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RELATIONSHIP BETWEEN RAW MATERIAL PROPERTIES AND PELLET QUALITY: PREDICTIVE MODELS BASED ON PRODUCTION DATA

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Low cost formulation of animal feed selects raw material on base of their availability, price setting and on certain limitations from a nutritional point of view. Volatile raw material prices and restricted availability result in a large variability of feed compositions of which some of them cause problems at production level. The feed mill operator is confronted with a reduced yield and/or a decreasing pellet quality. This decreasing pellet quality, shown by a lower hardness and durability of the pellet, results in farmers complaints.

The input for this research was the nutritional data of 101 different pig feed production batches in combination with the resulting pellet hardness and durability. To gain insight in these data a correlation analysis between the raw material characteristics and the pellet quality parameters was performed. The hardness and durability were significantly positively correlated with the water index (WI, defined as the amount of water absorbed to the raw material after a subsequent wetting and centrifugation step) (respectively $r = 0.81$ and $r = 0.66$) and were significantly negatively correlated with the amount of fat (respectively $r = -0.62$ and $r = -0.57$). So, it can be concluded that the pellet quality can be predicted by using the information on the raw material characteristics. In order to find the most suited model, different modelling techniques (multiple (stepwise) linear, lasso, ridge regression and regression trees) were compared. To estimate the model performance the cross-validated R^2 and Mean Squared Error (MSE) were calculated. For the pellet hardness, stepwise linear regression resulted in a predictive model for hardness based on two parameters: fat percentage and WI with $R^2 = 0,82$ and a MSE of 0.09.

Since the correlation between the raw material characteristics and the pellet durability were lower than for the pellet hardness, the pellet durability was more difficult to predict, resulting in a lower R^2 and a higher MSE for all models. Stepwise linear regression and lasso regression turned out to be the most suited modelling techniques to predict this variable. The final model was based on the components fat, WI, sugar and ADL with a cross-validated R^2 of 0.60 and a MSE of 0.12.

Keywords: *pellet quality, hardness, water index, modeling*

EFFECTS OF HEAT PROCESSING ON NUTRITIVE VALUE OF WHOLE COTTONSEED

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Whole cottonseed (WCS) is a by product of the cotton-fiber industry in world. There are a lot of cotton seed varieties is considered nutritionally. Some CS contains more gossypol and a higher proportion of the (-) isomer than some CS. Monogastric animals are particularly sensitive to the toxic effects of gossypol, whereas ruminants are somewhat more resistant. The sign of gossypol toxicity observed was an increase in erythrocyte fragility (EF) for cows receiving high dietary free gossypol. Pre- and postpartum consumption of free gossypol might impair some aspects of calf skeletal development and vitamin metabolism, but long-term performance of cows and calves was not affected. The possible effect of WCS fat on reducing microbial activity and potential gossypol toxicity may limit the amount of WCS that can be supplemented to high-yielding dairy cows. WCS processing, especially heat treatment, may aid in providing more unchanged WCS fat and CP to the small intestine, and decreasing ruminal CP degradability and increasing post ruminal digestibility. Heat treatment may also be a useful tool in reducing free gossypol in WCS. Thus, heat treatment may enable an increase in the supplementation rate of WCS for ruminant rations. Processing of WCS includes heat treatment, extrusion, cracking, expanding, expelling, pelleting, and chemicals treatment. WCS processing, especially heat treatment, may aid in providing more unchanged WCS fat and CP to the small intestine, and decreasing ruminal CP degradability and increasing post ruminal digestibility. Heat treatment may also be a useful tool in reducing free gossypol in WCS. Thus, heat treatment may enable an increase in the supplementation rate of WCS for ruminant rations.

Keywords: *ruminant nutrition, whole cottonseed, whole cotton seed processing*

LUPINE AND RAPESEED PROTEIN CONCENTRATE IN FISH FEED: A COMPARATIVE ASSESSMENT OF THE TECHNO-FUNCTIONAL PROPERTIES USING A SHEAR CELL DEVICE AND AN EXTRUDER

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The techno-functional properties of soy, lupine and rapeseed protein concentrates (SPC, LPC and RPC, respectively) in fish feed were evaluated relative to fish meal (FM). The effects were studied using a shear cell device and an extruder with emphasis on the added moisture content. Six diets were formulated: an SPC-based diet with 300 g SPC kg⁻¹, diets containing 100 and 200 g LPC kg⁻¹ or 100 and 200 g RPC kg⁻¹ and an FM-based diet with 450 g FM kg⁻¹. Each diet was extruded with an added moisture content of 29%, 25% and 22% of the mash feed rate. It was found that the technological properties of LPC closely resemble FM, being high solubility, low water-holding capacity (WHC) and low paste viscosity. The LPC 100 and 200 g kg⁻¹ diets could be extruded at 22% moisture, which gives an extrudate with reduced drying requirements. In addition, less specific mechanical energy was needed for extrusion. In contrast, both SPC and RPC have high WHC and paste viscosity. This explains the higher feed moisture required during extrusion. The properties of the feeds containing RPC could be well within the ranges acceptable for commercial fish feed use at even higher moisture content compared with SPC. The results of the extrusion trials confirmed the observations made from the shear cell device. Thus, the shear cell device can be used to study processing conditions that are close to extrusion conditions.

Keywords: *extrusion, fish feed, soy, lupine, rapeseed, protein concentrate*

MULTIPURPOSE FEED VALORISATION POTENTIAL OF FOOD PROCESSING BY-PRODUCTS- A REVIEW OF PAST, PRESENT AND EMERGING STRATEGIES IN EUROPE THROUGH CASE STUDY OF TECHNOLOGIES EMPLOYED BY IGV IN THE NOSHAN PROJECT

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Our society is currently experiencing constraints imposed by our own resource system, which drives industry to increase its overall efficiency by improving existing processes or finding new uses for residues, by-products and wastes. Food supply chain waste emerged as a resource with a potential to be employed as a raw material for the production of various higher value applications.

Waste produced by food processing companies is a good example of a pre-consumer type of waste generated on a large scale globally. This type of waste is becoming increasingly problematic as in some cases it may account for over 50% of the total waste produced in countries, with 60% of it belonging to organic matter.

The present case study is aiming to provide a general overview of the current and most innovative uses of food supply chain waste into **feed**, providing a range of worldwide case studies from around the globe, through the example of valorising residues and by-products generated by the rapeseed processing chain in NOSHAN Project.

Our current society needs in terms of economic competitiveness, efficiency and maximisation of profit minimising waste and energy consumption are fostering the design and development of advanced strategies and approaches to process food waste residues aiming to produce high added-value products, which can be implemented into existing markets. These must be implemented in line with **Europe2020 Strategy** and the **Innovating for Sustainable Growth: a Bioeconomy for Europe Strategy**, which are the two key Bioeconomy and Growth strategies of the European Commission, elaborated by a multidisciplinary scientific platform and adopted by Member Countries with the aim to shift the European economy towards greater and more sustainable use of renewable resources, residues, byproducts and wastes.

Keywords: *food residues, wastes, by-products, valorisation, feed, high-added value products*

IN VITRO STUDIES TO ASSESS THE MULTI-MYCOTOXIN ADSORPTION EFFICACY OF COMMERCIAL PRODUCTS AND POTENTIAL TOXICITY

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Mycotoxin contamination and co-occurrence of aflatoxin B₁ (AFB₁), deoxynivalenol (DON), zearalenone (ZEA), ochratoxin A (OTA) and fumonisin B₁ (FB₁) in animal feed are frequently observed and can impact animal health also at low doses. The addition of binders to contaminated diets is considered a promising dietary approach to reduce toxic effects of mycotoxins. In the EU, the use of these substances as technological feed additives has been officially approved and a variety of products are on the market claiming multi-toxin binding capacities. The efficacy of binders in sequestering different mycotoxins has been poorly addressed. The aim of this study was the screening of commercial products for preparing a nutritional composition intended to reduce bioavailability of a large range of mycotoxins. 52 commercial products from 26 industrial partners, including minerals, yeast-based products and blend of components, were tested. Preliminary adsorption tests allowed the selection of 4 commercial products as effective in sequestering simultaneously AFB₁, ZEA, OTA and FB₁. All products failed in binding DON, but activated carbon. Adsorption experiments were performed at physiologically relevant pH values commonly found in the stomach and intestine (pH 3.0 and 7.0) with selected binders to determine adsorption parameters (capacity, affinity, chemisorption index). Mineralogical analysis (XRD) and ash content showed that 3 out of the 4 commercial products selected as best multi-toxin adsorbents (designated by the supplying companies as minerals) were organoclays. Organoclays are not suitable for feed ingredients due to toxicity of the interlayer quaternary alkylammonium ions. Two organoclays and one yeast cell wall product, out of 52 commercial products, were found toxic in 2 bioassays. In conclusion, multi-toxin adsorbents covering major mycotoxins are not commercially available. Most of them lack effectiveness towards trichothecenes. The identity/composition of commercial products could be counterfeit and misleading. Some commercial products can be even highly toxic in toxicity bioassays.

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THE EFFECTS OF PROBIOTIC USE ON THE HEALTH AND GROWTH RATE OF FATTENING PIGS

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The trial involving German Landrace and Norwegian Landrace crossbred pigs was conducted at this the Institute of Animal Science of LUHS to investigate the effects of the probiotic (*Bacillus licheniformis* (DSM 5749) – 1.6×10^9 CFU/g and *Bacillus subtilis* (DSM 5750) – 1.6×10^9 CFU/g) use on health, growth rate, feed intake and nutrient digestibility of fattening pigs. The results from the trial indicated that the pigs had the highest growth rate when fed compound feed supplemented with 0.06 % probiotic. These pigs gained daily on the average 7.5-10,7 % ($P=0.027-0.096$) more weight than the control pigs. 0.04 % probiotic supplementation of pig diets did not affect the growth rate. The use of the probiotic resulted in 2.6-7.5 % lower feed intake per kg gain. The daily intake of feed was almost similar both at feeding pigs 0.04 % probiotic supplemented diets and probiotic-free diets. When the diets were supplemented with 0.06 % probiotic, the pigs consumed daily 3.8-7.9 % more feed. 0.06 % probiotic supplementation of the diets had a more favourable influence on pig health – there were no diarrhoea or other ailment cases. Feeding probiotic supplemented diets had no significant influence on nutrient digestibility.

Keywords: *probiotic, pig growth, feed intake, health, feed digestibility*

IN VITRO EVALUATION OF MIN-A-ZEL AND MIN-A-ZEL PLUS EFFICACY IN BINDING AFLATOXIN B₁ AND OCHRATOXIN A

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This study was aimed to determine the efficacy of natural and organomodified clinoptilolite zeolites (E567 and E568) on binding polar mycotoxin, aflatoxin B₁ and less polar mycotoxin, ochratoxin A. The mycotoxins were used in two concentrations, respectively, 1 µg/ml and 2 µg/ml and *in vitro* study was conducted in two different pH values 2 and 7.

Mycotoxin adsorbents, clinoptilolite of sedimentary origin (Min-A-Zel-S), clinoptilolite of volcanic origin (Min-A-zel-V), organomodified clinoptilolite of sedimentary origin (Min-A-zel Plus-S) and organomodified clinoptilolite of volcanic origin (Min-A-zel Plus-V) were added in quantity of 100 mg/10 mL of tested solution.

The investigation has shown that there is no significant difference between Min-A-zel -S and Min-A-zel -V in binding aflatoxin B₁ and ochratoxin A in all tested concentrations and pH values. The adsorption ability of Min-A-zel Plus-S and Min-A-zel Plus-V to bind mycotoxins in all tested concentrations and pH values was high and quite similar. On the other hand, Min-A-zel Plus-S and Min-A-zel Plus-V have shown significantly higher ability to bind ochratoxin A in both concentrations and pH conditions compared to Min-A-zel -S and Min-A-zel -V. All adsorbents used in this study have shown high affinity towards adsorption of aflatoxin B₁. In conclusion, the difference in binding polar and less polar mycotoxin which was observed can be attributed to the surface modification of clinoptilolites and not to different origin of clinoptilolite.

This implies the need for further studies to be conducted in *ex vivo* (Everted Duodenal broiler sac) and *in vivo* models in order estimate level of extrapolation for obtained results.

Keywords: aflatoxin B₁, ochratoxin A, E568, E567, zeolites organomodification

PATHOGENS OF ANIMALS AND HUMANS – PHOSPHOLIPASE D PRODUCTERS AND THEIR DIAGNOSTIC AND THERAPEUTIC FAILURES

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Arcanobacterium haemolyticum, *Corynebacterium ulcerans* and *Corynebacterium pseudotuberculosis* produce phospholipase D that significantly facilitates their laboratory diagnosis. Phospholipase D is easily and reliably identified in every bacteriological laboratory which will be shown in this paper.

The test was performed as well as conventional CAMP test. Instead of synergistic hemolysis, the absence of hemolysis caused by *Staphylococcus aureus* on blood agar was observed. Phospholipase D protects erythrocytes from lysis by staphylococcal haemolysin, resulting in inverse CAMP phenomenon. It is possible to perform *Rhodococcus* CAMP test in the same petri plates. In that case, synergistic hemolysis is observed between phospholipase D and *equi* factors of *Rhodococcus equi*. Thus, with high level of certainty, the identity of *Arcanobacterium haemolyticum*, and *Corynebacterium ulcerans/pseudotuberculosis* is proven. These agents are often misidentified in routine work, either in human or veterinary bacteriology. These zoonotic species can cause not only mild opportunistic infections, but also a serious clinical conditions and often require treatment different from usual. Diagnostic and therapeutic failures prolong hospitalisation and sick leave period in medicine and lead to unnecessary economic losses in veterinary medicine.

Without etiological diagnosis there can be no rational antimicrobial therapy. Non rational antibiotic therapy contributes to drug resistance, which is considered to be the plague of twenty-first century. This paper points out the most common reason for diagnostic and therapeutic failures of diseases caused by these bacteria. We also propose a simple, reliable and accessible test for sufficient bacteriological diagnosis of these three bacteria, available in any laboratory.

