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NUTRITION

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16th European Symposium on Poultry Nutrition

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Session I
Nutrition: an integrative tool from plants to poultry biology

Invited papers

Short communications

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Session III
Nutrition and Health

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Posters

Short communications

Posters

Session I
Nutrition: an integrative tool from plants to poultry biology

Invited Papers

Evaluation of Raw Materials for Poultry: What's up?

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Approximately three quarters of the feed costs are represented by costs for dietary energy. Therefore, an accurate estimate of the energetic value of raw materials is extremely important to reduce the price of poultry feed. The quality and composition of raw materials, especially by-products, can be highly variable. Inclusion rates of by-products are expected to increase due to the use of cereals for biofuel production. This implies that energy from starch in poultry diets will most probably be maximally exchanged for fat. Therefore, a correct estimate of the extra caloric value of fat is essential. In poultry, several systems are used like the Apparent and True Metabolizable Energy (both corrected for zero nitrogen balance) values and the Net Energy value. Evaluation systems are compared. Currently, most tabulated values are based on adult cockerels of broilers and effects of animal species and age are discussed.

Breeding for feed efficiency and adaptation to feed

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Physiological origins of variations in feed efficiency were first reviewed on the basis of energy balance principles, and effects of genetics on energy balance parameters were recalled from literature data. Effects of diet composition on responses to genetic selection were considered by focusing on three feed factors: protein concentration, energy concentration and utilisation of specific ingredients. Analyses of effects of genetic selection on responses to diet composition highlighted the problems associated with the increased protein concentrations needed by genetic selection. Interests and disadvantages in producing lean birds were discussed on the point of view of feed efficiency and adaptations to feed variations. Lastly, the problems of lowered digestibilities resulting from broiler selection were discussed.

Which perspectives for nutrigenomics in poultry production?

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The term nutrigenomics is about understanding how nutrients can impact on gene expression and how the genotype of an individual can impact on its susceptibility to nutrients. For poultry production, the move toward using less and less pharmaceutical substances justifies finding natural alternatives to incorporate in bird's diets to improve animal's health and tissue composition. Also, the large variety of available genotypes sets the need for further characterization of their nutritional requirements to achieve their full potential. The objective of the paper is to present some of the available technologies and their possible use based on studies conducted in model organisms or in poultry when available.

For the identification of the effects of nutrients on poultry physiology several approaches can be considered at transcripts (transcriptomics), protein (proteomics) or metabolite (metabolomics) levels. The full interpretation of such data requires analysing large sets of data, in terms of number of animals, diet compositions, time course and therefore requires sophisticated computational approaches to identify groups of co-regulated genes or metabolic pathways. To identify mutations linked to metabolic susceptibility, the challenge is to submit resource populations to nutritional trials measuring a large set of metabolic and health parameters on birds which will be individually typed for large sets of polymorphic markers.

The overall challenge is to integrate data coming from these different levels of information, build appropriate model for their interpretation and finally to predict the consequences of changing diet composition on poultry production.

Short Communications

Variability of Dietary Energy of Shea Nut (Vitellaria paradoxa) Meal for Poultry

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Shea nut meal is obtained after fat extraction from shea nuts in West Africa. The objective was to determine the effect of three dietary levels of different shea nut meals on metabolisable energy. Six shea nut meal samples produced in 2004 and 2005 [i.e. 4 industrial (expeller), 2 non-industrial (water-based extraction)] as well as two defatted samples (one of each type of shea nut meal) were fed at 3 dietary levels (0, 20, 40 g/kg) to 180 Ross 308 male broiler chicks (12-20 d). All droppings (last 4 days) were collected, dried and their gross energy (adiabatic bomb calorimeter) determined. ANOVA of data and orthogonal contrasts (GENSTAT) were used to compare the treatment means. Dietary level had significant ($P<0.01$) non-linear effect on apparent metabolisable energy (AME) with the 40 g/kg level giving a lower AME. However, this effect was not evident ($P>0.05$) for the two defatted samples. There was an interaction ($P<0.05$) between the shea nut meals and dietary level. There were no significant ($P>0.05$) differences between the industrial and non-industrial samples, samples containing fat and defatted samples, nor samples produced in 2004 and 2005 in determined AME. Removal of fat from the meal tended ($P>0.05$) to improve AME.

Influence of Caeca Microflora and Tannin on True Amino Acid Availability in Grain Sorghum Cultivars

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This study was conducted to determine caeca micro flora and tannin effects on amino acid availability (AAA) values for different grain sorghum cultivars (GSC). Three GSCs including low tannin (0.09%, LTS), medium tannin (0.19%, MTS) and high tannin (0.37%, HTS) were selected to determine AA availability compare to the corn by using the true metabolizable energy (TME) assay with both intact (INT) and caecectomized (CEC) roosters. The results showed that true AA availability (TAAA) of LTS was high (95%) whereas, corresponding value for MTS (82.7%) and HTS (41.6%) was significantly lower ($P < 0.05$). The correlation between tannin and availability of all of the AAs was negative and significant ($r > -0.78$, $P < 0.001$). However, the availability of proline was the most affected by tannin, which was 93.4% for LTS, 77.6% for MTS and 18.4% for HTS. The influence of caeca micro flora on AAs availability was found to vary between corn and GSCs and among different AAs. For the corn, CEC rooster exhibited lower AAs digestibility coefficient than INT rooster. In contrast, corresponding value for the GSCs in CEC rooster was higher than INT rooster.

Origins of Variation in Pea (Pisum sativum L.) Protein Digestibility in Poultry

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Origins of variation in pea protein digestibility in the chicken were studied and an in vitro hydrolysis assay was evaluated to select varieties. Eight pea genotypes were selected for their difference in seed protein content and composition. These genotypes varied also in other seed components (carbohydrates, trypsin inhibitor (TI)). After dehulling and micro-grounding, the pea meals were incorporated as the only protein source in isoproteinaceous and isocaloric diets. Amino acid (AA) digestibility was studied in cecectomized chickens. Apparent digestibility (AD) was measured by balance method. True digestibility (TD) and endogenous losses (Endo) were determined after a meal with 15N-labelled peas. Data were subjected to analysis of variance, and compared using Student-Newman-Keuls test($p<0.05$). The 8 diets showed an average AD for all AA varying between 79.5 and 86.3% (Table). This digestibility was negatively correlated with insoluble fibre content and TI activity. These differences in AD can be explained by the differences in Endo and in TD of pea proteins. Endo varied among genotypes between 3.6 and 5.4% of ingested AA (Table). They were positively correlated with soluble carbohydrate content and TI activity. The TD varied among genotypes, between 84.4 and 90.2% (Table). It was correlated with major protein fractions. These results emphasize the need for a characterization of the two components of AD, for a better understanding of the sources of digestibility variation, and a more effective selection of improved genotypes. This selection of genotype of high TD potential may be performed using an in vitro hydrolysis method involving first pepsin then trypsin and chymotrypsin.

Table . Amino acid digestibility (apparent, true) and endogenous losses of the 8 pea genotypes

Genotypes	Apparent digestibility (%) [1]	Endogenous losses (%) [2,3]	True digestibility (%) [2]
Cbina	81.4 [ab]	5.11 [a]	84.4 [ab]
Finette	86.0 [a]	3.99 [b]	90.2 [a]
Sommette	83.8 [ab]	3.94 [b]	89.7 [a]
Caméor	86.3 [a]	4.02 [b]	88.5 [a]
VavD265	83.0 [ab]	3.64 [b]	87.2 [ab]
Prédamex	85.8 [a]	4.28 [b]	89.4 [a]
E344	81.9 [ab]	4.15 [b]	84.8 [a]
Ballet	79.5 [b]	5.41 [a]	87.3 [ab]
SEM	1.17	0.218	0.79

[1] Average of 17 aa (Ala, Arg, Asp, Cys, Glu, His, Ile, Leu, Lys, Met, Phe, Pro, Ser, Thr, Trp, Tyr, Val) ; [2] Expressed in percent of amino acid ingested by pea fed birds ; [3] Average of 9 aa (Ala, Asp, Ile, Leu, Lys, Phe, Pro, Thr, Val)

Whole oats in broiler diets

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Whole wheat feeding is common practice in broiler production in many countries, but less interest has traditionally been given to inclusion of other whole cereals. Oats are generally not included in broiler diets due to its relatively low energy content in relation to the price. However, oats have beneficial properties such as a high protein content and quality, a good fatty acid composition and high contents of minerals, vitamins and antioxidants. In layers, oats inclusion has shown beneficial behavioural effects such as less feather pecking.
The present trial comprised 40 groups of 8 broilers, each group designated to one of four dietary treatments. From 7 days of age, whole cereals (100 % wheat/0% oats, 90 % wheat/10 % oats or 75 % wheat/25 % oats) were included in the diet at 10 %, gradually increasing to 50 % from 30 days. At 34 days, live weight, feed conversion ratio or feed intake did not differ between diets, despite the lower ME content in the oats supplemented diets. No differences in slaughter yield, total carcass fat or abdominal fat were found, and health was over-all good. These results indicate that oats possess interesting properties, not calculated for in traditional feed formulation.

Posters

Effect of Various level of canola Meal on Morphology of thyroid Gland in Broiler Chicks

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The present study performed to examine Canola meal on morphology of thyroid gland in broider chicks. In this experiment 300 1-d-old ross308 mixed sex broiler chicks assigned into 5 groups. The chickens were fed by five level of canola meal (0, 5, 10, 15 and 20%). Chickens fed from each day 1 to 42. After 42 days four chicks from each pen killed and their thyroid glands removed and immediately were immersed in formaldehyde, before fixation in Bouin's solution and paraffin embedding. Each sample was then sectioned at a thickness of 7μm, stained with haematoxylin and eosin, and examined by light microscopy. Measurements of diameter of follicles, epithelial cell number and epithelial cell height in all groups were made at 100 to 400x magnification. The data were analyzed through ANOVA by SAS package and mean of different treatment were compared by Duncan's multiple test. Diameter of follicles, epithelial cell number and epithelial cell height in treatment group (3, 4 and 5) were significantly increased as compared with control group (treatment 1) ($P<0.01$). These results shown that although glucosinolates in canola or double-Zero rapeseed is very low, but canola meal can be affected on morphology of thyroid gland in broiler.

The effect of different levels of surplus date in Layer performance

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One hundred forty-four 26-wk-old White Leghorn Layers (W-36)were fed commercial diets containing 0, 1.5, 3, 5% surplus date for three period of each 28 days in order to study the effects of feeding surplus date on hen performance (egg production, egg weight, egg mass, feed intake, feed conversion ratio (FCR) and weight gain) and egg quality parameters (Hough unit score , yolk colour index, yolk index, egg shape, shell weight, shell thickness and density). The yolk of eggs extracted and cholesterol content were determined in each period. Blood samples were collected in non-heparin zed tubes from six hens in each treatment by puncturing the bronchial vein in end of experiment and serum was collected after 8-10 hrs as per standard procedures and was stored for subsequent analysis. Hen performance (egg production, egg weight, egg mass, feed intake, FCR and weight gain) and egg quality parameters (Hough unit score, yolk colour index, yolk index, egg shape, shell weight, shell thickness and density) were not significantly ($p<0.05$) different between treatments; However in all traits the hens which were fed 0% surplus date had numerically lower value. The mean egg cholesterol and cholesterol content of yolks were not significantly ($p<0.05$) different between treatments. However hens which were fed 5% surplus date had numerically lower value. There was significantly difference ($P<0.05$) in serum cholesterol content. The 5 percent date level showed lower cholesterol content (129mg/dl), which it was non-significant difference with 3 % date level(155.3 mg/dl) however it was significant with 0.0(178 mg/dl) and 1.5(169.3 mg/dl) date levels.

Key words: date; cholesterol; egg quality; layer; egg production

The Effects of Dietary Biological Fish Silage on Performance and Egg Quality of Laying Japanese Quails (Coturnix coturnix japonica)

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An 8 week experiment was conducted to evaluate the effects of biological fish silage supplementation in laying Japanese quails diets on performance and egg quality. A total of 120, 60 d-old laying japanese quails were allotted in a randomized experimental design with four treatments (Controls, 2, 4 and 6% of biological fish silage), with five replicates and 6 birds per replicate .Diets were formulated to meet or exceed NRC recommendations Feed and water were supplied ad libitum and light was scheduled for 16 hours of light and 8 hours of dark each day. Feed consumption was measured weekly and feed conversion was calculated. Laying percentage, egg weight, and egg mass were recorded daily during 8 to 16 wk of age. Random samples of 8 eggs from each treatment were collected weekly to measure egg quality: such as, eggshell thickness, Haugh units, egg specific gravity, and yolk percentage. Productive parameters such as feed intake, , egg weight, , feed efficiency, body weight variation, and egg mass were not affected ($P>0.05$),only egg production was affected ($P<0.01$) by treatments. Egg quality parameters were no affected ($P>0.05$) by dietary treatments. Results obtained indicate that biological fish silage can be included in laying diets of Japanese quails up to 6% without adverse effects.

Improving the Use of Bioethanol By-products in Monogastric Feeding

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Eighteen DDGS samples (8 wheat DDGS and 10 corn DDGS) were obtained from 6 different countries. Each sample was analysed for proximate and total amino acids (TAA) and evaluated for true ileal amino acid digestibility (AAD) using caecectomized cockerels. Wheat DDGS were classified as low and standard whereas corn DDGS showed an additional high protein type. Important variations were observed among the total lysine and threonine of the wheat DDGS and among all total amino acids of the corn DDGS with the exception of total cystine. Both wheat and corn DDGS showed low lysine digestibilities (38 and 62%) and low cystine digestibilities (56 and 64%) associated to high variations. Original cereals, processing conditions and disposition of solubles, could explain the variations. The potential of NIRS (Near Infrared Reflectance Spectroscopy) was also investigated. The feasibility study show that the NIRS calibrations explain more than 95 and 80% of the variation respectively for TAA and DAA (with the exception of tryptophan digestibility, R2=0.66). Accuracies associated to the models varied from 2 to 6% (excepted for DLys, 9%). These encouraging results indicate that this tool is promising for the prediction of the nutritional variability measured among DDGS.

Effects of different levels of kidney bean on performance broilers chicks

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One tube-feeding experiment according to (sibbald, 1976) was designed to determine the nitrogen (N) digestibility and true metabolizable energy (TME) of raw kidney bean in cockerels (four cockerels/treatment).Test material in tube-feeding experiment was untreated raw kidney bean. Results of tube-feeding experiment indicated that apparent metabolizable energy corrected for nitrogen (AMEn) was 2135 Kcal/kg and apparent nitrogen digestibility was 866.2 g/kg. According to tube feeding results one growth experiment was carried out to evaluate the effects of inclusion of different concentrations of raw kidney bean in broiler chick performance, breast, abdominal fat, pancreas, liver and gizzard weight. Experimental diets were based on soy bean meal (control diet) which was replaced by (0, 10, 20 and 30%) of raw kidney bean and fed for a period of 42 days. A total of 320 week-old male broiler chicks from Ross 308 strain were fed on one of four diets, following a completely randomized design. All diets were isonitrogenous and isocaloric. Feed and water were offered ad-libitum during the experiment period. Over all live weight gains and feed intakes of diet containing 10% raw kidney bean was similar to control diet ($P>0.05$). Results from this study indicated that up to 10% inclusion of raw kidney bean could be recommended for practical diet formulation. Keywords: kidney bean; broiler; performance

The impact of heating procedures varying in duration and oxygen supply on the MEn-value of lard and soybean oil for broiler chickens

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In highly concentrated broiler diets, the MEn-contribution of dietary fat into the total dietary MEn-content may, however, vary widely, thereby depending on many factors : bird physiology, dietary inclusion level and fat quality (fatty acid profile, %-elution degree, oxidation, oeand interactions). The aim of this research was to determine the impact of heating procedures varying in duration and oxygen/nitrogen-supply on the MEn-value of lard and soybean oil included at a dietary concentration of 4 and 8% in a low fat broiler diet. The balance trial was carried out according to the European Reference Method. The MEn-values of the target component "fat" were calculated by difference in MEn between basal diet and the respective supplemented diets, thereby assuming additivity. There was a very significant effect of heating on fat composition, with a decrease in elution degree (as a measure for intact fatty acids) and U/S-ratio (as indication for the fatty acid dependent heat stability). The changes were more pronounced for soybean oil (vs lard) and air (vs N2-gas) supply. The multifactorial ANOVA showed a very significant effect of fat type, heating procedure and dietary inclusion level on MEn-value of the fat, with a lower MEn-value (1) for lard (vs soybean oil), (2) at higher dietary inclusion level (8 vs 4%), (3) with advancing heating duration and (4) with higher oxygen (vs N2-gas) supply.

Application of short fasting methods to induce molting in commercial laying hens

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One experiment was conducted to evaluate if induced molting methods using short fasting intervals can be satisfactory replaced for continuous feed removal. One hundred and eighty Hy-line W36 layers were randomly allocated to four treatments according to equal body weight in a completely randomized design. Treatments were: 1) continuous feed removal until 30% body weight reduction, then feeding ad libitum on a commercial layer diet as a control, 2) fasting for 3d followed by feeding at libitum a diluted commercial layer diet with ground, delinted, whole cotton seed (65% layer diet : 35% whole cotton seed), 3) fasting for 3d, then fed freely a 91% corn middling diet plus 9% vitamin and mineral supplements for 25d, and 4) fasting for 3d, then fed freely a 91% wheat middling diet plus 9% vitamin mineral supplement for 25d. The experiment was lasted 5 months consisting of 1mo molt period and 4mo postmolt period. The results indicated that T1, T2, T3, and T4 were respectively lost 32.5, 24.5, 5.05 and 9.1% of their initial body weight after 14 days of induction of molt and these differences were significant ($P<0.05$). At Day 20 in molt, ovary and oviduct weight regression were considerably lower in short fasting methods compared to continuous fasting. There were no significant differences with respect to postmolt egg production feed conversion ratio, egg shell strength and egg shell thickness.

Replacement of canola meal for soybean meal in female broiler diets with and without enzyme supplementation

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Three hundred and sixty female broiler chicks (Ross 308) were used in an experiment starting from 6 days of age and ending at 49 days of age. Experimental treatments were 5 substitution levels of canola meal (CM) for soybean meal (SBM) (0, 25, 50, 75 and 100%) with or without enzyme supplementation. Enzyme mixture (Endofeed®) contained ß-glucanase and xylanase activities and was added at 400g per ton of diet. Data were analyzed in a completely randomized design in a 2*5 factorial arrangement. The results showed that body weight gain and feed intake were significantly ($P<0.05$) affected by substitution level during the starting period but not during the growing and whole periods. The effect of enzyme and interaction of substitution level and enzyme supplementation were not significant during the entire experiment. The complete (100%) replacement of CM for SBM resulted in the best feed conversion ratio (FCR). Carcass yield and percentages of breast and liver were not significantly affected by main effects and their interaction. However, abdominal fat deposition was reduced by inclusion of CM instead of SBM ($P<0.05$). Plasma alkaline phosphatase activity and T3 and T4 hormone concentrations were not affected by main effects and their interaction.

Effect Enterococcus Faecium 2NF8001 Administered in Water on the Rearing Performances and the Gut Microflora in Free Range Chickens

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Two autochtonous free range chicken population was used, the Hungarian Yellow and the Speckled Transylvanian Naked-neck breeds.The probiotic treatment was given through the water until 12 weeks of age. The two phased feeding program included 0-4 weeks starter diet with 12,3 MJ/kg ME and 20% crude protein, 5-12 weeks grower diet with 11,9 MJ/kg ME and 19% crude protein level. Birds from the treated groups received 0,01g / l dietary water supplementation of dehydrated Enterococcus faecium preparate containing 4 x 1011CFU/g. At the age of 1,2,3,7,12 weeks ileum samples were taken for microbiological examination from each groups in order to assess changes in the microbial population of Lactobacilli (MRS), D-Streptococci (Slanezt.Bartley) as eubiotic microbiota and Coliforms (McConkey) as secondary flora. Important and statistically singificant difference was found in the mortality over the whole trial. In the Speckled Transylvanian Naked-neck breed the mortality of the control group was 12,91% while it was 5,41% only in the treated group. As the analysis of the bacterial population in the ileum, there were no noticeable differences in the tendency of log CFU values of the Lactobacilli, D-Streptococci and in the log CFU Coliform/Lactobacillus ratio between the groups and treatments.

