficulties in assigning boundaries between taxa. In natural conditions of Slovakia, these questions refers to putative hybrid swarms of *P. sylvestris* L. and *P. mugo* Turra on the localities of Zuberec, Suchá Hora, Tisovnica and Obšívanka. In order to understand their evolution and phylogeny, various morphologic, anatomic and molecular traits were used including DNA markers. However, no methodology has succeeded in providing species-specific DNA markers that could be appropriate to test putative hybrids for their hybrid origin or genetic status of a population as a whole. Here, based on DNA isolated from needles, we analyzed genetic structure and diversity of these swarms by DNA fingerprinting with inter-Primer Binding Site (iPBS) primer 2083. As a control, 9 relatively isolated populations of *P. sylvestris* and *P. mugo* from Tatra and Fatra Mts. were used. Single-primer iPBS amplification revealed genetic polymorhism within 29 biallelic loci in nuclear genome. As far as hybrid swarms are concerned, population-genetic analysis estimated gene diversity at $h = 0.260$ (Zuberec), $h = 0.217$ (Suchá Hora), $h = 0.209$ (Tisovnica) and $h = 0.227$ (Obšívanka). By comparing these data with the mean of *P. sylvestris* and *P. mugo*, $h = 0.267$ and $h = 0.206$ respectively, we conclude that, for 2083 loci, genetic variation of hybrid swarm on the locality Zuberec is significantly increased, indicating its highest age and probability of hybrid origin out of all other swarms in Slovakia. The genetic distance of this hybrid swarm was smallest with respect to *P. sylvestris* populations ($D = 0.0168$ to Oravský Biely Potok, $D = 0.0227$ to Hruštín, $D = 0.0247$ to Štrba and $D = 0.0309$ to Čierny Váh), as compared with *P. mugo* ($D = 0.0243$ to Skalnaté Pleso, $D = 0.0361$ to Roháče, $D = 0.0380$ to Vrátna dolina, $D = 0.0431$ to Jasná and $D = 0.0479$ to Suchý). With regard to hybrid swarm in Zuberec, these results support the previous conclusion about introgression in favor of *P. sylvestris* or transfer of *P. mugo* genes to the genome of *P. sylvestris*. In contrast, close phylogenetic relationships are suggested between *P. mugo* and hybrid swarms from Suchá Hora, Tisovnica and Obšívanka.

Key words: *Pinus sylvestris, Pinus mugo, hybridization, iPBS, species-specific DNA markers, genetic structure, genetic diversity*

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The effect of biochar addition on CO_2 soil greenhouse gas emission

Tatijana KOTUŠ

Supervisor: Ing. doc. Ján Horák, PhD.

Although fossil fuel combustion is the major cause of the increase in atmospheric CO_2 concentration, agricultural activities have also been a significant contributor. One of the possible ways to reduce CO_2 emission from the soil to the atmosphere is biochar application to the soil. The objective of this study was to evaluate, whether biochar applied in 2014 is still able to reduce daily CO_2 and cumulative CO_2 emissions from the soil in 2018 (4 years after its application). In this study we also evaluated the effect of selected soil physical properties (soil temperature and soil water content) on soil CO_2 emissions. The field site of this study is located in the Nitra region of Slovakia – Malanta. The study covered the period from April to October during the growing season of spring barley in 2018. The experiment consisted of two doses of biochar application (10 and 20 $t.ha^{-1}$) applied in 2014 combined with three fertilization levels. Nitrogen fertilizer was applied in 2018 at rates of 0, 40 and 80 kg $N.ha^{-1}$. The field experiment included together 9 treatments in three replicates. The biochar used in our study was produced by pyrolysing paper fiber sludge and grain husks at 550 ºC for 30 min in a Pyreg reactor. The soil CO_2 emissions were measured twice a month using closed chamber technique. The samples were analyzed using a gas chromatograph with thermal conductivity detector. After four years of biochar addition to the soil, biochar had an insignificant effect ($P > 0.05$) on CO_2 emissions with or without N-fertilizer. The result of this study showed that biochar applied in 2014 was still able to reduce cumulative CO_2 in 2018, however only in the treatments without N-fertilizer application. In general, biochar amendments (10 $t.ha^{-1}$ and 20 $t.ha^{-1}$) combined with N-fertilizer (40 kg $N.ha^{-1}$ and 80 kg $N.ha^{-1}$) increased daily and cumulative CO_2 emissions. There was one exception when the higher level of biochar (20 $t.ha^{-1}$) was combined with higher level of N-fertilizer which showed the potential to reduce CO_2 emission. According to these results can be concluded that the biochar applied to soil is not able to reduce CO_2 emission after four years of its application when it is combined with usual agriculture practices which include N-fertilization. Our study also showed that the temperature was the most important factor influencing soil CO_2 emission in all studied treatments. A significant correlation between the CO_2 flux and soil temperature could lead to the easy conclusion that only the soil temperature (not the soil moisture) was a controlling factor in all studied treatments, which wasn't our case. It was probably synergy effect where increase in soil water content due to precipitation events together with high soil temperature were associated with the highest CO_2 emissions.

Key words*: biochar, nitrogen fertilizer, soil CO_2 emission,* sustainable agriculture

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Influence of water stress to the dendrometric changes of sunflower (*Helianthus annus* L.) under controlled conditions

Martina KOVÁČOVÁ

Supervisor: prof. Ing. Viliam BÁREK, CSc.

Ongoing changes affect the global average air temperature, the total precipitation, and its division over the seasons. The consequences of these changes are periods of drought appearance, which can last from several days to months. Due to the drought, agricultural crops are subject to a water deficit, which is manifested by water stress. The experiment took place in laboratory conditions in 2019. The natural sunlight was replaced by Mars Hydro 400 LED lights every day for 12 hours in 30 days experimental period. These LED lights produce light in from the 440 – 730 nm range, covering wavelengths important for growth. The average air temperature in the laboratory was 23.5 °C. Six plants of sunflower (*Helianthus Annus L.*), were planted in the growing substrate in two containers with a diameter of 35 cm**.** Containers were marked with letters A and B. Variant A was supplied by irrigation water dose and B was not. In each variant, the dendrological changes of the three plants were measured using DD-S dendrometers (Ecomatic) with an accuracy of ±1.5 μm. The sensors were placed on plant stems 5 cm above the soil surface for 37 days after planting**.** ECH20 10HS sensors were used to monitor soil moisture. Variant A was irrigated every day and variant B was irrigated every third day, both with irrigation dose of 200 ml. An irrigation dose was delivered to the plants two hours after the lights were turned on. Dendrometric data were recorded continuously for 30 days by datalogger DL18 (Ecomatic). The results show that the expansion of plant tissue always occurs within an hour of irrigation, when the xylem tissue begins to fill with water. In the first days of measurements, the stem radial changes had a similar upward course due to the initial moisture of the substrate. The first signs of water stress were detected immediately after the second irrigation dose. Variant A tissue growth during the experiment took place in the first 10 days. When the stem tissue increment was 1.05 mm with a maximum increment of 1.20 mm for 30 days. The diametric growth of the variant B stem stopped on day 6 of the experiment, with a steady increment of only 0.28 mm with a maximum increment of 0.33 mm. Due to a water deficit in plant metabolism the response to water stress stops and the growth of stem diameter is slowed down. The stretching and contraction of plant tissue then occurs as a result of the plant's natural responses to the diurnal cycle. The difference in growth was not only in the stem diameter, but in the end, it was also visible on growth height of the individual plants. The experiment showed that water stress significantly affects the plant tissue development and thus their production potential.

Key words: *dendrometric changes, water stress, sunflower, irrigation dose*

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The effect of biochar and organo-zeolite substrate on contents of potentially toxic elements in soil and plants

Tatiana KVIATKOVÁ

Supervisor: doc. RNDr. Ingrid Turisová, PhD.