Keywords: *phospholipase D producters, double CAMP test*

AFLATOXINS IN FEED: ONGOING CHALLENGE

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Aflatoxins (AF), secondary metabolites of some species belonging to *Aspergillus* section Flavi, present a high health hazard for humans and animals. The contamination of plant materials, mostly seeds, can occur in field or during any phase of post-harvest process and storage. After the ingestion, aflatoxins can be transmitted along the food chain either unchanged or metabolised in other more or less toxic forms. In mammals, for example, AFB₁ is metabolized in AFM₁ secreted in milk. The concentration of these toxins in food and feed commodities is limited by law in almost all countries. Feed contamination by aflatoxins can cause severe economical damages to growers due to impaired animal growth, immune depression and consequent possibility of major exposure to infectious illnesses as well as animal products not conformed to the official food safety standards. Different strategies, either prevention or detoxification, have been applied to control the presence of aflatoxins in food and feed but none of them has completely solved the problem. Oxidative stress in fungal cell is considered a prerequisite for aflatoxin synthesis. Moreover the presence of lipoperoxides on the commodities contaminated with the aflatoxigenic fungi enhances toxin production. Different antioxidants are used in a prevention strategy to control the presence of aflatoxins in food and feed. An example of control strategy is application of adsorbents, clays or microorganisms, for removal of ingested aflatoxins in animal rumen. The research of new, more environmentally friendly strategies and tools in aflatoxin control is still ongoing.

Keywords: *aflatoxins, toxicity, control, feed safety*

ULTRA HIGH TEMPERATURE (UHT) TREATMENT EFFECT ON IODINE FORTIFIED MILK THROUGH COW FEED

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Iodine is an essential trace element for humans, because it is necessary for the synthesis of thyroid hormones. Its metabolic action influences many physiological functions, facilitating the expense of excess fat, and is also present in the growth of teeth, hair and nails. The daily Dietary Reference Intake (RDI) recommended for iodine is 150 µg/d. Natural sources of dietary iodine include seafood and vegetables growing on iodine-rich soils. However, milk, being a universal food, could be used as a rich source of iodine, because iodine concentration in milk depends of iodine intake by the animal. The aim of this work was to study the relationship between the intake of KI in dairy cow and the iodine content in raw milk after the heat treatment applied in order to reach more than 15% of the RDI. The cows were supplemented with 1 g of KI at 10% and were contrasted against a control group. Individual dry matter intake was monitored by a computerized system and the production of milk was recorded in a robotic milking system. Milk samples were collected weekly for analysis of chemical composition of fat, protein, SNF, lactose by mid-infrared and iodine by elemental mass spectrometry. There were no significant differences in intake, production and milk composition between groups. After supplementation, the average level of iodine was 60 mg I₂/100 ml of milk, reaching the goal after 2-3 weeks from starting the supplementation. The UHT industrial processing didn't affect the milk iodine concentration, losing less than 15% of total I₂ content.

Keywords: *iodine supplementation, milk, dairy cow, heat-treatment of milk*

THE EFFECTS OF DIFFERENT THERMAL TREATMENTS AND ORGANIC ACID LEVELS ON NUTRIENT DIGESTIBILITY IN BROILERS

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Poultry feed is a potential vector for pathogens. Thermal processing and organic acid treatments may decontaminate feed, and can affect animal performance as well as feed digestibility. The present study investigated the effect of different thermal treatments including pelleting (P), long-term conditioning at 85°C for 3 minutes (L), or expanding at 110°C (E110) and 130°C for 3-5 seconds (E130) without or with 0.75 and 1.5% organic acid supplementation (63.75% formic acid, 25.00% propionic acid and 11.25% water) on hygienic status of broiler feed, on broiler performance and nutrient digestibility. In total, 960 one-day-old broilers were randomly assigned to 8 replicates using a 3 × 4 factorial arrangement. Performance variables and ileal amino acid (AA) digestibility were determined at day 35. The applied treatments were effective for the decontamination of broiler feed. The organic acids inclusion linearly improved feed conversion ratio in the first week ($P \leq 0.05$). The acid inclusion and thermal treatments had no significant effect on the performance variables at later intervals of the growing period of the birds. The L group showed the lowest ileal AA and CP digestibility. The inclusion of organic acids had a quadratic effect on ileal digestibility of isoleucine ($P \leq 0.05$); while it had no significant effect on the ileal digestibility of other AA and nutrients. In conclusion, our study demonstrated that long-term thermal conditioning can decrease ileal nutrient digestibility while pelleting and expansion, independently of organic acid addition, seemed to have no negative impact on the broiler performance and nutrient digestibility. Moreover, adding a blend of organic acids to broiler diets had neither positive nor negative effects on nutrient digestibility and final broiler performance. This indicates the feasibility of short-term thermal treatment and acid supplementation for hygienization of broiler feed without negatively influencing performance and nutrient digestibility.

Keywords: *expanding, feed decontamination, long-term conditioning, organic acid, pelleting*

AGRI-FOOD CO-PRODUCTS AS ALTERNATIVE DIETARY SUPPLEMENTS AND FARM ANIMAL PRODUCT QUALITY: OPPORTUNITIES, LIMITATIONS AND RESEARCH GAPS

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Agri - food co-products are good sources of valuable compounds such as pigments, polyphenols and flavonoids that possess nutritional and health – promoting properties. Those compounds can be transferred to animal products and human diet through animal nutrition. Utilization of agri - food co-products in livestock nutrition helps towards reduction of the environmental burdens arising from food production. Moreover, nowadays consumers demand the production of “clean,” “natural” and “green” label food products and are willing to pay significant premiums for such products. On the other hand, the global market for feed ingredients is expected to expand due to population growth and increased consumption of animal products in the developing countries offering, thus, emerging and challenging roles for the application of agri – food co-products in livestock production. Current research has primarily focused on the utilization of co-products such as grape, tomato, oilseed or citrus pomace that are voluminously produced and have an important environmental impact. Utilization of apple, banana, potato, onion, carrot or sugar beet co-products remains underexplored. Other functions i.e. colour enhancement, antimicrobial activity have also not been extensively studied. Product quality, inconsistency of chemical composition, seasonality, anti-nutritional compounds, logistics, commercial value, and the complicated feed legislation are the main reasons restricting their use. Furthermore, the lack of detailed documentation and knowledge on end-product quality characteristics, the processed form of the product, adverse effects on animal health and performance, and product antagonistic or synergist effects with the main feed ingredients in different feed formulations, discourage animal nutritionists from using these products. Safety, sustainability, innovation and value addition are key drivers for product differentiation in the competitive animal food market and thus, the market potential of agri – food co-products in animal nutrition seems very promising. However, focused research on their effect on animal performance and health, and end-product quality is still missing.

Keywords: *agri - food co-products, dietary supplements, environment, product quality*

CHARACTERIZATION OF WINERY BY-PRODUCTS USED AS FEED ADDITIVES IN LAYER DIETS

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Winery by-products contain very high levels of polyphenols and citric acid, which are strong antioxidants. This allows their use as replacers of the synthetic antioxidants from the omega-3 polyunsaturated fatty acids-rich layer diets. The absence of antioxidants would cause peroxidation and the destruction of A, D and E vitamins, of the carotenoid pigments and of the amino acids, which would affect adversely the animal foods. This paper gives a characterization of the main nutrients and antioxidant capacity of the different winery by-products: grape yeast, dry grape marc and grape seed cakes. Thus, the protein concentration was 13.78g in grape yeast; 12.64g in grape marc and 10.64g /100g in the grape seeds cake sample, while fat was 0.23g in grape yeast; 2.68g in grape marc and 5.97g/100g in the grape seeds cake. Of the monounsaturated fatty acids, the oleic acid had the highest concentration, from 16.86g in grape marc and 17.05g/100g fat in the grape seeds cake, while of the polyunsaturated fatty acids, the linoleic acid had the highest concentration, from 58.99g in grape marc and 62.26g/100g fat in the grape seeds cake, followed by the linolenic acid with 2.19g in grape marc and 2.32g/100g fat in the grape seeds cake. Vitamin E ranged between 2.73 mg in grape marc and 1.61 mg/100g sample in the grape seeds cake. Given the large number of winery by-products, their high antioxidant capacity and their significant environmental risk as wastes, using them as feed additives in layer feeding is an efficient solution.

Keywords: winery by-products, feeds, layers

EFFICACY OF INORGANIC V.S. ORGANIC SELENIUM DIETARY ADDITION IN GROWING PIGS

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The modern meaning of the addition of selenium in the diet of pigs relates to the possibility of increasing the concentration of selenium in the pig muscle as a product that belongs to functional foods. Concentration in muscle and liver was higher after the addition of organic selenium, while the concentration of selenium in the kidneys was greater when inorganic selenium supplemented, which is explained by increased secretion. Meta analyses showed that increased selenium level in the pigs' grow linearly with increasing dietary addition inorganic as well as organic selenium. The question is if the inorganic source of selenium works as a prooxidant or increases antioxidant protection like organic ones.

The investigation is conducted on 40 growing pigs from 31 to 98.8 kg of body weight, fed with standard feed mixtures for growing pigs, divided into two groups, according to the level of dietary selenium addition: control (C) with 0.5 ppm inorganic selenium and E1 with 0.5 ppm organic selenium (Selplex®, Alltech, USA). The blood samples were taken from *v. cava cranialis* and enzymes activity of glutathion peroxidase (GSH-Px) and glutathion reductase (GR) were measured from hemolysate of erythrocytes by spectrophotometric methods with Randox® kit. Selenium content in the muscle (*m. longissimus dorsi*) and liver was determined 24 h after slaughtering, with hydride method by the inductively coupled plasma optical emission spectrometry (ICP-OES, Perkin Elmer, USA). Dietary addition of 0.5 ppm organic selenium significantly ($P < 0.001$) increased selenium concentration in the muscle tissue as well as in the liver, in relation to addition of inorganic selenium. Activity of GSH-PX and GR in erythrocytes did not differ between the dietary treatments.

Organic v.s. inorganic selenium dietary supplementation did not affect antioxidative response in growing pigs, but organic selenium raised total amount of selenium in the muscle and liver.

Keywords: selenium, growing pigs, antioxidative status, selenium in meat

IN VIVO DIGESTIBILITY OF NEW VARIETY OF CHICKPEA

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The efficiency of digestion and nutrient utilization in the ruminants are major determinants of the overall impact of ruminant production. Chickpeas are one of the earliest known and widespread legumes in the world, but their usage as a component in ruminant nutrition has not been extensively studied. The aim of this study was to evaluate the nutritional composition, the nutritive value and the *in vivo* digestibility of a new chickpea variety - *DULO* - in the whole gastrointestinal tract. Eight physiological experiments were carried out on wethers, including three experimental forage components (chickpea standard, chickpea *DULO*, and lupine). In the control experiments meadow hay was used as a single feedstuff. Two levels of replacement of meadow hay by experimental forages were tested: 20% and 40%. The study showed that the *DULO* variety of chickpea has the next nutritional composition: 19.40% crude protein, 4.80% fat, 3.68% crude ash and 8.94% crude fiber. On the average the levels of Net Energy for maintenance (NE_m) and Metabolizable Energy (ME) were higher by 10.25% and 9.79% respectively in the chickpeas diets than in the lupine diets. The content of Total Digestive Nutrients (TDN) was higher by 8.12% in all rations containing chickpeas. The study showed also that the *DULO* variety of chickpea significantly increases digestibility. Based on the results obtained it can be concluded that the ruminant diet should contain 20% chickpea *DULO* or lupine, while the standard chickpea variety may participate with up to 40%.

Keywords: chickpea, chickpea *DULO*, ruminants, digestibility, lupine

THE INFLUENCE OF PRESENCE OF ZINC IN DIET ON PRODUCTION TRAITS OF GOATS

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Animals require microelements in small quantities, and they play a significant role in all physiological and biochemical processes. Microelements are provided to animals by feed, by special supplementation (premixes), or in water.

Zinc is a little different from some of the other well-known minerals. Whilst some of these have a well-known, identifiable function familiar to us, such as calcium for bone strength and Fe for healthy red blood cells, zinc has no single clear action but instead performs a number of important functions in the body. This is because zinc is an essential component of around 200 enzymes that are involved in a range of actions within the body. Zinc is needed for a healthy immune system as it is involved with immune cell (T-cell) production in the thymus gland. Along with copper and manganese, zinc is a precursor of the antioxidant enzyme superoxide dismutase (SOD). Zinc is needed for protein synthesis and is important in wound healing and growth. It plays an important role in the repair and renewal of skin cells. A diet marginally lacking in zinc can lead to problems such as frequent infections, delayed wound healing, reduced appetite, decreased sense of taste and smell (sometimes also associated with low iron levels), poor skin condition and, sometimes, white flecks on the nails.

Supplemental zinc is usually added to animal diets in the form of zinc oxide or zinc sulfate. A level of 45 to 75 ppm zinc should be used in the total diet of goats until their zinc requirements are met. Manganese is a mineral element which is in the body of goats essential for normal skin and increase in bone growth; additionally it participates in the activation of a number of enzymes. Higher concentrations of calcium and iron in the diet of goats can lead to increased needs in manganese. Amount of 20 to 40 mg/kg of dry matter of food is considered to be adequate for most of the goat production conditions.

Keywords: *goat, minerals, zinc, manganese, production traits, health status*

EFFECT OF SPICE HERBS IN BROILER CHICKEN NUTRITION ON PRODUCTIVE PERFORMANCES

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Aim of this paper was to investigate the effect of various medicinal herbs such as garlic (*Allium sativum* L.), black pepper (*Piper nigrum* L.) and hot red pepper (*Capsicum annuum* L.) in broiler chicken nutrition on productive performances. For biological research eight treatments with 1200 broiler chickens of hybrid line Hubbard in total were formed, with four replicates. Control treatment (T1) was fed with commercial mixtures of standard composition and quality based on corn flour and soybean meal. Experimental treatments were fed with same commercial mixtures only with addition of medicinal herbs as follows: garlic 0.5 (T2) and 1.0 g/100g (T3), black pepper 0.5 (T4) and 1.0 g/100g (T5), hot red pepper 0.5 (T6) and 1.0 g/100g (T7) and mixture of garlic, black pepper and hot red pepper (1:1:1) in total of 0.5 g/100g (T8). First two weeks chickens was in preparation period with starter mixtures diets without addition of medicinal herbs, after which chickens were fed with grower and finisher mixtures according the plan till the end of experiment which lasted 42 days. At the end of experiment and on the basis of gained results it can be concluded that the chickens at experimental treatments T6 and T7 achieved statistically significant ($p < 0.05$) higher final body masses (2460.6 and 2442.4 g) compared to the chickens at control and other treatments. Feed conversion ratio for the whole fattening period ranged from 1.8 kg/kg (T2, T5) to 2.1 kg/kg (T1) with no statistically significant differences ($p > 0.05$). European broiler index (EBI) was lowest in treatment T1 (220.4) and the highest in treatment T6 (298.6) with statistically significant differences ($p < 0.05$). In the end it can be concluded that the chickens at treatments T6 and T2 achieved better production results compared with other experimental treatments as well as with control treatment.