Influence Of Methodology On The Determination Of Ileal Amino Acid Digestibility In Cereals And Grain Legumes For Broilers

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The apparent ileal amino acid digestibility coefficients in two cereals (maize and wheat), two grain legumes (sweet lupin and peas) and soybean meal for broilers were determined using direct and substitution assay methods. In the direct method, the test ingredient served as the sole source of dietary protein. In the case of maize and wheat, assay diets contained 93.8% of the test ingredient. For lupin, peas and soybean meal, assay diets were based on dextrose and the test ingredient to supply 20% dietary crude protein. In the substitution method, assay diets were formulated by substituting the cereals and legumes for 50 and 25% (w/w), respectively, of a maize-soy basal diet. For soybean meal, the digestibility values determined for most amino acids with the direct method were similar ($P>0.05$) to those determined with the substitution method. In general, for the cereals and legumes, the digestibility values determined with the direct method were numerically lower than those determined with the substitution method, although the differences were significant ($P<0.05$) only for some amino acids. These results suggest that the use of direct method may underestimate the apparent ileal digestibility of amino acids in low and medium protein ingredients.

Additivity Of Apparent And True Ileal Amino Acid Digestibility Coefficients In Complete Broiler Diets

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The additivity of apparent and true ileal amino acid digestibility values in three complete diets based on maize (M), wheat (W), rice bran (RB), soybean meal (SBM) and canola meal (CM) for broilers was investigated. The three complete diets contained the following as the main ingredients: M + SBM. W + SBM and M + RB + SBM + CM. Endogenous amino acid flow was determined using the enzyme hydrolysed casein method and used to calculate the true digestibility values. Additivity was tested by comparing the differences between the determined digestibilities of ingredient combinations and the predicted values from measurements with individual ingredients. In general, for both apparent and true digestibilities, there were no significant differences ($P > 0.05$) between the determined and predicted values in the M + SBM diet. In the W + SBM diet, the determined and predicted true digestibility values were similar ($P > 0.05$), but the determined apparent digestibility values were higher ($P < 0.05$) than predicted values for some amino acids, including threonine, leucine, isoleucine and valine. In the M + RB + SBM + CM diet, the determined and predicted true digestibility values were similar ($P > 0.05$), but the determined apparent digestibility values were higher ($P < 0.05$) than predicted values for most amino acids. The present results indicate that apparent digestibility values of individual ingredients are not additive when ingredients with low amino acid digestibility and/or anti-nutritive factors are used in feed formulations. This finding may be related, in part, to the limitations in the methodology used in digestibility bioassays for the cereals. The data also suggest that true digestibility values are additive and digestible amino acid supply in a complete diet can be predicted from true digestibility coefficients of individual ingredients.

Bioavailability of Zinc Sources in Chickens determined via real time Polymerase Chain Reaction (RT-PCR) assay for Metallothionein

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Tissue zinc is used to define zinc availability, but deposition is far from the absorption site and only a fraction of absorbed zinc is deposited. Alternatively, zinc availability may be defined by quantifying expression of specific zinc-responsive genes in the small intestine. Metallothionein (MT) protein binds zinc and its mRNA expression is reported to reflect zinc status. A real time polymerase chain reaction (RT-PCR) assay was developed to measure MT mRNA expression in chickens fed titrated levels or sources of zinc. MT was inducible by zinc in small intestine, liver and kidney. Broilers were fed a zinc-deficient milo-soy diet for 20 days, then were provided an unsupplemented corn-soy basal diet or the basal with 70ppm zinc from zinc oxide (ZO), a zinc amino acid complex (ZAAC) or MINTREX® Zn. Jejunum scrapings were collected after two days and assayed for MT expression. ZO and ZAAC failed to induce MT expression significantly above the basal. Birds fed MINTREX Zn exhibited MT expression significantly greater than all other treatments, suggesting that MINTREX Zn is more bioavailable than ZO or ZAAC. Subsequent commercial trials with reduced (50%) mineral inputs via MINTREX support equal live performance.
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Effects of Diet Particle Size on Digestive Parameters in D+ and D- Chicken Lines Selected for Divergent Digestion Efficiency

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The experiment aimed at studying the effects of diet particle sizes in the D+ and D- genetic lines selected on divergent digestion efficiency. The effect of diet particle size was investigated by testing a "S" Standard pelleted diet (maize/soybean starter diet), a "H" Hull pelleted diet (S diet diluted with 7% coarse cereal hull) and a "C" Coarse diet (the "S" diet distributed as 30% coarsely crushed maize and 70% remaining part as pellets). Interactions were observed between diet and line for gain:feed ratio (7 to 20 d), AMEn (20 to 23 d), and [measured AMEn:calculated AMEn] ratio (20 to 23 d). Gain:feed ratio (7 to 20 d) decreased with Coarse and Hull diets for D+ chickens, whereas there was no diet effect for D- line. Digestion efficiency assessed by the [measured AMEn:calculated AMEn] ratio was improved in D- chickens fed with the Coarse and Hull diets compared to the Standard diet, while it remained the same for all diets in D+ chickens. Independently of the diet, gizzard and pancreas were heavier, and intestine was lighter in D+ line compared to D-. Within both genetic lines, the relative weight of gizzard and pancreas increased with the Coarse and Hull diets.

Effect of crimped barley on the performance of broiler chickens

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The effect of crimped or ensiled barley (CB) on the performance and digesta viscosity of broilers was examined in a 38-day experiment. Broilers (2,880 Ross 508) were fed experimental diets from day 10 to 37. Diets consisted of a compound mixture for wheat (CMW) or for barley (CMB) and grains, 50% of diet dry matter (DM) from both. Treatments were: CMW 50% + dried whole grain wheat 50% (control); CMB 50% + dried whole grain barley (B) 50%; CMB 50% + B 37,5% + CB 12,5%; CMB 50% + B 25% + CB 25%; CMB 50% + B 12,5% + CB 37,5%; CMB 50% + CB 50%. Data was analysed using the GLM procedure of SAS. Broilers fed B and CB diets had higher ($p<0.001$) growth rates and DM intakes compared with the control. DM intake decreased linearly ($p<0.001$) and feed conversion ratio based on DM was improved linearly ($p<0.001$) with increases in dietary CB. Digesta viscosity decreased linearly ($p<0.01$) with increases in dietary CB at 21 days, but was not affected by diet at 37 days of age. Litter DM content decreased ($p<0.05$) with increases in dietary CB. Results indicate that CB is a suitable feed ingredient for broilers.

Energy value of wheat-DDGS in adult cockerels and growth performances of broiler chickens

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With ethanol production development in Europe, volumes of wheat dried distillers grains with solubles (w-DDGS) available for animal nutrition are going to increase. Two experiments were carried out in order to study the nutritional value of two w-DDGS batches produced in two different French bioethanol plants. In a first experiment, the energy value (AMEn) of two w-DDGS batches (A and B) was measured in adult cockerels. In a second experiment, we measured the effect of the introduction of 10 and 20% of w-DDGS (B) on the growth performances of broiler chickens. In the first experiment, the AMEn measured were 11.2 and 10.6 MJ/kg DM, respectively for w-DDGS A and B. The results of the second experiment showed that 10 and 20% of w-DDGS in broiler chicken diets reduced the weight gain during the starting period despite similar feed intake. This reduction was probably due to the overestimation of digestible lysine value of w-DDGS during feed formulation. Overall (37 days of the trial) the feed conversion ratio tend to decrease ($<2\%$, $p<0.09$) with 20% of w-DDGS. In summary, introduction of 20% w-DDGS in poultry feeds is possible if the real digestible lysine content of w-DDGS is taken into account.

The effect of Satureja hortensis on performance of broiler chickens and NDHI titers

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In order to study the effects of Satureja hortensis (S.h)(a plant from family Lamiaceae) on performance and NDHI titers of broiler chickens, 144 day old Ross male broiler chickens, were randomly divided into 4 groups of 36 (consisting 3 replicates) and placed in 12 separate pens. The groups 1, 2, 3 and 4 received 0, 0.15, 0.3 and 0.45 % S.h in their feed respectively from 3 until 42 days of age. Performance indexes were recorded on a weekly basis. At 42 days of age, serum, liver and kidney samples were taken for NDHI test and histopathological studies. The results analyzed by One Way ANOVA, Tukey and Ch-2 tests. The birds of the 3rd group (0.3% S.h), had higher body weight and lower FCR, but the differences were not significant ($p>0.05$). All treatment groups had higher HI titers than the control, and the titers of the 3rd group were significantly higher than the control ($p<0.05$). Adding of S.h to the diet had no effect on histological structure of the liver and kidney samples.

Session II
Matching Feed composition to Animal's performances

Invited Papers

Nutrient requirements of broilers for optimum growth and lean mass

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To take advantage from genetic improvement of broiler chickens, updates must be made of the nutritional levels that promote maximum protein accretion and minimum fat deposition. The development of growth models is a valuable tool to understand nutrient deposition in poultry. This article presents experimental results and methodologies used to obtain prediction equations for true digestible lysine requirements, based on performance; however, higher dietary lysine levels are needed to minimize abdominal fat deposition. Feed conversion ratio is the most commonly used parameter to determine broiler nutritional requirements. Methionine + cystine and threonine requirements determined by feed conversion ratio optimize carcass parameters. The reduction of protein level in broiler diets does not affect performance or breast fillet yield, but linearly increases abdominal fat deposition. Further studies need to be carried out aiming at reducing the variation of the parameters used to evaluate broiler carcasses.

Optimizing Laying Performance and Egg Quality

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Due to changes in potential production, housing systems, breeds, health status and animal welfare issues, matching feed composition to performance and egg quality of laying hens can be quite complicated. In this paper, matching energy levels, energy sources and amino acid, calcium and phosphorus levels to egg production and egg quality is discussed. Energy levels can be adjusted to live weight, age and housing systems in order to optimise egg production and to change bird behaviour. Examples are given of existing models to calculate optimal energy, amino acid, calcium and phosphorus levels in laying hen feeds. Calculated optimal levels not always correspond with optimal levels found in experiments. Experimental data are lacking to justify changes in current models in order to improve the estimation of optimal nutrient levels, which might limit further developments to optimise laying performance, egg quality and feed costs. With increasing energy costs, it seems that aiming for heavier birds at the start of the laying period can help to optimise laying performance, egg quality and feed costs.

Optimum feed composition of broiler breeder diets to maximise progeny performance

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Recent research to define a measure of chick quality has evaluated the effects of incubation conditions, breeder age and genotype on progeny growth and survival. Nutritional research has focused on defining the optimum concentration of maternal dietary nutrients for progeny growth, mortality and immune status. There is a research requirement to bring these two areas together to better understand optimum maternal nutrition for maximum progeny performance. Recent research suggests that nutritional concentrations for vitamin D are higher for optimum progeny performance than for egg production. Research also suggests that increased breeder dietary concentrations of vitamin E, zinc, manganese and selenium may benefit progeny performance. Low energy density diets improved progeny growth in young broiler breeders and liveability in offspring of older broiler breeders. There is evidence that different broiler breeder genotypes may have different responses to maternal nutrient concentrations. Further research to quantify the relationships between broiler growth, mortality and immune status in relation to maternal dietary nutrient concentrations in different broiler breeder genotypes is warranted.

Short Communications

A Comparative Evaluation of Functions for the Analysis of Growth in Turkeys

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Three mathematical functions, used previously to describe the relationship between body weight (BW) gain and metabolizable energy (ME) intake in broilers, were used in this survey with growing turkeys to investigate the relationships between BW and cumulative ME intake (cMEI), and between BW gain and crude protein (CP) intake in two different studies. All statistical analyses were performed using the mixed non-linear procedure of SAS (SAS 2000). In the first analysis, two functions (monomolecular and Richards equations) were assessed as candidates for describing the relationship between BW and cMEI. When the Richards equation was fitted, the additional parameter n tended to the value -1, resulting in the monomolecular equation as a special case of this generalised function. Therefore, it was concluded that the monomolecular equation was adequate to describe the relationship between BW and cMEI. In the second analysis, the scope of a specifically re-parameterized monomolecular equation was extended to growing turkeys to provide an estimate of their CP requirements for maintenance and growth. The estimated maintenance requirement (3.95 g/kg of BW/d) and the calculated values of efficiency of utilization of protein for growth (0.64) were in good agreement with values reported previously by other researchers.
Figure 1 Plots of A) body weight (BW, g) against cumulative metabolizable energy intake (cMEI, MJ) showing the fit of the monomolecular equation (Analysis I), B) comparison between BW proposed by NRC (1994) and BW values estimated from cMEI using the monomolecular equation (Analysis I), C) rate of BW gain (BWG, g/g BW/d) against crude protein intake (CPI, g/g BW/d) showing the fit of the monomolecular equation (Analysis II).

Effects of amino acids on egg number and egg mass of brown (heavy) and white (light) hens

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Different types (light to heavy) of laying hens are used in practice and questions on optimum dietary amino acid supply raises. Therefore, a broad range of amino acid intake levels (500 through 750 mg apparent fecal digestible (AFD) Lys/h/d) was tested on light (Lohmann LSL Classic) and heavy (Lohmann Brown Classic) laying hens from 24 through 35 weeks of age. The other indispensable amino acids were fed in fixed ratios to AFD Lys in all treatments. A total of 564 hens (24 weeks of age) were divided into 12 experimental groups (individually housed) based on daily egg mass production and body weight. Diets were fed restrictively with an aimed feed intake of 110 g/h/d (298 kcal/h/d AMEn (layers)) and 100 g/h/d (277 kcal/h/d AMEn (layers)) for brown and white hens, respectively, to achieve the required amino acid intake levels. A daily intake of 650 mg AFD Lys was sufficient to maximise the laying % for brown hens and 550 mg AFD Lys intake for white hens. Egg weight, daily egg mass production and FCR improved up to the highest tested AFD Lys intake for both breeds, suggesting optimum AFD Lys intake of at least 750 mg/h/d for these criteria.

Meta-analysis of phosphorus utilisation by broilers

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In the last decades, many publications addressed phosphorus (P) utilisation by broilers and the reduction of its negative impacts on environment while maintaining performances. Additional publications studied factors of variation of P utilisation as phytase, vitamin D and calcium (Ca) supplies. A meta-analysis was performed to predict P utilisation and to highlight major factors influencing it. In this first step, effects of Ca and non phytic P (NPP) intakes were investigated for starter broilers. Ca negatively affects P utilisation and this effect is greater in low-P diets. Simultaneous levels of NPP and Ca to optimise performances and mineralization were derived from this meta-analysis.

Reductions in Dietary Phosphorus are achievable in Egg Layers by different Feeding Strategies

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Excess phosphorus (P) in manure creates environmental problems due to leaching of nutrients from agricultural soils. As legislation requests limits on dietary P, the effect of reduced P supply on performance and shell-quality were studied in 900 Lohmann Tradition layers in floor pens (age: 19-35 weeks). Total P was reduced from 5.7 g/kg feed (A) to 3.2 g/kg feed (B). Furthermore, diet B was supplied with either phytase (C), non-heat treated wheat (D), particulate oyster shells, fed separately (E) or combinations of D and E (F). Compared with A, hens fed diet B had reduced performance regarding laying rate (86.7% vs. 90.6%, $P<0.05$) and egg number (97 vs. 101, $P<0.05$). However, diets C-F generally improved egg production (NS from A), indicating increased P-availability. Mean laying rate was 88.3% and egg number 99 in groups C-F (NS). Feed consumption did not differ significantly. Shell weight and shell-% were low with diet A (6.1g and 9.4%) compared with diets C and E both with 6.4g shell weight and 9.9 shell-% (NS). The shell stiffness was lower in diet A compared with diets C and E ($P<0.05$). In conclusion, reductions in dietary P are achievable in layers when different feeding strategies are applied.

Table 1 Production parameters from 19-35 weeks (n=5) and eggshell quality at 35 weeks (n=15), per hen

	Treatments					
	A	B	C	D	E	F
Egg number	101a	97b	99ab	98ab	99ab	100ab
Egg mass, kg	6.1a	5.7b	5.8ab	5.8ab	5.9ab	6.0ab
Rate of lay, %	90.6a	86.7b	88.0ab	87.9ab	88.3ab	89.0ab
Feed/day, g	113	111	112	108	111*	110*
Kg feed/kg egg	2.08	2.17	2.15	2.07	2.12*	2.06*
Shell weight, g	6.1	6.2	6.4	6.3	6.4	6.1
Shell-%	9.4	9.5	9.9	9.6	9.9	9.6
Shell strength, N	38.1	37.2	39.8	37.0	39.5	36.0
Shell stiffness, N/mm	168.4b	178.8ab	192.9a	183.9ab	190.2a	181.3ab

Values in the same row with different letters (a-b) are significantly different ($P<0.05$). *Including intake of oyster shells from separate administration (on average 4.6g/hen/day). Treatments offered 32g or 18g (E, F) calcium/kg.

The effects of dietary electrolyte balance on performance of laying hens exposed to heat stress environment in late laying period

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This study was conducted to determine the effects of varying dietary electrolyte balance(DEB) on performance and eggshell quality of laying hens under heat stress condition in late laying period. Four diets were formulated using different inclusions of NaCl, KHCO3 and NH4Cl to give the dietary electrolyte as 0, 120, 240 and 360 mEq/kg, and fed to 256 laying hens from 55 weeks to 65 weeks of age exposed to heat- stress environment in a completely randomized design. all birds used in the experiment were reared in caged. Hens housed in cages were randomly assigned to four equall main groups (n=64). Treatment groups were formed according to dietary electrolyte balance. Prior feeding, laboratory assays were conducted in each diets for sodium, potassium and chloride. Eggshell weight and shell thickness were determined by randomly collecting 4 egg from replicate in each 25 day. after the eggs were broken the shells were washed and dried in room temperature for the determination of shell weight. Shell thickness was measured at the middle using a micro meter. These measurements were pooled. Egg production, feed intake, water consumption, egg mass and feed conversion ratio were not significantly affected by the diets of various DEB ($P>0.05$). Among egg parameters shell weight/surface area, shell weight, shell thickness and egg specific gravity were significantly affected by DEB ($P<0.01$). In conclusion, increasing dietary electrolyte balance to 360 mEq/kg in laying hens rations under heat stress condition in late period of production can improve egg quality.

Key words: laying hens; electrolyte balance; potassium; bicarbonate.

Posters

The effect of duration of feeding starter and grower diets on performance of broiler chicks

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This study was carried out to investigate the effect of duration of feeding starter (0-11, 0-16 and 0-21 days) and grower diets (11 -35, 16 -35 and 21 - 35days) on final broiler performance to 42 days of age. A total of 320 mixed broiler chicks (Ross 308) were allocated to three dietary regimens in a completely randomized design (4 replicate /each 20 chicks). Chick body weight, feed intake and feed conversion ratio were determined at 11, 16, 21, 35 and 42 days of ages. The results showed that the duration of feeding the starter and grower diets had no significant effect on broiler liveweight, feed intake and feed conversion ratio. The relative weight (%) of breast meat, abdominal fat, intestinal weight and length, and liver were not significantly affected by dietary treatments. Considering the fact that the typical cost of a starter diet is much greater than a grower diets, replacing the starter diets at an earlier age may have significant economic benefits on broiler production.

Calcium - Phosphorus contents: The effect of extreme Ca: P ratios on growth rate, feed intake, mortality and P-utilization in Japanese quail (Coturnix Jap.)

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Previous experiments have shown that Japanese quails are not susceptible to high levels of Ca even at very low levels of P. The present experiment was carried out to study the utilization of P under further extended Ca: P ratios. A total of 144 three weeks old quail chicks were randomly assigned to 9 treatments of 8 replicates each. The treatments comprised three levels of Ca (2.6, 3.0, and 3.3 %) and total P (0.10, 0.20, and 0.30 %) in a complete 2-factorial design. Body weight gain, feed intake and mortality were recorded from 3 to 6 weeks of age. Feces were collected and analyzed to determine the P-balance. Feed intake and body weight declined with increasing levels of Ca at the lowest level of P (0.10 %). There was no response at 0.20 and 0.30 % P. Neither of the treatments influenced mortality. The utilization of P varied from 25.34 to 70.44 %. There was a decrease of P-utilisation with increasing inclusion of Ca. The results show that the recommendations for P in quail diets are far above requirement. Growing quails are not susceptible to extreme levels of Ca when minimum requirement of P is provided.