The mining heaps are a remnant of intensive mining activity. Characterized by a specific type of soil, namely technosol, with an increased content of potentially toxic elements, it poses a risk to human, animal and plant health, as well as the environment. One way to remediate technosol is to add natural sorbents as an organo-zeolite substrate or biochar, which are low-cost, environmentally friendly and relatively fast-effective methods to reduce content of potentially toxic elements. The aim of the paper is to demonstrate the effectiveness of organo-zeolite substrate and biochar to reduce the amount of PTEs in technosol and to support vegetation growth. Their effectiveness was tested by a 12-week pot experiment in a greenhouse at the Faculty of Natural Sciences, Matej Bel University in Banská Bystrica. Technosol was taken from the Libiola heap (Italy) by stratified collection and was mixed with biochar in the amount of 20% (BCH) and with organo-zeolite substrate in the amount of 9% (OZS). The organo-zeolite substrate consisted of chicken manure, perlite and $CaCO_3$. Control samples were also established without the addition of sorbents (C). A grass mixture of species kentucky bluegrass (*Poa pratensis* L.), red fescue (*Festuca rubra* L.), colonial bentgrass (*Agrostis capillaris* L.), creeping bentgrass (*Agrostis stolonifera* L.), was planted. The contents of PTEs in technosol were determined by the multi-acid ICP-ES method, in plants by the ICP-MS method. The results show that the addition of sorbents decreased the selected PTEs compared with a control sample Cu 2638 ppm (C), 1590 ppm (BCH), 1838 ppm (OZS), Mn 784.67 ppm (C), 611.67 ppm (BCH), 674.67 ppm (OZS), Cr 583.66 ppm (C), 327.33 ppm (BCH), 393.33 ppm (OZS). The addition of the organo-zeolite substrate and biochard to the technosol also resulted in a change in pH 5.41 (BCH), pH 6.81 (OZS) compared with a control sample of pH 3.43. Sorbents also helped to support the growth of the grass mixture. The maximum average plant height after 12 weeks was 1 cm (C), 13.45 cm (BCH) and 33.97 cm (OZS). The additament of natural sorbents have a positive effect on the growth of the grass mixture and contributed to the reduction of PTEs in technosol.

Key words: *technosol, organo-zeolite substrate, biochar, potentially toxic elements*

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Identification of differences in Slovak and Czech methodological procedures, time and financial demands related to land adjustment project

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In this paper, we focused on the identification of differences between Slovak (SR) and Czech Republic (CZ) methodological procedures in the time and financial demands of land consolidation (LC) projects in selected model cadastral areas. For detailed identification and comparison, we chose the model cadastral area Nýrovce for SR and cadastral area Milotice u Kyjova for the CZ which have similar landscape and ownership parameters. The cadastral area of Nýrovce is in located the district of Levice with an area of 1,349 ha. The LC project was started in 2005 and ended in 2014 with an entry in the cadastre of real estates. Before the implementation of the LC project, there were 11,341 ownership relationships in the village of Nýrovce, and after the end of the LC project, they decreased by up to 92% to 889 ownership relationships. The cadastral area of Milotice u Kyjova is in located the South Moravian region, Hododín district with an area of 1,260 ha. The LC project was started in Milotice in 2008 and ended with registration in the cadastre of real estates in 2014. Before the started LC project, there were up to 4,762 ownership relationships in the village of Milotice u Kyjova, and after the LC project this count dropped to 2,908 ownership relationships. Analysis of the geodetic stages of the LC project in the SR and in the CZ revealed that these stages are almost identical. The biggest difference is in the stage of purposeful mapping of topography and elevation, which is performed in the SR with greater measurement accuracy. A detailed analysis of the landscape stages revealed several differences in the stages of the LC project. The biggest differences are mainly the time length of processing of individual stages, such as the elaboration of general principles of the functional land rerrangment documentation. Within this stage, the local territorial system of ecological stability is being developed in the SR, which is already being draft in the CZ in the municipal zoning plan and is being taken over into the LC project, where it is subsequently updated. The study also compared the total prices of the project in both countries. We divided the prices of LC projects into two parts, geodetic and landscape activities. In the cadastral area of Nýrovce it was found that most of the total prices of the project was spent on geodetic activities in the ratio of 70:30. In the CZ in the cadastral area of Milotice u Kyjova, the ratio between geodetic and landscape activities was 60:40. But in contrast to the SR cadastral area, 80 EUR per hectare was spent on funding for landscaping activities, which is almost double to the SR cadastral area. We can state that in the CZ LC projects place more emphasis on landscape activities compared to the SR.

Key words: *land consolidation, project stages, Slovakia, Czech Republic*

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Identification and proposal of measures in localities endangered by water erosion - Horná Nitra agricultural cooperative case study

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Water erosion has a negative impact on agricultural production due to the irreversibility of the soil removal, direct damage to cultivated crops, negative physical, chemical and biological changes in the soil properties. The changes are reflected by a reduction in the depth of cultivated soil, a removal and transport of the mineral and organic material, which head to reduction of soil fertility and change in soil structure. For this reason, it is important to monitor the intensity soil loss caused by erosion. The identification of the affected localities is a necessary step in the correct design of erosion control measures. The aim of the study is to evaluate the soil loss due to water erosion, identify soil units more sensitive to water erosion and to propose measures that minimize the loss of land cultivated by the agricultural cooperative Horná Nitra (PDHN) based in Nedožery - Brezany, Slovakia. To achieve the set of goals, we used the universal soil loss equation (USLE) in the geographic information system (GIS) environment. We applied the model to 140 land units with an area of 2264.52 ha, which are managed by PDHN and spread over 12 cadastral areas. USLE predicts the long-term average soil loss in practice and is also used for proposals of permissible slope length, crop rotations and other erosion control measures. The calculated potential intensity of water erosion in studied area (without the use of a protective vegetation cover layer and erosion control measures) reached a higher value by 157 $t.ha\text{-}^{1}.year^{-1}$ than the calculated real intensity of water erosion where we considered the current sowing procedures without application of erosion control measures. Based on the calculation of soil loss and depending on the soil depth in soil units, we obtained information on the potential and real degree of soil erosion risk (SEOP). SEOP from 2^{nd} to 5^{th} class represents erosively endangered soil. Based on modeling, the total representation of potential SEOP according to STN 75 4501 within these categories of erosion risk was higher by 346.22 ha than of real SEOP. In the case of SEOP calculation according to Act no. 220/2004 Coll., we have found that the potential SEOP had a higher total representation of 2^{nd} up to 5^{th} erosion risk classes by 232.41 ha than the real SEOP. The results of the modeled erosively endangered localities in GIS were verified in the field. We have identified 5 endangered sites that require adequate erosion control measures in order to conserve soil resources and reduce erosion risk on cultivated land units. We proposed the measures that minimize the removal of soil, humus and plant nutrients and the consequent damage to cultivated crops. Among the financially and technically inexpensive measures applicable in the identified endangered localities are grass belts, fortification of valleys with permanent grasslands, use of suitable sowing procedures, construction of erosion ditches around the perimeter of soil units and contour tillage.

Key words: *soil units, cooperative, water erosion, erosively endangered localities, USLE, GIS*

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Grassing systems for erosively endangered soils

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The article presents the need for year-round protection against soil erosion, the need to grow crops with a long-term anti-erosion effect during the entire vegetation (grasslands, perennial forages, clover grass mixtures). Soil erosion is a set of processes of mechanical destruction and removal of the surface layers of the earth's crust by the action of exogenous factors, especially water and wind. It represents a loss of the most fertile layer of agricultural soil, a loss of nutrients, humus, soil organic matter (SOM), a decrease in microbiological life. From the point of view of the long-term negative effect on the productive capacity of the soil, soil erosion is identified as a significant environmental threat. The aim of the research task was to verify the procedure of grassing erosively endangered soil with the help of anti-erosion belts, to obtain experimental data for sustainable management of soil at risk of erosion. The research area is located in a mountainous part of Slovakia with a mosaic of deciduous draws and mixed forests. It is located at an altitude of 480 m on a sloping slope of 12º with NE exposure. The average annual rainfall is 853 mm, for the growing season 441 mm. The evaluation of sustainable farming conditions was tested by sowing a 5-component grass and a 6-component clover grass mixture. Seed mixes were sown in the spring with a full 41 kg*ha^{-1} (100%) and 20.5 kg*ha^{-1} (50%) by sowing. The field experiment was established by the method of long bands in three replicates. The area of the experimental plot was 7 x 1.5 m (10.5 m^2). A precision seed drill (Qyord Plot Drill with a reach of 1.5 m /row spacing 0.125 m) was used to perform the sowing. The evaluation of the impact of grassland was analyzed over 2 years, used by 2 mowers with divided application of mineral fertilizers. Before each mowing, the floristic composition of the stands was determined by the method of projective dominance according to Regál. Dry matter production and stand involvement were determined by counting plants from 1 m^2 of each variant. The involvement of grassland had a minimum of vacancies and mainly sown species predominated. The highest dry matter production of 6.48 t*ha^{-1} was achieved on the variant with a clover grass mixer with full seeding. Soil samples were taken by the system of an average sample in the spring term from the layer 0 – 150 mm. Soil moisture, total microbial biomass content was determined gravimetrically in the fine soils by the fumigation method. The stability of SOM was evaluated by gas chromatography respirometric test of the evoked response. The highest value of stability of organic substances in the soil was achieved on the variant with a clover-grass mixture with full seeding. Soil abundance was monitored in capture deluometers. In the control variant without plant cover, a washout in the range of 0.9 – 26.6 t*ha^{-1} was recorded. The grassy variants were fully affected by their anti-erosion effects and no surface soil soil was recorded. The output was the transfer of knowledge for practice.