Keywords: garlic, black pepper, hot red pepper, nutrition, chickens

PARTICLE SIZE DISTRIBUTION OF DAIRY DIET IN THE FEEDING ALLEY WITH LOW-LOADED MIXING WAGON

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Provision of adequate nutrient amounts to dairy ruminants, beside optimal diet formulation, passes through a homogenous distribution of the rations. In this view, the mixing wagon efficiency in discharging well-mixed homogenous diets along the feeding alley is a key factor. Mixing wagon efficiency is usually reduced in case of overloads or when going below the optimal designed operative volumes at the end of the distribution of feed. The aim of the present trial was to evaluate the particle size distribution in the feeding alley of a dairy diet discharged from a mixing wagon starting from 35% of the optimal operative load up to the end of distribution. A two-screws vertical mixing wagon (maximum load 22 m³), with an initial load volume equal to 35% of the optimum load, was used to discharge a dairy diet based on corn silage, corn meal, ryegrass haylage, soybean meal (DM 53.85%, CP 16.83%, EE 5.29%, NDF 28.38%). Samples of 700g of the diet were collected on a 35mt feeding alley (seven samples taken each 5.8mt from the beginning of feed release) in triplicate for a Penn State Forage Particle Separator analysis. Collected data were submitted to a analysis of variance (Proc GLM, SAS 9.3, 2014) to highlight a potential demixing effect due to the wagon in released diet along the feeding alley. Obtained results showed that the content in the last sieve, with particle size smaller than 1.78mm, gradually increased (P<0.001) from 18.35% at the first sampling point to 23.26% at the end of the feeding alley. The first, second and third sieves content (openings diameters 19mm, 8mm, 1.78mm, respectively) did not show significant overall demixing effects. These preliminary results show that smaller particles of concentrates are submitted to demixing during feed release, with potential unbalances in feed administration to dairy cows.

Keywords: *mixing wagon, dairy cow diet, particle size distribution, concentrates*

OBTAINING PROTEIN RICH FRACTIONS OF SUNFLOWER MEAL USING AIR CLASSIFICATION

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Sunflower meal is a by-product of the vegetable oil industry. It remains in large quantities after oil extraction from sunflower seeds and it is mostly used as a feed for all classes of animals. It consists of broken sunflower kernels and fiber rich hulls. Crude fiber is a limiting factor for usage of this feedstuff in diet formulation for monogastric animals. Thus, the removal of sunflower hulls can contribute to an increase of the protein content and therefore increases the nutritional value of it. In this study sunflower meal was first crushed by the use of conical mill and in a second step classified by the use of a cascade air classifier. Starting, unmilled, sunflower meal was also classified by same classifier. The aims were to evaluate the air classification process for obtaining protein enriched fractions, as well as to determine efficiency of conical mill for grinding sunflower meal prior to the air classification. During the classification process air flow and feed rate were varied. Air flow was set at 5, 8.7 and 12.5 m³/h, respectively, and feed rate was changed by setting rotation speed of dosing element at 30, 60 and 90%. The results showed that an air flow of 5 m³/h was not efficient for obtaining protein rich fractions of unmilled meal. The lowest values of protein enrichment in coarse fractions of both used meals were obtained at 8.7 m³/h. The highest used air flow, 12.5 m³/h, was proved to be the best for obtaining protein rich fractions. Conical mill was efficient tool for preparing sunflower meal prior to the air classification at 12.5 m³/h. The highest protein enrichment level achieved at this air flow was 12% compared to the protein content of unclassified sunflower meal. Milling also ensured even and undisturbed material flow from feed chute into classifier, thus positively affected the feed rate. Protein content of obtained protein rich fractions was affected by air flow, therefore protein enrichment and yield combination can be adjusted by only modulating this parameter of air classification.

Keywords: *sunflower meal, air classification, conical mill, protein enrichment*

THE REMAINS OF LACTIC ACID FERMENTATION ON STILLAGE AS HIGH QUALITY FEED ADDITIVE

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Stillage as a by-product of bioethanol production on wasted bread could be utilized for effective lactic acid production by *Lactobacillus rhamnosus* ATCC 7469. After lactic acid fermentation liquid fraction with dissolved lactic acid could be easily separated while solids of fermented stillage with biomass of *L. rhamnosus* remaining. These solid remains were chemically characterized and *in vitro* probiotic potential of *L. rhamnosus* ATCC 7469 strain was assessed. In comparison to unfermented stillage, fermented remains were higher in content of oil and nitrogen free extract. The digestibility as well as digestible and metabolisable energies of fermented stillage was even higher than reported values for corn or wheat DDGS. Based on chemical composition, the solid remains of fermented stillage were the most suitable for monogastric animal diet. Good survival characteristic of *L. rhamnosus* ATCC 7469 strain in simulated gastric environment and antimicrobial activity against most common intestinal pathogens have recommended application of *L. rhamnosus* biomass in animal diet. Valorisation of the residues of lactic acid fermentation on stillage as feed additive improves sustainability and financial aspect of both bioethanol and lactic acid production processes with significant decrease in effluent treatment costs.

Keywords: *feed, probiotic, lactic acid fermentation, stillage, biorefinery*

IMPACT OF TECHNOLOGICAL PROCESSES OF ANIMAL FEED PRODUCTION ON VITAMIN A STABILITY

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This study was carried out to determine if technological processes of expanding and pelleting affect the stability of formulated commercial form of retinol-acetate (vitamin A) in feeds for broilers and piglets. The stability of vitamin A in pelleted feed for broilers and expanded feed for piglets was monitored during the storage under storehouse conditions (at temperature 22°C and relative humidity 54%) during the period of three months. The vitamin A content was determined by the High Performance Liquid Chromatography (HPLC) at 326 nm.

At the beginning of the study, the concentration of vitamin A in pelleted feed for broilers decreased by 3%, while its average concentration in the sample of expanded feed for piglets decreased by 1%. The concentrations of vitamin A in untreated samples of feed for broilers and piglets decreased during the three month storage period by 28% and 20%, respectively. As well, in the samples of pelleted feed for broilers and expanded feed for piglets, concentrations of vitamin A decreased by 47% and 36%, respectively. Obtained results between pelleted and expanded feed samples show the pelleting process has a greater impact on the degradation of vitamin A than expanding process.

After the first month, the difference in vitamin A stability in untreated feed samples was higher than in treated feed samples, but after three months of storage this distinction was significant ($P < 0.05$). The difference in decrease of vitamin A content between pelleted and expanded feed samples after a defined period of storage was around 11%, which is statistically significant distinction.

Vitamin A showed the appropriate stability within the three month long period of storage. Furthermore, decrease of vitamin A content, between pelleted and expanded feed samples, was statistically significant and shows that the pelleting process has a higher influence on the degradation of vitamin A than expanding process.

Keywords: *pelleting, expanding, stability, vitamin A, HPLC*

THE IMPACT OF FEED PROCESSING ON THE ESSENTIAL OIL OF *ORIGANUM VULGARE*

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From antiquity, essential oils of medical plants and their derivatives have been used for flavoring foods and beverages and for medication. These additives have been usefully used in animal nutrition for improvement of health and animal wellbeing, since they have high antimicrobial and antioxidant activities. In the present study, the effect of pelleting process on essential oil composition and stability was investigated, since they are very unstable during thermal processing which is widely used these days in feedstuff production.

The composition of essential oil obtained by hydro distillation from the plant *Origanum vulgare*, which was added into feed for broilers in concentration of 2 g/kg, was analyzed by GC/FID before and after pelleting process. After pelleting of feed, the essential oil was also isolated from animal diet by hydro distillation. Analysis of essential oils obtained before and after pelleting process showed some quantitative differences. Origanum essential oil was characterized by the presence of thymol (19.9%) and carvacrol (61.8%) at the beginning of the experiment. After pelleting process the concentration of thymol and carvacrol amounted to 15.3% and 50.4%, respectively.

It was concluded that pelleting process had significant effect on thymol and carvacrol stability in animal feed, i.e. on reducing their initial contents in animal feed.

Keywords: *feed, pelleting, essential oil, stability*

INFLUENCE OF NUTRITION ON GOAT MILK PRODUCTION TRAITS

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This paper describes the effects of nutrition on milk traits and milk fat content in goat herds. The study was performed on the Balkan goat herds (four herds), from private farms, in the two-year period, with a total of 578 animals.

Winter feeding of goats has been consisted of concentrate and meadow hay. Bulky food was given in small quantities (about 300 grams) three times a day and concentrate in the morning and evening. All goat breeders have applied a semi-intensive system of rearing (sheds-pasture system). Period of summer-autumn nutrition of examined herds has been based on grazing, with no supplemental feed, even during goats mating period.

Grazing of examined herds (1, 2 and 3) was based on the use of pastures and herbaceous vegetation growing in the area of thermophilic oak forest (500-800 m above sea level), while the fourth herd was grazed at higher altitudes (1200-1850 m), i.e. in the height range of beech forest and above it, where the influence of a community of *Nardus stricta* is dominant.

The statistical processing of the results pertinent to the milk production traits was performed on a personal computer, using the LSMLMW program (Harvey, 1990).

Based on the conducted research on the effects of nutrition on milk production and milk fat content in the population of domestic Balkan goat, the statistically significant effect ($P < 0.01$) was registered in all studied traits of milk production (lactation length, amount of milk, daily milk production), while the difference in milk fat content was significant at $P < 0.05$. Better nutrition of goats during high pregnancy and in the first period of lactation, including both concentrate and bulky food derived from the sown meadows, had a positive effect on milk production in the fourth herd.

Keywords: goat, nutrition, milk production, milk fat, herd

SUITABILITY OF SILAGE MAIZE HYBRIDS BIOMASS AND DDGS FOR ANIMAL FEED PRODUCTION

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The objective of the present study was to observe and compare properties of nine silage ZP maize hybrids biomass and dried distillers' grains with solubles (DDGS) samples in order to determine their suitability for animal feed production. The DDGS samples were obtained from the respective ZP maize hybrids after bioethanol fermentation.

Yields, structure of the dry matter of the investigated silage maize hybrids, as well as the yield of the digestible dry matter were determined. The content of lignocellulose fibres and the digestibility of dry matter of the whole maize plant were established. Samples of maize DDGS were tested for dry matter content, protein content and dry matter digestibility.

The results indicated significant differences in dry matter *in vitro* digestibility of the whole plant among different hybrids in the most optimal harvest stage, as well as higher dry matter digestibility of the investigated DDGS samples. The whole plant dry matter digestibility of the investigated silage maize hybrids ranged from 59.67 to 65.53%, while dry matter digestibility of the investigated DDGS samples varied between 75.90 and 82.41%. High levels of protein determined in DDGS samples (29.58 - 34.40%) indicate that these by-products of bioethanol production can be used as valuable high-protein feedstuff. Both biomass of the selected silage hybrids and DDGS from bioethanol production meet the criteria for quality animal feed prescribed by regulations and can, therefore, be used in animal feed production in different ratios depending on animal species, category and dietary needs.

Keywords: *maize hybrids, silage, biomass, DDGS, animal feed*

UTILIZATION OF PROTEIN AND ENERGY FROM FEED MIXTURES CONTAINING DIFFERENT CONTENT OF PROTEINS IN CARP YEARLINGS

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Proteins present a necessary component in animal feed due to its important role in various physiological processes. The raising cost of fish meal (FM) on the world market mostly due to the stagnating global capture fisheries production initiated a lot of research among fish specialists to try and find possibilities for replacement of FM with more sustainable alternatives and optimize the protein level in diets for a variety of fish species and categories.

The aim of this study was to investigate the utilization of proteins and energy in feed mixtures with different content of proteins in diets for carp yearlings.

Fish were fed with concentrate mixtures having 38% (feed A), 41% (feed B) and 44% (feed C) of proteins.

Based on the results of Tukeys' test, fish fed with concentrate mixture containing 38% of proteins had significantly lower protein intake (1167,43 g) than fish fed with feed containing 41% (1457,73 g) and 44% of proteins (1569,83). Values of protein efficiency ratio (PER) were in the range from 0,96 (feed A) to 1,47 (feed C). Significant difference for PER was noted between fish fed with feed A and C and between fish fed feed A and B.

Average values of energy intake were 600,57 kJ (A), 695,16 kJ (B) and 718,13 kJ (C), providing significant difference between fish fed mixtures with the highest and the lowest content of proteins in diet and significant difference between fish fed mixtures with 41 and 44% of proteins.

The obtained values for energy efficiency ratio were 1,86 (A), 2,42 (B) and 3,21 (C), providing significant difference depending on the level of proteins in the diet. The highest feed utilization was obtained with feed C where FM is the prevailing protein.

Keywords: *protein utilization, carp yearlings, fish feed*

PCR AS NEW TECHNIQUE FOR DETECTION OF MEAT AND BONE MEAL IN FEED

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Since bovine spongiform encephalopathy (BSE) was proven to be a "feed-borne" disease, the ban of processed animal proteins (PAP) in feed for farmed animals was introduced, which led to a significant reduction of the number of new cases. Although optical microscopy has been the only reference method for the detection of PAP for years, the EU legislation also foresees that other methods may be applied in addition to the microscopy, if they provide appropriate information about the origin of the animal constituents present in feed. That would lead to an easing of rigorous prohibitions, which was set to become a reality in the European Union from the 1st of June 2013, when meat and bone meal (MBM) was reintroduced in fish feed. Further relaxation is yet to come for all EU members, as well as for Serbia in the process of harmonization and accession.