Response of broiler chickens to energy and protein dilution in the starter, grower and finisher diets

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This study was conducted to determine the effect of dietary energy and protein dilution on growth performance and carcass characteristics in broiler chicks. A total of 160 mixed broiler chicks (Ross 308) were allocated to two dietary treatments in a completely randomized design (4 replicate /each 20 chicks). One group served as the control, while the other group was fed 5% energy and protein diluted diet (by washed sand) throughout starter (1-21d), grower (21-3) and finisher (35-42d) periods. Chick body weight, feed intake and feed conversion ratio were determined at 21 and days of ages. The results showed that the energy and protein dilution of the diets had no significant effect on broiler liveweight at 21 and 42d, feed intake during 1-21d, feed conversion ratio and carcass characteristics during different experimental periods. Broiler feed consumption had significantly ($P<0.05$) affected by diet dilution through out 21-42 and 1-42 growth periods. The results indicated that 5 percent dilution of energy and protein content of broiler diets had no significant inverse effects on bird performances and it seems to have some economical benefits.

The Influence of Diets on Broilers' Performance Differentiated for Summer Seasons of South

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The experimental study aimed to determine the influence of diets with protein and energy high content on broilers' performance in summer seasons of south was carried out in southern region of Armenia (air temperature in broiler house varied from 25,50C to 36,30C). The experiments were carried out over 180 day-old Cobb broiler chicks, which were equally divided into control and 4 experimental groups (36 broilers per group). Each group was fed on 3 types of diets (with corresponding durations 1-21 days; 22-35 days; 36-42 days). The control group was fed on commercial diets used in any season, experimental groups were fed on diets with high protein and energy content. The effectiveness of using diets with high protein and energy content is approved by the results of experiments obtained for IV, III and especially II experimental groups (with 25% of protein), their live body weight significantly differed ($P<0.001$) as compared to the control group. The results of II experimental group (with 25% of protein and 132 EPR) is overrating (2300g live weight). The results in the final feeding period of II experimental groups obviously exceeded (by 3.9-15.5%) the other groups. The II, III and IV experimental groups have higher percent of eviscerated, breast meat, so as thigh and drumstick meat yield as compared to control group. Thus, the definitive variant for hot summer condition should be considered the II, III and IV experimental groups rations with high protein and energy content, but low feed consumption - 1.90; 1.91 and 1.92 kg feed per kg live weight gain, respectively.
Keywords: broiler; feed conversion; energy/protein ratio; summer

The Particularities of Broilers' Feeding in Spring and Summer Seasons of South

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The experimental study aimed to determine the particularities of broilers' feeding in spring and summer seasons of south was carried out in southern region of Armenia (air temperature in broiler house varied from 25,00C to 32,10C in spring and from 25,50C to 36,30C in summer). The experiments were carried out day-old Cobb broiler chicks (n=360). Each group was fed on 3 types of diets (with corresponding durations 1-21 days; 22-35 days; 36-42 days). The control group was fed on commercial diets used in any season, experimental groups were fed on diets with high protein and energy content. The results of spring experiments show that the decreasing of protein content in the second period of fattening /22-35 day/ results in broilers' live weight losses in the final period. The broilers of I, II and III experimental groups successfully exceeded the control group by carcass weight on 9.5; 4.9 and 2.7%, respectively. The effectiveness of using diets with high protein and energy content is approved by the results of summer experiments obtained for IV, III and especially II experimental groups (with 24.9% of protein), their live body weight significantly differed ($P<0.001$) as compared to the control group. The results of II experimental group (with 24.9% of protein and 131.5 EPR) is overrating (2300g live weight). The results in the final feeding period of II experimental groups obviously exceeded (by 3.9-15.5%) the other groups. The II, III and IV experimental groups have higher percent of eviscerated, breast meat, so as thigh and drumstick meat yield as compared to control group. Thus, the definitive variant for hot summer condition should be considered the II, III and IV experimental groups rations with high protein and energy content, but low feed consumption - 1.77; 1.84 and 1.91 kg feed per kg live weight gain, respectively.

The Usage of Protein-carbohydrate Concentrates in Broilers' Diets Received by Microbiological Processing of Tomatoes, Grapes and Apples

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The aim of this investigation was to determine the influence of diets with protein-carbohydrate concentrates on broiler's performance and meat quality. The experiments were carried out over 36 day-old Cobb broiler chicks, in summer season of south (air temperature in broiler house varied from 25,50C to 36,30C). The protein-carbohydrate concentrates received by microbiological processing of tomatoes, grapes and apples is a valuable source of easy-digesting carbohydrates. It contains 40% crude protein and 6.1% of crude fiber. The amino acids content of protein-carbohydrate concentrates is near to fish meal, particularly by content of critical amino acids. The protein-carbohydrate concentrates occupy intermediate position between animal and plant proteins by adequacy. The broilers' of experimental group received diet with 9% of protein-carbohydrate concentrates. They were fed on that diet 7 days up to slaughtering at the age of 42 days. The experimental group had higher percent of eviscerated, breast meat, so as thigh and drumstick meat yield as compared to control group. The broilers of experimental group successfully exceeded the control group by carcass weight on 9.5%. Feed consumption in control group was 2.05kg and in experimental group - 1.91. The using of protein-carbohydrate concentrates allow to avoid fish meal specific smell and taste in meat. On the other hand, manufacturing and using of protein-carbohydrate concentrates on the basis of processing waste products of tomatoes, apples and grapes enables for an effective utilization leguminous, expensive protein feeds of animal origin and the organization of without waste manufacture when waste products of one branch serve as raw material for another, it promotes preservation of ecological cleanliness of environment.

Effect of In ovo Injection of Vitamins on the Chick Weight and Post-Hatch Growth Performance in Broiler Chickens

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An experiment was conducted to study the effect in ovo injection of vitamins on the embryonic and post-hatch growth performance. Fertile eggs (n=350) were weighed, distributed in to 7 groups and set in force-draft incubator. On 14th ED five groups were injected with 100 IU Vitamin-A, 0.5 IU Vitamin-E, 50 mg Vitamin-C, 100 μg Vitamin B1 and 100 μg Vitamin B6 dissolved in 0.5 ml of sterile water. Rest two groups were used as sham control (0.5 ml sterile water) and un-injected control. The chicks hatched from the above experiment were housed in battery brooders and provided standard diet and other managemental practices. Hatchability on fertile egg set basis in the Vitamin B6 group was apparently higher (81.5%) than sham control (72%) and un-injected control (80%). Vitamin E and Vitamin B1 injected groups had more number of deaths just before piping of chicks. Chick weight to egg weight ratio (%) was higher ($P<0.01$) in chicks injected with Vitamin-A (72.66%), Vitamin-C (72.26%) than un-injected control (70.94%). Body weight was more at 14 and 28 d of age ($P<0.01$) in Vitamin-E and B1 injected groups than un-injected control. However, FCR did not differ among treatment groups. It may be concluded from the above experiment that vitamin A and vitamin C may influence the embryonic development, whereas, vitamin-E and vitamin B1 may be required for early post-hatch growth.

Effect of In ovo Injection of Glucose on Growth, Immunocompetence and Development of Digestive Organs in Turkey Poults

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Three hundred fertile eggs of small white turkey were divided into 7 groups. First four groups were injected with 1 ml 10% glucose on 21st and 25th day of incubation through 25mm needle at broad and narrow end of egg. Fifth and sixth group was selected as 21st and 25th day sham control (1 ml sterile water), respectively. Seventh group was maintained as un-injected control. In ovo injection of glucose on 21st day resulted the deposition in allantoic cavity and yolk sac, whereas, on 25th day deposition sites were amniotic sac and yolk sac. Percent hatchability on fertile egg set basis was higher in 25th day sham control group (90.9) and un-injected control (87.5) whereas, glucose injection on 25th day into yolk sac (73.7) and amniotic sac (72.2) had lower hatchability.Chick weight to egg weight ratio was significantly ($P<0.001$) higher when glucose was deposited either in the yolk sac(65.11%) or in amniotic sac (64.27%) than un-injected control (62.27%). Humoral immune response was significantly higher ($P< 0.001$) in chicks hatched from eggs injected with glucose either on 21st day or 25th day of incubation than the control group (8.08 vs 5.50). Glucose injected in to the yolk sac on 21st d had higher titre value than other glucose injected groups. Higher bursa weight was noted in in ovo glucose injected groups than control (188 vs 162 mg %). Cellmediated immune response (in vivo PHA-P response measured as footpad index) was not affected by glucose treatment. Hence, it may be concluded that in ovo injection of 10% glucose on 21st day in to the yolk sac of developing embryo may enhance post hatch turkey poult growth and also may elicit better humoral immune response.

Sequential feeding with diets varying in protein and energy contents

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Sequential feeding is a cyclic feeding programme of two feeds for one or several days. The aim of the present study was to investigate energy (2,800 (E-) and 3,200kcal/kg (E+)) and protein (230 (P+) and 150g/kg (P-)) content effects on daily feed intake and growth in 900 male broiler chickens, and to compare these results to standard feeding (CP=190g/kg and ME=3,000kcal/kg). Sequential feeding was carried out during 48h-cycles and two periods (period 1: 10-17d of age, period 2: 18-29d of age). Five treatments were compared during periods 1 and 2: complete diet (C), alternation of diets varying in crude protein (SP: P+ following by P-), in energy (SE: E- following by E+), and in protein and energy contents (P+E- following by P-E+; SEPA: periods 1 and 2, and SEPB : period2 only). Chickens received the same feed during the finishing period (30-35d of age). Feed intake was similar with sequential feeding and complete feed but in proportion to total feed intake, chickens over-consumed high energy feeds (E+ and E+P-) during each period, and P- only for period 2 ($P<0.01$). During period 2, over-consumption was greater with SEPA than SEPB, ($P<0.01$). Weight gain was similar for all treatments during period1. At 35d of age, SE chickens were heavier than SEPA and SEPB ($P<0.01$). Feed efficiency was similar for all treatments for period1, and decreased for SP, SEPA and SEPB compared to C and SE for period2 ($P<0.01$). Changes in locomotor behavior were not related to differences in gait scores between treatments. Regarding conformation, breast yield and abdominal fat did not differ between treatments but pHu of breast meat was improved with SP. In conclusion, broiler chickens adapted to sequential feeding with 48h-cycles and diets varying in protein and energy contents, particularly when sequential feeding began early.

Table Feed intake, growth performances during the sequential feeding period from 10 to 29 d of age and finishing period from 30 to 35 d of age, gait score and carcass conformation at 35 d of age

[1] Averages followed by different superscript letters are significantly different (Newmann and Keul's test, $P < 0.05$).

Treatment Diets ($1^{st}/2^{nd}$ d) Experimental period	C Complete	SP Sequential P+/P- 10 to 29 d	SE Sequential E-/E+ 10 to 29 d	SEPA Sequential P+E-/P-E+ 10 to 29 d	SEPB Sequential P+E-/P-E+ 18 to 29 d	SEM	P<
10 to 17d: Total feed intake, g	484	479	494	488	-	8	NS
Feed eaten during the 1^{st} days of the cycle, % total feed intake	48.2[a]	47.6[a]	44.2[b]	44.4[b]	-	0.7	0.01
18 to 29d: Total feed intake, g	1400	1424	1431	1380	1417	22	NS
Feed eaten during the 1^{st} days of the cycle, % total feed intake	48.5[a]	46.8[b]	45.0[c]	43.2[d]	44.5[c]	0.2	0.01
Body weight, g							
17 d	571	569	577	568	-	5	NS
30 d	1480[bc]	1478[b]	1520[a]	1456[b]	1467[b]	14	0.05
35 d	2022[ab]	2022[ab]	2059[a]	1974[b]	1998[b]	17	0.01
Feed/gain ratio							
9-17 d	1.28	1.29	1.29	1.31	-	0.02	NS
18-30 d	1.59[a]	1.63[b]	1.58[a]	1.65[b]	1.65[b]	0.01	0.01
0-35 d	1.54[a]	1.55[ab]	1.54[a]	1.57[b]	1.57[b]	0.01	0.01

Reactions of Ross chickens to sequential feeding

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Sequential feeding is a 48h-cycle feeding programme of two feeds, one protein-rich-energy-poor (P+E-) and the other energy-rich-protein-poor (P-E+). The intake of each sequential feed is an essential key to reach an overall nutritional balance with sequential feeding. Therefore, for the present study, it was of interest to investigate the effect of sequential feeding on feed intake and consequences on growth performances of chickens (Exp. 1-2), and short- and long-term feed intake (Exp. 3). A control group (C) was fed with a standard diet, whereas for the sequential group (S) four cycles of 48h were used for sequential feeding of the two different diets E+P- and E-P+. Experiments 1 and 2 showed a significant decrease in growth with S (-6% for live weight at d28-30), due to low intake of feed and especially for E-P+ (Figure 1). This effect was greater when the cycle started with E+P- (SE). For experiment 3, feed intake kinetics indicated lasting under-consumption of E-P+: -9% after 1h of distribution, -1% the rest of the day, -2% at 24, 48 and 72h (Figure 2). In this situation, sequential feeding seemed to exacerbate how animals reacted by decreasing feed intake, which penalizes growth performance.

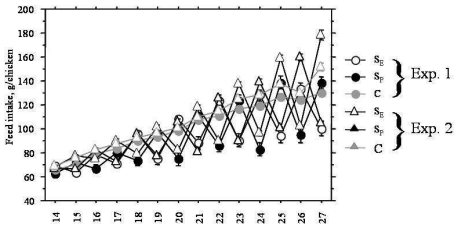

Figure 1. Daily intakes - Experiments 1 and 2

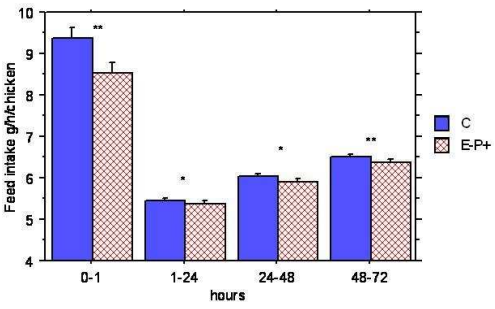

Figure 2. Changes in intake during the 72 hours following change of diet - Experiment 3

** : P<0.01; * : P<0.05

Effects of delayed access to feed and water on performance and small intestine growth in broiler chickens

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Gastro intestine development and broiler performance at the end of rearing period may be influenced by post hatch feeding. A study was carried out to evaluate the effects of delayed access to feed and water on performance and small intestine length and weight from 1 to 42 days of age in broiler chickens. Treatments were included 0, 16, 32 and 48 hours fasting. Significant differences ($P \leq 0.05$) were observed in feed intake and body weight between 48 h fasted and control group in 42 d old chicks, but feed conversion ratio did not affected. Relative liver and pancreas weight (g/100gBW) significantly ($P \leq 0.05$) increased by 48 h fasting at 21 day of age. Relative small intestine weight decreased significantly ($P \leq 0.05$) by 48 h fasting compared with control in day 4 of age. Forty eight hour fasting also resulted to a significant reduction in jejunum and ileum relative weight at 4 day of age. Duodenum length was lower in 48 h fasted chicks than control group at 4 day of age. The result of this study showed that long term fasting post hatch adversely affect broiler performance and starter feeding immediately after hatching resulted to desirable performance and gastrointestinal development.

Effect of corn soybean diets versus high moisture supplements feeding on broiler chickens performance

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An experiment was carried out to evaluate the effect of early feeding with corn-soybean meal starter diet and semi solid hydrated supplements on yolk suck utilization and broiler chicken performance. The treatments were included: feeding a corn-SBM diet immediately after hatch (control), feeding Omaj (a mixture of corn, egg and milk) and a semi Oasis product for 32 h after hatching. All treatments were followed by feeding the corn-SBM diet for 21 d. Chicks fed with Omaj and semi Oasis for 32 h had similar daily feed intake and weight gains at 42 days of age, and had no significant differences with control. Feed conversion ratios were similar in all experimental groups. The decrease in yolk sack weight was more pronounceable at 32 hours after hatch and chicks that fed with corn-soybean meal diet and semi oasis product used yolk sack faster (38 to 42 %) than those which fed with Omaj (24%). During the 4 day after hatching the 78 % of yolk sack was utilized by chicks and there was no significant difference in yolk sack weight between experimental groups. It could be concluded that feeding high moisture semi solid hydrated supplements after hatching could not improve broiler chickens performance.

Comparative Effect of Sodium Salts on Growth Performance and Ammonia Emission Under Temperate or Cyclic Heat Stress Conditions

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The objective of the study was to evaluate the possibility to replace sodium bicarbonate (SB) by sodium sulfate (SS) under heat stress conditions on broiler performance and litter ammonia emission. The experiment involved 1200 male broiler chickens allocated in two identical rooms with 24 pens and 600 animals each. Temperature scheme was standard in one room while increased in the other to 33 °C during 10 hours from 21 to 43 days of age. In each room, four dietary treatments were applied: Control (0.37% NaCl), SS 0.1% (NaCl 0.29% + SS 0.1%), SS 0.27% (NaCl 0.14 % + SS 0.27%) and SB 0.1% (NaCl 0.3% + SB 0.1%) on a wheat-soybean meal based diet. There were significant differences between temperature conditions on growth performance between Controls (400 g live weight). In similar ambient conditions, no performance differences appeared between dietary treatments. However, in cyclic heat stress conditions, a numerical improvement was observed with higher dose of sodium sulfate (SS 0.27%) on final body weight compared to Control and to SB 0.1% treatment (2917 vs 2823 g). At D43, no significant difference in litter ammonia production irrespective of the climatic conditions was observed. However, in temperate conditions, the Sodium sulfate (0.1 %) treatment exhibited the lowest ammonia values compared to sodium bicarbonate: 15 vs 20 ppm, P=0.09.

Utilization of Quality Protein Maize in the Diet of Layer

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A feeding trial was conducted for a period of 5 months with 80 ready to lay pullets (Starcross-579) to determine the effects of quality protein maize (QPM) on production performance egg quality traits of layer. The birds were arranged in a Completely Randomized Design with 4 dietary treatments. There were 20 birds per treatment. i.e. each treatment was consisted of 20 replications where each pullets was considered as a replicate. The dietary treatments were normal maize plus lysine and methionine (D1; control diet), normal maize without lysine and methionine (D2), Pacific 11 maize without lysine and methionine (D3) and QPM without lysine and methionine (D4). All diets were isocaloric and isonitrogenous that contained around 2806 Kcal ME/kg DM and 17.8% crude protein. Management condition was similar for all treatments groups. It is found in the study that there was no clear advantage of using QPM over normal maize or another hybrid Pacific 11 was found in terms of feed intake, total gain and egg production. Similarly, there was no advantage of using lysine and methionine in normal maize-based diet used in the present study. Therefore, further a series of research trials are necessary to draw a definite conclusion for using QPM in the poultry diet.

Reducing dietary crude protein while maintaining performance and improving economics in Ross 708 broilers

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A study was conducted to determine the effects of reduced dietary crude protein on performance of Ross 708 broilers at week 8. 1440 straight-run broiler chicks were assigned to 4 treatments (12 pens of 30 birds). Diets were formulated to have the minimum digestible level for lysine, and same ratios to lysine for Met+Cys, threonine, valine, and isoleucine across the four phases (starter, grower, finisher, and withdraw). An industry standard diet was the control (CT). The remainder of the treatments (CT-0.5%, CT-1.0%, and CT-1.5%) had CP reduced in 0.5% increments. Birds were weighed at 2, 4, 61/2, and 8 weeks of age for feed to gain calculation. At week 8, 4 birds per pen (48/trt) were sacrificed and meat yield was determined. Income over feed cost/MT breast meat and /MT carcass were calculated. Treatments had no effect (P>.05) on performance throughout the 8-week period. Treatments had no effect on abdominal fat pad, carcass, and breast meat yield at 8 weeks. Birds fed CT-1.5% CP had increased income over feed costs of $5.46/MT carcass and $16.46/MT breast when compared to CT. To conclude, a decrease of CP by 1.5% did not affect performance, carcass, and meat yield, and resulted in higher revenues (*Table 1*).

Table 1: Effects of reduced crude protein levels on income for carcass and total breast meat of Ross 708 broilers

Economic value, US$[1]	CT	CT-0.5%	CT-1.0%	CT-1.5%
Feed costs/kg live BW[2]	0.3036	0.3023	0.3010	0.2997
Feed costs/kg carcass[3]	0.4246	0.4228	0.4210	0.4192
Feed costs/kg breast meat	1.2732	1.2678	1.2623	1.2568
Income over feed costs/kg carcass	0.8054	0.8072	0.8090	0.8108
Income over feed cost/kg breast	0.7068	0.7122	0.7177	0.7232

[1]Economic value for carcass: US$1.23/kg; breast meat: US$1.98/kg (USDA, 2006). Referenced prices for all ingredients were taken from Feedstuffs (2006).

[2]BW at day 56 = 3.61kg.

[3]Carcass = bird without blood, feathers, head, hocks, abdominal fat, and intestines.