Key words: *soil protection, erosion, grassing, soil organic matter.*

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Comparison of soil organic matter composition under different land uses by DRIFT spectroscopy

Saven THAI

Supervisor: doc. Ing. Lenka Pavlů, Ph.D.
Co-supervisor: RNDr. Václav Tejnecký, Ph.D

Soil organic matter (SOM) plays vital importance for biological, chemical, and physical soil improvement and productivity. Organic matter composition also depends on different types of vegetation covers. Thus the study was aimed to estimate and characterize the soil organic matter (SOM) under different land uses (cropland, grassland, and forestland) and depths (0 – 10 cm, 10 – 20 cm, and 20 – 30 cm) in Prague Suchdol. Ninety samples of disturbed soil and 30 samples of undisturbed soil were collected within different land uses and within different depths. The soil organic matter (SOM) composition was assessed by diffuse reflectance infrared fourier transform spectroscopy (DRIFT). Humic and fulvic acid were extracted from soils and their composition was also assessed by DRIFT. Additionally, soil bulk density, dissolved organic carbon (DOC), cation exchange capacity (CEC), humus quality as ratio between absorbances of soil extract with sodium pyrophosphate at the wavelengths 400 and 600 nm, soil organic carbon (by the rapid dichromate oxidation technique), were determined on the samples as well as physical characteristics as bulk density. The data were analysed statistically by statistical package for the social sciences (SPSS) version 20. The results indicated that pH_{KCl} is significantly different among land uses. Cropland had the highest values of pH_{KCl} with a range from 6.86 to 7.76, followed by grassland with a range from 5.72 to 5.93 and forestland with 3.34 to 3.65, respectively. The bulk density among the three land uses were also significantly different; cropland had the highest bulk density, followed by grassland and forestland, respectively. Additionally, the soil organic carbon deviates statistically in depth 0-10 cm and 20-30 cm, while the depth in between from 10 to 20 cm showed no substantial difference among the land uses. However, the humus quality was significantly different for all depths where forestland had the lowest humus quality compared to grassland and cropland, respectively. The largest differences in the composition of organic matter depending on the vegetation cover were observed in the upper parts of the soil profile. In the deeper parts, the differences in the spectra of both own soils and humic or fulvic acids disappeared. Additionally, the soil spectra analysis determined the deviation of the organic matter composition in the band range from 2800 to 3010 cm^{-1}. The forest had more intensive aliphatic bands of organic matter than grassland and cropland. However, there were also differences in between the fulvic spectra in regards to that nitrogen was less in the forest while it had a higher amount in cropland and grassland. The bands of C=O stretching, aromatic C=C, and quinones were less visible in grassland for the first depth, and in cropland in the second depth.

Key words*: soil organic matter, landuse, infrared spectroscopy*

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Impact of biochar application and re-application on the selected physical and hydro-physical properties of the soil

Lucia TOKOVÁ

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The use of biochar appears to be one of the suitable alternatives in connection with the improvement of the physical and hydro-physical soil properties. The potential benefits of biochar as a soil amendment are well identified in the scientific literature, but there has been only a limited amount of studies tracing biochar's long-term effects (> 5 years). Our research was conducted at the experimental site of the Slovak University of Agriculture in Nitra located in Dolná Malanta. This biochar field experiment was established in 2014 to examine the effect of biochar application on greenhouse gas emissions, soil quality and crop yields. Fifteen treatments with three replicates were arranged on plots 4 x 6 m. Biochar was manually applied at the doses of 0, 10 and 20 $t.ha^{-1}$ and the N fertilizer was applied annually at the application levels of N0, N1 and N2. The application level N1 was calculated according to the requirements of crop grown in the specific year using the balance method. A dose in N2 fertilization level was 50% higher than in the level N1. In 2018, the original plots with biochar application were divided in halves (4 x 3 m subplots) and the biochar was re-applied to one subplot at the same doses as in 2014. In our study, we focused on examining the impact of biochar application in the fifth year (2019) after its application in combination with N fertilizer on bulk density, porosity, saturated hydraulic conductivity and available water content. Another goal was to analyze the effect of biochar re-application on the above-mentioned soil properties in 2019. Our results from the measurements in the year 2019 showed significant differences after biochar application and re-application in bulk density (a decrease), porosity (an increase), saturated hydraulic conductivity (an increase) and plant available water (an increase). The most markedly decrease in bulk density was observed in treatments with biochar application and re-application at dose of 20 $t.ha^{-1}$ without nitrogen fertilization (B20 + N0 and B20 reap + N0) which resulted in an increase in of porosity.

Key words*: biochar, bulk density, plant available water content, porosity, saturated hydraulic conductivity*

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The impact of climate change on the length of the main growing period

Adrián VARGA

Supervisor: Ing. Yvetta Velísková, PhD

Climate change affects all aspects of our lives, today each of us can observe its effects in our surroundings today, such as rising maximum temperatures, short winters often without snow, heavy and short rains, excessive drought. This contribution was focused on evaluation of climate change impact in the territory of Slovakia. This evaluation was done on the basis of a selected climate indicator using a geographic information system (GIS). For our purposes, the climatic indicator $T \geq 10.0°C$ - TS10 was selected, which is defined as the sum of average daily temperatures above 10°C for the period from the onset of this temperature to its end, and which also defines the length of the main growing period. The methods used in this study as far as the theoretical part is are primarily a search of available resources that dealt with climate change and its effects on the environment. Data on average daily temperatures above 10°C from 1961 to 2015 came from meteorological stations that are located throughout Slovakia. These data were then used for the prediction to 2100. The trend method as a part of spreadsheet software was used for the forecast. Map outputs were made using ArcGIS - ArcMap software where the geostatistical stochastic Kriging method was used as an interpolation method of values. The results show that climate change has a noticeable impact on the length of the main growing period, which will be prolonged. By prediction results the sum of average daily temperatures above 10°C could be increased by 800°C. The results of this study can be used to investigate the impact of the extension of the main growing period on agricultural production in the future.

Key words*: climate change, main growing period, impact, GIS, prediction*

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SECTION

Plant Production

Effect of selected plant biostimulants on yield and quality of onion (*Allium cepa* L.) and potatoes (*Solanum tuberosum* L.)

Samuel ADAMEC, Alena ANDREJIOVÁ

Supervisor: doc. Ing. Alena Andrejiová, PhD.

„A plant biostimulant is any substance or micro-organism, or a combination thereof, in the form in which it is supplied to a user, applied to plants, seeds or the plant rhizosphere to stimulate natural plant processes such as nutrient efficiency and/or tolerance to abiotic stress, regardless of on their nutrient content.“ Due to many studies demonstrating the efficacy of biostimulants, we expected confirmation of the influence of applied biostimulants based on humic acids (Agriful) and soil bacteria (Novaferm Multi) on the improvement of yield and quality parameters of consumable parts of model crops included in our field experiments. The experiments were located in the southwest of Slovakia, in the integrated cultivation system on an area of 50 ha^{-1} in growing season 2019. The observed crops together with their genotypes – Rockito and Centro for common onion; Toscana and Mozart for potatoes, were chosed based on economic significance. The qualitative parameters evaluated in the work were determined due to their importance for the farmer, especially in terms of the storability and marketability of products. The experiment was divided into 4 variants: Control, Agriful, Bacteria, and Agriful with bacteria combination. Biostimulants were applied in prescribed doses by drip irrigation. The biostimulant based on humic substances had the highest efficiency - an increase of yield in both onions cultivated varieties was 15.20 – 21.75% and for potatoes up to 15%. For both varieties of onion, we recorded an increase in the refractometric dry matter by 3.3 – 6.7%, while similar results were obtained also for tubers of potatoes. In the case of dry matter – biostimulants affected the onion Centro variety with a 0.4 – 4.4% increase and for potatoes Toscana variety with a 4.75 – 11.63% increase. On the contrary, there was a reduction of starch content in both varieties of potatoes but with a simultaneously very high content of reducing sugars in the tubers of plants treated with biostimulants.

Key words: *biostimulants, bacteria, humic substances, common onion, potatoes*

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Chlorophyll fluorescence as a tool for assessing the tolerance of wheat to drought

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Supervisor: prof. Ing. Marián Brestič, CSc.