This paper presents the use of polymerase chain reaction (PCR) for detection of fish meal and bovine, poultry, pig and mixed meat and bone meal in cattle feed. It was also combined with classical light microscopy in order to create more accurate analytical system. The obtained results show certain inconsistency, which is also the proof that feed is specific matrix, that do not allow simple transfer of method intended for food testing. Therefore development of parallel techniques for feed control is necessary, which means narrower and more intensive cooperation with the European Reference Laboratory for Animal Proteins engaged in research and validation of new methods.

Keywords: *animal proteins, feed, microscopy, PCR*

TRICHINELLA SPECIES IN DOMESTIC AND SYLVATIC ANIMALS

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Trichinellosis is a zoonosis caused by a parasitic larvae of genus *Trichinella*. It is an endemic disease which is present in most of European countries. The research of trichinellosis that has been carried out in Serbia so far, aimed at reducing the risk of transmission of trichinellosis on people and reducing economic loses in pig production, but sylvatic trichinellosis has been poorly researched. The aim of this study is molecular determination of *Trichinella* larvae isolated from domestic, synanthropic and sylvatic animals to determine the specificity of *Trichinella* life cycle in Vojvodina region. Totaly of 552 samples (domestic and wild pigs, jackals and fowex) were examined. *Trichinella* was isolated from 11 samples (1.99%) by artificial digestion and examined by molecular methods. Two species were determined - *T. spiralis* and *T. britovi*. The given data point out that in the implementation of the measures for reducing the trichinellosis in domestic animal is necessary to include measures for prevention of the transmission of trichinellosis from domestic pigs to sylvatic animals.

Keywords: *Trichinella*, domestic and sylvatic animals

SUPPRESSION MEASURES FOR MYCOTOXIN CONTAMINATION OF FOODS AND FEEDS

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Suppression measures for mycotoxin contamination of foods and feeds include mold growth control and the elimination of biosynthesized mycotoxins.

The control of mycobiota development as a preventive measure starts from planting (crop sort or variety selection, sowing date, etc.) and continues through the pre-harvest i.e. vegetative period (selection of appropriate cropping practices, predictive models, preventing insect attacks, etc.) to the post-harvest period (storage, grain sorting, etc.).

Mycotoxins in foods and feeds can be eliminated by using non-nutritive additives, i.e. different adsorbents (mineral, organic and biological) or by detoxification of mycotoxins by their transformation (using physical or chemical treatments, microorganisms or their enzymes) into non-toxic or less toxic compounds.

A disadvantage of mineral adsorbents is their non-selectivity. Yeast cell wall-derived biological adsorbents were therefore proven to be the best. The transformation of mycotoxins by physical and chemical treatments do not often give satisfactory results because of a change in the nutritional value of the food and feed treated or because of forming toxic compounds. Recently, the transformation of mycotoxins by microorganisms or their enzymes is a procedure that promises to be one of the best methods to increase foods and feeds safety and eliminate all negative effects of their mycotoxin contamination.

Keywords: *suppression measures, mycotoxin contamination, foods, feeds*

THE EFFECTS OF DIFFERENT THERMAL TREATMENTS AND ORGANIC ACID LEVELS IN FEED ON BACTERIAL COMPOSITION AND ACTIVITY IN GASTROINTESTINAL TRACT OF BROILERS

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Thermal treatments of feed and supplementation of organic acids are known to affect the gut micro biota in birds. This study investigated the effect of different thermal processes including pelleting (P), long-term conditioning at 85°C for 3 minutes (L), expanding at 110°C (E110) and 130°C for 3-5 seconds (E130) as well as organic acids (63.75 % formic acid, 25.00 % propionic acid and 11.25 % water) inclusion levels (0, 0.75 and 1.5 %) on gut microbiota in broilers. In total, 960 one-day-old chicks were randomly assigned to 8 replicates using a 3 × 4 factorial arrangement. At day 35, bacterial cell numbers and bacterial metabolites in the crop, ileum and caecum were determined. The inclusion of 1.5 % organic acids increased cell numbers of all clostridia clusters in the crop. The organic acid inclusion increased the propionic acid concentration in the crop whilst there was a decrease in lactic acid concentration. In the ileum, 0 % organic acid group had the highest numbers of *Lactobacillus* spp. and enterobacteria. Inclusion of 1.5 % organic acid increased ileal acetate concentration. Increasing the feed processing temperature led to an increase of lactobacilli in the crop and ileum, while clostridia and enterobacteria seemed unaffected. Similarly, lactate concentrations increased in the ileum, but short chain fatty acids remained identical. In the crop, an increase for acetate was found for the E130 group compared to all other thermal treatments. In conclusion, this study showed that the effect of thermal treatment and organic acid supplementation to broiler diet more markedly affected the bacterial status of the crop compared to the downstream segments and their effect decreased along the length of gut. While organic acids markedly modified bacterial composition and activity in the crop, expansion increased lactobacilli and lactate in the crop and ileum.

Keywords: *bacterial composition and metabolism, decontamination strategy, expanding, long-term conditioning, pelleting*

EFFECTS OF Mn AND Fe ORGANIC CHELATES AND INULIN IN LAYERS' DIET ON ABSORPTION COEFFICIENTS AND THEIR CONTENT IN EGG AND TISSUES

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The aim of this study was to evaluate effects of Mn and Fe organic sources and inulin, from layers diet, on absorption and deposition in egg and tissues. The study was conducted on 90 Lohmann Brown layers (48 – 52 weeks), assigned to 3 groups (C, E₁, E₂) with 30 hens/group (3 hens/cage). The basic diet was the same for all groups. The hens from C received a conventional diet (corn, rice bran and soybean meal) with 16% CP, 2710 ME/kg, 60 mg Fe/kg and 71.9 mg Mn /kg. The formulations of the experimental diets differed from C group diet by the replacement of the inorganic Fe and Mn salts by organo-metallic chelates of these elements, at a level of 25% lower than in the premix for C and included 0.5% dry Jerusalem artichokes (E₁), while E₂ included 0.5% synthetic inulin. At the end of experiment, 6 hens from each group were slaughtered: blood serum and biological samples (liver, kidneys and tibia) were collected. These samples were assayed for the concentration of trace elements. Every two weeks we collected randomly 18 eggs/group and assayed them for Fe and Mn concentrations. Concerning serum parameters: Fe (µg/dL), Hb (g/dL), HCT (%), Mn (ng/mL), the concentrations of E groups were lower than C, but no significant differences (P> 0.05) were registered. For Mn, the absorption coefficients showed higher values of E groups than C (20.43±3.03 (C); 22.97 ± 4.33 (E₁); 29.10± 6.2 (E₂)). A significant increasing of Mn concentration in liver was noticed for E₂ than C (7.40±0.55 (C); 7.75 ± 0.51 (E₁); 8.66± 0.49 (E₂)). Absorption coefficients of Fe registered lower values for E groups than C. No significant differences (P> 0.05) were observed for Mn and Fe concentration in egg yolk.

Keywords: manganese, iron, organic sources, hens, Jerusalem artichokes, inulin

THE UNCONTROLLED USE OF ANTIBIOTICS IN PIG PRODUCTION - A THREAT TO PUBLIC HEALTH

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Modern farming is characterized by the tendency of increasing the size and capacity of the farms, which results in increased number of pigs housed at relatively limited space, disturbance of environmental hygiene as well as increased impact of stress factors. Under such conditions, a profitable production implicates successful disease control within the herd. In our country, the majority of farmers are facing with financial difficulties and are not able to overcome the drawbacks and problems in the production. Thus, their production strategies often rely on medicamentous therapy.

Antibiotics have wide application at pig farms as prophylactic, therapeutic and metaphylactic agents. However, their application leads to the development of resistant microbial strains in both domestic animals and humans. Antimicrobial resistance has emerged as major clinical and public health concern due to its negative effects reflected in prolonged and more complicated therapy course, increased therapy expenses and increased risk of lethal outcomes. A number of consumers and their associations and organizations believe that meat produced without use of antibiotics is safer than that obtained in conventional farming conditions.

Our research encompassed industrial farms that have their own veterinary service department or at least one full-time veterinarian, as well as small family-owned farms. The data on prophylactic, therapeutic and metaphylactic measures were obtained from the database and records from the Department of Swine Health protection of the Scientific Veterinary Institute Novi Sad, which were previously obtained from the veterinarians or farm owners.

The obtained results indicated a wide range of inadequate procedures in antibiotic application, such as: therapy selection by the owner/farmer himself, free availability of antimicrobial drugs in the market, illegal import, therapy of viral diseases, lack of knowledge on basic principles of pharmacotherapy, lack of effective control in this field.

Keywords: *pigs, resistance, inadequate use of antibiotics*

IMPACT OF FISH FEED FATTY ACID COMPOSITION ON OMEGA FATTY ACID PROFILE OF CARP FLESH

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Fish are a source of proteins, vitamins and minerals, but they are also a rich source of polyunsaturated fatty acids (PUFAs). To PUFAs and in particular long-chain omega-3 fatty acids (n-3 FAs) have been given special attention due to their positive effects on human health. Another essential group of fatty acids are omega-6 acids (n-6 FAs). Besides the level of n-3 FAs, the ratio of n-6/n-3 FAs is also important for human health. The aim of this study was to establish the impact of linseed and fish oil addition to carp feed on omega fatty acids composition of carp flash. Experimental diets were based on mixture of soybean meal and sunflower meal with addition of 6% of linseed oil (Diet 1) or fish oil (Diet 2). Fatty acids in lipids of carp feed and carp flash were analyzed by gas chromatography. The contents of eicosapentaenoic (EPA) and docosahexaenoic (DHA) omega-3 FAs were the highest in the flash of carp fed Diet 2, where EPA and DHA contents were 3.43% and 2.30% respectively, vs. 0.20% and 0.71% in the control group. Flash of carp fed experimental diets had significantly better n-6/n-3 ratio than the control group. Addition of both linseed and fish oil to carp feed favourably influenced omega fatty acid composition of carp flash, but addition of fish oil generated slightly better results.

Keywords: *omega fatty acids, carp feed, carp flash*

EXTRACT FROM MEDICINAL PLANTS MIXTURE AS ANTICOCCIDIAL AND ANTIOXIDANT IN BROILERS

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The mixture of *Artemisia absinthium*, *Thymus vulgaris*, *Menthae piperitae*, *Thymus serpyllum* was evaluated upon blood and liver oxidative status (glutathione peroxidase-GSHPx, superoxide dismutase-SOD and concentration of malondialdehyde-MDA) and anticoccidial effects in broilers experimentally infected with mixture of oocysts of *Eimeria* spp. (20,000 oocysts/bird), in comparison to coccidiostatic salinomycine.

The *in vivo* investigation was carried out on 120 day-old Arbor acres broilers separated into 4 equal groups with 3 replicates each. Group A was uninfected and untreated. Group B was infected and untreated. Group C preventively received coccidiostatic salinomycine in quantity of 60 mg/kg and was inoculated with coccidia species at 21st day-of-age. Group D consumed a basal diet supplemented with extracts of herbs mixture in quantity of 2 g/kg and was infected with *Eimeria* oocysts at 21st day-of-age. Clinical signs, number of oocysts per gram faeces (OPG) and mortality were monitored daily for 42 days. The anticoccidial activity of chosen medicinal plants extract caused a significant decrease in output number of oocysts per gram of faeces in broilers challenged with *Eimeria* spp.

The obtained results indicated a statistically significant ($P < 0.05$) increase of GSHPx activity in blood hemolysates. Moreover, the catalytic activity of SOD showed a statistically significant increase in group B comparing with the group A. The preventive doses of coccidiostatic indicated a statistically significant ($P < 0.05$) decrease of MDA concentration, reduction of SOD activity and decrease of GSHPx activity compared with group B. The activity of GSHPx in liver homogenates of broilers group B showed a statistically significant increase in comparison to the group A. Furthermore, the SOD activity increased the level of statistical significance.

Medical plants mixture can be used as prophylactic feed additive and source of antioxidant in dietary supplement since reduces the severity of coccidial infection induced by *Eimeria* spp. and exhibits a significant antioxidant activity in broilers fattening.

Keywords: broilers, medicinal plant mixture, antioxidative status, anticoccidial

EFFECT OF FEEDING PROGRAMS WITH DIFFERENT PROTEIN AND ENERGY CONTENT ON PERFORMANCE AND CARCASS QUALITY OF BROILERS

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The objective of this paper was to investigate the effect of feeding programs, i.e. the effect of mash feeds with different protein and energy content, on production performances and carcass quality of broiler chickens.

The investigation was conducted on 1200 chickens of Ross 308 provenience, separated by sex. The experiment lasted for 42 days and the standard technology was used. The groups (4 treatments) differed in a type of a feed mash, as follows: T1 (control group) was fed mashes containing 23%, 19% and 18% crude proteins (CP) and 12.76, 13.49 i 13.49 MJ / kg metabolizable energy (ME), during the periods: 1st - 14th day, 15 - 35th day and 36th - 42nd day, respectively; T2 (experimental group) was fed mashes with the same CP content and reduced ME content during the periods: 15 - 35th day (13.28 MJ / kg) and 36th – 42nd day (13.28 MJ / kg), compared to the T1 group; T3 (experimental group) was fed mashes with the reduced CP content in the starter period (22%) and the same ME content compared to the T1 group; T4 (experimental group) was fed mashes with reduced CP content in the starter period (22%) and reduced ME content during the periods: 15-35th day (13.28 MJ / kg) and 36th - 42nd day (13.39 MJ / kg). Slaughtering performance was investigated on six male and six female chickens for each of the treatments.

According to the obtained results, the difference in the average final body weights, feed conversion and mortality of broilers between the control (T1) and experimental groups were not statistically significant ($P>0.05$). Investigated feeding programs did not have a significant effect on the carcass yields "traditional processing" and "ready to grill" ($P>0.05$). The lowest percentage of abdominal fat was observed in T4 group (1.98%), for each sex separately and on the level of both sexes, while a statistical significance ($P<0.05$) was observed only compared to the T3 group.

Obtained results showed that the levels of energy and protein in broiler feed could be slightly lowered without an unfavourable effect on the production performances and carcass yield, but rather a significant effect on the reduction of abdominal fat content could be achieved.