Effects of ammonium chloride and potassium chloride on performance and serum blood electrolytes in chicks exposed to chronic heat stress

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In order to evaluate the effects of dietary NH4Cl and KCl on chicks subjected to chronic (36°C for 4 hrs in days) heat stress (CHS), 280 male and 280 female broilers were used in a 2*4 factorial arrangement with two sexes and four dietary (supplemented drinking water) treatments: 1) 0.3% NH4Cl, 2) 0.3% KCl, 3) 1+2, 4) Control (0% NH4Cl, 0% KCl). NH4Cl and KCl decreased ($p<0.05$) blood K+ during the period of 5 to 7 week , so that the greatest responses were observed in treatments 1 and 3 respectively. Blood K+ and Cl− was not different ($p<0.05$) between M and F chicks, but blood Ca++ and Na+ improved in M chicks. NH4Cl decreased ($p<0.05$) blood Ca++ during CHS but the lowest levels of blood Ca++ were observed in treatments 1 and 2 respectively. Broilers given 0.3% KCl from 5 to7 week of age had lower ($p<0.01$) body weight and feed consumption than control broiler. Adding 0.3% KCl to broiler drinking water improved ($p<0.05$) daily weight gain, body weight gain and no effect on feed conversion ratio. The data reported here in suggests that 0.3% KCl to broiler drinking water improved broiler production parameter measured under CHS.
Keywords: ammonium chloride; potassium chloride; chronic heat stress; performance; electrolytes

The impact of nutrient density in terms of energy and/or protein on zootechnical performance of female and male broiler chickens of a commercial strain

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Livestock performance and profitability in the intensive husbandry are closely related to an interaction between genetics, broiler physiology and dietary characteristics (nutrients and additives) thereby influencing growth rate, shape of growth curve,.oeThe objective of the present study was to determine the effect of a reduction in nutrient density in terms of either metabolisable energy and protein (c.q. amino acids) or only protein(c.q. amino acids) on performance of female and male broiler chickens of COBB-500. The experiment was designed as a complete block design (4 dietary treatments*2 sexes) with 5 replicates (= 40 pens with 30 males or 34 females per pen). For this trial a three-phase "1-14-28-42 days" feeding schedule was used. The dietary treatments were: (1) the control, (2) the control with a reduction for both MEn and protein c.q. amino acids, (3) the control with a reduction for only protein c.q. amino acids and (4) the control with a lower but constant protein c.q. amino acids level. The control group reached a final body weight (kg) and feed conversion rate (1-42d) of 3.03 and 1.64 for the males and 2.50 and 1.70 for the females, respectively. The performance was lowest for treatment 2 being very significant for both body weight, feed intake and feed conversion. The differences in performance were more pronounced for males than for females. There was no indication for compensatory growth. The reduction in nutrient density had a favourable effect on mortality especially in males. The present results demonstrated that a decrease of dietary MEn had a more detrimental impact on performance than protein c.q. amino acids.

Reduction of Inorganic Phosphorus in Broiler Feed Optimised for High Growth - Influence on Performance and Welfare Traits

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In order to meet restrictions imposed by the Danish authorities, there is a need to minimize excretion of phosphorus (P) from broilers. The objective of the present study was to examine the influence of reduced P and calcium (Ca) levels in broiler feed, optimised for high growth, on performance, bone breaking strength, and welfare traits. A total of 1,680 male Ross 308 broilers were randomly distributed to 24 floor pens. Until day 10, all chickens were fed the same starter diet. From 10 to 32 days of age the chickens were fed experimental grower diets supplemented with phytase. Diet 1 and 3 were produced with normal and no supplementation of inorganic P, respectively. Diet 2 consisted of 50% of diet 1 and 3, respectively. The present study showed that dietary P and Ca could be lowered in broiler feed until 21 days of age without affecting the examined parameters. However, continuation until 32 days of age had a negative effect on performance, bone breaking strength, and welfare traits. The frequency of chickens with femoral degeneration was 0, 3, and 25% in treatment 1, 2 and 3, respectively, at 32 days of age.

The effect of calcium and available phosphorus levels on the performances of growing meat type Japanese quail: 1. Effects on body weight, weight gain, feed consumption and feed efficiency

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In a 28 day trial (7-35 day of age), 800 meat type Japanese quail chicks were used to determine the effect of different Ca and (aP) levels. The diets based on corn-wheat-corn gluten meal were formulated in a complete isonutrient basis except Ca and aP. Chicks were kept in a complete randomized 3 x 3 factorial design. Three level of Ca (1, 0.8 and 0.6%) and aP (0.4, 0.3 and 0.16 %) were used. There were 4 replicates of 20 chicks per treatment. First week was pre experimental and chicks were fed commercial starter quail diet. Next four weeks, chicks were fed ad libitum the experimental diets. Feed consumption (FC), feed conversion ratio (FCR); body weight (BW) and body weight gain (WG) were measured weekly. At the start of experiment body weight was not statistically different (>0.986). Body weight was statistically affected by different Ca and aP levels after 7 and 14 days of the experimental phase; (>0.0006 and 0.0024) but not after 21 and 28 days of experimental phase (0.406 and 0.861). WG was statistically significant immediately after first week of trial (>0.0001), but total WG (7-35days) was not statistically significant (>0.861). FC and FCR where statistically affected (P=0.039 and 0.0049) only during first 7 days of experiment. It is concluded that the best performances are achieved with 0.8% Ca and 0.30% aP but the quail were also able to maintain normal growth when fed extremely low Ca:aP levels (0.6 to 0.16%).
Key words: Japanese quail; Calcium and Phosphorus; body weight; feed consumption

Effects of Sodium Bicarbonate, Potassium Chloride and Sodium Chloride Supplementation on Some Blood Biochemical Parameters in Laying Hens

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This research was carried out to determine the effect of supplementation of sodium bicarbonate (% 0.38, % 1.5), potassium chloride (% 0.7) and sodium chloride (% 0.25) at different levels in diets of 480 25-week old laying hens on blood plasma Ca, Pi, Mg, CI, Na, K, total protein, albumin and uric acid levels. During the 90-day trial, animals were divided into eight groups, 60 animals in each. Then each group was divided into six subgroups, 10 animals in each. Animals had access to ad libitum feed and water. The research was done in Konya Animal Research Institute. At the end of the experimental period, blood samples of six chicks from each group were collected into heparinized tubes and plasma were separated by centrifugation at 2500 rpm for 10 min at +4 C°. Na and K concentration were quantified by flame fotometry and Ca, Pi, Mg, CI, total protein, albumin ve uric acid concentration were measured by spectrophotometry. Data was analysed using variance analysis and Duncan Multiple Range Test. Supplementation of diet with sodium bicarbonate, potassium chloride and sodium chloride did not affect plasma Ca and uric acid concentrations beetween control and treatment groups. However, Pi, Mg, CI, Na, K, total protein, and albumin concentrations differed statistically among groups due to the diet supplementations. As a result, in laying hen diet, supplementation of sodium bicarbonate, potassium chloride and sodium chloride either alone or combined caused important changes in some biochemical values. Detection of interaction among minerals warrants further investigations.

Increased Dietary Balanced Protein Levels at Varying Length of Application in 1-14 days old Broilers

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In the present trial increasing levels of balanced protein (BP; 100 (control), 115, 130, 145, 160% of recommendation) were fed from day one either for two, four, eight, or twelve days to male broilers (control + 4 x 4). After feeding the experimental diets dietary BP was reduced to the control level. This was done in two steps (2-day transition period) in order to avoid too strong changes in amino acid supply. Increasing BP levels non-linearly improved weight gain and feed conversion. This effect was most pronounced when experimental diets were fed for 12 days ($p<0.05$). Feeding increasing BP levels for two or four days had no effects on weight gain and feed conversion ratio. On day 14 two birds per pen were selected for dissection. Weights of the empty small intestine were determined. Enhancing the length of feeding the experimental diets from 2 to 12 days significantly increased the relative weight of the duodenum and jejunum (% of body weight) whilst dietary BP had no effect. However, small intestine weight of the control treatment was similar compared with that of birds received the experimental diets for 8 and 12 days.

Nutritional Value of Methionine Hydroxy Analogue Calcium Salt Compared with Both Pure DL-Methionine and Diluted DL-Methionine with 65% Purity

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Correct use of DL-methionine (DL-Met) and methionine hydroxy analogue calcium salt (MHA-Ca) requires knowledge on their nutritional value which can be determined by multi-exponential regression analysis of dose response data. In order to both examine the biological value of MHA-Ca compared with DL-Met and to validate the mathematical approach a dose-response trial was performed with graded levels of either DL-Met, MHA-Ca or DL-Met-65 the latter being DL-Met diluted to a purity of 65%. It was hypothesised that the biological effectiveness of DL-Met-65 must be about 65% if the regression method is valid. Basal unsupplemented starter, grower and finisher diets contained 0.63, 0.57, and 0.52% Met+Cys, respectively, and were fed to male Ross 308 chicken. Regarding weight gain, feed conversion ration (FCR) and breast meat yield (BMY), broilers responded significantly and non-linearly to either Met source. Biological effectiveness of MHA-Ca compared with DL-Met was on average 60% (gain-65%; FCR-60%; BMY-53%) whilst that of DL-Met-65 was 62% (61%; 62%; 63%). These findings suggest that 1kg MHA-Ca can be replaced by 650g or less DL-Met for achieving the same animal performance. The determined bio-efficiency of DL-Met-65 was close to 65% supporting the mathematical approach to be suitable for bio-efficiency determination.

The effect of rapeseed meal in the feed of broiler chickens

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The aim of the study was to investigate the effects of rapeseed meal in diet on broiler performance. In a six-week feeding trial with chickens of Ross 308 genotype, chickens were divided into three groups and fed by starter diets for 21-days and grower diets until 42 days. The control diet (group 1) was based on corn, soybean meal and fullfat soybean. The second diet (group 2) contained 4% rapeseed meal and the third one (group 3) contained 8% rapeseed meal. The results indicated that there are a slight depression in production performances caused by using rapeseed meal. Chickens of group 1 had live weight of 2.112 kg, group 2 - 2.077 kg, and group 3 - 2.081 kg. Daily weight gain was 49.31 g (group 1), 48.41 g (group 2) and 48.56 g (group 3). The control group had the best feed conversion ratio - 1.766 kg/kg, group 2 - 1.780 kg/kg and group 3 - 1.894 kg/kg. Mortality rate was: group 1 - 5.00%, group 2 - 5.33% and group 3 - 5.67%. EPEF was in group 1 - 271; group 2 - 263 and group 3 - 247. Differences between parameters of the groups have not been statistically significant.

Keywords: rapeseed meal; broiler chickens; production performance

Table 1. Performance of broilers chickens

Paramters	*Group 1	Group 2	Group 3
Number of day-old chickens	300	300	300
Body weight, kg	2.112	2.077	2.081
Daily weight gain, g	52.81	51.93	50.85
Mortality rate,%	5.00	5.33	5.67
Feed conversion ratio kg/kg	1.77	1.78	1.81
EPEF	284	268	276

*Group 1: Control; Group 2: Rapeseed meal - content in diet 4%; Group 3: Rapeseed meal - content in diet 8%

Sulfur amino acids requirements of laying hens in low protein diets

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An experiment was coducted with White Leghorn hens in early laying stage to determine the influence of dietary crude protein (CP) concentration on the requirement for total sulfur amino acids (TSAA).The experiment was conducted for 8 weeks on 600 commerical layer hens, Hy-Line w-36 (six groups of 4 hens, 30 weeks old). This experiment arranged to factorial 5×5 in a complete random design with five levels 13.1, 13.6, 14.1, 14.6 and 15.1% of CP and five levels 0.53, 0.57, 0.61, 0.65 and 0.69% of TSAA. Both CP and TSAA significantly improved feed intake, egg production, egg weight and feed efficiency ($p<0.01$). But these two factors together had significantly improvement effect just on feed intake and egg weight. So as a result the recommendable levels of CP and TSAA in layer diets to reach the optimum egg weight and feed efficiency, were 14.6% or 15.1% of CP and 0.69% of TSAA. However, higher levels of TSAA in such low protein diets, may have an extra effect on hen's performance. Also this experiment showed that TSAA levels had the best influence of hen's performance in lower levels of protein.
Keywords: laying hen; sulfur; amino acid; protein

Comparison of Different Indigestible Markers for Digestibility Estimation in Turkeys and Chickens

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Ileal transit time of digesta (marker), apparent ileal protein digestibility and apparent metabolizable energy (AMEN) estimates of different cereal-based diets (containing wheat, dehulled barley, oats) fed as such or enzyme-supplemented in 3- and 6-week-old turkeys and broilers (Exp. 1) and in 9-week-old turkeys and adult hens (Exp. 2) were investigated. The differences between ileal digestibility and AMEN estimates calculated by using titanium dioxide (TiO2), chromic oxide (Cr2O3) or acid insoluble ash (AIA) as indigestible markers were detected. TiO2 retention time in ileum was elongated with bird age, but more pronouncedly in broilers than in turkeys. Oats inclusion to the diets decreased retention time more in turkeys than in broilers especially at 6 weeks of age. Differences between ileal digestibility estimates obtained with TiO2 or Cr2O3 were small and mainly not significantly different from 0. At faecal level, however, AMEN estimates were generally higher when calculated with TiO2 than with Cr2O3 in Exp. 1 but higher with TiO2 than with Cr2O3 in Exp. 2. AIA gave remarkably lower AMEN values than TiO2. In addition effects of markers interacted with age of the birds and dietary treatments. It is concluded that comparability of digestibility results obtained by different markers can be questioned.

The effects of elevated dietary vitamins (OVN) combined with Hy-D (25-hydroxyvitamin D3) on performance, health and processing yield of broilers

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In this study the effects of a supplementation of broiler chicks with elevated dietary levels of vitamins (OVNTM) in combination with Hy-D® (25-hydroxyvitamin D3) were evaluated. Male broilers were allocated to two dietary treatments: Control and OVN-Hy-D (enriched in vitamins plus Hy-D®). In the starter period (days 0-21) chickens fed OVN-Hy-D gained more weight than those receiving the control feed ($P<0.01$) and showed a more favorable feed efficiency ($P<0.01$). In the grower period (days 21-40) no differences in performance between the two treatments were observed. The utilization of the OVN-Hy-D premix increased breast weight ($P<0.01$) and breast meat yield ($P<0.01$) in relation to the control premix. Tibia breaking strength was numerically improved in the OVN-Hy-D group. In the meat from OVN-Hy-D a clear reduction of the TBARS values after 7 days of storage was recorded, when compared to the control meat ($P<0.001$), indicating protection from oxidative deterioration of the lipids. The present results suggest that the use of an enriched OVNTM vitamin premix in combination with Hy-D® exhibited beneficial effects on performance of broilers in the starter period, improved breast meat yield at slaughter and increased the oxidative stability of the meat.

Effect of Supplementary Feeding Level on Growth Performance of Native Geese in Bangladesh

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A study was conducted for 12 weeks with 168-day-old goslings to find out the growth performance supplying different levels of supplementary feed. The experiment was conducted among 24 farmers of Baghabari, Sirajgonj, Bangladesh. The farmers were trained on nutrients, feed ingredients, ration formulation, ingredient mixing etc. A total of 168 goslings were distributed to four different levels group farmers (50g, 75g, 100g and No supplement group) having six replications with 7 goslings per replication. The nutrient composition of the diet was followed as per recommendation. The other management practices were semi-intensive on farm trial at farmers house. According to the findings of the experiment weight gain of the native geese increased significantly among feed supplementary groups upto 8 weeks of age. Interestingly, it is found no significant effects on weight gains were observed in supplementary feeding groups with no supplementary group at 11 and 12 weeks of age. Considering the result, supplementary feeds may be provided upto 8 weeks of age and the medium level i.e. 75g may be recommended to the rural geese farmers of Bangladesh. For drawing a rigid conclusion further research is needed in Bangladesh context.

Meta-Analysis on the Relative Effectiveness of the Liquid Hydroxy Analogue of Methionine Compared with DL-Methionine in Broilers Using Multi-Exponential Regression

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Plenty of experiments comparing the nutritional value of DL-methionine (dlMet) or the liquid methionine hydroxy analogue free acid (dlMHAFA) have been published in the past. Therefore, a meta-analysis was performed to estimate the relative efficiency of dlMHAFA compared with dlMet by means of exponential regression analysis taking into account daily weight gain (DWG) and gain to feed ratio (GF) as performance criteria. Each referenced study hereunder was individually analysed by exponential regression ($Y=\alpha+\beta*\exp(-\gamma X)$) and only those which converged and which parameter estimates fulfilled the constraints $\alpha>0$, $\beta>0$, and $\gamma>0$ were eligible for further analysis. Data from 38 (GF) to 40 (DWG) dose-response experiments, extracted from a total of 27 peer-reviewed papers were used. Mixed-effects nonlinear regression was extended to allow for testing heterogeneity among plateaus. The analysis revealed that plateaus of both methionine sources can be assumed identical. Inclusion of the co-variable "age at start of experiment (ASE)" had a significant effect on the models ($p<0.05$) which were: DWG = (32.83 + 1.03 * ASE) + 10.46 * (1 - exp(-13.58 * dlMet - 10.96 * dlMHAFA); GF = (0.516 - 0.0026 * ASE) + 0.119 * (1 - exp(-8.41 * dlMet - 6.66 * dlMHAFA). Regression analysis on DWG and GF revealed relative efficiencies of 80.7 % and 79.2 %, respectively, for dlMHAFA, based on equimolar comparison with dlMet, and the differences in efficiency proved to be significant ($p<0.05$).

Effect of Feeding Protein and Phosphorus Reduced Feeds on Performance of White and Brown Laying Hens in Aviary Systems

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The purpose of this study was to evaluate the influence of feeding for ecological reasons protein and phosphorus reduced feeds on laying performance of white and brown layers. In a first trial 2860 LSL-hens were put in place in two different aviary systems. In a second trial 1872 LSL resp. 1872 Hyline-brown hens were kept in a floor system with elevated perches. All layer feeds were formulated to an energy content of 11.6 MJ and same level of amino acids, but they differed in raw protein (RP, g/kg) and phosphorus (P, g/kg). Feed treatments were control (= St, RP 180, P 6.0), phase feeding (= Ph, RP 180/160, P 6.0/5.5), nitrogen and phosphorus reduced feed (= NPr, RP 170/150, P 4.8). Feeding phase 1 lasted from week 21-44 and phase 2 from week 45-64. In trial 1 hens resulted with good laying performances during 336 days. There were no significant differences in performance between feed treatments (control resp. phase feeding). Trial 2 lasted over 11 laying periods (322 days). There was a significant difference in laying performance between feed treatments. Hens with feed "NPr" reached a significant higher laying performance than hens with phase feeding. The average egg weight of hens with feed "NPr" was significant lower than these of hens fed "control" feed. There was no difference in feed consumption. These two trials showed that a reduction of raw protein and phosphorus contents didn't result in negative effects on performance compared to control feed.

Effect of Feed Restriction on the Production Parameters, Carcass and Meat Quality of Heat Stressed Broilers

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The experimental groups were the feed restrected (R) and the control group (C). The poultry house was heated about 28°C (between 10am to 14pm) when the chicks reached the age of 21 days. The feed restriction (from 10 am to 14 pm) started at the age of 25 days. The live weight at 42d of age was better in the group R (2047g) than in the group C (1916g), ($P \leq 0.05$). FCR (21-42 days) was better in the group R than in C. The abdominal fat % was lower in the group R than in the group C ($P \leq 0.05$). Dry matter % of thigh and breast meat was higher in the group C than in R, ($P \leq 0.01$). Fat % of thigh and breast meat was also higher in the group C than in R, ($P \leq 0.01$). Protein % of thigh was lower in the group C than in R ($P \leq 0.01$) and protein % of breast meat was higher in the group C than in R, ($P \leq 0.01$). Ash % of thigh was higher in the group C than in R, ($P \leq 0.05$) and ash % of breast meat was higher in the group R than in C, ($P \leq 0.01$).

Influence of different feed restriction programs during rearing on reproductive performance of broiler breeder

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The research was conducted to study the effect of various quantitative feed restriction programs during rearing of broiler breeder on growth and subsequent reproductive performance.A 4X2 factorial experiment consisting Four quantitative feed restriction methods including (daily, five days a week, six days a week and skip-a-day studied in both sexes) with four replicate in each treatment and based on a random completely design during 3 to 22 week.In the end of the breeder period were measured body weight, the coefficient variation of body weight, feed efficiency.In addition,birds stress assessed by determining cholesterol concentration and heterophil to lymphocyte ratio.The results showed that in birds treated by skip-a-day feed restriction as compared with other treatments reduced body weight and feed efficiency and increased plasma cholesterol ($P<0.05$) and heterophil to lymphocyte ratio in female. The females' body weight uniformity was highest in six days a week program at the end of breeding period. The fertility and hatchability percentage was significant lowest in birds with daily feeding program than six days to week, five days to week skip-a-day feeding program and the highest fertility and hatchability percentage was observed in five days a week program.