Increasing the tolerance of crops to drought and high temperatures are one of the main challenges, that plant research and breeding practices are currently facing. Wheat production, as one of the strategic crops in the world, is reduced by 10 – 40% every year, given the long-term water deficits and high temperatures due to the environmental changes, which are associated with climate change. Drought responses involve complex changes in physiological, biochemical, and growth-production properties. These manifest with a certain time interval after the action of the stress factor. Therefore, methods that characterize the current physiological state of plants are getting more attention, for example, the measurement of the state of the photosynthetic apparatus. The aim of our work was to characterize the specific phenotypic manifestations of modern wheat genotypes and the sensitivity of photosynthetic parameters to progressive drought. In pot experiments, 35 genotypes of wheat (*Triticum aestivum L.*), with various ploidy, and mutations of light-harvesting antennas, drought tolerance were experimentally tested. Water stress was simulated by interrupting irrigation up to 62% of the RWC in the leaves. During the gradual dehydration, changes in the fluorescence parameters characterizing the structure and state of photosystem 2 (PSII) were recorded (Handy Pea, Hansatech, GB). The results show that although photochemical processes in photosynthesis are resistant to water stress, water deficit can lower parameters such as Fv/Fm, as well as electron transport processes. The results also show that drought resulted in a statistically significant reduction in the number of specific photosynthetic reaction centers (RC / ABS parameter). Therefore, the analyzes used in our experiment appear to be a useful and reliable tool for monitoring the physiological responses of individual varieties of wheat exposed to stressed conditions. At the same time, they provide the possibility of applying them as suitable selection criteria that could be potentially useful in the wider screening of wheat genotypes.

Key words: *wheat, drought, tolerance, chlorophyll fluorescence*

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Effect of plant growth promoting *Streptomyces* on the growth of oilseed rape (*Brassica napus* L.) *in vivo*

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Supervisor: prof. Ing. Soňa Javoreková, PhD.

Actinomycetes of the genus *Streptomyces* are important producers of bioactive metabolites. Due to their ability to support plant growth, we also call them Plant Growth Promoting Streptomyces – PGPS. They affect plant growth by direct and indirect mechanisms by which they ensure the availability and use of different types of microelements and macroelements. The aim of our work was to test 19 streptomycetes isolates from Collection of microorganisms of The Department of Microbiology, FBFS, SUA for direct growth promotion mechanisms with subsequent testing *in vivo* for oilseed rape growth. From direct mechanisms we tested production of indolyl-3-acetic acid (IAA), siderophores production, HCN production and phosphate dissolution, In *in vivo* test, rape seeds were soaked in a bacterial suspension of *Streptomyces* strains with concentration 1.5 x 10^8 and applied to the organically poor soil. Plant growth was performed under controlled conditions in a cultivation chamber for 5 weeks. The conditions were as follows: light phase for 16 hours with temperature 28° C and dark phase for 8 hours with temperature 22 °C and 80 % humidity in both phases. An untreated plant was used as a control. We observed the length and weight of the root system. Based on the tested direct mechanisms, six isolates proved to be the most active and were applied under *in vivo* conditions to rapeseed. The most active isolate KmiSK16A011 was identified as *Streptomyces flavovariabilis*, which produced 40.34 $mg.ml^{-1}$ IAA, had a positive production of siderophores, HCN and dissolved phosphates. After application to rapeseed, it increased the weight of the root system by 46.56% compared to the control. Isolate KmiSK16A006 identified as *Streptomyces olivochromogenes* produced 24.09 $mg.ml^{-1}$ IAA, produced siderophores and HCN and at the same time prolonged the rapeseed root system by 42.30% compared to the control. While the KmiICH17A098 isolate identified as *Streptomyces albidoflavus*, in addition to producing only 8.12 $\mu g.ml^{-1}$ IAA, had positive siderophore production and HCN increased fresh plant weight by 41.21% compared to control.

Key words: *Plant Growth Promoting Streptomyces, IAA, HCN, siderophores, in vivo experiment, oilseed rape*

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Analysis of foreign trade in the potato market in the Russian Federation and the Slovak Republic

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According to FAOSTAT, over the past 20 years, there has been a tendency for potato production to decrease by about 1% in the world, especially in the CIS and European countries. While international trade in potatoes and potato products market is still insignificant compared to potato production, as only about 6 percent of that one goes into trade. High shipping and storage costs are major obstacles to expanding the international market. In addition, import tariffs to protect the domestic market and plant control measures severely restrict international trade. As an example of the foreign trade analysis in the potato market, the author considers the situation in the Russian Federation as the third world potato producer, and the EU country, the Slovak Republic, which is actively trying to use modern technologies and improving potato product quality in order to approach a stable situation in the Slovak potato market. The analysis of foreign trade in the studied countries will be considered in the period 2014 – 2019. According to Federal State Statistic Service the Russian Federation imported 759,9 thousand tons of potatoes in 2019, which is 20% less compared to the import of 2014 (1071,6 thousand tons). Exports from Russia in 2019 amounted to 463,6 thousand tons, which is 85% more than in 2014 (69,1 thousand tons). At the same time, 66,8 tons of potatoes were imported in the Slovak Republic in 2014, which is 3.3% less than in 2014 (64,5 thousand tons). Exports from Slovakia amounted to 13,6 thousand tons, which is 29% more than in 2014 (9,7 thousand tons). The main trading partners of the Russian Federation are the CIS countries (Azerbaijan, Belarus, Tajikistan, Uzbekistan, Turkmenistan), the EU (Finland, the Netherlands), Serbia and Egypt. The Slovak Republic cooperates mainly with the countries of the European Union, primarily the Czech Republic, France, Poland, the Netherlands, etc. The article will conduct and consider a detailed analysis of foreign trade in the studied countries.

Key words: *potato market, import, export, Russia, Slovakia*

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Assessment of photosynthetic traits in phenotyping of high temperature effects in wheat varieties

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Supervisor*:* doc. Ing. Marek Živčák, PhD.

The importance of high temperature as an environmental factor is growing in proportion to deepening global climate change. High temperatures affect virtually all physiological and metabolic processes in plant cells with the negative effects on growth, biomass production and the yield of crops. The aim of this work was to evaluate the physiological effects of high temperature on different genotypes of wheat, to assess their thermostability and environmental plasticity. The main emphasis was placed on the measurement of photosynthetic and photochemical events measured by in vivo methods. Three genotypes were tested, which were selected from a wide collection based on leaf markers and photosynthetic performance: Thesee (*Triticum aestivum L.*, GER), Roter Samtiger Kolbenweizen (*Triticum compactum Host.*, DEU) and ANK 32A (*Triticum aestivum L.*, RUS). The pot experiment was established in natural conditions outdoors (high temperature non-acclimated variant) and a part of the plants were placed in foil tunnel in which the plants were exposed to temperatures up to 38 °C for 14 days (high temperature-acclimated variant). Severe heat stress screening experiment was induced by subsequent exposition of the plans in a climate chamber where the plants were exposed to temperatures up to 45 °C for one day. The non-invasive measurements were applied in leaves of selected genotypes before and after the high temperature treatment. We focused on assessment of photosynthetic CO_2 assimilation, stomatal conductance (Licor 6400, USA), photochemical reactions (PhotosynQ, USA and Dual-PAM-100, Walz, DE) and rapid kinetics of chlorophyll a fluorescence (Handy Pea, Hansatech, GB) at the leaf level. In plants exposed to heat stress, we recorded a decrease in the value of the maximum quantum yield of PSII photochemistry (Fv/Fm), with the most significant decrease in ANK 32A. However, we did not observe a decrease of Fv/Fm below the critical value (0.5) in any of the genotypes. The heat stress led to a significant decrease in electron transport rate and CO_2 assimilation rate, and we identified significant differences in capacity to recover after heat stress. The analysis of the fast chlorophyll fluorescence kinetics identified a good recovery of PSII after heat stress in plants of high temperature acclimated variant in all genotypes, whereas there were significant differences in sensitivity of genotypes when non-acclimated genotypes were tested. The most significant was the reduction of the number of active reaction centers (RC/ABS) and efficiency of electron transport at the PSII acceptor side (ϕEo). Our results indicate that, in group of observed genotypes, the differences in thermostability were higher than the differences in acclimation capacity. Our results also indicated that short episodes of high temperature (heat waves) coming suddenly after the period with a moderate temperature may affect the photosynthetic plant productivity more than a long, sustaining period of gradually increasing high temperature. The data obtained in our experiments may be useful for further screening and research focused on efficient utilization of crop genetic resources available in gene banks.