Keywords: broilers, protein content, energy, carcass yield, abdominal fat

EFFECTS OF CHROMIUM (III) SUPPLEMENTS IN GROWING PIG DIETS ON NUTRITIONAL QUALITY OF LOIN (*LONGISSIMUS DORSI*)

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Trivalent chromium it was recognized to play a role in regulating glucose and lipid metabolism in humans and laboratory animals. There are relatively few papers on the effect of Cr supplementation on pork quality.

The objective of this study was to highlight the positive effects of the chromium picolinate on nutritional quality of loin.

A 6-week study on growing pigs evaluated the effect of the dietary chrome picolinate (CrPic) on the growth performances and nutritional quality of loin (*Longissimus dorsis*). The experiment was conducted on 8 castrated Landrace x Large White males with an initial weight of 17.16 ± 0.62 kg, assigned to 2 groups (C, E), housed in individual metabolic cages and fed on corn-soybean meal-based diets (18.75% CP; 3063 kcal/kg ME). The diets of E group was supplemented with 200 ppm CrPic. Blood samples were collected at the end of the experiment, following which all animals have been slaughtered and samples of loin were collected. The nutritional quality of the collected samples was evaluated for: proximate analysis, amino acids profile, fatty acids profile, mineral content.

No significant differences of productive parameters were noticed. In loin samples, the fat / protein ratio was lower in group E (22.18% fat DM; 63.4% protein DM), than in group C (22.27% fat DM; 57.57% protein DM). There were no significant differences between groups for fatty acids analysis but it was noticed a significant increase of methionine (essential amino acid) concentrations ($0.73 \pm 0.07\%$ DM for C and $0.88 \pm 0.06\%$ DM for E). Chromium supplements decreased, but not significant ($P > 0.05$) Fe and Zn deposition in loin (32.16 ± 2.57 ppm DM (C); 28.15 ± 0.56 ppm DM (E) for Fe and 40.22 ± 2.50 ppm DM (C); 39.12 ± 1.67 ppm DM (E) for Zn). The antagonist relation between Cr and Fe was expected due to the same minerals transporter.

Keywords: *trivalent chromium, pigs, nutritional quality, loin*

PRESENCE OF MYCOBIOTA AND MYCOTOXINS IN SILAGE

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The growth of molds and production of mycotoxins in silage depends on proper ensiling, and environmental conditions (oxygen, pH, moisture, etc.). During the initial stages of ensiling, after oxygen depletion, strict aerobes (*Fusarium* species) first disappear followed by other, so-called field mycobiota, *Alternaria* and *Cladosporium* spp., so the dominant mycobiota become fungi tolerant to oxygen deficiency among which the most common are some *Mucorales* and *Penicillium* species, *Aspergillus fumigatus*, *Trichoderma viride*, *Geotrichum candidum*, *Paecilomyces variotii* and *Monascus ruber*.

Although changes in pH value during ensiling caused by the production of organic acids do not have adverse effect to mycobiota (they can grow between pH 3 and 8), some of these acids (propionic and butyric) have a strong inhibitory effect on most of fungi.

Many mycotoxins (aflatoxin B1, zearalenone, fumonisins, trichothecenes etc.) detected in different types of silage all over the world are in fact produced in the field, considering that in the case of proper ensiling toxigenic mold species are being replaced with characteristic silage mycopopulations. The results of mycological and mycotoxicological investigations of corn and alfalfa silages in Serbia show that the most significant contaminants of these silage types are zearalenone (750-1640 µg/kg) and type A trichothecenes (T - 2 toxin and DAS).

Keywords: silage, toxigenic mycobiota, mycotoxins

LIPID PEROXIDATION IN NATURAL-INGREDIENT AND PURIFIED DIETS FOR LABORATORY ANIMALS

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Various types of diets are available for feeding laboratory animals. Selection of the most appropriate type will depend on the amount of control required over nutrient composition, as well as on several other factors including diet acceptance by the animals, and cost. Accordingly, the aim of this study was to evaluate nutritional composition and fat quality in rodent diets.

For this purpose 12 diets, natural ingredient diets (NIDs) and purified diets (PDs), have been selected and analysed for dry matter (AOAC, 1990), crude protein (Kjeldahl), crude fiber (AOAC, 1990) and ether extract (AOAC, 1990) contents. In order to investigate lipid peroxidation, peroxides values have been determined (AOAC, 2000). The mean chemical composition (expressed on DM) of the NIDs was crude protein 20.4 ± 0.5 %, crude fiber 4.4 ± 0.5 %, ether extract 5.4 ± 1.06 %, and 115.1 ± 25.09 meq O_2 /Kg fat for peroxides value. Instead, the chemical profile of the PDs was crude protein 15.24 ± 0.8 %, crude fiber 2.23 ± 0.7 %, ether extract 7.56 ± 1.6 %, and 102.6 ± 38.3 meq O_2 /Kg fat for peroxides value. When peroxidation of lipid has been considered, it has been observed that lipid content did not affect systematically peroxidases values. In fact, in both groups high peroxidase values (>100 meq O_2 /Kg fat) have been measured in low fat content diets (2.81 up to 5% of ether extract). By contrast, when the highest fat content diets for each group (8.89 and 11.38% for NIDs and PDS, respectively) was considered, peroxide value was lower in PDs diet than in NIDs one (25.90 vs 120.60 meq O_2 /Kg fat).

Therefore, it could be assumed that low fat content do not prevent lipid peroxidation, while fat sources (olive oil vs soybean oil) as well as technological treatments (i.e. extrusion) may affect fat quality and stability. However, it should be also considered that this study has been done on limited number of samples, as well as that peroxides are transitory products that represent just an indication about fat quality.

Keywords: *laboratory animal's diets, fat, lipid peroxidation*

INFLUENCE OF STORAGE CONDITIONS ON DEOXYNIVALENOL LEVEL IN MAIZE

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Mycotoxins are toxic chemical compounds produced by moulds. They can occur in wide variety of commodities such as raw agricultural products, processed foods, animal products (meat, milk, eggs), imported products, etc. Contamination with mycotoxins is an additive process, meaning that it begins in the field and is increasing during harvest, drying, and storage. Level of the contamination depends on geographic region (climatic conditions), availability of water, inoculum concentrations, mechanical damage, etc. The aim of this study was to investigate influence of storage conditions on deoxynivalenol (DON) level in maize. Samples of infected maize were stored for 2 months under warehouse conditions (air temperature of 20°C, relative humidity 50 %) as well as for 20 days in laboratory climatic chamber (air temperature of 20°C, relative humidity 80 %) in order to study influence of relative humidity increase on DON level. For the samples stored in climatic chamber, form of maize (kernel vs. milled) was also investigated. It was noticed that after storage period of 2 months in warehouse, DON level in maize increased from 5 to 15 %. DON level in samples of maize kernels stored in climatic chamber for 20 days increased up to 2.5 %, although relative humidity was very high. On the other hand, DON level in milled maize increased from 15 to 60 % when compared with whole kernel maize. Storage stability test proved that increase in relative humidity increases DON concentration in maize. Milled maize was more susceptible to DON contamination than unground maize.

Keywords: *mycotoxin, deoxynivalenol, storage conditions*

EFFECT OF POPULATION DENSITY ON THE DEVELOPMENT RATE AND THE NUMBER OF RED FLOUR BEETLE *TRIBOLIUM CASTANEUM* (HERBST) OFFSPRING IN COMPLETE ANIMAL FEEDS

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Red flour beetle *Tribolium castaneum* is a dangerous pest especially in the ground grain products, which can cause significant damage to the complete animal feed. The aim of this study was to examine still insufficiently known development rate and the number of this pest's offspring in complete feeds.

The tests were done under controlled conditions ($30 \pm 1^\circ\text{C}$ and r.h $55 \pm 10\%$) with four initial population densities of 100, 50, 25 and 10 insects in complete feed for pigs and laying hens and wheat flour (control). Insects were placed in the 50g of above mentioned substrates in four replicates, and extracted after seven days to determine development rate of their offspring and the number and weight of newly emerged adults. Data were statistically analyzed using analysis of variance. We found that the *T. castaneum* development length in complete feeds at the highest density was 60 days, while at the lowest density this cycle lasted 20 days. In the control substrate, the length of insects development, at the highest density lasted for 21 days, and 18 days at the lowest. At the highest density, the highest number of offspring (1230) was determined in control, followed by pig feed (582.8) and significantly lower in the feed for laying hens (260), while at the lowest density there were no statistically significant differences between the substrates. The mass of insects (1.16865mg-1.5653mg) that were developed in feed for laying hens was significantly less than of insects (1.12285mg-1.6686mg) in pig feed, except at the highest density.

The results show that the initial population density significantly influences the development rate, number and weight of *T. castaneum* offspring, which is especially pronounced in the feed for laying hens. Knowing the cycle of reproduction and development of this pest on different substrates may contribute to the timely and economically profitable protection of stored products.

Keywords: *T. castaneum*, population density, development rate, number of offspring, animal feed

IN VITRO STUDY ON THE EFFECT OF ZEARALENONE ON THE INTEGRITY OF THE INTESTINAL EPITHELIAL CELL BARRIER

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Zearalenone is a mycotoxin that often contaminates maize and small grain cereals. It is produced by several *Fusarium* species prevalent in temperate and warm climates. Zearalenone and some of its metabolites possess strong estrogenic activity, impairing the normal reproductive function of domestic animals, especially in swine. Gastrointestinal tract is the first biological obstacle for food and feed mycotoxins when ingested, intestinal epithelial cells forming a barrier of tight junction proteins. The integrity of the epithelial layer can be damaged by external compounds, including mycotoxins, with severe effects on diffusion processes. The aim of the present work was to find out if zearalenone is affecting the intestinal barrier. The effect of *E.coli* co-contamination was also studied. Human epithelial cells Caco-2 and porcine epithelial cells IPEC-1 were cultivated in DMEM F12 medium using Transwell® inserts. When reaching the confluence 25µM zearalenone solution was added to the apical side of the cell monolayer. In order to evaluate the effect of the mycotoxin on the permeability of epithelial cell monolayer zearalenone quantification was performed both in apical and basolateral pole. After 1, 2 and 24 hours of incubation, the cells were washed, trypsinized and centrifuged. Zearalenone was assessed by HPLC-FLD method. Samples preparation involved enzymatic treatment with glucuronidase (for cells), followed by immunoaffinity clean-up. The obtained results for Caco-2 indicated that zearalenone is able to induce loss of intestinal epithelial layer barrier function, increasing permeability. Co-contamination with *E.coli* doesn't result in higher permeabilisation of the epithelial monolayer.

Keywords: zearalenone, mycotoxin, Caco-2, HPLC, intestinal barrier

PRESENCE OF AFLATOXINS, ZEARALENONE, OCHRATOXIN A AND TRICHOHECENES IN CORN (*ZEA MAYS*) IN REPUBLIC OF SERBIA

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Mycotoxins are toxic metabolites produced by a range of fungal species which common occurrence in food and feed and presents a threat to the humans and animals health. The purpose of the current study was to examine the content of total aflatoxins (AFs), zearalenone (ZEN), ochratoxin A (OTA), deoxynivalenol (DON) and T-2 toxin in corn intended for animal nutrition, which was sampled during the year 2013. Content of mycotoxins was analyzed by Enzyme-Linked Immuno Sorbent Assay (ELISA). Among 70 analyzed maize samples, AFs were detected in 59 (84.3%) of samples, in the concentration range from 2.17 to 67.6 µg/kg with the mean level of 13.8 µg/kg and 4 samples (5.7%) were above the 90 µg/kg. AFs content above 50.0 µg/kg was found in 15.7% samples making them inappropriate for animal consumption by Serbian regulations. Content of ZEN, OTA, and DON was determined in 28 samples and content of T-2 in 29 samples. ZEN, OTA, DON and T-2 were detected in 10 (35.7%), 11 (39.3%), 7 (25%) and 11 (37.9%) samples, respectively. ZEN, OTA, DON and T-2 content ranging from 25.84 to 130 µg/kg, from 5.03 to 11.99 µg/kg, from 82 to 792 µg/kg and from 54.7 to 374 µg/kg, respectively. Republic of Serbia is among the biggest exporters of corn, and there are remarkably economic consequences of aflatoxin contaminated corn. Moreover, continuous monitoring is necessary for prevention of occurrence of mycotoxins in order to protect humans and animal health.

Keywords: aflatoxin, zearalenone, ochratoxin A, trichothecenes, corn

LABORATORY EVALUATION OF A BACTERIAL INOCULANT FOR ENSILING ALFALFA

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Effects of a bacterial inoculant on fermentation characteristics and aerobic stability of alfalfa silage were determined under laboratory conditions. For ensiling were used 2.0 dm³ poly-propylen containers, which were opened on days 9, 18 and 55 for sampling and analysis of pH and content of dry matter, crude protein, ammonia, lactic acid and volatile fatty acids. Aerobic stability of silages was determined on day 55 of ensiling. Dry matter and crude protein were significantly ($P<0.05$) higher in inoculated than in the control samples on all sampling days. There was significantly ($P<0.05$) lower pH in inoculated silage samples on days 9 and 18. Addition of inoculant caused higher ($P<0.05$) lactic acid concentration on days 9 and 18, while concentration of acetic acid was higher ($P<0.05$) in inoculated silage on all sampling days. Inoculated silage was aerobically more stable than the control silage as indicated by significantly ($P<0.05$) lower CO₂ production.

Keywords: *silage, alfalfa, fermentation, aerobic stability*

INFLUENCE OF MYCOTOXINS IN SWINE FEED ON THE HEALTH STATUS OF SWINE BREEDING CATEGORIES

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Mycotoxins are toxic secondary metabolites of fungi commonly found on grains, which can cause severe impacts on animal health and performance. They are often present in swine feed in amount that can have detrimental impact on reproduction and health of swine breeding categories. Reproductive failure in swine is often a difficult diagnostic problem. Problems are expressed only as alterations of the reproductive cycle, reduced feed intake, slow growth or impaired feed efficiency. Many times, when diagnosis of infectious disease or management problems is not obtained, feed quality and safety may be questioned. This paper include field observations regarding the influence of swine feed containing different mycotoxins on the health status and occurrence of the reproductive failure in swine breeding categories (sows, gilts). The material for this research included four swine farms, where certain reproductive disorders and health problems in breeding animals were detected. Depending on the specificity of each evaluated case and available material, the applied research methods included: anamnestic and clinical evaluation, pathomorphological examination, standard laboratory testing for detection the presence of aerobic and anaerobic bacteria, and microbiological feed testing, in order to examine the presence of fungi and mycotoxins by the method of thin layer chromatography. On the basis of the obtained results, it may be concluded that the presence of mycotoxins in swine feed was directly connected to the chronic health disorders (swine dysentery) and reproductive failures in the examined breeding swine categories (vulvovaginitis, endometritis, rebreeding, infertility). The presence of mycotoxins in swine feed have influence on the reproduction and health status of pigs and in the certain conditions may significantly disturb the production process.