The balance of macroelements and mechanical parameters of tibia in chickens fed mixtures diversified in calcium to phosphorus ratio

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The "turn over" of some macroelements as calcium and phosphorus in organisms in relationship to their concentration in diets, influenced the skeletal system development, especially on bone formation, body weight growth etc. The 128 Hubbard male broiler chickens in age between 1st and 28th days of life were fed isoprotein and isoenergetical diets, differed in calcium and available phosphorus level: group I Ca 11.0 g/kg and 4.50 g/kg of Pavail. (Ca:Pavail. 2.44:1), group II - 9.0 g/kg of Ca and 3.70 g/kg of Pavail. (Ca:Pavail. 2.44:1), group III - Ca 11.0 g/kg and Pavail. 3.70 g/kg (Ca:Pavail. 2.96:1), group IV - 9.0 g/kg of Ca and 4.50 g/kg of Pavail. (Ca:Pavail. 2:1). The retention of Ca, P and tibia mechanical parameters were estimated in 7 and 28 days of life. Use in nutrition of chickens diets diversified in calcium to phosphorus avail. level increased the calcium retention when diets contained higher phosphorus content and phosphorus retention when diets contained a lower phosphorus level 3.7g/kg. The better tibia quality based on evaluation of strength in maximal force was found in group fed diets balanced with calcium to phosphorus ratio 2.44:1 or higher calcium level 11.0g/kg. ($P<0.05$)

Session III
Nutrition and Health

Invited Papers

Mechanisms of Action of Nutritional Tools to Control Intestinal Zoonotic Pathogens

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Poultry can carry different zoonotic pathogens in their intestinal tract, including Salmonella and Campylobacter. Recent E.U. regulations constitute an incentive for the poultry producers to take measures aiming at reducing the degree of contamination in the live birds. Moreover, for Salmonella national control plans are implemented. Many different tools are avialable that can help reducing the level of contamination. Among these tools, numerous feed additives are on the market for which a claim is made with respect to reduction of carriage of Salmonella and other zoonotic agents. Most of these additives can be classified as prebiotics, probiotics, synbiotics, short chain fatty acids or mixtures of natural plant extracts. Most claims are based on trial and error experiments. In recent years however, both in vivo and in vitro experiments have provided a better understanding of the pathogenesis of the carrier state in chickens infected with different zoonotic agents. Simultaneously, insight has grown in specific and non-specific protection mechanisms in the chicken intestinal tract. By combining new information on the intestinal mucosal barrier with new data on pathogenesis of the infections, a rational explanation can be provided for the activity of certain feed additives. Some of the newly discovered mechanisms appear to be generic. Therefore in the near future it may be possible to exploit an to steer these intestinal mucosal protection mechanisms.

Feeding animal or microflora: the nutritional dilemma

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The microflora of the digestive tract of poultry is still incompletely known. But the withdrawal of the antibiotic growth promotants (AGPs) has resulted in an increased interest in the role of the microflora of the digestive tract and its controle in birds. It is necessary to gain a better knowledge of the microflora of the digestive tract and its effect to be able to propose effective AGP alternatives, but also to better understand how works the whole digestive system. The current knowledge on the digestive flora shows a strong interaction between the microbial populations and their host. Particularly, there is a competition for nutrients, and depending on the diet composition and presentation, the growth of some bacteria or the growth of the animal is favoured. Moreover, among the microbial population, beneficial bacteria are continuously competing with pathogens through competitive exclusion. Thus, nutrition offers an array of approaches to influence different bacterial control mechanisms that play a role in competitive exclusion, including specific diet formulations or the use of feed additives. The main objectives of these approaches are to enhance the performance of the birds as well as to improve their health status.

Coccidiosis in poultry: review on diagnosis, control, prevention and interaction with overall gut health

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Coccidiosis in poultry is still considered as one of the main diseases affecting performance of poultry reared under intensive production systems. Although a lot of research efforts have been allocated towards molecular techniques, and a lot of progress has been noted in this field, practical use of these techniques are not yet common, except in the field of diagnostics, where several Polymerase Chain Reaction (PCR) tests for chicken Eimeria spp. are available today. Still, with currently available diagnostic methods such as oocyst counts and lesion scoring, an interpretation of the impact of (subclinical) coccidiosis is not easy. Another problem difficult to address with currently available tools is interpretation of the efficacy of an anticoccidial program. Anticoccidial sensitivity testing is the only reproducible method available today, but interpretation is far from easy. These findings make that, although coccidiosis is not perceived as a major problem in poultry production, economical impact of coccidiosis is most probably underestimated and optimisation of anticoccidial programmes might be advantageous to the broiler industry. In addition to this, a link between subclinical coccidiosis and bacterial enteritis complicates choosing the right tools and strategy for poultry producers. Sound shuttle and rotation programs can be part of the answer in order to not only control clinical, but also subclinical coccidiosis.

Short Communications

Anticoccidial drug sensitivity of the Coccidial Vaccine HIPRACOX BROILERS

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The attenuated Eimeria species/strains included in the coccidiosis vaccine HIPRACOX BROILERS: Eimeria acervulina, maxima, mitis, praecox, and tenella were evaluated for their anticoccidial drug sensitivity. Each strain was independently examined. The test treatments were nonmedicated noninfected, nonmedicated infected (NMI), Diclazuril (1 ppm), Lasalocid sodium (125 ppm), Maduramicin (5 ppm), Monensin sodium (125 ppm), Narasin (70 ppm), Nicarbazin (125 ppm), Robenidine (36 ppm) and Salinomycin sodium (70 ppm). Six days post inoculation, birds and feed were weighed and coccidial lesions scored. Because E. mitis and E. praecox do not produce discernable coccidial intestinal lesions, dropping scores and Day 5-7 oocyst shedding (OPG) were used for these two species. The challenge for all species was sufficient to determine anticoccidial drug sensitivity. All medicated challenged birds had significantly ($P<0.05$) higher live weight gain and lower feed conversion compared to NMIs. All medicated challenged birds had significantly ($P<0.05$) lower lesion scores or dropping score and OPGs than NMIs. All species were shown to be very sensitive to all anticoccidial drugs included in the study. Vaccination with the anticoccidial drug sensitive strains found in this vaccine should produce increased anticoccidial drug sensitivity.

Table 1. Mean ASTs

Treatment	Feed conversion	Live wt. gain (kg)	Lesion score	Dropping score	OPG
1. NMU	1.448 b	0.465 a	0.0 c	0.0 b	0.0 b
2. NMI	1.648 a	0.388 b	2.2 a	2.2 a	2.2 a
3. Monensin 125 ppm	1.472 b	0.453 a	0.7 b	0.2 b	0.2 b
4. Nicarbazin 125 ppm	1.493 b	0.439 a	0.4 bc	0.2 b	0.2 b
5. Narasin 70 ppm	1.487 b	0.452 a	0.8 b	0.3 b	0.3 b
6. Salinomycin 70 ppm	1.487 b	0.452 a	0.5 b	0.0 b	0.0 b
7. Lasalocid 125 ppm	1.489 b	0.448 a	0.4 bc	0.5 b	0.5 b
8. Maduramicin 5 ppm	1.483 b	0.456 a	0.3 bc	0.2 b	0.2 b
9. Diclazuril 1 ppm	1.490 b	0.451 a	0.4 bc	0.0 b	0.0 b
10. Robenidine 36 ppm	1.473 b	0.451 a	0.4 bc	0.2 b	0.2 b

a-c Means differ significantly $P< 0.05$

Effect of pea and probiotic and/or acidifier supplementation on growth performance and composition of caecal microbiota of broiler chicken

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Growth performance and composition of caecal microflora were measured in broiler chickens fed diets formulated with/without white pea and supplemented with dietary probiotic and/or encapsulated acidifier. One-day-old broiler females allotted into 8 groups of 12 birds and maintained individually were fed isoprotein and isoenergetic wheat and soybean meal-based diets with/without white pea (150 g/kg), unsupplemented or supplemented with probiotic (1 g/kg)and/or acidifier (1 g/kg). Performance was measured for 5 weeks, birds were killed and samples of caecal digesta prepared. The caecal microbiota was characterised by fluorescent in situ hybridization (FISH) and terminal-restriction fragment length polymorphism (T-RFLP). Inclusion of pea into diet increased feed intake, but negatively affected FCR ($P<0.05$), while neither probiotic nor acidifier supplementation affected performance. Total bacterial numbers in caecal contents were higher in birds fed pea diets ($P<0.01$), but were not affected by any dietary supplement. Neither pea inclusion nor probiotic supplementation affected the Lactobacillus/Enterococcus and Streptococcus/Lactococcus counts in caecal contents. But, the acidifier supplementation increased Lactobacillus/Enterococcus counts. In conclusion, dietary inclusion of pea and encapsulated acidifiers may change the bacterial community structure in the distal parts of the chicken gastrointestinal tract.

Effect of diets with different fibrous contents on broiler gut microflora and short-chain fatty acid (SCFA) production

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Fibers are dietary indigestible carbohydrates supplements which play an important role in avian digestive physiology and thus in production performances. In this study, we examined effects of diets on intestinal and caecal microflora and on production of SCFA in 21-day-old broilers. Diets differed in fibrous content (3, 4.5 or 6% of crude fiber, e.g. T1, T3, and T5, respectively) or in nature of fiber (T6 and T7). Five birds per diet were sacrificed at day 21 and microflora of their intestinal and caecal contents were analyzed using PCR-DGGE method with universal eubacterial 16S rDNA primers. In intestines, lactobacilli were the major bacterial population. However, several supplementary high intensity bands were found in the T5 diet. In caeca, profiles were rather constant, but some new bands appeared in the three experimental group diets T5, T6 and T7. Variations in SCFA were more significant in caeca samples. A significant increase in butyrate was observed in broilers on diet T5, T6 and T7. In contrast, acetate and lactate were the major SCFA observed for broilers on diet T1 and T3. In conclusion, these results provide insights into effect of fiber on the modulation of the broiler gut microbiota and on the SCFA production.

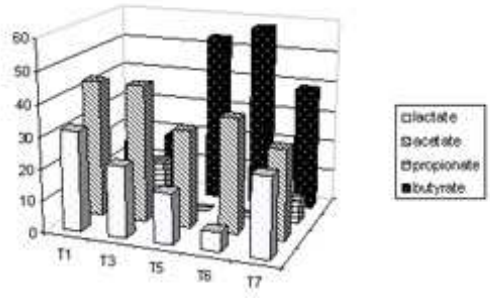

Figure 1. Relative concentration (%) of SCFA in caeca samples from the different diets (T1 to T7)

The Effects of Fructo-Oligosaccharides or Whole Wheat on the Performance and the Digestive Tract of Broiler Chickens

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The objective of this experiment was to study two different feeding methods, which could potentially alter the gut microflora, the structure and/or the function of the digestive tract and thereby improve the performance of broilers. In this study 4 different treatments were studied: a negative control (C), a positive control with 10 ppm avilamycin (AV), 0.06% FOS and 40% of whole wheat (WW). The performance and the characteristics of the digestive tract were studied (bacterial counts, gut morphology and activity of different intestinal enzymes). The data were analysed with one-way ANOVA and the means were compared using Student-Newman-Keuls test ($p \leq 0.05$). Treatment AV improved the live weight and the FCR compared to treatment C, which might be due to a reduction in the number of bacteria in the caeca or an increased activity of one of the measured digestive enzymes. FOS resulted in a reduction in live weight, which can be explained by a lower feed intake, they also resulted in an improved FCR, probably due to a higher activity of a digestive enzyme. The inclusion of whole wheat resulted in a reduced live weight which could be caused by a numerically lower intake.

Table: Effect of feeding (C), Avilamycin (AV), fructo-oligosaccharides (FOS) and whole wheat (WW) on the live weight, FCR and feed intake of broiler chickens

	C	AV	FOS	WW	P
Live weight (g)					
Day 11	242 ± 2,2^{b}	255 ± 2,2^{a}	221 ± 2,3^{c}	245 ± 2,1^{b}	<0,0001
Day 25	994 ± 10,5^{b}	1078 ± 10,5^{a}	910 ± 12,8^{d}	946 ± 9,3^{c}	<0,0001
Day 36	1854 ± 18,6^{b}	2006 ± 18,5^{a}	1745 ± 23,0^{e}	1744 ± 17,2^{e}	<0,0001
Day 42	2453 ± 23,2^{b}	2647 ± 22,8^{a}	2328 ± 28,0^{e}	2332 ± 21,4^{e}	<0,0001
FCR					
Day 1-11	1,25 ± 0,008^{bc}	1,22 ± 0,004^{ab}	1,28 ± 0,009^{c}	1,19 ± 0,019^{a}	0,0002
Day 12-25	1,50 ± 0,006^{ab}	1,46 ± 0,010^{a}	1,45 ± 0,011^{a}	1,53 ± 0,023^{b}	0,0018
Day 26-36	1,77 ± 0,011^{c}	1,73 ± 0,008^{b}	1,69 ± 0,008^{a}	1,80 ± 0,014^{c}	<0,0001
Day 37-42	1,85 ± 0,019	1,83 ± 0,013	1,81 ± 0,018	1,79 ± 0,022	0,1539
Day 1-42	1,64 ± 0,004^{b}	1,61 ± 0,005^{a}	1,60 ± 0,006^{a}	1,65 ± 0,009^{b}	<0,0001
Feed intake (g/day)					
Day 1-11	25 ± 0,2^{ab}	26 ± 0,3^{a}	22 ± 0,5^{c}	24 ± 0,4^{b}	<0,0001
Day 12-25	80 ±1,1^{ab}	84 ± 1,3^{a}	70 ± 2,2^{c}	75 ± 1,9^{b}	<0,0001
Day 26-36	134 ± 3,5^{b}	144 ± 1,5^{a}	126 ± 4,6^{b}	128 ± 2,0^{b}	0,0032
Day 37-42	182 ± 2,2^{ab}	192 ± 3,6^{a}	174 ± 5,2^{b}	175 ± 3,1^{b}	0,0094
Day 1-42	91 ± 1,6^{ab}	96 ± 1,0^{a}	84 ± 2,8^{c}	87 ± 1,5^{bc}	0,0010

(a-c) The means ± standard error in the same line followed by different letters indicate a significant difference (p<0,05)

Influence of a staggered Savoury content in hen diets on laying and breeding performance

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Herbs or herbal plant extracts can beneficially affect the feed intake, secretion of digestive juices and the immune system of animals. The objective of these studies was to determine the effect of a diet supplemented with savoury on performance of laying hens. Laying hybrids were allocated to 4 or 6 groups with 36 hens per group over 13 laying month. Three times eggs were stored in the incubator. The effect of savoury (5/10 g/kg) was investigated and in Trial 2, two groups could choose between a control diet and a diet with Savoury. In Trial 1 10 g Savoury significantly decreased egg weight in comparison to the control and the 5 g Savoury group. In Trial 2 supplement of Savoury decreased the daily feed intake of the hens. In the two groups choosing diets, feed intake of the control diet was significantly higher. The daily egg production mass was significantly reduced in the groups with Savoury diet and the choice diet group with 5 g Savoury. Only in the choice group with 10 g Savoury did the hens achieve the same level of egg mass production as the control animals. The hatching parameters were not influenced by the feed supplement.

Posters

The effects of nonlphenol on growth, egg production and hatching results in the quail

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Alkylphenolpolyethoxylates (APEs) are used as non-ionic surfactants and anti-oxidants in detergents, herbicides, pesticides, paints and plasticware. In this study, it was sought to determine the effects of nonylphenol (NP), a derivative of (APEs), on growth, feed conversion ratio, egg production, and hatching in quails. Quails were exposed to 0 (control), 10, 100, 500, 1000 and 5000 μg NP/kg feed. Data were analyzed by one-way ANOVA followed by TUKEY's test. Results showed that nonylphenol did not have significant effect ($P>0.05$) on growth and feed conversion ratio in quails among all groups in the first six weeks of treatment. Although nonylphenol did not have significant effect on egg production and feed consumption in layers after six weeks of treatment, there was a significant reduction in egg production after ten weeks of treatment in quails exposed to the highest concentration of NP ($P<0.05$). It was also determined that nonylphenol did not have significant effect on hatching results ($P>0.05$). In conclusion, it can be said that NP could have adverse effects on egg production when quail exposed to higher concentrations of NP in a longer period of time.

Effets of Pediococcus acidilactici Feed supplementation on Broiler chicken performances, Immunity and Health

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16000 broiler chickens were assigned in two groups: experimental (10ˆ {9}cfu of Pediococcus acidilactici /kg of feed MA18/5M) and control. In each group 8000 broiler chickens were allocated in the same batch and divided by a physical barrier. Individual live weight of a sample of 200 birds for each group from day 1 to day 56 was measured weekly. Feed intake, feed efficiency, mortality, carcass quality, serum lipids (cholesterol and triglycerides) and number of white blood cells, were recorded per group. The administration of Pediococcus acidilactici affected positively the growth performance of broilers (2586.43 vs 2252.79 g, p <0.01) and feed conversion ratio (2.00 vs 2.5). There were no significant difference between groups in dressing, breast meat and thigh percent, at the day 56. Analysis of variance showed significant difference between treatments for serum lipids (cholesterol, 0.84±00.9 vs 1.09±0.11 g/l and triglycerides, 0.84±0.06 vs 0.86±0.06 g/l). Mortality was almost similar in both groups (6.56 vs 6.51). The number of white blood cells was significantly affected by dietary treatment (25260 ± 3258 vs 30365±3210 n/mm3).

Researches on the immunological reactivity of domestic birds during hydric deficiency

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The researchers were carried out on a 49 adult hens livestock of special breeds, 24 hens being used for developing the partial hydric deficiency and infection and the rest ones for two control groups. The partial hydric deficiency status was realized by strictly individual administering of water in the amount of 30% from the initial intake. The infection of poultry was developed by the aid of a vaccinal strain, Pasteurella multocida var. avium, au attenuated strain used against the avian cholera. The partial hydric deficiency in hen has as a characteristic feature a leucopenia, which has the highest level in the 8-10 days after the partial hydric deficiency. The significant modifications are presented into the ratio between the serous protein fractions. The ascorbinemia in the experienced group does not present statistic significant variations. The piruvicaemia in the experienced group presents an increasing, the maximum values being recorded at 14 days after deficienced started. The noticed modifications are linked to significant variations of packed cell volume, in the increasing way of this, correlated with the hydric deficiency evolution. Poultry under the partial hydric deficiency become more sensible beside the pathogen action of Pasteurella multocida var. avium, the doses of 0.5 ml broth culture of 24 days vaccinal strain of avium pasteurella being well supported by control birds, while the hydric deficienced ones are dying, having characteristic lesions of cholera. The severe leucopenia, the decreasing of γ-globulins and the increasing of piruvicemia contribute to the increasing of partial hydric deficienced poultry sensivity beside the pasteurellic infection.

Differences between Generic and Brand Specific Approved (BSA) Anticoccidials

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Different maduramicin 1%-premixes were compared for evaluation of quality. Anticoccidial premixes consist of two elements: active compound and carrier. Eleven generic premixes originating from different countries were compared with Cygro®, the only EU BSA-approved maduramicin. Maduramicin concentrations were analysed and compared. Only Cygro® contained the claimed concentration. One generic had lower concentration than claimed (0.75%); all the other generics had at least 10% more active than claimed. Underdosing anticoccidials can cause poor control of coccidiosis, higher oocyst output and has been suggested to induce resistance faster. Overdosing maduramicin can cause target animal safety problems. Premix quality was evaluated, using laser diffraction equipment, for parameters that impact homogeneity and thus imply a risk for under- or overdosing. Next to Cygro®, only three out of eleven generics had good results for premix features. Combined with active evaluation, just one generic would have passed release specifications of Cygro®. Another batch of this generic had excessive maduramicin content and poor particle strength. As a conclusion, these results confirm the need for high requirements for anticoccidial premix registrations such as BSA in the EU. Generic premixes might cause significant problems during (poor parasitological control, toxicity) and after use (higher infection pressure, faster resistance).