Key words: *wheat, stress, heat, photosynthesis, chlorophyll fluorescence*

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Effect of exogenous abscisic acid on content malondialdehyde of Ravnaq-2 seedlings under salinity

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Salinity is a serious problem in worldwide agriculture areas because it limits plant growth and productivity. Salt stress alters various biochemical and physiological responses in plants and thus affects almost all plant processes including photosynthesis, growth, and development. Studies on salinity stress will be a stride towards the urgent need for developing crop varieties with a better ability to grow and produce yields in salt-affected environments. To improve the adverse outcome of salinity stress on plant growth, diverse phytohormones are extensively used and one such kind of a phytohormone is abscisic acid (ABA) which is a plant stress hormone and is considered as an important agent in the mechanisms of resistance and adaptation in plants against various abiotic stress conditions such as water, salt, and temperatures. Malondialdehyde (MDA) is a low molecular weight product that occurs naturally as an outcome of lipid peroxidation. According to literatures, free radical-induced peroxidation of lipid membranes is a reflection of stress-induced damage at the cellular level. Therefore, the intensity of MDA is regularly used as an indicator for estimating the level of oxidative damage. Our results point towards the important role of ABA in tolerance to abiotic stresses and also provide new insights into the molecular mechanism of enhanced salt tolerance by the application of exogenous ABA on crops. Seven-day-old seedlings of cotton (*Gossypium hirsutum* L.) cultivar to name a salt-tolerant Ravnak-2 was used in this study. The seedlings were grown with tap water to be subsequently subjected to salt stress by exposing the samples to 1% and 4% NaCl solutions for 1 hour and 24 hours. 10^{-7} M concentration of exogenous ABA was used in the experiment. The Ravnak-2 variety is an example of modern selection based on the precise selection of genome sites that do not contain gene engineering and are suitable for useful agronomic traits. In our study, MDA concentrations were found to reduce at salinization after 1 hour in a 1% NaCl solution in Ravnak-1 variety by 36.4%. After 24-hour exposure to 1% NaCl, we observed a more significant decrease in MDA (13.7%). When ABA was added, a considerable reduction in MDA concentrations occurred (59%). After 1-hour exposures to 4%, NaCl+ABA declined the MDA concentrations by 13.7%. It shows that salt resistance of the variety stimulates the capability of protection from oxidative damage by the exposures above. MDA production is considered an indicator of membrane lipid peroxidation and also the level of various stresses in plant membranes. Results in the present study reveal that the degree of MDA accumulation was higher in salt-treated samples than that of the ABA pretreated samples.

Keywords: *salinity, cotton, phytohormone, abscisic acid (ABA), malondialdehyde, lipid peroxidation, NaCl solution.*

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Effect of salinity stress on sugar content of cotton plant

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Supervisor: prof. Ali A. Akhunov

Soil salinity is a major factor limiting agricultural productivity of nearly 20% of the cultivated area and half of the irrigated area worldwide. Cotton (*Gossypium hirsutum* L.) is a salt-tolerant crop that can improve productivity on saline soil and lead to economic development in regions of high salinity. Plants normally cope with salinity stress in various ways. Among these responses, the accumulation of compatible solutes including proline, soluble sugars, sugar alcohols, and glycine betaine has received the most attention in terms of their functions in osmotic adjustment. The osmotic adjustment refers to the net accumulation of solutes in cells in response to a fall in the water potential of their environment. As a consequence, the cell osmotic potential lowers, and turgor pressure tends to be maintained. Their role in terms of osmotic adjustment is, however, still under debate. In many species, the absolute osmolyte concentrations are unlikely to mediate osmotic adjustment. Sugars, owing to their regulatory function, affect all phases of the life cycle of plants and, interacting within phytohormones, control the processes of growth and development of plants. The material of the study is 7-day old seedlings of tolerant cotton varieties “Ravnak-2”. The samples were subjected to salt stress by exposing them in a solution of 1% and 4% sodium chloride, followed by the determination in the seedlings of the content of reducing sugars. “Ravnak-2” variety is an example of modern selection based on the precise selection of genome sites that do not contain gene engineering and are suitable for useful agronomic traits. According to the results, as the salinity increased, the sugar levels also increased relative to control. Sugar content in shoots had a significant increase under salinity stress. Increased accumulation of sugars has been reported in many plant species exposed to salinity. According to Stoop and Pharr, the increase in glucose pool induced by salinity in celery petioles appeared to be due to decreased demand for carbon. It is believed that under salinity stress accumulation of sugars along with other compatible solutes contribute to an osmotic adjustment that allows the plant to maximize sufficient storage reserves to support basal metabolism under a stressed environment.

Keywords: *salinity, cotton, phytohormone, abscisic acid (ABA), malondialdehyde, lipid peroxidation, NaCl solution.*

Acknowledgement: The work was supported by state project A-FA-BV-2019-6.

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Cannabis sativa L. and its multipurpose use

Ksenija LONČAR

Supervisor: doc. Ing. Janka Nôžková, PhD.

In recent years, hemp has come to the attention of scientific community all around the world and has clearly become one of the most studied plants. Hemp is a plant with many applications and can provide natural resources for humans. When it comes to its multi-purposes use, hemp stalks are known to provide fiber used to make weave cloth and cordage, female flowers are also very interesting from a medical point of view, however hempseed holds an interesting place in human nutrition, not only for its amino acids and fatty acids composition but also for other bioactive constituents. Considering the project that will support our doctoral studies, we decided that the main component of our research is going to be hempseed, fruit of *C. sativa* L., regarding its nutritional profile (high amount of unsaturated fatty acid and preferable levels of ω-6/ω3 fatty acids, protein content (high level of arginine and glutamic acid), antioxidative bioactive peptides, polyphenols (hydroxycinnamic acid and lignanamides) and other bioactive compounds. In addition to different genotypes of hemp (*C. sativa* L.) and their unique phenotypic diversity in plant morphology, it is our main goal to find and identify hemp cultivars which would be the best match for food purposes by their compositions. To fulfill this goal, we will use different methods and monitor various parameters – morphological (seeds, leaves, flowers), nutritional (protein spectrum), and agronomic. Furthermore, we will use new approaches of morphology characterization by image analysis methods. Obtained results will be the straight output of approved scientific project. We will propose a new way of use in the field of sustainable and innovative foods by studying selected genotypes of *Cannabis sativa* L.

Key words: *Cannabis sativa L., hemp, hempseed, genotype, human nutrition*

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Comparison of the influence of static and dynamic methods of grape must clarification on the selected parameters of wine

Jakub MANKOVECKÝ

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The aim of the experiment was to compare the influence of different methods of must clarification on the content of soluble oxygen (O_2), selected physico-chemical parameters of must and wine, as well as on the regime of sulfur dioxide and sensory properties of wine. We obtained the must by processing of grapes of the standard white must variety Pinot Gris (*Vitis vinifera*). We used technologies of static and dynamic clarification of grape must. Dynamic method of clarification, so-called flotation, is a physical process in which solid particles are suspended and carried into a surface by fine bubbles of air or inert gas. The static method consists in the gravitational sedimentation of solid particles (solids) to the bottom of the vessel where must clarification takes place. We used three experimental variants: a dynamic clarification method with the addition of flotation enzyme, gelatin and polyvinylpolypyrrolidone (PVPP). In the control variant (static method) we used the clay mineral bentonite as a clarification agent. We determined the oxygen content in musts and wines by the luminescence method. Physico-chemical parameters of musts and wines were determined spectrometrically by FT-IR method. The amount of total sulfur dioxide was determined by iodometric titration. We evaluated the organoleptic properties of wines using a 100-point evaluation system according to the International Organization of Vine and Wine (OIV). In addition, the descriptors of taste and smell were used for evaluation. The evaluation of wines took place under the conditions regulated by the standard STN EN ISO 8589: 2010. We used the analysis of variance in the program Statgraphics Centurion XVII (StatPoint Inc. USA) for statistical evaluation of the results. We found significant differences between the variants of clarification methods in terms of the oxygen content in the must. Content of oxygen in the variant with dynamic clarification with use of PVPP was 1.52 mg/L and in control variant 2.32 mg/L, which represents an increase of more than 52 %. After the fermentation of the musts, we did not find statistically significant differences between the variants in terms of O_2 content, which ranged from 0.64 to 0.71 mg/L. We explain this by the reduction processes that arise during alcoholic fermentation by the activity of the yeast *Saccharomyces cerevisiae*. During propagation, the yeast consumes some of the oxygen present in the must to form esters and higher fatty acids that are essential for their development. We did not find a statistically significant effect of the clarification method on the physico-chemical parameters of musts and wines, nor on the sulfur dioxide regime. The highest rating (88.2 points) in terms of organoleptic properties obtained the wine from the variant with dynamic clarification with the addition of flotation enzyme and the lowest rating (86.2) wine from the variant with use of gelatin. Flotation is an action, operative method and is also suitable for large-scale production purposes. The positive benefit of dynamic clarification of must in terms of labor and time savings is incomparable with the static method of must clarification.

Key words: *must, clarification, flotation, oxygen, wine, sensory properties*

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The efficacy of fungicides against *Fusarium* head blight and grain blight of spring barley under natural infection

Ľudovít MIŠĽAN

Supervisor: prof. Ing. Kamil Hudec, PhD.