Keywords: *mycotoxins, swine reproductive disorders, breeding*

BIOACTIVE COMPOUNDS OF GARLIC, BLACK PEPPER AND HOT RED PEPPER

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Goal of this review is to show the most important bioactive compounds in herbal plants such as garlic (*Allium sativum* L.), black pepper (*Piper nigrum* L.) and hot red pepper (*Capsicum annuum* L.) and its modes of action. Allicin (allyl 2-propenethiosulfinate or diallyl thiosulfinate) is thought to be the principal bioactive compound present in aqueous garlic extract or raw garlic homogenate. When garlic is chopped or crushed, allinase enzyme, present in garlic, is activated and acts on alliin (present in intact garlic) to produce allicin. Other important sulfur containing compounds presents in garlic are allyl methyl thiosulfonate, 1-propenyl allyl thiosulfonate and γ -L-glutamyl-S-alkyl-L-cysteine. Piperine is an alkaloid responsible for the pungency of black pepper, along with chavicine (an isomer of piperine). The active compound in black pepper is piperine (1-piperoyl piperidine) which is responsible for bio enhancing effect. It has been found that piperine bioavailability enhancing property may be attributed to increased absorption, which may be due to alteration in membrane lipid dynamics and change in the conformation of enzymes in the intestine. Capsinoids is a family of compounds that are analogues of capsaicin, which is the pungent component in hot chilli peppers. Capsinoids are widely present at low levels in chilli pepper fruit, it includes capsiate, dihydrocapsiate and it has a very favourable safety profile. Capsaicin (8-methyl-N-Vanillyl-6-nonenamide) is the active substance responsible for the irritating and pungent effects of various species of hot pepper. These biological responses of all this bioactive compounds have been largely attributed to reduction of risk factors for cardiovascular diseases and cancer, stimulation of immune function, enhanced detoxification of foreign compound, hepatoprotection, cholesterol content reduction, antimicrobial effect, antifungal effect, antiinflammatory effect and antioxidant effect.

Keywords: *garlic, black pepper, hot red pepper, allicin, piperine, capsaicin*

**RAGWEED (*AMBROSIA ARTEMISIIFOLIA* L.) –
DETERMINATION OF PHYTOESTROGEN ACTIVITY, BASIC
NUTRIENT CONTENT AND ITS POTENTIAL AS A FORAGE
FOR SMALL RUMINANT**

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The aim of this study was to investigate the level of estrogen activity of the ragweed by bioassay in immature female rats and nutritional value of the plant. In bioassay a standardized curve of dose-dependent response of the uterus weight after treatment with various doses of 17- β estradiol was established. Experimental groups of rats were fed with ragweed extract through a gastric tube, and estrogen activity was calculated. There were no clinical signs of disease during treatment, as well as in sections (post-mortem) no changes in the internal organs. Results indicate that ragweed has a weak estrogenic activity, with no statistical significance and is not expected to influence on sexual development of the experimental animals.

Ragweed has been analyzed for the nutrient status. Chemical analysis showed that plant has a high protein concentration that could be used for the production of proteins of animal origin. A high level of ash indicates the presence of mineral matter (micro and macro elements). Short time feeding sheep with ambrosia did not led to the appearance of adverse effects on health and behavior. Animals ate ragweed with pleasure, especially at the stage before flowering.

In rural areas, small ruminants may serve as a biological enemy in controlling the spread of ragweed, either grazing or after mowing. It is necessary to determine whether the products obtained from animals fed with ambrosia, possibly possess residues that may be harmful to people allergic to ragweed pollen.

Keywords: *ragweed, phyto-estrogens, rat, nutritional value, sheep*

EVALUATION OF SOME FEED ADDITIVES FOR LAYING HENS, IN TERMS OF LUTEIN, ZEAXANTHIN AND OTHER NUTRIENTS

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Lutein and zeaxanthin are believed to be the only carotenoids vital to retinal function, being the only ones found in the retina. Within the eye, lutein has a protective role against age-related macular degeneration (AMD). Green leafy vegetables represent a rich source of lutein and zeaxanthin, but with a smaller availability when compared with eggs. Animals cannot synthesize lutein, though they have the ability to absorb carotenoids from their diet and deposit them into tissue. Lutein supplemented eggs may be a highly available dietary source, due to the carotenoids dispersal in fat.

The aim of this study was to assess the nutritional quality of four feed additives rich in carotenoids (AFC): AFC 1 (red corn, pumpkin pulp, marigold), AFC 2 (alfalfa meal, pumpkin pulp, marigold), AFC 3 (kale, alfalfa meal, marigold, spinach leaves), AFC 4 (buckthorn, red corn, pumpkin pulp, marigold), in terms of carotenoid content and amino acid composition, for include them into the laying hens diets. In order to achieve the nutritional requirements of the lang hens and for safety insurance, the proximate analysis (protein, fat, fiber, ash) and contaminants determination were performed. The crude protein content for the analysed feed additives ranged between 10.08-18.65 % DM, and crude fiber between 10.82-31.63 % DM.

The higher content in lutein and zeaxanthin was found in AFC 4 (66.659 mg/100g), which also had the higher amount of vitamin E (640.93 mg/kg), when compared with the others. The amino acid profile of AFC 4 revealed a content of limiting essential amino acids for laying hens, important in ratio formulation: 0.811 % lysine (DM), 0.149 % methionine (DM) and 0.626 % threonine (DM), however below AFC 3 (1.092 % lysine (DM), 0.201 % methionine (DM) and 0.877 % threonine (DM)).

It can be concluded that AFC 4, based on vegetal materials, had the higher concentration of lutein, zeaxanthin and vitamin E and can be used in the laying hens diet to obtain lutein enriched eggs.

Keywords: *lutein, zeaxanthin, amino acids, feed additive, egg*

CONTROL OF AFLATOXIN CONTAMINATION IN MAIZE BASED FEED BY *TRAMETES VERSICOLOR*

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Contamination of feed and feed stuff with aflatoxins is a worldwide problem. Probably due to climatic changes the contamination of maize with aflatoxins has become more frequent problem also in some European countries. These toxic secondary metabolites of some filamentous fungi belonging to genera *Aspergillus* can severely impair animal production both due to their health hazardous effects and possibility of transmission along the food chain. Along the years different control strategies were applied but none of them has solved the problem of aflatoxin contamination. The ongoing researches often focus on detoxification strategies.

In this work the effect of the basidiomycete *Trametes versicolor* metabolites on the aflatoxin production by *Aspergillus flavus* in maize, was investigated. The addition of fine powder, obtained by milling 14 days old *T. versicolor* cultures grown on pure sugar beet pulp, to maize kernels (moistened up to aw 0.85) at 1% w/v significantly ($p < 0.001$) inhibited the production of aflatoxin B1 (up to 85%). Furthermore, treatment of contaminated maize with culture filtrates of *T. versicolor* containing ligninolytic enzymes, namely laccases at 1U/mg protein, showed a significant reduction of the content of aflatoxin B1 (-70%; $p < 0.01$). Finally, treated and control maize samples were also compared under *in vitro* ruminal digestive condition to simulate the possible releasing of aflatoxins upon cow's digestion.

These results indicates that *T. versicolor* could be applied both in prevention of aflatoxin contamination and detoxification of contaminated feed and feed stuff.

Keywords: aflatoxins, maize, *Trametes versicolor*, detoxification

NUTRITIVE VALUE OF VITAMINIZED SILAGES

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Plant species that are suitable for silage have a higher dry matter yield in the field and higher digestibility, low buffer capacity, and a higher amount of water soluble carbohydrates. Maize silage is characterized by high concentration of soluble carbohydrates that enable a good fermentation, good energy supply, and high rumen degradability. Whole plant maize silage is widely used worldwide in rations for cattle. However, β -carotene content in corn silage, which is a popular main feed for dairy cows, is very low. In our region, pumpkin and carrot may be considered alternative crops and an option for production of vitaminized silage. Ensiling can be considered as the method for using wet raw materials more effectively. The aim of this work was to evaluate the quality of silage based on the whole corn plant and carrots as well as pumpkin silage in dairy cows nutrition. For the ensilage, the following combinations of raw materials were used: whole corn plant and carrot, carrot and oat grits, corn grits and pumpkin and muscat pumpkin. Silage samples were taken from the top, centre and bottom parts of the trench silo, i.e. the barrel. Lactic and volatile organic acids (butyric and acetic acid) were analyzed by the method of Flieg. Determination of moisture, fat, crude fiber, ash, calcium and phosphorus in the samples was performed by standard methods, while the protein was analyzed by measuring total nitrogen by total combustion (according to Dumas). The amounts of microelements were determined using atomic absorption spectrophotometry. The results of testing the fermentation process parameters and results of testing nutritive value indicated that vitaminized silages can be successfully ensiled, preserved for several months and utilized as a feed for cows.

Keywords: *silage, carrot, pumpkin, dairy cows*

THE QUALITY OF CORN STILLAGE OF BIOETHANOL PRODUCTION

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High consumption and depletion of fossil fuels require finding the alternative solution. Among the alternative energy resources an important place takes the biofuels, in particular bioethanol as a renewable and environmental friendly fuel. The highest percentage of bioethanol in the industry is produced from corn grain. During the bioethanol production process the large amounts of by-products are formed. Since the by-products of bioethanol industry are excellent sources of proteins and energy for animals, these are commonly used as components for the animal feed preparation. Valorisation of by-products provides greater productivity and environmental protection.

The aim of this study was to investigate examine the overall quality of whole stillage that remains after the distillation of ethanol, wet cake and liquid phase obtained after separation of total stillage for utilization in animal feed.

The samples were analysed to crude protein content by the Kjeldahl method and aflatoxin content by the Elisa test. Furthermore, content of heavy metals was analysed by the Atomic Absorption spectrophotometer.

The contents of crude protein in the dry matter of the total stillage, wet cake and liquid phase were 21.50%, 34.27% and 8.31%, respectively. Aflatoxin content in all the samples was <0.005 mg/kg. Moreover, the content of heavy metals (As, Pb, Cd and Hg) meets the requirements of the corresponding regulation (Pravilnik o kvalitetu hrane za životinje).

The obtained results showed that by-products of bioethanol industry can be used as components of animal feeds.

Keywords: corn, bioethanol, stillage, feed

FRUIT AND VEGETABLE WASTE: PHYSICO-CHEMICAL AND NUTRITIONAL CHARACTERIZATION FOR UTILIZATION IN ANIMAL FEEDING

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The increasing amount of waste generated each year in most industrialized countries has raised concerns about its treatment and disposal. Food waste represents about 40–50% of the biodegradable municipal wastes.

The aim of this study was to characterize fruit and vegetable waste collected from a Despar food store supermarkets, Messina (Italy) to contribute to its use in animal feeding.

The fruit and vegetable samples were collected three times a week for a year, homogenized and dried at 65°C for the following analysis: ash, crude protein, crude fat, crude fiber. Moreover pH values and moisture were measured.

In average, the fruit mix had a pH of about 4.08, humidity 85%, and contained 4.3% crude protein, 1.26% crude fat, 15.74% fiber, 3.30% ash. On the other hand the vegetable mix, with a pH of 5.11 and a 92.27% moisture, contained about 18.64% protein, 1.59% fat, 14.26% fiber and 12.66% ash.

The results obtained from this research reveal that the vegetable waste can be considered a good sources of crude protein and together with the fruit waste also an important supply of crude fibers.

Fruit and vegetable waste could possibly be used as animal feed, and its recycling could prevent the discharge of a large amount of landfill waste, minimizing the environmental impact.

In addition, drying of these products is certainly a better treatment, but it is necessary to evaluate the costs that this process entails. In this regard, the ensilage could be a possible alternative, obviously after in-field silage tests. The food waste could partially replace the green forage and partly also the dried forage (hay), bringing economic benefits to livestock farms.

Keywords: *fruit and vegetable waste, protein, fiber, animal feed, economic benefits*

THE IMPACT OF BENURAL-S ADDITION ON CHEMICAL COMPOSITION AND QUALITY OF ENSILED GRAPE POMACE

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The impact of Benural-S (commercial non-protein source of nitrogen) addition and inoculation on chemical composition parameters and quality of ensiled pomace from grape variety Rkatsiteli was examined in this study. The experiment was set up as a two-factorial (4×2; n=3), wherein the factor A was the dose of Benural-S (A₁= control; A₂= 10 gkg⁻¹; A₃= 20 gkg⁻¹; A₄= 30 gkg⁻¹), while the factor B was the inoculation (B₁= without inoculant; B₂= with inoculants). Ensilages were stored in plastic experimental vessels of 120 dm³ volume. The experimental tanks were opened 150 days from ensiling and representative samples were taken for the chemical analysis. During ensiling, the highest change was determined on unstructured carbohydrates (BEM) that were intensively consumed for bacterial fermentation and synthesis of lactic, acetic and butyric acid. It was determined that addition of Benural-S significantly increased the amount of crude proteins and ammonia nitrogen in ensilages, as well as pH values. The amount of crude proteins in ensilages with addition of 30 gkg⁻¹ of Benural-S was two times increased, while the share of ammonia nitrogen in total nitrogen (from crude proteins) in the treatment A₂B₁ was around 500 gkg⁻¹. At the same time, pH values were below 4.5, which is considered as a border for the occurrence of more intensive butyric fermentation. Inoculation of ensilages modified the fermentation, therefore inoculated treatments had lower content of ammonia nitrogen and higher lactic acid content.

Addition of Benural-S at the doses of 10, 20 and 30 gkg⁻¹ positively influenced the most parameters of chemical composition and quality of ensilages. At the same time, there is a significant increase of ammonia nitrogen share, which can be negative for productive and reproductive parameters of cows due to intake of large amounts of degradable protein.