Plant of the Juglandaceae family as alternative to antibiotic growth promoters in broiler production

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Two experiments were conducted in order to evaluate the effect of the dietary addition of a plant belonging to the Juglandaceae family and strongly inhibiting in vitro growth of Clostridium perfringens, on the production results of male broilers (240 birds, Ross 308). From d11 to d28, the birds received a diet with a high content of fishmeal and animal fat, which was formulated to increase the intestinal growth of Clostridium perfringens. The diet was fed either not supplemented or supplemented with 1% freeze-dried plant material (green leaves) or salinomycin (60 mg/kg feed). At 28 d, the dietary inclusion of the plant material increased the body weight (1338 g vs. 1165g, $P< 0.01$) and improved the FCR (kg feed/kg body weight, 1.38 vs. 1.52, $P<0.001$). Further, in one of the two experiments the intestinal Clostridium perfringens counts were numerically reduced in the range of 1.2-1.5 log units. The effect of salinomycin with respect to the improvement of the production results and intestinal growth inhibition of Clostridium perfringens was superior to that of the plant material. However, it is concluded that this plant of the Juglandaceae family has a potential as an alternative to antibiotic growth promoters.

Keywords: Juglandaceae; broilers; growth promotion; Clostridium perfringens

TNIBetain Improves Broiler Chicken Performance and Carcass Quality under Heat Stress Conditions

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In an experiment with 300 male and 300 female Ross 308 broiler chickens housed in floor pens, the effect of betaine (TNIbetain) on bird performance and carcass and meat quality was studied. The experiment included 3 treatments. Treatment 1 included feeds adequate in methionine and cystine according to CVB (1996) that contained in total 2.4 g/kg choline. In treatments 2 and 3, 1 and 2 g/kg betaine was added to these feeds respectively. Treatments were applied from 0 to 40 days of age. Heat stress was introduced by increasing temperature to 35 °C during 10 hours of the day. During the rest of the day, temperature was gradually decreased to 25 °C. The addition of 1 and 2 g/kg betaine to the feed improved feed conversion ratio from 1.322 to 1.274 and 1.256 respectively from 0 to 14 days of age (P=0.0153) and body weight at 40 days of age from 2093 g to 2116 and 2158 g respectively (P=0.0376). The addition of 1 and 2 g/kg betaine to the feed increased breast meat percentage in male chickens from 17.44 to 18.21 and 18.30 respectively (P=0.0350). It was concluded that betaine can improve broiler chicken performance significantly during heat stress.

Methionine requirements for optimal health and welfare in fast-growing organic broilers

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In Sweden, only fast growing broiler hybrids are available for organic production, and due to the required rearing period of 10-12 weeks growth rate restrictions are needed. Organic feed legislation further complicates the composition of a well balanced diet, which may affect animal health. The experiment comprised 180 Ross 308 broilers divided over 3 dietary treatments; a low crude protein and methionine diet; or a high crude protein diet with similar amino acid levels as used in conventional production, both composed according to organic standards; or the low protein diet supplemented with lysine, methionine and threonine up to levels of the high protein diet; Chickens were immunologically challenged with an inactivated IBDV vaccine, and antibody titres, heterophil/lymphocyte ratios, and lymphoid organ weights were studied. The high protein diet gave the highest live weight and the most efficient FCR. Supplementing the low protein diet with amino acids increased live weight and FCR, even though the effect on FCR at 10 wks was less pronounced. Dietary treatments did not significantly affect any of the immune or stress related parameters measured, indicating that amino acid levels obtained in the organic diets studied are sufficient for the birds to maintain an adequate immune response.

Individual Variability in the Digestive Flora of the Chicken Analysed by Molecular Fingerprint

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With the withdrawal of antibiotic growth promotants, a better knowledge and control of the microflora of the digestive tract is essential for animal feeding. The digestive bacterial community varies between individuals. This variability may be lower in broilers due to the increased homogeneity in animals by genetic selection. Individual variability was studied at various ages according to diet. Broilers were fed with a diet composed of wheat either ground (G) or as whole grains (W) given as free choice feeding. Caecal contents of 6 birds per diet were sampled weekly (from 16 to 44 d) to study the predominant bacterial population using a molecular fingerprinting method. Similarity coefficients (Pearson correlation method) were calculated for each pair of profiles, and were compared between diets with Student's t-test ($p < 0.05$). Gel profiles showed inter-individual differences (Figure). At some ages, this variability differed according to diet. At 23 d of age, inter-individual differences appeared higher with W diet than with G diet which may be due to inter-individual variability of whole wheat intake with W diet. However, at 37 and 44 d, W diet led to higher microflora homogeneity between birds than G diet. The digestive microflora of broilers showed an inter-individual variability that can be modified by diet. This variability must be taken into account when studying factors influencing microflora.

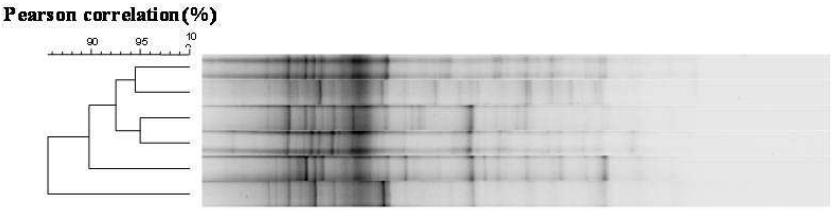

Figure . Inter-individual variability of the microflora of caecal content of chickens (ground wheat diet, 30 days)

Characterization of Non-Specific Digestive Disorders in Turkey using Intestinal Morphometry

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We tried to characterize the non-specific digestive disorders (NSDD) that are increasing in turkey production using intestinal morphometry. Analyses were carried out on 304 turkeys (42 d) from 19 flocks. Turkeys were autopsied to distinguish healthy birds from those with specific or NSDD. Morphometry of the small intestine of healthy birds and birds suffering from NSDD was determined by a histological method (microdissection). Means were subjected to analysis of variance and compared by Student-Newman-Keuls test ($p < 0.05$). Turkeys with NSDD, non-specific enteritis (NSE) or maldigestion, had a lower body weight than healthy birds (Table). Analysis of intestinal morphometry of turkey with NSE or maldigestion showed a lower intestinal villi development and an increased heterogeneity of the size of these structures (Table). With maldigestion, intestinal crypt depth was increased. The heterogeneity of the crypt depth was increased with NSE or maldigestion. Thus, with NSDD, the smaller villi size led to lower digestive capacity of the intestine. With maldigestion, the increase in crypt depth, place of cell turn-over and mucus production, implied a significant nutritional cost for the animal which uses nutrients for digestive tract renewal instead of using it for its growth. Moreover, the heterogeneity of villi and crypts morphology showed a disorder in intestinal development. NSDD were characterized by important modifications of intestinal structure that might partly explain the lower body weights.

Table. Histological measurements of the intestine wall (jejunum) of turkey (42 d)

Parameter			Turkey group		
			Healthy	NSE [1]	Maldigestion
Number of birds			60	95	41
Number of flocks			6	11	5
Bird weight (g)			2204 ± 48 a	1888 ± 48 b	1680 ± 66 c
Measure	Villus	Height (µm)	1516 ± 37 a	1296 ± 36 b	1234 ± 57 b
		Surface (µm²)	895 888 ± 45 771 a	715 342 ± 34 938 b	680 904 ± 74 688 b
	Crypt	Depth (µm)	267 ± 9 b	272 ± 7 b	304 ± 9 a
		Surface (µm²)	17 490 ± 670	17 688 ± 679	19 803 ± 731
Variation of measure (SE/mean x 100)	Villus	Height (%)	6.3 ± 0.4 b	9.3 ± 0.4 a	8.0 ± 0.5 a
		Surface (%)	19.5 ± 1.2	23.4 ± 1.0	20.4 ± 1.1
	Crypt	Depth (%)	6.2 ± 0.3 b	8.3 ± 0.3 a	7.4 ± 0.4 a
		Surface (%)	14.9 ± 0.8 b	17.9 ± 0.6 a	16.3 ± 0.7 ab

(a-c) Mean (± standard error) with different letters for a given parameter differ significantly ($p \leq 0.05$)
[1] NSE : non-specific enteritis

Results of Clostridium perfringens ELISA test profiles in commercial broiler chickens in various broiler integrations in France

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Poultry digestive disorders are dominated by the Gram positive flora disbalance, especially Clostridium perfringens which may be the necrotic enteritis or dysbacteriosis causal agent. The specific culture needs of this bacteria and difficulties in interpretation of bacteriological findings make a definitive diagnosis difficult. A Clostridium perfringens ELISA test provides a practical way of improving detection of Clostridium perfringens and producing farm profiles through routine analysis of fecal samples. This study, conducted in various commercial broiler integrations, allowed an assessment of the disease and determination that a considerable number of digestive disorders are associated with Clostridium perfringens but also that there was substantial variability among flocks and broiler producers. These studies also indicated that the anticoccidial program was a contributing factor in influencing the level of Clostridium perfringens in poultry droppings.

The Use of Short and Medium Chain Fatty Acids as an Alternative to Antibiotic Growth Promoters in Broilers Infected with Malabsortion Syndrome

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In an experiment with 624 malabsorption syndrome infected (MAS-infected) Ross-308 male broiler chickens the effect of a mixture of short and medium chain fatty acids on performance of animals was studied. Animals were housed at day-old in one room with 48 pens. Infection was spread out by two seeder birds per pen, infected at day 0 and removed at day 14. The experiment included 3 treatments of 16 replicates each. Treatment 1 was the control group. In treatments 2 and 3, 0.20%, 0.15% and 0.10% of medium chain fatty acids (MCFA, treatment 2) or a mixture of short (SCFA) and MCFA (Selacid Green Growth Poultry, Selko, treatment 3) were included in the starter, grower and finisher diets, respectively. Antibiotic growth promoters were not included in any of the feeds. Data were subjected to analysis of variance. At 14 days of age, the addition of short and medium chain fatty acids resulted in significantly higher average daily gain of birds compared to the control and MCFA groups. At 42 d, the addition of the mixture gave numerical higher broiler growth than the others treatments. The results of the experiment showed that the mixture of short and MCFA presents beneficial effects when animal health is impaired.
Keywords: short chain fatty acids; medium chain fatty acids; malabsorption syndrome; broilers

Effect of vitamin E on performance and immune response of broiler chicks

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The effect of dietary level of vitamin E(VE) on performance and immune response of broilers was studied. Immunity was assessed as antibody production to infectious bronchitis virus(IBV) and Newcastle Disease virus(NDV),mitogenic response to phytohemagglutinin A(PHA) and concanavalin A(conA) , cutaneous basophil hypersensitivity (CBH) to PHA. A range of vitamin E(0,25,50,75,and 100 IU/kg) were supplemented to a basal diet(corn-soy) containing 10.5 IU of vitamin E/kg. Maximum body weight gain, daily weight gain(21-42d) and efficiency of feed utilization were obtained in chicks fed diets with supplemented 50Iu/kg vitamin E. Lymphoid organ weights and daily weight gain(0-21) were not influenced by VE. Humoral immunologic response showed that antibody titer to Newcastle disease vaccines were highest($p<0.05$) in groups receiving 50 IU/kg diet VE. Adding 50 and 75 IU/kg VE to the diets significantly increased($p<0.05$) antibody responses to IBV. CBH to PHA was significantly increased($p<0.05$) in chicken fed 50,75 and 100 IU vitamin E. Mitogenic responses were improved($p<0.05$) by supplemented 75 IU vitamin E for PHA.Overall,the results of this experiment showed that 50 and 75 IU/kg VE, improved some of performance parameters and immune response in broiler chicks, respectively.
Keywords: vitamin E; immune response; performance; broiler

Effects of a Dietary Yeast Extract on Hematological Parameters, Heterophil Function, and Bacterial Clearance in Turkey Poults Challenged with Escherichia coli and Subjected to Transport Stress

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There is a need to develop nutritional methods for controlling pathogens in poultry production. A standardized yeast extract supplement, Alphamuneô (YE), was added to turkey poult diets. Male poults were challenged by air sac injection with 60 cfu of *E. coli* at 1 week of age. At 3 weeks of age challenged birds were subjected to transport stress and birds were bled and necropsied the following morning. Blood cell numbers and percentages and hematological parameters were determined. Oxidative burst activity of isolated heterophils was measured using stimulation with phorbol myristate acetate and a 2',7'-dichlorofluorescein diacetate (DCF-DA) assay. Data was analyzed using GLM and LS Means procedures of the SAS® program. The percentage of heterophils in peripheral blood was increased and their oxidative burst activity was stimulated by YE. Transport stress also increased oxidative burst and this increase was modulated by YE treatment. Serum levels of calcium, phosphorus, and triglycerides were decreased and uric acid levels, erythrocyte numbers, hemoglobin and hematocrit were increased by YE supplementation. Bacteria were isolated from the air sac and liver of a lower percentage of birds provided with YE. These results suggest that dietary YE has potential as a non-antibiotic alternative for decreasing bacterial pathogens in turkey production.

KEYWORDS: turkeys; yeast extract; Alphamuneô; transport stress; heterophils

The effect of increased dietary sodium chloride on spontaneous turkey cardiomyopathy

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Two hundreds two day-old turkey poults were wing-banded and placed randomly in 6 groups and 24 replicates. The six groups received commercial turkey starter diet contains 0.12, 0.17, 0.22, 0.27, 0.32 and 0.37 per cent of sodium respectively. They received food and water ad- libitum during this study. Suffering and dead birds weighed and were examined for post mortem and cardiomyopathy and a summery of necropsy was reported. Live body weight of turkey poults measured individually on days 1, 2, 5 and 19. On nineteenth day all the poults were weighed and killed by cervical dislocation in order to study the hearts for cardiomyopathy. The hearts of killed birds is immediately removed and the atria, major vessels were cut off and were weighed to determine the hearts weight. For determination of cardiomyopathy the ratio of the inner cavity of left ventricle to the total diameter of left ventricle (IClv/TDlv) was calculated. Myopathic ratio (IClv/TDlv) for groups 1, 2, 3, 4, 5 and 6 were measured: 0.1±0.14, 0.29±0.13, 0.3±0.12, 0.34±0.15, 0.35±0.12 and 0.36±0.1 respectively. Myopathic ratio of group 1 was significantly lower than groups 2, 3, 4, 5 and 6 ($P<0.05$). There was not significant differce on hearts weight of the six turkey poults groups on nineteenth day ($P>0.05$).

Effect of different levels of chromium chloride on performance and antibody titre against Newcastle and Avian Influenza virus in broiler chicks

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Three hundred one-day-old male broilers (Ross 308) were allocated to five treatments with four replicates in a completely randomized design. Treatments supplemented with 0 (control), 400, 800, 1200 or 1600 ppb chromium in the form of chromium chloride. All birds were intramuscularly immunized with killed vaccine of Newcastle and Avian Influenza (H9 N2) virus at 8 d. On days 18 and 28 blood samples were collected from the wing vein of eight birds per treatment and serum antibody titres against Newcastle and Influenza virus were determined. At 42 days of age, two chicks from each replicate were slaughtered, spleen and bursa of fabricius were removed, weighed and expressed as a percentage of live body weight. Body weight, weight gain and feed efficiency improved significantly ($P<0.05$) in broilers fed 1600 ppb supplemental chromium. Feed intake of broilers was not affected by supplemental chromium. Percentage of bursa of fabricius and spleen in broilers fed 1600 ppb chromium increased. Broilers fed chromium supplementation had higher antibody titres against Newcastle and Influenza virus ($P<0.05$). The results of this experiment indicated that chromium supplementation improved performance and antibody titre against Influenza and Newcastle virus in broiler chicks

Supplemental Guanidino Acetic Acid Improved Feed Conversion, Weight Gain, and Breast Meat Yield in Male and Female Broilers

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After the ban of meat and bone meal in 2001, European poultry producers observed a certain drop in performance. This may be due to the lack of creatine supply because vegetable feed ingredients do not contain this semi-essential nutrient. Guanidino acetic acid (GAA), which is a natural precursor of creatine, was supplemented (0.04, 0.06, 0.08, and 0.12 % of diet in form of CreAminoô) to a vegetable diet (negative control). A positive control with 6 % meat and bone meal in feed was also included. 1056 male and 1056 female broilers were each equally distributed to 48 floor pens (eight / treatment) and fed starter and grower diets. At day 42, three birds per pen were sacrificed for carcass evaluation. Weight gain of female broilers fed the negative control diets was lower than that of birds fed the positive control diet ($p<0.05$) - for other performance criteria this effect was only numerical. Supplemental GAA in vegetable diets more than resolved this effect. Analysis of variance revealed that the optimal GAA supplementation level was somewhere between 0.06 % ($p<0.05$, breast yield - males) and 0.12 % ($p<0.05$, feed conversion - males and breast yield - females). In a few cases regression analysis was possible suggesting optimum GAA supplementation levels of 0.05 % (weight gain) and 0.11 % (feed conversion).

Supplemental Guanidino Acetic Acid Affects Energy Metabolism of Broilers

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The semi-essential nutrient creatine is an important molecule in the cellular energy metabolism for short term energy storage. Energy from surplus adenosine tri-phosphate (ATP) can quickly be overtaken by creatine and vice versa. Supplemental guanidino acetic acid (GAA) is a natural precursor of creatine and might be used as creatine source. Either no (negative control), 0.20, 0.40, or 0.60 g/kg GAA were added to pure vegetable basal starter, grower, and finisher diets and fed to 3120 male broilers (six pens with 130 birds per treatment) for 41 days. GAA supplementation significantly improved feed conversion ratio (0.40 g/kg GAA; $p<0.05$). At day 41 five birds per pen were slaughtered and breast meat samples were collected for biochemical evaluation. The muscle creatine content gradually increased from 3986 (negative control) to 4560 mg/kg breast meat (0.60 g/kg GAA; $p<0.05$). In contrast, the muscle GAA content stepwise decreased with increasing GAA supplementation (from 24 to 4 g/kg, $p<0.05$). One hour post mortem the muscle ATP content was increased up to 0.40 g/kg dietary GAA compared to the control whereas the ADP content was rather unaffected. The muscle AMP and IMP levels gradually declined with increasing dietary GAA up to 0.60 g/kg. Results indicate that supplemental GAA improves the cellular energy metabolism.

The Threonine Requirement of Broiler Chickens during a Subclinical Intestinal Infection

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Besides the threonine (THR) requirement to obtain good performance of broilers, THR is a major component of intestinal mucins and digestive secretions. It is hypothesised that the THR requirement increases when intestinal metabolism is disturbed by increased microbial activity. Higher intestinal THR use will limit THR availability for growth resulting in decreased performance. Two 20-d experiments were performed to determine the optimal THR/LYS ratio in broilers during a subclinical Clostridium infection. 612 Ross broilers were fed a wheat/barley-based diet with an AME-value of 12.1 MJ/kg and CP-content of 19%. Besides an uninfected and infected control, treatments consisted of diets with graded levels of standardized ileal digestible THR/LYS ratios from 0.56 to 0.75 (0.65 is the current advice) and 0.65 to 0.72 in the first and second experiment respectively. Results showed no effect of THR/LYS ratios on necrotic enteritis (NE)-incidence or lesion severity, but results indicated the best production performance at a THR/LYS ratio of 0.65 to 0.70, which exceeds current recommendation of 0.65. It is suggested that increasing dietary THR contents might prevent body protein break-down and thereby alleviating the consequences of NE-infections in poultry on production performances.

Comparison of Impact on Zootechnical Performance of Robenidine, Lasalocid and Monensin in Meat Turkeys during the First Seven Weeks of Production

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A floor pen trial with 300 turkeys was performed to assess the influence of different anticoccidials on zootechnical performance in meat turkeys during the first seven weeks of production under low coccidiosis pressure. Three groups were included, a Cycostat®-treated (robenidine 30 ppm), an Avatec®-treated (lasalocid 90 ppm), and an Elancoban®-treated (monensin 60 ppm) group. All anticoccidial treatments were administered from day 1 to 50. Mortality, body weight (BW), daily growth rate, feed conversion rate (FCR) and European production efficiency factor (EPEF) were assessed. Avatec®- and Cycostat®-treated birds demonstrated significantly better zootechnical performance results (higher BW, daily growth and EPEF) compared with the birds from the Elancoban®-treated group. Overall, the Cycostat®-treated group showed the best zootechnical parameters (higher end weight and EPEF, slightly lower FCR). Since no large differences in FCR were noted, it was demonstrated that the lesser zootechnical results (lower end BW, lower daily growth) in the Elancoban®-treated group were mainly due to lower feed intake. Maintaining an optimal feed intake is often a challenge for turkey producers. Therefore, both Cycostat® and Avatec® might abide a benefit over Elancoban® for turkey producers, even in conditions of limited coccidial challenge.