Fusariosis of spring barley ears negatively affects the quantitative and qualitative parameters of grains. Mycotoxins ingested by humans or animals cause serious health problems. Crop protection consists of a precise system of crop control and correctly timed application dates for fungicides. Even if all procedures are followed, the success rate is not 100 %. This work was focused on the evaluation of the effectiveness of authorized fungicides in spring barley against ear fusariosis in conditions of natural infection. A small plot experiment was carried out in the locality of Pavlovce nad Uhom on spring barley, Malz variety. The fungicides Bontima, Osiris, Prosaro 250 EC and their mutual combinations were used, which were applied in terms T1, T2 and T3 (BBCH 31 – 32, BBCH 37 – 39, BBCH 61). We randomly selected 100 ears were evaluated, on which the % infestation of the Fusarium head blight was determined. Fungicidal efficacy was calculated according to Abbott's formula. The average infestation of barley ears in the check variant was 31.99%. The fungicidal efficacy was determined in the following order: Bontima (T1) 15.4 %, Osiris (T2) 23.51%, Prosaro 250 EC (T3) 32.43%, Bontima + Osiris (T1 + T2) 37.17%, Osiris + Prosaro 250 EC (T2 + T3) 54.67%, Bontima + Prosaro 250 EC (T1 + T3) 60.64%, Bontima + Osiris + Prosaro 250 EC (T1 + T2 + T3) 66.85%. The average grain infestation in the untreated control was 14.75%. The fungicidal efficacy evaluated on the basis of grain infestation was as follows: Bontima (52.54%) Osiris (67.80%) Prosaro 250 EC (28.81%) Bontima + Osiris (25.42%), Osiris + Prosaro 250 EC (15.25%) Bontima + Prosaro 250 EC (- 8.47%), Bontima + Osiris + Prosaro 250 EC (- 35.59%). From the above results, it is possible to rank the preparations and their combinations in descending order as follows: on the classes: Bontima + Osiris + Prosaro 250 EC, Bontima + Prosaro 250 EC, Osiris + Prosaro 250 EC, Bontima + Osiris, Prosaro 250 EC, Osiris, Bontima and on grains: Bontima, Osiris, Prosaro 250 EC, Bontima + Osiris, Osiris + Prosaro 250 EC. Bontima + Prosaro 250 EC, Bontima + Osiris + Prosaro 250 EC. The fungicidal efficacy against ear fusariosis does not correspond to the efficacy against grain fusariosis. The results of the present work show that the use of fungicides in the application period (T2 and T3) had a positive effect on the symptoms of Fusarium head blight. The results show that reliable (chemical) protection against ear fusariosis in practice is still unresolved.

Key words: *spring barley, fusariosis, grains, ears, fungicides, efficacy*

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Effect of different levels of nutrition durum wheat on the amount and quality of harvested production

Marek PROVAZNÍK

Supervisor: prof. Ing. Ladislav Ducsay, Dr.

Nitrogen fertilizers are best applied during the period of the most intense growth, in the stages of plant growth to stalk creation when it utilizes, from the total taken up nitrogen, up to 70%. From the viewpoint of the impact of nitrogen nutrition on grain production of wheat regeneration and production fertilization is considered the most important. Qualitative fertilization of the crops by nitrogen in the growth phase after bloom, increases grain balance, content of nitrogenous substances and wet gluten. Ontogenetic development of wheat, directly related to its nutrition, begins at the level grains (seeds). When swollen, the activity of the enzymes is mobilized to transform complex substances (starch, disaccharides, etc.) into simple substances that seed uses for its growth. From „maternal nutrition" depends the quality of plant rooting (transition to soil nutrition) and their further growth. Operational, nutritional trials was established in growing season 2017 – 2018 at arable land managed by the agriculture plant ROD Skalica. The experimental factor was a different levels of nitrogen nutrition in terms of the amount of nutrient applied and its effect on quantity and quality of achieved harvest. The distribution of experimental variants was in the form of a block method. Each experimental variant had three false repeats. Part of the experimental block was also a control variant. The aim of a one-year plant nutrition experiment was to quantitative assessment of winter durum wheat grain harvests from a viewpoint of mutual interaction of the chosen N nutrition and weather conditions. The second goal was evaluation of macro and microelement content in grain of durum wheat. The demonstration material for our nutritional experiments was the wheat variety durum winter with the trade name Lunadur. Nitrogen fertilizers of the LAV 27 type was used in the semi-productional experiment (granulate containing 27% N, which is ½ nitrate form and ammonium). The second experimental fertilizer was urea (diamide of carbonic acid – $COO(NH_2)_2$, in the form of a white granulate containing N – 46%). The highest average yield 7.12 $t.ha^{-1}$ was reached at treatment T1, where the total dose of applied nitrogen was 110 kg $N.ha^{-1}$. There was found statistically significant difference between treatment T1 and unfertilized (control) treatment T0. The relative yield increase compared to unfertilized control (T0) represented 51%. The statistically significant increase of yield was observed in treatment T2 (6.88 $t.ha^{-1}$) with the total dose 190 kg $N.ha^{-1}$ and T3 (6.84 $t.ha^{-1}$) compare with unfertilized control T0. A Precise fertilized variant was a T3 treatment. The total dose of nitrogen for T3 treatment (35 kg $N.ha^{-1}$) was planning on the base of soil and plant analysis. The effect of nitrogen nutrition had also a positive influence on N concentration in grain. Its concentration depends on dose of nitrogen. The statistically significant highest concentration (2.80%) was observed at T2 treatment. There was applied nitrogen in the biggest dose.

Key words: *durum wheat, fertilization, nitrogen, grain harvest, macroelement*

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Comparative chemical study of the composition of plants of *Urtica dioica* L.

Kamola RAIMOVA, Nodira ABDULLAJONOVA

Supervisor: Doctor of chemical sciences Alimjan Matchanov

Currently, one of the urgent tasks of pharmaceutical chemistry is to reduce the side effects of drugs, to obtain combined drugs with a prolonged effect of drugs, to obtain combined drugs with a prolonged effect. In folk and modern medicine, various herbal preparations, decoctions, and tinctures are used. One of these plants is *Urtica dioica* L., which grows in the mountainous regions of Uzbekistan. The aim of this work is a comparative study of the chemical composition of *Urtica dioica* L., which grows in various climatic conditions of the Republic of Uzbekistan. Comparative studies of the Stinging nettle plant for the presence of heavy metals, macro- and microelements have been carried out. For research, the aerial parts of the plant (leaves and stem) were used. The quantitative content of heavy metals and micro and macro elements was carried out by inductively coupled plasma mass spectrometry (ICP-MS). From the data obtained, it was revealed that some heavy metals such as lead 1.075 ppm, arsenic 0.002 ppm were detected. From macro-, microelements, silver was found to be 0.521 ppm, aluminum 530.410 ppm, calcium 33.931 ppm, iron 6.752 ppm, magnesium 15.802 ppm, 111 ppm, and other elements. The aerial parts of the Stinging Nettle plant were studied for the content of phenolic compounds and flavonoids growing in the mountainous regions and on the plains. Ethanol was used to produce flavonoids, followed by concentration on a rotary evaporator. To remove residual lipophilic substances and chlorophyll, the aqueous extract was purified with chloroform. The obtained fractions were identified by two-dimensional paper chromatography using systems: butanol: acetic acid: water (4:1:5), 2% acetic acid. The following substances were identified by mass spectrometry: hyperin, resorcin, apigenin, quercetin, and other phenolic compounds. The results of the study showed that stinging nettle growing in mountainous regions is more suitable for obtaining dietary supplements, in contrast to stinging nettle used in the literature, since the environment in mountainous regions is less polluted.

Keywords*:* *Urtica dioica* L, macro- and microelements, flavonoids, heavy metals

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The influence of foliar selenium fertilization on oat grain yield

Marek SLEPČAN

Supervisor: prof. Ing. Ladislav Ducsay, Dr.

The selenium is in little amount essential for animals because of biological functions ensuring. The reason of this essentiality is its incorporation as selenocystein to the structure of antioxidative selenoproteins. Selenium deficiency causes male infertility, increases cancer predisposition and the risk of viral infection. The selenium has not been classified as essential plant micronutrient, although it provides some beneficial effects to plants which are able to accumulate it in higher concentrations. In the present study is described the influence of different doses of the foliar selenium fertilization applied in two growth stages on oat grain yield. The small plot field trial was realized on Research and Breeding Station Vígľaš – Pstruša in the years 2014, 2015, 2016 with oat (*Avena sativa* L.) variety Valentin. The experiment was realized by complete block method with four repetitions with plots in size 10 m^2. The seeding rate represented 5 million germinating grains per hectare. As forecrop was grown alfalfa. Before the sowing was accomplished basic fertilization in the form of 100 kg ammonium nitrate containing dolomite, 100 kg of 60% KCl and 100 kg of monoammonium phosphate. In total-was applied 39 kg of nitrogen, 49.8 kg of potassium, and 22.9 kg of phosphorus per hectare by these fertilizers. The selenium was foliar applied in the doses of 25, 50 and 75 g per hectare at growth stages BBCH 33 (stem elongation) and BBCH 53 (heading) as the solution of sodium selenate (Na_2SeO_4). The experimental treatments were the following: C – control, untreated with the foliar selenium fertilization; Se 25_{33} – treated with 25 g of Se per hectare at BBCH 33; Se 25_{53} – treated with 25 g of Se per hectare at BBCH 53; Se 50_{33} - treated with 50 g of Se per hectare at BBCH 33; Se 50_{53} - treated with 50 g of Se per hectare at BBCH 53; Se 75_{33} – treated with 75 g of Se per hectare at BBCH 33; Se 75_{53} – treated with 75 g of Se per hectare at BBCH 53. Harvesting was realized by small plot harvester at BBCH 91. The achieved experimental data were statistically evaluated by the analyse of variance for the individual treatment comparison at $p = 0.05$ and by LSD test to find out differences between years. Alterative weather conditions during experimental years had statistically significant impact on oat grain yield. The highest yield was harvested in year 2014, the average yield per all treatments was 7.36 tonnes. The highest statistically significant decline in yield was observed in year 2016 (with the average per all treatments 5.61 tonnes). Selenium treatments had also statistically significant influence on oat grain yield. From all experimental variants, the highest average grain yield of all years was achieved by control variant, untreated with the selenium fertilization. With the increasing dosage of applied selenium and also with its earlier application, the average grain yield decreased.