Keywords: grape pomace, ensilage, Benural – S, inoculation

RAW STORAGE INGREDIENTS AND LEFTOVER BREAD AS A RAW MATERIAL IN ANIMAL FEED

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Food processing industry is one of the most important industries worldwide. Concerning that population is constantly increasing, lack of food is a growing problem throughout the world as well as in Serbia. There is an evident problem of withdrawn bread in Serbia, in terms of quantity, environmental and health aspects. Leftover bread represents an environmental problem, but also potentially valuable raw material for food and animal feed. Increase in food production for humans and animals can be achieved by use of new technologies in agro-food industry. Nowadays, there are many different ways for thermal processing of cereals: toasting, extrusion, hydrothermal processing, micronization, microwave treatment. In Serbia, most frequently used processes are extrusion and hydrothermal processing. Large quantities of waste storage and its utilization as animal feed are advisable. Bread consumption per capita in Serbia is far above average consumption in EU. Withdrawn bread and its ingredients present environmental problem, and one of possibilities of their utilization as raw material in food and animal feed was described in this study. According to the survey conducted in previous research, there is a significant amount of leftover bread in Serbia. Additionally, the directions for use of leftover bread and raw storage ingredients have been presented in this paper.

Keywords: *withdrawn bread, waste revalorization, health and safety food*

BACTERIAL BIOFILM: AN ANCIENT SURVIVAL STRATEGY OF BACTERIA IN THE BASIS OF THE NEW APPROACH TO UNDERSTANDING THE PATHOGENESIS OF SOME INFECTION IN VETERINARY MEDICINE

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The ability of biofilm formation is an integral feature of prokaryotes and from the context of evolution it presents the strategy for survival and the maintenance of homeostasis within the unfavourable environmental conditions. In a hostile environment, the bacteria in the time that is measured in minutes from "swimmers" turn into "stickers", maintaining a specific dormancy state and waiting for more favorable conditions for life. It is now known that more than 60% of human infections in developed countries are caused by biofilm, and they become a new category of infectious diseases that are radically different from acute epidemic infections that were dominant until the mid-twentieth century. Biofilm infections can be cured using the conventional antibiotics, although some improvements can be achieved during the acute phase of disease. Also, using standard laboratory techniques, in many cases it is not possible to isolate the cause of such infection and it was concluded that inflammatory processes are sterile. In veterinary medicine, biofilm infections are investigated to a lesser extent, and still most of the information is derived from an analogy with infections in human medicine. In this paper we present the relevant facts about a new approach to understanding the pathogenesis of certain infections of importance in veterinary medicine from the aspect of bacterial biofilms. Biofilm infections are persistent, recurrent and failure of therapy by using antibiotics poses a need to search new prophylactic, therapeutic and control methods and strategies.

Keywords: *biofilm, infection, veterinary medicine*

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FEEDNEEDS: AN ITALIAN-SERBIAN BILATERAL PROJECT FOCUSED ON THE FEED SECTOR

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Throughout the EU the livestock sector is a major player of the agricultural economy. Feed is the most important production factor for livestock producers. In spite of that the entire European feed supply chain, is experiencing challenges created by the market. Accordingly, research and innovation in livestock sciences, and in particular animal nutrition including feed technology, is fundamental for the sustainability of EU livestock farming, as well as a good investment for the future. In this contest, FEEDNEEDS has been financed by Ministero Affari Esteri. Project participants namely, the Institute of Food Technology of the University of Novi Sad (FINS) and the Department of Health, Animal Science and Food Safety of the Università di Milano (VESPA), are both involved in feed and animal nutrition research according to the territory in which they are embedded (i.e Lombardy and Vojvodina). FINS is one of the leading research institutes in the field of food and feed science and technology and dissemination of knowledge in Serbia and South Eastern Europe, while VESPA represents one of the leading university departments in veterinary and animal science in Italy. Both institutions cooperate with feed industries, which will represent further partners in the project. Accordingly, the main aim of this bilateral project is to identify the needs in term of research and development of the feed sector in the two territories. Methodologies proposed are mainly: Exchange visits, lab and desk work, questionnaire development, data collection, analysis, reports and publications, seminar and workshop organization. Presentation will provide the result obtained in the first part of the project.

Keywords: *feed, R&D, Italy, Serbia*

BACTERIOLOGICAL QUALITY OF DRINKING WATER AND IMPACT ON ANIMALS HEALTH

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Food Safety Law prescribes the duties and responsibilities of participants who are taking part in quality testing of the food and feed. In terms of the existing law the food is any substance or product that is used or can be expected to be used for human consumption. Drinking water used for public supply is also regarded as food. Water that is used by farm animals can be a source of bacterial contaminants that can affect the health of animals and indirectly people. The subject of this paper is microbiological control of water collected from different parts of the supply systems used in pig farms. The goal is to determine whether there are differences in the composition of the bacterial flora at different critical points in the water systems. Analyses have shown that water collected before entering premises differ in terms of number and types of bacteria comparing to water that animals consume from drinkers. The most important finding was that *Pseudomonas aeruginosa* and coliform bacteria *Escherichia coli*, including the presence of coliform bacteria of faecal origin could be found in drinking water at the farm. The results indicate the possibility of a negative impact of microbiologically contaminated water on animal health.

Keywords: *water, bacteria, animal health*

IDENTIFICATION OF *CORYNEBACTERIUM PSEUDOTUBERCULOSIS* ISOLATED FROM MILK SAMPLES FROM COW WITH MASTITIS

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Corynebacterium pseudotuberculosis is the most frequent causative agent of the disease in sheep and horses, but also in other mammals and humans. It could induce mastitis in lactating animals. The organism can survive the phagosomal mechanisms, which can lead to subsequent formation of abscesses. It is often misidentified in routine work. The goal of this work is to suggest diagnostic algorithm that is cost-effective, available, applicable and reliable.

This research was performed at the farm of dairy Holstein-Friesian cows during an outbreak of acute mastitis. Milk samples were collected from 560 lactating cows. The samples were taken after cleaning and disinfecting each quarter of the udder. Samples were collected into sterile sampling tubes. California mastitis test was applied in all samples by adding equal volumes of CMT reagent (provided with the test) and milk collected from each quarter. The changes in milk fluidity and viscosity were observed. Samples were then inoculated on to the 10% sheep blood agar, Endo agar, Sabouraud, thioglycolate medium and nutrient broth. The plates were incubated for 3 days at 37°C in aerobic conditions. Cultural, morphological and conventional biochemical testing was done. Double CAMP and plasma coagulation tube test were applied as well. Total 28 isolates were included in a synergistic haemolysis with *Rhodococcus equi* (ATCC 6939) and inverse CAMP phenomenon with *Staphylococcus aureus* and coagulated rabbit plasma. Additionally, *Corynebacterium pseudotuberculosis* was confirmed using API Coryne V 2.0 and relevant BioMerieux software program. The identity rate was 99.9%, accuracy rate was T = 1 and test count was 0. Based on the results we concluded that the *Corynebacterium pseudotuberculosis* is present in our country. It could be misdiagnosed since applicable diagnostic protocols are lacking. In this paper we are suggesting simple, inexpensive and reliable diagnostic method for identification of *Corynebacterium pseudotuberculosis*.

Keywords: *Corynebacterium pseudotuberculosis*, mastitis, diagnostic protocol, double CAMP

ANTIMICROBIAL RESISTANCE OF *SALMONELLA* SPP ISOLATED FROM POULTRY FARMS IN SOUTHERN BAČKA AND SREM COUNTY

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The goal of our work was to detect salmonella on poultry farms situated in Southern Bačka and Srem County and to test their antimicrobial resistance.

During the year 2013, we isolated salmonellas from 69 farms. *Salmonella* Enteritidis, *Salmonella* Infantis resistant to nalidixic acid and tetracycline and *Salmonella* Typhimurium were detected in broilers. The most frequently isolated serotypes found in layer chickens were *S. Enteritidis* as well as *Salmonella* Infantis resistant to nalidixic acid and tetracycline. Broiler breeders (three farms were included) were infected with serovar Enteritidis and Infantis as well. These results correlate well with the previous research on clonal spread of *S. Infantis* in Serbia. *Salmonella* Newport was found in breeder eggs and one broiler farm. These isolates were multiresistant, harboring resistance to ampicillin, nalidixic acid and tetracycline.

Improved farm management is important to minimize the rate of salmonella infection in poultry flocks. Prudent use of antibiotics in livestock industry is necessary to prevent spread of resistant bacteria along the food chain.

Keywords: *Salmonella*, resistance, monitoring

COMPARATIVE ANALYSIS OF TROUT FEEDING PROGRAMS

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Ukraine has great potential in the trout farming. Nevertheless all farms use foreign produced fish feed. Overcoming the obstacles of developing domestic trout feed production is necessary goal of Ukrainian feed industry. Nutrient requirements of trout have been changed through fish life-cycle. Energy and protein requirements of fish depend upon water temperature, oxygen saturation, type of feeding etc. Trout feeding programs of different foreign enterprises were analyzed. The main steps of trout cultivation were considered. Ukrainian trout feeding program was improved, based on theoretical research. Four main periods of trout feeding were distinguished: prestarting, starting, growing and productive. The developed trout feeding program with nutrient requirements was recommended for trout feed production.

Keywords: *mixed feed for trout, trout feeding program, requirements of trout*

USING PROBIOTICS TO IMPROVE PERFORMANCE PARAMETERS OF WEANED PIGLETS

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Probiotics have been defined by Collins and Gibson (1999) as "a live microbial feed supplement which beneficially affects the host animal by improving its intestinal balance". There is a relatively large volume of literature that supports the use of probiotics to prevent or treat intestinal disorders. In this study, a combined probiotic preparation of 1×10^9 CFU/kg, *Enterococcus faecium* DSM 7134 and 2×10^9 CFU/kg *Saccharomyces cerevisiae* E 1703 was used and supplemented to a basal ration for piglets. Thirty piglets (White x Duroc) were transferred after weaning (28 days) to flat decks and randomly allocated to 2 groups. The basal diet was supplemented with 1g/kg feed of the probiotic preparation (experimental group) or without supplementation (control group). During six weeks experimental period, performance parameters were measured. The supplementation of combined probiotic improved slightly daily weight gain (DWG), feed conversion ratio (FCR) and apparent nutrient digestibility. Fibre digestibility was slightly increased and fat digestibility was slightly decreased. It can be concluded that the supplementation of the combined probiotic preparation improved the performance data. However, the differences were not always significant. Possibly this was due to the combined probiotic preparation. The level of 1g/kg feed of the combined probiotic as the optimal dose is recommended.

Keywords: probiotics, performance parameters, piglets

THE OCCURANCE AND EFFECTS OF AFLATOXIN IN NATURALLY CONTAMINATED COMPLETE FEED FOR FATTENING TURKEYS

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Aflatoxins are products of numerous fungi from *Aspergillus* genus. The most significant aflatoxin producers are *A. flavus* and *A. parasiticus*. Feed contamination can occur on field, at harvest or during postharvest operations as well as during the feed processing. Among poultry, ducks are the most sensitive to aflatoxins, followed by geese, turkeys and pheasants, while chickens show considerable resistance.

Five consecutive fattening cycles of turkeys that were fed with complete diet naturally contaminated with aflatoxin were included in one year study, from 2012 to 2013. The flock size was of approximately 2500 to 3000 turkeys. Clinical signs, pathological changes and flock performance, here presented, were diverse and correlated to aflatoxin level and bird age. The level of feed contamination widely ranged from below 10 µg/kg to over 47 µg/kg. In one particular flock, due to prolonged exposition and the highest level of aflatoxin, the cycle ended prematurely.

Keywords: aflatoxin, broiler turkeys, complete diet

MEAT QUALITY OF RABBITS AFTER ADMINISTRATION OF LANTIBIOTIC GALLIDERMIN

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The aim of this study was to test *in vivo* application of lantibiotic gallidermin in the model experiment using rabbits. The effect of gallidermin on selected parameters of meat quality was examined. A total of 48 weaned rabbits (35 days of age, both sexes) were divided into 2 groups (experimental - EG and control - C) with 24 animal in each group. Maternal albinotic line (crossbreed New Zealand White, Buskat Rabbit, French Silver) and paternal acromalictic line (crossbreed Nitra's Rabbit, Californian Rabbit, Big Light Silver) were used. The rabbits in group EG were administered 5µl of gallidermin per animal/day from day 1 to day 21 applied into the drinking water. On days 21 and 48, four animals from each group were slaughtered and samples were taken for testing. Meat quality was analysed from a 50 g sample of MLD for parameters characterizing the content of nutrients (content of water, proteins, fat, amino acids and fatty acids composition) and processing technology parameters (electric conductivity, pH, colour). Changes in amino acids and fatty acids content were statistically insignificant ($P > 0.05$). It was concluded that lean rabbit meat could be a high quality protein source due to its well-balanced essential amino acid composition. A positive influence of gallidermin on animal health was noted.

Keywords: rabbits, gallidermin, meat quality

INFLUENCE OF GRINDING METHOD AND GRINDING INTENSITY OF CORN ON MILL ENERGY CONSUMPTION AND PELLET QUALITY

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The aim of this research was to investigate influence of grinding method (hammer mill vs. roller mill, i.e. wide vs. narrow distribution of particle size) and grinding intensity of corn (coarseness of grinding) on mill specific energy consumption (SEC) and on pellet quality.

Grinding on roller mill resulted in more uniform particle size distribution (PSD) compared to hammer mill. As it was expected, increasing of grinding intensity significantly increased SEC of both hammer mill and roller mill ($p < 0.05$), while increase was more pronounced for the hammer mill. When comparing SEC for similar grinding intensity on hammer mill and roller mill (similar geometric mean diameter), SEC was higher for the hammer mill. Pellet quality decreased with coarser grinding on hammer mill but, surprisingly, this effect was not observed for the roller mill. Generally, pellet quality was better when roller mill was used compared to hammer mill and this was attributed to more uniform PSD of corn ground using roller mill.

From the obtained results it can be concluded that high energy savings of grinding process could be achieved by coarser grinding of corn before pelleting. But, from the aspect of pellet quality, if coarser grinding is applied it is better to use roller mill, concerning that more uniform PSD of corn ground on roller mill results in more uniform PSD in pellets and this provides better pellet quality.