Evaluation of a Yeast Extract Product, Containing a Guaranteed Range of β-glucans, in Free Range Laying Hens

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A trial was run to evaluate if the inclusion of Alphamune® (autolysed cells from Saccharomyces cerevisia) in the feed ration of free-range laying hens improves performance. One control house and one trial house, each with approximately 8,000 birds, were included in the trial. The hens in the trial house received Alphamune® in the diet at 500 g/ton from 16 weeks of age (point of lay) to 35 weeks of age. The performance of both groups of birds was monitored from 16 until 41 weeks of age by determining egg production, mortality, feed consumption, feed conversion ratio; egg quality, feather cover assessment (every two weeks from 20-29 weeks) and body weight (16-30 weeks). Both groups of birds suffered from an infectious bronchitis challenge at 25 weeks and from another unidentified illness at 34 weeks of age. The birds on Alphamune® produced a higher number of total eggs and first quality eggs and a lower number of seconds. The main difference noted during the trial was that birds on Alphamune® recovered faster (feed consumption, egg mass and egg numbers) than control birds after the illness at 34 weeks, indicating the positive effect of Alphamune® on performance of laying hens.

Indication of Cross-resistance between different Monovalent Ionophores as Determined by an Anticoccidial Sensitivity Test (AST)

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Anticoccidial sensitivity tests (AST's) are used to determine the anticoccidial sensitivity profile of field Eimeria strains with the goal to decide rationally on future anticoccidial programs in order to avoid resistance. In 2006 an anticoccidial sensitivity test (AST) was performed for an integration without clinical coccidiosis problems but with an increased incidence of bacterial enteritis. The farms of the integration were using monensin (full program) for 8 years. When comparing parasitological results and zootechnical performances it was shown that the field isolate proved totally resistant to diclazuril. Robenidine, maduramicin and lasalocid significantly reduced E. acervulina gross lesions, whereas salinomycin and monensin (both monovalent ionophores) reduced them only numerically. Against E. tenella, three anticoccidials proved very significantly effective: robenidine, lasalocid and maduramicin. Salinomycin also significantly reduced E. tenella gross lesions, but monensin showed no effect. Except diclazuril, all other tested anticoccidials were effective in improving zootechnical performance, although, compared to the monovalent ionophores, lasalocid (divalent) and maduramicin (monovalent glycoside) showed the tendency to be more efficacious (numerically higher daily weight gain, higher weight gain improvement), indicating cross-resistance between different ionophore classes did not arise. All results were comparable for monensin and salinomycin, although salinomycin had not been used previously in the farms. In this AST, although not all the data proved to be significant in this set-up, an indication for the existence of cross-resistance between ionophores of the same class was seen.

Microbial equilibrium of Meleagris gallopavo Turkey intestine and its modulation by non-antibiotic feed supplementations

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Turkey is the second produced poultry in Europe after broiler chicken. As animal health and development is dependent on gastrointestinal (GI) microflora, antibiotics were used as growth-promoters until the recent European authority ban. Thus, alternative substitutes are welcome. In present study we evaluate effects of non-antibiotic feed supplementations on modulation of microbial equilibrium in GI tract of Meleagris gallopavo. Five different diets were used: (1) Fructooligosaccharides (sc FOS); (2) essential oil compounds (EO); (3) essential oil extracts (EOX); (4) association of natural plants and EOX; (5) CCPA diet (used as a reference). Ten birds in each diet group were sacrificed at age of 4-wk- and 7-wk- and their intestinal and caecal contents were analyzed. Microbial community was analyzed by using DGGE method with universal eubacterial and Lactobacillus genus-specific 16S rDNA primers. The majority of identified bacteria belong to four genera: Bacteroides, Clostridium, Lactobacillus, and Ruminococcus. We observed modulation in Lactobacillus, Bacteroides and Clostridium microflora depending on age, GI compartment and used diet. These results are relevant and provide insights in understanding of the mechanism of action of the different non-antibiotic feed supplementations on the gut microbiota of turkey.

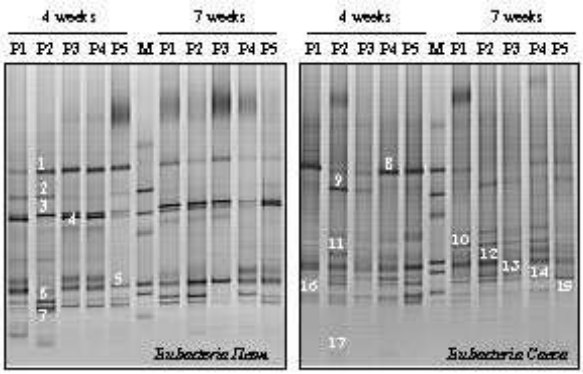

Figure 1. DGGE gels of 16S rDNA gene eubacterial amplifications. M : Marker (Identified genus : bands 1 to 4: Lactobacillus ; band 5 : Escherichia ; bands 6, 7, 10 to 15 : Clostridium ; band 8 : Bacteroides ; band 9 : Ruminococcus ; band 16 and 17 : Bifidobacterium.)

Performance improvement with a feed added coated blend of essential oils, a coated blend of organic and inorganic acids with essential oils, or virginiamycin in broilers challenged with Clostridium perfringens

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The objective was to evaluate the anticlostridial efficacy of feed additives RepaXol, a blend of double coated essential oils (EO), AciXol an encapsulated blend of organic and inorganic acids along with the essential oils (as in EO) (ACI) or virginiamycin, an antibiotic. A randomized block design with 6 replications of 10 birds per cage was used. The treatments were nonmedicated, non-challenged (NMNC), nonmedicated, challenged (NMC), EO 100 ppm, ACI 500 ppm, and virginiamycin (VIR) 22 ppm. Birds were challenged on Day 14 with E. acervulina and E. maxima and on Days 19, 20, and 21 with Clostridium perfringens. The parameters measured were feed conversion and weight gain, Necrotic Enteritis (NE) mortality and NE lesion scores. There was a significant improvement in feed conversions and weight gains for EO, ACI and VIR. The percent NE mortality for NMC was 33 %. There was no significant difference in percent NE mortality between EO (23 %), ACI (22 %) and VIR (12%). All treatments had significantly lower NE lesion scores compared to NMC. This study demonstrated the benefits of adding EO 100 ppm, ACI 500 ppm, or virginiamycin 20 ppm into the feeds of broiler chickens exposed to Clostridium perfringens.

Effect of dietary mannan oligosaccharide (Bio-Mos) on live performance of broiler chickens given an anticoccidial vaccine (Paracox) followed by a mild coccidial challenge

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A 42 days pen trial with 720 Ross 308 males chicks evaluating the effects of Paracox-5 vaccination at d 1, dietary mannan oligosaccharide (MOS; Bio-Mos® at 0.5, 1.0 or 2.0 kg/t) and an Eimeria challenge (15 d of age) on animal performance and intestinal lesions was carried out. Thirty chicks were placed per cage with a floor area of 2.1 m2. A 3-phase feeding program was applied: starter (0-15 d), grower (16-22 d) and finisher (23-42 d). Experimental treatments (4) were as follows: 1) without vaccination, dietary MOS, or coccidiosis challenge; 2) without vaccination and dietary MOS but with a 3-strain pathogenic Eimeria challenge; 3) with Paracox-5 vaccination at hatch and Eimeria challenge but no dietary MOS; and 4) with Paracox-5 vaccination at hatch, dietary MOS, and Eimeria challenge. The pathogenic Eimeria sporulated oocysts were supplied at day 15 via feed (100,000 E. acervulina; 10,000 E. maxima; and 15,000 E. tenella per bird). Coccidiosis lesion scores were recorded at 22 d of age (scored as 0, 1, 2, or 3 with increasing severity). Overall mean lesion scores ($P < 0.001$) were higher in challenged birds. Paracox-5 alone improved 15 d BW, and 1-15 and 15-22 d average daily gain among Eimeria challenged broilers ($P < 0.05$). Dietary MOS significantly improved FRC at 15-42 and 22-42 d periods of Paracox-5 vaccinated, Eimeria challenged broilers ($P<0.05$). Mortality varied from 4.4 to 5.8%, with no significant differences between treatments. It was concluded that dietary MOS improved FCR of Paracox-5 vaccinated (d 1), challenged (d 15) broilers from 15-42 d of age.

Organic acid water treatment effective in decreasing Salmonella colonization and horizontal transmission in broiler chickens

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The objective was to evaluate the water treatment effect of two organic acid blends on Salmonella (SAL) colonization and horizontal transmission in broiler chickens. In the first experiment, a total of 1080, day-old Cobb X Cobb male chicks were allocated 60/pen to each of 18 pens by blocks and divided into three treatment groups: T1, unmedicated control; T2 , 0.04%; and T3, 0.08% of an organic acid blend (OAB1; ACTIVATE® US WD MAX). In the second experiment we had similar experimental design but with only T1, unmedicatd control and T2, 0.04% of the European organic acid blend (OAB2; ACTIVATE® WD MAX). In both experiments, the OABs were added to water from 0-14 days and 42-49 days. Half of the birds in each pen were orally dosed with Naladixic acid resistant-S. heidelberg on Day 0 and housed with the remaining uninfected birds. Dragswabs of pens were obtained on days 0, 14 and 49 and also on day 49, Salmonella status of ceca and crops was evaluated. Results showed significant reduction of SAL + dragswabs in both experiments. Similar results were found in ceca and crops cultures. These results demonstrated that both OABs treatment significantly reduced SAL colonization, horizontal transmission and reduced environmental SAL contamination.

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Interaction of some plant lectins with poultry gastrointestinal pathogenic bacteria - an alternative to antibiotic therapy

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Immunization strategies and antibiotics use in farm animals is confronted with a series of limitations because of the increasing concern about drug residues in the food products. Prevention of both infections and parasitoses is the best approach for these diseases. The aim of the present study was to investigate the ability of some plant lectins to interact with pathogenic bacterial strains. There were performed in vitro interactions of five plant lectins purified by affinity chromatography with seven pathogenic bacteria cultivated in liquid media. The positive results were scored by the degree of bacterial cells agglutination. There have been noticed strong agglutinations of Salmonella typhymurium and Salmonella gallinarum with the lectins isolated from pumpkin seeds and potato buds and potato tubers. Escherichia coli and Pseudomonas aeruginosa were better agglutinated by vegetable marrow and pumpkin seeds lectins and weaker by potato buds and tubers lectins. Glutaraldehyde immobilization of the lectin isolated frompotato buds resulted in an insoluble polymer suspension. The interaction of the lectin polymer suspension with the liquid cultures of Salmonella and Pseudomonas was quantified by measuring the OD (660 nm) at time 0 and after 10 minutes of standing. The decrease of the OD demonstrated that immobilized insoluble lectin polymer bound bacterial cells and the aggregates settled. The experiments were performed in five replicate each and the results proved to be statistically significant ($P<0.01$). Gram stained slides of the sediments showed the bacterial binding to the lectin polimer. These results suggest that immobilized lectins could be included in the feed formula in order to prevent bacterial infections.

Nutrition and Coccidiosis Control Interactions and Effects on Growth and Performance in Broilers

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Interactions between two methods of coccidiosis control (Paracox 5 or in-feed coccidiostat; ACS) and nutrition (withdrawal diets with a range of energy and digestible amino acid concentrations) were tested in a 64 pen 2x4 factorial trial with male and female broilers. The hypothesis tested was that during the withdrawal period, vaccinated birds may have better gut health due to development of immunity than birds previously fed ACS, allowing the use of a reduced specification withdrawal diet. Liveweight (LW), feed and water consumption were measured, and feed conversion ratio (FCR) was calculated at each feed change and at depletion of females (42 days) and males (49 days). Statistical analysis (Genstat 8.1) showed that at 36 days birds vaccinated with Paracox 5 were significantly lighter and had a poorer FCR than birds fed ACS ($p<0.05$). By day 42, there were no significant differences in LW and FCR between Paracox 5-vaccinated birds and ACS-fed birds and this finding was repeated with males at 49 days. This could be explained either by compensatory growth in the Paracox 5-vaccinated birds or by depressed performance in ACS-fed birds as they face a late coccidiosis challenge during the withdrawal period. During the withdrawal period there was no significant effect of diet on liveweight gain or FCR but there was a significant ($p=0.038$) interaction between method of coccidiosis control and withdrawal diet specification. This trial demonstrated that equivalent performance was achieved in Paracox 5-vaccinated birds compared with ACS-fed birds following a typical UK growing regime and feeding programme.

Effect of an Organic Acid Blend in Drinking Water on Intestinal and Caecal Microflora and Performance of Turkeys

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The objective of the trial was to study the effect an organic acid blend (ACTIVATE® WD Max) on performance and ileal and caecal microflora of turkeys. 3 cages of 4 turkeys were allocated to both control and organic acid treatments. Organic acids were included in drinking water on two occasions: Day 14 to 17 (0.5ml/l) and Day 31 to 34 (1ml/l). Weight gain, feed and daily water consumption were measured. Ileal and caecal microflora of control and treated birds were also analysed. At Day 34, organic acid treatment tended to improve body weight gain (1550.4 g vs 1483.5 g from D10 to D34 $P<0.06$). During acid treatment water consumption decreased. The water/feed ratio was lower with organic acid addition from 31 to 34 days (2,35 vs 2.64 $P<0.02$). Microbiological results at 34 days showed significant differences between the Control and ACTIVATE® WD Max groups. Total microflora, enterobacteria and streptococcus were reduced with organic acids in both the ileum and caecum. This was statistically significant in the ileum. There is no change in lactobacillus numbers. In conclusion, administration of organic acids in drinking water resulted in increased growth performance of turkeys while reducing water consumption and modifying the gastro intestinal microflora.
Keywords: turkey; gut microflora; performance; organic acids; ACTIVATE® WD Max

Effects of Pellet and Mesh Diets on the Activity of the Microflora, and Morphology of the Small Intestine of Broiler Chicks

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In order to evaluate the effects of pellet and mash diets on bacterial count, and morphology of the small intestine on broiler chicks, 400 Ross-308 broiler cockerels were used. They were divided into 2 treatment groups of 25 randomly selected birds and 8 replications, and were housed in 8 pen floors, with controlled temperature and humidity at the rear parts, for 42 days. The broilers diet was prepared for 2 stages of (0- 21 days) and (21-42 days). In 42 days old, 4 birds per pen were randomly selected and slaughtered. Total bacterial counts, abundance of Lactobacilli, coli forms, and clostridia in small intestinal contents were determined. duodenum, jejunum and ileum were removed from the body immediately after death and transverse sections, were successively cut with 2 cm interval and fixed with 10 % buffered formalin. Paraffin sections stained with hematoxylin-eosin and PAS and studied under light microscope. The height, width of the intestinal villi, the depth of the intestinal crypts and the number of goblet cells /mm^2 area of the villi and crypts were measured.10 slides for each block were randomly selected and 5 fields of microscope in each slide were measured. Pellet and mash diets proved no significant effect on the number and activity of small intestinal microflora. Increasing in the villus height of ileum, villus width and crypt depth in the jejunum of broilers chicks fed with meshed diet, may suggest the better performance of those fed meshed.

Key Words: pellet; mash; small intestine; morphology; broiler chick

Effects of Graded Levels of Creatine and Guanidino Acetic Acid in Vegetable-Based Diets on Performance and Biochemical Parameters in Muscle Tissue

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Fish meal is still allowed as feed ingredient in broiler diets, however, recently its availability decreased while prices increased. When switching to pure vegetable diets, poultry producers often observe a reduction in performance which may partly be explained by a lack of creatine supply. Playing an important role in energy metabolism of animals, creatine is not found in plants. Supplemented creatine (as Creapureô) or guanidino acetic acid (GAA, as CreAminoô) which is the only natural precursor of creatine, may balance the animal's demand for this semi-essential nutrient. A trial with male broilers was conducted in order to investigate the potential of both supplements to resolve a performance reduction under vegetarian nutrition conditions. The arrangement comprised a negative control (vegetable-based), treatments with 0.04, 0.08 and 0.12% creatine, treatments with 0.031, 0.063, 0.094, and 0.126% supplemental GAA, and a positive control (50 (1-21 days) and 30 g/kg fish meal (22-42 days)). Overall weight gain and feed conversion in the positive control were superior to the negative control ($p<0.05$). Increasing levels of supplemented creatine and GAA improved performance until almost reaching the levels of the positive control. Muscle creatine content in breast meat was lower in the negative control compared to the positive control ($p<0.05$), but graded creatine and GAA supplementation increased the content to even higher levels than in the positive control (highest inclusion $p<0.05$). Results suggest that both supplemental creatine and GAA have the potential to counteract performance declines due to feeding pure vegetable diets. Data further suggest that GAA can be used as an efficient creatine source.

Diminishing the effect of aflatoxins and fumonisins contaminated diets on health and performance of broilers

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Dietary aflatoxins and fumonisins cause a variety of effects in poultry performance and health. A trial was set up to investigate the efficacy of a mycotoxin in-activator, UNIKE (based on botanicals, yeast and clay-minerals) on counteracting the toxic effects of aflatoxins and fumonisins in broilers. A randomized experimental design with two mycotoxin types (aflatoxins and fumonisins) and four levels of the mycotoxin in-activator was used. 300 day-old male Cob broilers were distributed into 5 treatments with 6 replicates of 10 birds. UNIKE was included at 0, 1.5, at 2.5 and at 5.0 kg/ton of feed, contaminated with aflatoxins (1.4 mg/kg) and fumonisins (25 mg/kg). The loss in weight gain at 21 days of age was significantly lower in birds fed diet containing the mycotoxin in-activator (resp. 5.1 %, 7.4 % and 7.9 %) compared to birds receiving the mycotoxin contaminated control diet. Birds receiving treated feed at 0.25 % and 0.50 % in the contaminated diets showed significant lower relative liver weight versus the control diet.
The administered aflatoxins and fumonisins had a negative impact on performance parameters of broilers after 21 days and on relative liver weight. A dose-dependent protecting effect of UNIKE was demonstrated in this experiment.
Figure 1: Average body weight of broilers at 21 days of age. Birds receiving mycotoxin free diet (T1) and birds receiving Aflatoxin and fumonisin contaminated diets treated with 0 % (T2), 0.15 % (T3), 0.25 % (T4) and 0.50 % Toxy-Nil Plus UNIKE dry (T5)
Key words: Aflatoxin, fumonisin, liver, body weight

The Influence of Caprylic Acid on Counts of Salmonellas and Coliforms in Chickens Experimentally Infected with Salmonella Enteritidis

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Medium-chain fatty acids are efficient antimicrobial agents. In our in vitro experiments, caprylic acid (C 8:0) was found the most effective fatty acid against salmonellas. The aim of this study was to evaluate the effect of caprylic acid on counts of salmonellas and coliforms in chickens experimentally infected with Salmonella enteritidis. Fourteen days old chickens were fed a commercially available diet. Treatment groups received a diet supplemented with 0.25 % and 0.5 % of caprylic acid. The feed of treated birds was infected with 5 ml of overnight-grown bacterial culture per one kilogram of feed. On the eighth day of the experiment, chickens were slaughtered and crop and caecum contents sampled for microbiological analyses. Differences between control and treated samples were evaluated by the Student's t-test. Caprylic acid at both concentrations significantly decreased counts of salmonellas and coliforms in all samples, the effect of caprylic acid in the crop contents, however, was more pronounced. Antibacterial activity of caprylic acid was dose-dependent. It can be concluded that caprylic acid is able to reduce numbers of salmonellas in the gastrointestinal tract of chickens and has a potential to improve health status of infected animals.

Mannan-oligosaccharide Yeast Extract Supplementation Enhances Early Gut Development in Turkey Poults

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Alphamuneô, a yeast extract antibiotic alternative, has been shown to stimulate the immune system, increase BW in pigs, and reduce Salmonella colonization in chickens. Two trials were conducted to evaluate the effects of 1 lb/ton or 2 lb/ton supplementation of Alphamuneô on gut maturation of 7 and 21 day old turkey poults (n = 18/group). Gut samples were collected from the duodenum, jejunum and ileum of each bird (9 poults/day/treatment) fixed and stained and villus height, villus surface area, lamina propria thickness, crypt depth and density of neutral, sialomucins, and sulfomucin goblet cells were evaluated. Alphamuneô supplementation influenced intestinal morphology differently based on gut location. Ileum parameters were enhanced with Alphamuneô treatments on day 7 and 21 ($P<0.05$) and in a dose dependent manner for many of the parameters evaluated. Duodenum villus height, surface area, and goblet cell density were higher for the 2 lb/ton Alphamuneô groups on day 7, however intestinal morphology of the duodenum was not different between the controls and treated birds on day 21. These results suggest that Alphamuneô can accelerate gastrointestinal maturation in turkey poults and is more pronounced in the ileum than in other portions of the small intestine.