Key words: *oat, grain yield, selenium fertilization, sodium selenate*

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Effect of biostimulants on some mineral elements of lettuce (*Lactuca sativa* L.) grown under plastic tunnel

Arshad YASEEN

Supervisor: Associate professor Dr. Maria Takacs-Hajos

This study was carried out in April 2019 at the University of Debrecen, Farm and Regional Research Institute in its Botanical and Exhibition Garden to investigate the influence of some natural plant extracts on some macro and micro nutrient element contents of lettuce leaves. Biostimulants (Willow bark extract and Bistep) were treated on three different lettuce varieties (*May King*, *Kobak* and *Great Lakes*) to evaluate the mineral uptake by the lettuce varieties. Willow bark extract was diluted to 5% and directly applied to the plants through irrigation with the amount of 50 – 60 ml.plant^{-1}. The extract is rich for some essential minerals like (N, P, K, Ca, B, Mn, Fe, Zn and, Mg) as well as plant growth regulator (IAA), whereas Bistep is a manufactured humus reach in many macro and micro nutrients which is used to promote plant growth and yield of many crops. This extract was sprayed onto the plant leaves with 0.5% with the amount of 20 ml.plant^{-1} every two weeks from transplanting. In this regard, macro elements Ca, K, Mg, Na, S, and P (mg.kg^{-1}) and micro elements B, Cu, Mn and Fe (mg.kg^{-1}) were measured. The plants were grown under plastic tunnel during spring time. The results show the varieties were different in their reaction to the treatments. Lettuce varieties treated with Willow bark extract recorded a significant difference macro element contents in comparison to control and other treatments. Whereas, except for boron there was no significantly differences among the treatments for the micro nutrient, significantly the highest boron content was also recorded in the plants treated with Willow bark extract at 1.463 (mg.kg^{-1}). Among the varieties, *Kobak* was the most influenced variety to the treatments, while *Great lakes* was the least sensitive variety to react to the treatments. The result indicates that Willow bark extract is a proper extract to be used on the lettuce to improve some micro and macro nutrient alongside to Bistep.

Keywords: *lettuce (Lactuca sativa L.), biostimulants, Willow bark extract and Bistep, macro- and micro element content, lettuce varieties*

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Evaluation of oil content of Milk thistle cultivated in conditions of warm agro-climatic macroregion Dolná Malanta (district Nitra)

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Milk thistle (*Silybum marianum* (L.) Geartn.) is a commercially cultivated plant for the production of silymarin complex in a drug Silybi mariani fructus. It is used to treat liver, gallbladder and stomach diseases. In addition, the seeds contain oil, which is a by-product in obtaining of silymarin from seeds. Our aim was to determine the oil content in the dry matter of fruit milk thistle in three varieties (Silyb, Silma, Mirel) of growing seasons 2019 and 2020. Field experiments were carried at Dolná Malanta (experimental station) at Slovak University of Agriculture in Nitra. This locality belongs to the warm agro-climatic region, dry agro-climatic microregion and mostly mild winter zone. Seeds were harvested at full maturity and analyzed at the Department of Crop Science, Breeding and Plant Medicine at Mendel University in Brno. Soxhlet extraction was used for the extraction of oil from the seeds following the ČSN EN ISO 659. We converted the weight of oil to dry matter determined according to the ČSN EN ISO 665 standard in the standard way. For the evaluation of data was used MS Office Excel and statistical software STATISTICA version 10, multiple factors analysis of variance (ANOVA) and Fisherov LSD test ($\alpha = 0.05$). The average oil content in the dry matter of all samples was 28.62% ± 1.12. The maximum (30.30%) and minimum value of oil content in the dry matter (26.25%) was determined in variety Silma 2019. The differences between the individual varieties were not statistically significant. Year had a statistically significant effect on oil content. Statistically significant average differences ranged from 27.88% ± 0.31 (2019) and 29.36% ± 0.13 (2020). The highest oil content was found in the Silma variety 28.18% in 2019 and 29.52% in 2020. Based on the results, we can say, that milk thistle can be used in addition to medicinal properties also in the food industry due to the oil content in the seeds.

Key words*: Silybum marianum, silybi mariani fructus, oil content, Soxhlet extraction*

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SECTION

Technology, quality and safety of raw materials and foodstuffs of animal origin

Development of egg white based products with pre- and probiotic effects

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Supervisor: Dr. Csaba Németh

Egg white is one of the most important protein sources from animal origin. It contains almost all essential amino acid in the proper quantity for human. Today's consumers show several allergic reactions against dairy ingredients like whey protein and lactose, although dairy product's consumption should have many positive effects on health. E.g. fermented dairy products have pre- and probiotic effect which contribute preventing the health of digestive system. Thus, food science should develop new, functional products improving consumer's health and providing a delicious dairy replacer. In our experiments special egg white based products are investigated with pre- and probiotic effects. This study highlights the techno-functional properties of egg white based products, Rheological properties of milk replacer was investigated with an Anton Paar MCR 92 rheometer applying a CC 27 system between 10 – 631 1/min shear rate at 20°C. Texture of yogurt replacer was investigated with a Stable Micro System Ta.xtPlus (SMS), maximal force for penetration and hardness of samples were measured with a needle (d=10 mm) at 20°C. Our results show that shear stress is increasing during storage (21 days) of milk replacer significantly which may a result of growth of probiotic bacteria. In contrast, yogurt replacer's texture became softer during storage time. Both textural changes may highly conectid with the metabolism of probiotic bacteria. Our experiment may a key for providing functional foods as lactose- and whey protein-free, protein rich protein source for consumers.

Keywords: *egg white, egg white based products, minimal processing technologies, high hydrostatic pressure, HHP*

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Authentication of baby foods with meat content using DNA-microarray technique

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Supervisor: prof. Ing. Jozef Golian, Dr.

The main reason for choosing the presented topic is the issue of food adulteration, which is proving to be a growing global problem. There are countless ways to adulterate meat, most often by replacing a more expensive type of meat with cheaper, meat substitutes or in its complete absence. For detecting these acts we use several types authentication methods. The most often there are methods based on DNA or proteins. The aim of our work was to identify the present of animal species in selected foods for children which contained a meat component. We analyzed 17 samples, of which 10 samples were purchased in Slovakia, 2 in Spain, 2 in Poland and 3 in Czechia. We chose the DNA – LCD microarray method as the authentication method. DNA isolation was performed using a Maxwell ® 16 Tissue DNA Purification Kit. First, we obtained PCR products using a PCR reaction, which we mixed with the appropriate chemistry and applied to the chips, where hybridization, labeling and highlighting of the results took place. The chips were evaluated by a scanning device with appropriate software. These steps were performed using the Chipron Meat 5.0 LCD – Array Kit, which can identify 24 animal species and the necessary instrumentation. Individual samples were analyzed in triplicate. Of the 17 samples, we identified animal DNA in 13 samples. DNA of unknown species was identified in 2 samples from Slovakia. In the case of 4 samples we didn't detect the presence of DNA, 3 samples came from Slovakia and 1 from Czechia. The presence of unknown species may have been caused by the deliberate addition of such a species in some form to replace a more expensive species or by contamination of the production process. The non-identification of animal DNA in the case of 4 samples could be due to the presence of various PCR blockers, which may also be found in different plant and vegetable species, or the complete absence of the meat component of said animal species.

Key words: species identification, DNA microchips, LCD microrray method, baby food.