Keywords: *grinding, energy consumption, pellet quality, poultry, corn*

CHALLENGES FOR EFFECTIVE FOOD/ FEED SAFETY CONTROL: ALL CONTAMINANTS IN A SINGLE RUN

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Rapid, simple and cost-effective analytical methods with performance characteristics matching regulatory requirements are needed for effective control of occurrence of multiple contaminants in food and feed to ensure its safety and consumers health. The most widespread contaminants of cereals, cereal-based foods / feedingstuffs, fruits and vegetables are mycotoxins, toxic secondary metabolites of microscopic filamentous fungi, and pesticides residues, substances being applied on agricultural crops to ensure the protection against various pests. Moreover, considering the herbs and herbal-based foods (dietary supplements), also pyrrolizidine alkaloids, as toxic secondary metabolites of some plant species, can be of concern.

Nowadays, the trend to develop methods covering as much contaminants as possible is followed. The generic extraction approaches (QuEChERS or "dilute and shoot"), followed by liquid chromatography separation coupled with high-resolution mass spectrometric detection (HR-MS), allowing retrospective non-target screening of the originally non-targeted analytes, is preferred. The first types of HR-MS analyzers, time-of-flight (TOFs) or orbitraps, providing the mass spectral resolution from 10,000 up to 100,000 FWHM, brought a huge benefit in terms of selectivity of detection. However, due to their inability to perform the specific ions fragmentation, achieving a sufficient number of identification points (as required by EC legislation / 2002/657 and SANCO / 12495/2011) was very difficult. Progress in the development of MS instrumentation, a new MS analyzer arrangement comprising the quadrupole (Q-TOF, Q-orbitrap), provided the possibility of acquisition of specific MS / MS spectra in high resolution mode, enabling the full compliance with the legislative required for official methods. During the presentation, various types of MS systems for analysis of multiple pesticides / mycotoxins / pyrrolizidine alkaloids will be demonstrated, and their potential will be critically assessed.

Keywords: *mycotoxins, pesticides, pyrrolizidine alkaloids, multi-method, liquid chromatography, mass spectrometry, food, feed*

THE INFLUENCE OF RUMEN ACIDOSIS ON CELL WALLS RUMEN DEGRADABILITY OF MINOR BYPRODUCTS FROM FOOD AND NON-FOOD PROCESSING OF PLANTS

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While the influence of low rumen pH on the rumen degradability of the main feeds is well established, data are missing for less known feeds, such as minor by-products. Seven underutilised by-products sampled from the Romanian feeds market (grape marc, grape peels, grape seeds meal, linseed meal, wheat germs meal, camelina meal, pumpkin seeds meal and poppy seeds meal) were studied in the context of a regular versus acidogenic diet, in order to determine the influence of a low rumen pH on their rumen degradability. Acidogenic diet consisted in high concentrate:forage ratio and a high starch content, having a fast rumen degradability.

Normal diet was associated with an average postprandial pH of 6.27, 3.1 hours of pH decrease below 6 and an intensity of pH decrease below 6 of 0.62 units, while the corresponding values for acidogenic diets were 5.78, 9.0 hours and 4.53 units, respectively.

The rumen degradability of the studied feeds was assessed through in situ method, followed by data fitting using Orskov model. Preliminary data showed no significant influence of low rumen pH on the dry mater degradability, while the cell walls degradability was overall decreased, although not systematically. It is concluded that the moderate decrease of rumen pH did not noticeably influenced cell walls degradability of the studied by-products.

Keywords: *rumen, acidosis, by-products, degradability, cell walls*

RUMEN DEGRADABILITY OF VARIOUS UNDERUTILIZED BY-PRODUCTS SAMPLED FROM THE ROMANIAN FEED MARKET

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Rumen degradability of 14 samples of less known and underutilized by-products collected from the Romanian feed market was assessed using in situ method, based on nylon bags incubations. These by products were obtained from the winery industry (grape marc, grape peels, grape seeds meal) and oil extraction (linseed meal, wheat germs meal, camelina meal, pumpkin seeds meal and poppy seeds meal) and were chosen on the basis of their occurrence on the Romanian feed market, opportunity to be used in ruminants' diets and scarceness of rumen degradability data.

Dry mater rumen degradability of winery products varied from 23.6 to 32.9%, whereas that of the protein meals varied from 61.4 to 81.1%. The indicators expressing the rapidly degradable fraction (a), slowly degradable fraction (b), as well as the hourly rate of degradation (c) varied more, both for winery by-products (7.0-23.9%, 14.5-26.8% and 3.6-11.1%, respectively) and protein meals (32.9-74.6%, 12.2-58.2% and 5.2-8.8%, respectively). Nitrogen degradability showed similar trends.

Although literature data on the rumen degradability of the studied by-products is rather scarce, some comparisons could be made, allowing assessment of Romanian feeds: while DM degradability of grape marc was similar to literature data, those of pumpkin seed meal and wheat germ meal were lower while the values for poppy seed meal and linseed meal were higher.

Keywords: rumen, degradability, by-products

KEEPING FOOD LOSSES IN THE FOOD CHAIN THROUGH ANIMAL FEED

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Food waste is a topic that keeps attracting more and more attention all around the world, both socially and politically. Processing former foodstuffs into animal feed is a typical example that fits perfectly in a circular economy as it helps to reduce food waste by keeping food losses in the food chain through food producing animals, albeit under strict conditions that respect EU regulation as regards safety and traceability. Energy-rich former foodstuffs with a high nutritional value like biscuits, bread, crisps and chocolates provide feed manufactures with an alternative feed material source comparable to grains in their compound feed formulations. In addition, using former foodstuffs in animal feed it also offers food producers a sustainable outlet for the foodstuffs they consider no longer suitable for human consumption.

Former foodstuff processors have to cope with a legislative framework that causes many challenges as legal definitions for the status of former foodstuffs not qualifying as a waste product and technical solutions for packaging residues are not equally enforced throughout the EU, despite the fact companies operate internationally in a single market. Also, EU legislation restricting the use of ruminant gelatine in animal feed and subsidising of bioenergy producers prevent former foodstuff processors from unlocking their full potential as regards reducing food waste. EFFPA represents the sector at European level and insists on facilitating the integration of former foodstuffs into the feed chain and calls for recognition of the important role the sector plays in reducing food waste.

Keywords: *former foodstuffs, food waste, animal feed, circular economy*

**INNOVATION, KNOWLEDGE AND TECHNOLOGY TRANSFER:
CIFAR AS A UNIVERSITY-INDUSTRY MODEL OF GLOBAL
COLLABORATION FOR DEVELOPMENT OF FOOD AND FEED**

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Food and feed and their ingredients are sourced today from every part of the world. Thus, 'connecting the dots' is paramount to the delivery of safe, nutritious, and sustainable ingredients to global consumers. The California Institute of Food and Agricultural Research (CIFAR) at the University of California, Davis, USA was founded to foster a sustainable relationship enhancing business and scientific exchange. It serves as a forum for engaging innovation, facilitation, and distribution of new technologies thereby, enabling this process, maximizing the value and utility of the entire production system. Its globally recognized Food Foresight report and Global Action Platform will be presented to illustrate some challenges and new opportunities for food and feed in a world where natural resources are becoming more scarce and where peoples needs and wants are becoming more demanding. Particular emphasis in this presentation will be given to advances in enzyme and microbial technologies that now and in the future have impact on our food and feed systems.

THE INFLUENCE OF PIG DIET ENRICHED WITH n-3 POLYUNSATURATED FATTY ACID ON FATTY ACID COMPOSITION IN MEAT

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The aim of this study was to determine the influence of pig diet enriched with n-3 polyunsaturated fatty acids on fatty acid composition in meat. All pigs included in this investigation were of the same genetic origin and initial weight. Control group (C) was fed with standard mixture for pigs, while experimental group (E) was fed with the same mixture but with the addition of extruded flaxseed rich in polyunsaturated fatty acids. Fatty acid composition in meat was investigated on *M. semimembranosus* (SM) and *M. longissimus dorsi* (LD).

Most prevalent fatty acid was oleic acid (C18:1 n-9) ranging from 43.30 % (LD, E group) to 49.75 % (SM, C group). The content of alpha-linolenic acid (ALA, 18:3, n-3) varied from 0.22 % (SM, C group) to 1.26 % (SM, E group) and was higher in experimental group compared to the control group.

In SM PUFA/SFA ratio was above WHO/FAO recommended value, but higher in group fed with the addition of extruded flaxseed rich in polyunsaturated fatty acids, while in LD was lower than recommended values in both groups.

Content of n-3 fatty acids was higher in the experimental group compared to control group for both muscles. In SM this content in the experimental group was 3.18 times higher than in control group, while in LD this ratio was 2.32.

In present study n-6/n-3 ratio was higher than recommended and ranged from 8.16 (LD, E group) to 25.60 (SM, C group). Both muscles (SM and LD) from experimental group had lower n-6/n-3 ratio compared to muscles from control group.

Based on the obtained results it can be concluded that the use of a well-balanced diet enriched with n-3 polyunsaturated fatty acids resulted in the functional pork or pork with modified fatty acid composition, i.e. meat with a higher content of n-3 fatty acids and better n-6/n-3 ratio.

Keywords: pig diet, pork meat, fatty acid composition

FATTY ACID COMPOSITION AND MEAT QUALITY TRAITS OF BROILER CHICKENS FED A DIET FORMULATED WITH FLAXSEED CO-EXTRUDATES

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The aim of this work was to investigate the influence of diet supplemented with flaxseed co-extrudates on quality and fatty acid composition of chicken breast meat. Broiler chickens were fed a mash diet, a starter until 21 days and finisher diet, until slaughter at 35 days of age. Two diets, control (C) and flaxseed (F), were assessed with the aim of increasing the content of n-3 polyunsaturated fatty acids and evaluating their influence on proximate composition, technological and sensory properties of breast meat. The F diet was formulated with two types of co-extrudates (5%), flaxseed-soybean meal (starter diet) and flaxseed-sunflower meal (finisher diet). 120 broiler chickens were assigned to each diet. The use of F diet did not influence significantly ($P < 0.05$) the technological parameters of breast meat. On the other hand, it enhanced the α -linolenic (ALA) (7.76% vs. 3.54%), EPA and DPA (EPA+DHA, 0.45% vs. 0.29%) fatty acids content in meat and drastically reduced the n-6/n-3 ratio (9-4). Sensory attributes of roasted breast meat samples were negatively affected by supplementation with flaxseed co-extrudates.

Keywords: *breast meat, flaxseed, co-extrudates, fatty acids*

ELECTRONIC NOSE IN COMMERCIAL PET FOOD EVALUATION

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The electronic nose sensor technology may represent a powerful tool in food and feed industry providing real time evaluation of quality and safety.

The aim of this study was to evaluate the potential use of the electronic nose in pet food analysis. Twelve samples of commercial dry complete dog and cat pet food were used. In particular, the real potential of the electronic nose to discriminate 1) the concerning species (dog vs cat), 2) the pet food type (complete and balanced vs dietetic) and 3) the ingredient composition from label was evaluated. Each sample was tested in glass vials and the odour profile was determined by the 10 MOS (metal oxide semiconductor) sensors of the electronic nose PEN 2. Ten different descriptors, representing each sensor of the electronic nose, were used to characterise the odour of each sample. Data were analysed by Principal Component Analysis and Discriminant Analysis procedures using the Statgraphics Centurion XVI software. All analyses showed that the data variability was explained by the two first principal components (corresponding to two electronic nose sensors: W1A-aromatic and W5B-broadrange) and was enough to explain more than 83.97% and 97.07% of total variability in odour pattern for PCA and DA, respectively.

In the present study, the electronic nose did not correctly classified both categories dog and cat pet food and complete and balanced pet food, since two cat samples clustered close to dogs ones. By contrast, when dietetic pet food were considered, dog and cat samples were correctly classified. Pet food samples were not correctly classified according to the different ingredients reported in their label. Even though further studies using a wider set of samples are needed, results herein presented suggest that electronic nose can represent an effective tool in pet food industry in providing effective information about different formulated pet food and standardization of the aroma.

Keywords: *electronic nose, pet food, PCA, DA, feed analyses*

USE OF SOY CONCENTRATES IN ANIMAL NUTRITION

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Today, animal nutrition cannot be imagined without the use of soy products in the preparation of animal feed and the development and emergence of new soy products on the market. In animal nutrition, Soy Protein Concentrates (SPC) are ranked among the top products in the soy processing system. SPC has considerably higher nutritive value composed to soybean meal and are characterized by a lower level of oligosaccharides (<39 and antigen factors (<100 ppm of glycinin). SPC are a cost effective alternative for high-quality proteins of animal origin such as skimmed milk, powder of fish flour in the nutrition of calves, pigs, chickens, pets etc. The present study investigated the effect of use of SPC in broiler, piglets and dairy cows feeding. In broiler feeding trial conducted in "Perutnina Ptuj" in Melenci, soybean meal was replaced with SPC in the second, the third, and the fourth period with 19, 2, 17, 1 and 15, 3% respectively. Based on obtained results, it can be concluded that there was no statistically significant differences ($P < 0,05$) between values of the production performances but feed consumption and feed conversion ratio was lower for the group fed with diet containing SPC. Chickens fed with addition of SPC had higher values of live mass, chilled carcass mass as well as mass of selected anatomical parts. The price of the experimental diet was lower compared to price of control diet for the feeding periods in which large quantity of feed was consumed (3rd and 4th feeding period), although the price of the SPC is high. Feeding trials with piglets were performed at farm "Kotlenik promet" in Lađevci. The animal feed for the experimental group included 17% of SPC in the first part of the feeding trials and 14% of SPC, in the second part. Feed consumption for kg weight gain was 6% lower in the experimental group, which favors better utilization of protein from SPC. The third trial was aimed to determine the effect of SPC TRADKON 75 in diets of dairy cows in early phase of lactation housed on modern dairy farm. Experimental group received additional 2.5 kg of SPC daily, which increased the milk production by ~ 6.3 l of milk per cow and first 100 days of lactation they produced 15% higher yield compared to the control group. Taking this fact into consideration, it is expected that the experimental cows produce a total of 1,500 liters of milk per year more, than the cows which did not receive soybean concentrate in the diet.

Keywords: *soybean concentrate, feed, broilers, piglets, dairy cows, production performances*

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