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SECTION

Technology, quality and safety of raw materials and foodstuffs of plant origin

Antioxidant activity and phenolic content in Slovak varietal wines of Muscat type

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Wine is one of the most frequently consumed alcoholic beverages worldwide. This is due to its organoleptic qualities, such as aroma and taste, but also due to its positive health effects. These effects are mainly caused by the presence of bioactive compounds in wine, such as antioxidants. Grapes and wine are significant sources of antioxidants in human nutrition. These are mainly polyphenolic compounds, which include phenolic acids, flavonoids, anthocyanins and catechins. Phenolic substances contained in grapevine berries belong to an important group of natural substances that get into the wine in the process of wine making. Polyphenols and flavonoids are primarily responsible for the colour and taste of wine, they also affect the perception of acerbity and bitterness. They also have antioxidant properties, thus have a positive effect on human health. Thanks to the development of modern analytical methods, wine is constantly being researched in terms of the content of antioxidants, and its importance to human health. Until recently, the prevailing opinion was that the consumption of white wine does not have positive effects on the human body and health, in terms of antioxidant content, but white wines have also been shown to have antioxidant activity and health benefits. Sixteen Slovak white wines of Muscat type, from different geographical origins, were examined in this study. The aim of this study was to determine total polyphenol content and total flavonoid content, and to evaluate antioxidant effects of quality wines of Muscat varieties produced in Slovakia. Total polyphenol content, total flavonoid content and antioxidant activity of particular wines is described in the study. Studied parameters were analysed by UV-VIS spectrometry method. The total polyphenol content in the Muscat type varietal wines ranged from 262.1 GAE.l^{-1} to 568.3 GAE.l^{-1}. Average total polyphenol content was 382.13 GAE.l^{-1}. The total flavonoid content in Muscat type varietal wines ranged from 24.8 mg CE.l^{-1} to 169.1 mg CE.l^{-1}. Average total flavonoid content was 100.5 mg CE.l^{-1}. Muscat wines showed weak to high antioxidant activity, ranging from 25.2% inhibition of DPPH to 67.7% inhibition of DPPH. Average antioxidant activity was 38.7% inhibition of DPPH.

Key words: *wine, muscat, polyphenols, flavonoids, antioxidants*

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Use of essential oils in food industry

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The main aim of the study was to analyze chemical composition, antioxidant and antimicrobial activity of essential oils. The minimum inhibitory doses of essential oils (EO) against *Stenotrophomonas maltophilia* in the gas phase on carrots, potatoes and apples were examined as well. The tested essential oils (*Canarium luzonicum* CLEO, *Melaleuca leucadenron* MLEO, *Amyris balsamifera* ABEO) were bought from the Slovak company Hanus s.r.o. There was Gas chromatographic mass spectrometric analysis of the essential oils performed. The semi-quantitative content of the determined compounds was calculated by dividing the individual areas of the peaks by the total area of all peaks. The main volatile compounds CLEO based on the reduced percentage were limonene 36.38%, elemol 16.65%, α-fellandren 12.18% and elemicine 9.59%. The main volatile compounds MLEO based on the reduced percentage were eucalyptol 49.23%, α-terpineol 9.92%, limonene 8.12% and caryophyllene 5.65 %. The main volatile compounds ABEO based on the reduced percentage were valerianol 23.24%, guaiol 16.56%, elemol 9.62% and γ-eudesmol 7.95%. The antioxidant activity of essential oils was determined by using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) test. CLEO had an antioxidant activity of 33.43 %, MLEO inhibited the DPPH radical at 18.43 % and ABEO reached an inhibition value of 9.29 %. The analysis of the minimum inhibitory concentration (MIC) was performed with broth dilution method. We determined the EOs activity for *S. maltophilia* MIC for CLEO 6.67 μl/ml, MLEO 8.25 μl/ml and ABEO 10.31 μl/ml by using the broth microdilution method. We performed vapor phase of antimicrobial assay with carrots, potatoes and apples. Individual samples were cut into 5 mm slices. Warm Muller Hinton agar (MHA) was poured into 60 mm Petri dishes (PD) and into the lid. We placed the potato, carrot and apple on agar. Subsequently, the inoculum was added on the vegetables and fruit. The EOs were diluted twice in ethyl acetate to a final volume of 500, 250 and 125 μl and applied to a 55 mm round sterile filter paper using a micropipette. The filter paper was dried for 1 minute to evaporate the ethyl acetate and then placed in a PD on the walls to ensure a distance of 2 mm between the paper and the agar. Finally, the PD was hermetically sealed with a lid containing solidified agar. Petri dishes were incubated at 37 °C for 7 days. ABEO and CLEO showed the best antimicrobial activity. They showed antimicrobial activity at a concentration of 125 mg/ml. MLEO had an effect up to a concentration of 250 mg/ml. All of these measurements were carried out in triplicates. Statistical variability of the data was processed with Microsoft™ Excel® software.

Key words*: Stenotrophomonas maltophilia, Canarium luzonicum, Melaleuca leucadenron, Amyris balsamifera, essential oil*

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Arsenic, cadmium and mercury in *Macrolepiota procera* (Scop.) Singer

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Supervisor: Ing. Július Árvay, PhD.

Edible mushrooms have been collected from forests and consumed due to their nutritional value and unique flavor for centuries. They may accumulate in their fruiting bodies considerable amounts of metallic elements and metalloids due to specificities in their physiology. *Macrolepiota procera* is a good source of minerals, as well as of carbohydrates, proteins, and dietary fibers. However, this specie is also an accumulator of toxic elements. In this study, the content of As, Cd and Hg was determined. These three elements were determined in 94 Macrolepiota procera samples (separately for caps and stems) and their corresponding soils/substrates collected from 8 different localities in Slovakia. Arsenic and cadmium were analyzed by Optical Emission Spectrometry with Inductively Coupled Plasma (OES-ICP), and mercury by Advanced Mercury Analyzer (AMA-254). In the soil/substrate As content varied from ND (not detected) to 11.9, Cd from 0.66 to 22.9 and Hg from 0.02 to 0.28 mg kg^{-1} DW (dry weight), respectively. In mushroom stems arsenic content varied from ND to 4.77, cadmium from ND to 5.96 and mercury from 0.03 to 2.83 mg kg^{-1} DW. In the mushroom caps, As content varied from ND to 13.0, Cd from ND to 19.8 and Hg from 0.04 to 4.00 mg kg^{-1} DW, respectively. After comparing obtained results with the EU limits, for As in mushrooms 6.6% (cap) of analyzed samples exceeded the limit value, while for Cd, 4.7% (cap), 2.0% (stem) of analyzed samples exceeded the limit value. Regarding the background values in the soils/substrates of selected elements in Slovakia, only 82% (Cd) exceeded the limits. Regarding Hg content, all analyzed samples (mushrooms and soils/substrates) did not exceed the limit value. The selected monitored localities in Slovakia have been contaminated with trace elements. Some of the analyzed mushroom samples exceeded EU limits, and as such, they can pose a risk to human health.

Key words: *Macrolepiota procera, accumulation, arsenic, cadmium, mercury*

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Tea tree and St. John's wort essential oils in vapor phase do not significantly inhibit *Penicillium* species growth artificially inoculated on bread

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Supervisor: Miroslava Kačániová

Efforts are currently being made to search for simple bioactive compounds of plant origin against fungal growth on food products in terms of ecologicall and safe food standards. The essential oils (EOs) are known to contain a mixture of natural bioactive substances such as monoterpenes, diterpenes and hydrocarbons, with a variety of functional groups, which are responsible for their antimicrobial and antifungal properties. In our study, EOs from Tea tree (*Melaleuca alternifolia*; TTEO) and John's wort (*Hypericum perforatum*; HPEO) were used to evaluate their growth inhibition potential against three *Penicillium (P.)* species (*P. citrinum, P. solitum, P. expansum*) on inoculated sliced bread. Increasing EOs concentrations (from 125 $\mu L.L^{-1}$ to 500 $\mu L.L^{-1}$) were used in our experiment. First of all, antioxidant activity of EOs, and moisture content (MC) and water activity (a_W) of bread as a substrate for fungal growth were determined. Changes in colony size of *P.* species during 2-week storage of bread were evaluated as markers for mycelial growth inhibition (MGI) effect of the EOs. We have found that both TTEO and HPEO had strong antioxidant activity (64.94 ± 7.34%; 70.36 ± 1.57%, respectively). From the technological characteristics of bread (MC, a_W) it was found that the bread is suitable as a substrate for monitoring its microbial characteristics during storage (43.01 ± 0.341% and 0.947 ± 0.006). Our results suggest that HPEO is the only weak inhibitor of the colony growth of *P. citrinum* and *P. solitum*. Also, the highest concentrations of TTEO displayed only the weak capability of mycelial growth inhibition of *P. citrinum* and *P. solitum*. By contrast, the colony growth of *P. expansum* was enhanced by both EOs at all levels used. Finally, applications of both HPEO and TTEO in vapour phase against *Penicillium* species do not seem to be a promising alternative for extending the shelf life of bakery products including bread.

Key words*: essential oils, antifungal activity, antioxidant activity, bakery products, Melaleuca alternifolia, Hypericum perforatum*

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