Evaluation of Phytogenics and Synbiotics as Natural Growth Promoters in Broilers

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The impact of phytogenics (Biomin® P.E.P.) and synbiotics (Biomin® Poultry5Star) was investigated using 2400 one-day-old Ross broilers, which were assigned to 4 dietary treatments, comprising 10 replicates per treatment with 60 birds per replicate. The treatments were (1) Control, (2) Phytogenics, (3) Synbiotics, (4) Antibiotic Growth Promoter (AGP, Flavomycin). All birds were subjected to 3 feeding phases (starter: d 1-17, grower: d 18-38, finisher: d 39-45). The diets were based on corn and soybean meal. Monensin was included in the starter and grower diets as anticoccidial agent. Feed and water were available ad libitum. Birds were subjected to a vaccination program, including Newcastle Disease (ND), Infectious Bursal Disease (IBD) and Infectious Bronchitis (IB). In blood samples from 3 birds out of each replicate, ND, IB, and IBD immune status was determined by hemagglutination inhibition test and ELISA assay. Compared to the control treatment, phytogenics, synbiotics and the AGP increased weight gain by 4.2, 2.8 and 4.5%, respectively (1894 vs. 1973 vs. 1947 vs. 1979 g, SE=61.2, $P > 0.05$) after 45 d. Feed:gain ratio amounted to 1.77, 1.71, 1.73 and 1.75, respectively (SE=0.05, $P > 0.05$), and mortality was 1.12, 0.36, 0.53 and 0.59% (SE=1.28, $P > 0.05$), respectively, in treatments 1, 2, 3 and 4. Compared to the control treatment, immune parameters indicated numerically ($P > 0.05$) better values in treatments 2, 3 and 4 for IBD and IB. In conclusion, synbiotics and phytogenics represent efficient alternatives to antibiotics in broiler production.

Specific targeted research project Poultryflorgut

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The objective is to provide a strong factual basis for the optimisation of the hygienic quality of the poultry products meant for human consumption, in conformation with the new European regulations concerning feed additives, and the changes occurring in poultry production. The project has been divided into five main work packages. The first work package is dedicated to the management of the project and to the dissemination of the scientific results. Work package 2 and 3 focus on the effects of the new European regulations and the new tendencies in breeding management on the food-borne pathogens (traditional and emerging) along the food chain: at the farms in work package 2 and at the slaughterhouse and processing plants in work package 3. Work package 4 aims to validate the utilisation of new molecular methodologies for the study of the whole intestinal flora of poultry as well as poultry meat and to determine the effect of dietary factors and rearing types, and interactions with the food-borne pathogens. Work package 4 will provide operational methodologies that will be also used in work packages 2 and 3. Work package 5 provides economic assessment of changes in poultry practice under the current pressure of the European regulatory and studies the effect of organizational arrangements in the poultry food chain affecting food safety.

Evaluation of a Yeast Extract Product, Containing a Guaranteed Range of β-glucans, on Performance in Broilers

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A trial was run in broilers to evaluate the effect of different yeast cell-wall products, originating from Saccharomyces cerevisiae and containing β-glucans and mannan oligosaccharides (MOS). The experimental facilities were new, resulting in a low infection pressure environment. Four groups were included: 1) negative control; 2) Alphamune®, 500g/ton; 3) Alphamune®, 1000g/ton; 4) yeast cell wall product containing an uncertified β-glucan level, 1000g/ton. At day 14 and day 35, weight, feed intake and bacterial counts in the small intestine were assessed. The birds were vaccinated at day 13 and day 26 with a LaSota strain via drinking water, and at day 35, Newcastle Disease (ND) titres were determined. Feed conversion rates (FCR) in groups 1, 2, 3 and 4 were 1.836, 1.782, 1.800 and 1.825, respectively, with significant differences between the Alphamune®-treated (500g/ton) group and the control group, indicating a positive effect of Alphamune® on performance. A trend was seen in the ND-titres: titres of 4490, 6339, 6465 and 5145 were found in groups 1, 2, 3 and 4, , respectively, strongly supporting the generally accepted idea that β-glucans might have stimulatory effects on the immune system. Furthermore, the bacterial counts demonstrated that beneficial changes had occurred in the intestinal microbiota of the Alphamune®-treated birds.

Round table

Impact of EU and national legislation on production cost for broilermeat and eggs

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The objective of this study was to gain an insight into the current and future competitive position of the EU broilermeat and egg sector. The calculations were performed by collecting the most important data for each country and determining the production cost for eggs and broilermeat in each country using a uniform calculation method. This was done for the year 2004. The USA and Brazil were selected as examples of the situation outside the EU. During the coming years, both European and national legislation will come into force which will exert an influence on the production cost. These regulations relate to food safety, animal welfare, and the environment. For all countries the impact on the production cost was calculated for the situation in 2010 (broilers) or 2012 (layers). The results reveal that the production cost for broilermeat and eggs in the Netherlands in 2004 was comparable with those in Germany and France. The production cost were lower in Poland (eggs and broilermeat), slightly lower in Spain (eggs) and slightly higher in the United Kingdom (broilermeat). The poultry farmers in the USA and Brazil have 30 to 40% lower production cost. This is due to lower feed price and the favourable conditions. However, also the absence or lower level of legislation and regulations plays a role. Two examples are the absence of legislation on housing requirements for layers and the use of meat-and-bone meal. As a result of several national and also EU legislation the production cost for layer farmers in the EU will increase with 11 to 13% towards 2012. For broilerfarms in the EU the increase towards 2010 will be 4 to 6%. No cost increases are forecast for countries outside the EU, and consequently the competitive position of EU broiler farmers will deteriorate further in the coming years.

Nutrition as tool for environment preservation

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Animals excrete substances and nutrients for different reasons and in different forms. Therefore, livestock industries interact with the environment when they aim to serve consumer demands for animal products. Nutrition plays a key role in controlling effects on the environment and to avoid negative effects. This presentation summarises and describes tools that were developed in research and implemented in practise with special emphasis on nitrogen and phosphorus. The tools are mainly based on the changes that occur in the chemical composition of gained body weight during growth, the variable contribution of maintenance and production cost depending on the level of performance, the evaluation of feed raw materials on a standardised basis of availability, and the inclusion of specific feed additives. These tools still need development for application to other nutrients, e.g. trace elements. Key issue in environment preservation remains the adjustment of animal production and related excreta to the acreage where feed is produced.

Impact of nutritional factors on feather pecking behaviour of laying hens in non-cage housing systems

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The expected bans on battery cages (EU) and beak trimming (e.g. The Netherlands) may cause an increased risk of feather pecking and cannibalism in layers. Many factors influence feather pecking behaviour, but in this review we will focus on nutritional factors. Dietary deficiencies, resulting in inaccurate delivery of nutrients, may increase feather pecking behaviour and cannibalism. Severe feather pecking has been demonstrated in birds that were fed too low mineral levels, protein levels or amino acid levels (methionine, arginine). Feeding high-NSP diets, low energy diets, or roughages reduced feather pecking. Providing additional grain or straw in the litter during rearing could result in lower levels of feather pecking behaviour in adult stages. Nutritional factors seem to reduce feather pecking behaviour in laying hens if these factors increase the time related to foraging, feed intake and satisfying. Laying hens may spend more time on these behaviours when they are fed 1) mash diets in stead of crumbles or pellets, 2) low energy diets, 3) high (in-)soluble fibre diets or 4) roughages. This paper gives an overview of the relationships between the occurrence of feather pecking behaviour and nutritional factors, such as diet composition and feeding strategies in laying hens.

Session IV
Nutrition, Technology and Feed Additives

Invited Papers

Control of bacteriological contamination in animal feed

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This type of control is growing in the animal feed sector, driven by public pressure and current legislation (Feed Hygiene regulation). salmonella is the bacterial contamination that attracts the most attention due to its resistance. Control should be viewed as a whole, so that raw material purchases are also managed on microbiological criteria. Due to salmonella's low prevalence, enterobacteria appear to be the reference flora to evaluate treatment effectiveness. The treatments are essentially hydrothermal, occasionally combined with mechanical effects. Recent studies by Tecaliman show that it is possible to establish pelleting tables for a targeted decontamination. Chemical treatments can also be used with relative effectiveness. A thermal/chemical synergy effect is probable. Finally, treatment application should now be managed according to HACCP principles, without omitting downstream recontamination risks, particularly in coolers. However, having more treatment conditions for food safety is not necessarily consistent with lower production costs and environmental protection (greenhouse gas).

Improving nutritional value through feed technology

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Nearly all feeds used in commercial poultry production are subjected to some form of feed processing. A majority of the feed is ground through a hammer mill and formed into pellets by pressing the heated feed through a pellet press. The two major effects of processing are thus changes in the micro- and macrostructure of the feed, and heat-induced chemical changes of some components in the feed. It has been shown that the microstructure of the feed, ie the particle distribution of the dissolved feed particles, has a significant impact on gut function. Gizzard activity increases significantly, resulting in a very finely ground feed material entering the small intestine. In addition, secretion of bile acids and pancreatic enzymes is enhanced. The macrostructure determines to a large extent the feed intake pattern. Although poultry feeds are usually subjected to moderate heat treatments such as the pelleting process, heat-induced chemical changes may take place. A small fraction of the starch will gelatinise, solubility of fibres may increase, and proteins may form indigestible new bonds. In addition, vitamins and enzymes may lose their effect.

The use of Water in Diets as an Additive to Improve Performance of Poultry?

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Limitation(s) in voluntary feed intake of broiler diets is directly linked to reduced broiler growth and higher feed conversion ratios (FCR). This review illustrates that in many feed scenarios, particularly with wheat-based diets, the rate of digesta passage is limited and this directly limits the intake necessary to support growth potential. This is supported by an unexpected negative or absent relationship between feed intake and energy levels of diets. In some trials feed intake was negatively associated with FCR and believed to be a consequence of a larger portion of consumed diet being used to support maintenance rather than growth - alternatively, with higher feed intake diets a greater portion of nutrients were available for growth; hence, reduced FCR with higher feed intake. Although feed intake was increased with pelleting of cereal and/or enzyme supplementation, considerable variability in feed intake (and broiler performance) was still observed. Marked improvements in feed intake and broiler performance were observed with wet-feeding of wheat-based diets. We propose that the limitations in digesta passage rate of diets are related, at least in part, to variability in diet hydration time which is a consequence of particle size, and as yet unquantified physicochemical properties of the specific grain sources.

Short Communications

Efficacy assessment of anti-CCK chickens egg yolk antibodies as enhancer of broiler performance

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The efficacy of anti-CCK chicken's egg yolk antibodies as a performance enhancer in broiler feeding was assessed. CCK (cholecystokinin) is a gastric peptide that inhibits appetite. Six hundred and forty male broiler chicks were allocated into 16 pens. The experimental product DEAP (Dried, Egg, Anti-CCK, Product) was mixed with Sipernat ® 320 at 2.0 % in order to increase its flowability and mixing capacity. Levels of inclusion of DEAP in the diet were 0 g, 102 g , 255 g and 612 g per Tm. The basal diet was based on wheat-maize-barley soybean meal (3150 Kcal /kg ME, 22 % protein). The 4 experimental treatments were replicated four times. The DEAP supplementation increased the average daily gain at 7, 21 and 25 days significantly ($P < 0.03$) having a linear effect with a R2 0.63. The feed to gain ratio was also numerically improved. Chickens fed with high doses of DEAP had an 8 % higher body weight gain compared to that of the control group (1125 vs 1036) at 25 days. DEAP had no significant effect on daily feed intake.

Effect of Particle Size on Precaecal Digestibility of Amino Acids from Maize and Soybean Meal in Broilers

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Maize and solvent extracted soybean meal (SBM) were ground through a 2 or 3 mm screen, resulting in "fine" and "coarse" material. The mean particle sizes of fine and coarse feed were 0.62 vs. 0.96 mm (maize) and 0.63 vs. 1.01 mm (SBM). Maize or SBM of either particle size was included in experimental diets at two different levels at the expense of maize starch. Three week old broilers had free access to one of the 9 diets for a period of 7 days. Six pens of 10 broilers were allocated to each diet. Digesta was sampled from a standardised section of the terminal ileum immediately after slaughter. Precaecal digestibility of amino acids was calculated for maize and SBM by linear regression analysis, which considers the basal endogenous amino acid losses. All amino acids from coarse maize were higher digested than from fine maize, with a mean difference of 6.3%. In contrast, all amino acids from coarse SBM were less digested than from fine SBM, with a mean difference of 5.5%. It is concluded that particle size affects amino acid digestibility and that this effect is different between feed ingredients. Therefore, standardising particle size is important in routine studies on amino acid digestibility of feed ingredients.

Microencapsulation Allows Slow Release of Organic Acids in the GI Tract of Broilers

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Aim of the study was to investigate intestinal concentrations of citric and sorbic acid (OA) from a microencapsulated blend and the possible consequences on intestinal fermentations. Twelve male ROSS 508 broilers were selected from 2 dietary treatments: a control diet (CTR), or the control diet added with a microencapsulated blend of citric and sorbic acid at 400 ppm (TRT). Contents of gizzard, small intestine and ceca were collected to be analysed for pH, NH3, VFA and OA concentration; coliforms and lactic acid bacteria were counted. All data were analysed with an unpaired t-student test, and considered statistically significant at $P<0.05$. Citric acid was detected all along the GI tract in both CTR and TRT group, but it was present in higher concentrations in TRT (gizzard:1.8 mmol/L for the CTR group vs 3.8 mmol/L; small intestine 0.58 mmol/L vs 1.16 mmol/L; ceca: 0.40 mmol/L vs 0.46). Sorbic acid was not detectable in birds fed the CTR diet whereas it decreased along the GI tract of TRT fed birds (gizzard: 60 μmol/L; small intestine: 6 μmol/L; ceca: 0 μmol/L). Data showed that the microencapulation allowed the supply of sorbic acid to the small intestine.

Fig: concentration of sorbic and citric acid along the GI tract of sampled birds.

Hydrothermally treated rapeseed meal does not increase the incidence of tainted eggs in brown layers

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Rapeseed meal is an interesting raw material for poultry feed, but in most brown egg laying strains a small percentage of the birds is sensitive for producing tainted eggs due to the presence of sinapine in the rapeseed meal. In this project, rapeseed meal was treated, based on the principle of hydrothermal treatment as described by Kahl to reduce the sinapine content of the rapeseed meal. The hydrothermally treated rapeseed meal (HT-RSM) was fed to brown layers (Hyline brown) at 0 (negative control), 5, 10 and 15%; a positive control group was fed 15% untreated rapeseed meal from the same batch. The experiment ran from 18 weeks until 44 weeks of age. Data were collected on technical performance and at 26 weeks of age, eggs were evaluated by a trained panel on egg taint. Results of the test on egg taint shows, that the positive control group had a significant ($p < 0{,}001$) higher egg taint index (ETI) then any of the other treatments. There were no differences ETI between the negative control and any of the treatments with HT-RSM included. Results of this experiment show that by hydrothermal treatment of rapeseed meal, it is possible to feed rapeseed meal to brown layers, without increasing the incidence of tainted eggs.

Key words: rapeseed meal, hydrothermal treatment, brown layers, tainted eggs.

Table 1: results of the test on egg taint at 26 weeks of age as evaluated by a trained panel.

Tr	Neg control	5% HT-RSM	10% HT-RSM	15% HT-RSM	pos control	p-value
ETI	57 a	49 a	51 a	39 a	149 a	< 0.0001

*) higher index value means higher incidence of tainted eggs. ab: different superscript within the same row means significantly different ($p < 0{,}05$)

Posters

Effects of β-Mannanase on Broiler Performance and Gut Morphology

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An experiment was designed to assess the effects of graded levels of β-mannanase on performance and gut morphology of broilers provided with diets based on corn and soybean meal. Four dietary treatments contained 0, 500, 700 and 900 g β-mannanase (Hemicell®) /ton. Each treatment contained 4 pen with 15 birds/pen. β-mannanase inclusion at 900 g/ton reduced ($P<0.05$) feed intake in finisher and total period, whereas inclusion at 500 or 700 g/ton resulted in no significant benefit. Enzyme supplementation had no effect on body weight and feed conversion ratio. β-mannanase inclusion at 900 g/ton improved gut morphology and increased ($P<0.01$) villus height and crypt depth and decreased ($P<0.01$) goblet cell number, epithelial thickness and ratio of crypt depth to villus height in different sections of small intestine.

The Effect of Kombucha Tea on Production of Broiler Chicks: a Pilot Study

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Kombucha tea (KT) is prepared by placing the kombucha culture in solution of tea and sugar and allowing fermenting. The inoculum is a fungus consisting of symbiotic colony of yeast and bacteria. KT has a wide range of organic acids, vitamins and enzymes that give it its extraordinary value. No study on the effect of KT use in poultry was available in the literatures. Therefore, the focus of this study was to test the influence of KT on the growth performance of broiler fed on a corn-soybean based diet. In this study we used 80 male broilers and were equally divided into two treatment groups. To determine whether or not KT has an effect on the broilers performance the t test was used to compare the control group and treatment group. The body weight of broilers fed the KT was significantly lower as compared to the water treatment. Feed intake of broilers fed KT was 14.8 g b-1 d-1 lower than those fed water treatment. The FCR of the chicks in the group exposed to KT was not found to differ from those of the controls. These results demonstrated that KT do not cause deleterious effects in the FCR, therefore, at the light of the results of the present study it might be suggested that KT seemed to be effective for early-age feed restriction. Further research, however, is needed because broilers in the present study were exposed to one amount KT and for KT antimicrobial activity.

Effects of Corn Particle Size in Layer Diet on Laying Performance and Uniformity of Egg Quality under High Stocking Density

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A total of 600 laying hens (Roma Brown, 30 week old) raised under tropical environment were used to determine effects of corn particle size on growth performance and uniformity of egg quality. Hens were randomly allocated to three different meal diets made up of corn from each 3 particle sizes: 638, 870 μm hammer-mill milled corn and 1,079 μm roller-mill rolled corn. There were 5 pens per diet. Each pen comprised of 10 cages with 4 hens per cage. Feeding larger corn particle size resulted in increased ($P < 0.04$) average daily feed intake. Egg quality; weight, specific gravity, yolk color, Haugh unit and egg shell thickness, was not affected with the larger corn particle size. However, the uniformity of egg weight and egg yolk color was depressed ($P < 0.02$) with the corn particle size of 638 and 1,079 μm. Our results suggested that feeding laying hens raised under tropical environment with the corn particle size approximately of 870 μm or the completed diet particle size of 735 μm resulted in the uniformity distribution of egg production and egg quality.

Effects of Terbutaline feeding on some blood parameters and carcass characteristics in broiler chicks

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Today, people are looking for ways to improve overall production efficiency in producing lean chick products. The aim of this experiment was to assess the effects of terbutaline, a beta-adrenergic agonist, feeding on some blood parameters and carcass characteristics. 300 male and female of Cobb broiler chicks (3w-old) were randomly assigned to one of five dietary treatments (terbutaline levels: 0 (control), 5, 10, 15 and 20 mg/kg). Blood samples were collected before the start of terbutaline feeding and before slaughtering. In twelve 6 week old chicks (6 males and 6 females) selected randomly from each treatment and carcass characteristics were measured. Data were analyzed using the SAS and probability level was 5 %. Levels of creatine phosphokinase (CPK), blood urea nitrogen (BUN), glutamate oxaloacetate transaminase (GOT) were not affected by terbutaline. Cholesterol and triglyceride levels were significantly increased at level of 10 mg/kg. Terbutaline significantly affected glucose levels at 10, 15 and 20 mg/kg treatments. At level of 5 mg/kg, there was a significant increase in live weight, drumstick muscle in male chicks. Feed conversion rate of male chicks was reduced at levels of 5 and 10 mg/kg of body. Terbutaline, a beta-adrenergic agonists seems therefore capable of improving growth performance in poultry.

Effects of bacterial xylanase on egg production and quality and on diet digestibility in laying quail (Coturnix coturnix japonica) fed on diets based on Corn and Soybean meal

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Corn and soybean meal (SBM) are high-quality feed ingredients for poultry diets. Despite the fact that such diets are low in indigestible carbohydrates, it has been suggested that the inclusion of exogenous feed enzymes to such diets could improve nutrient availability and, subsequently, improve energy digestibility. This study was carried out to determine the effects of bacterial xylanase (Nutrase® Xyla) on egg production, feed consumption, feed conversion ratio, egg weight and egg quality of laying quail (Coturnix coturnix japonica). A total of 120 8 week old laying quail (Coturnix coturnix japonica) were divided into six groups of 20 birds each (which were, subdivided into 10 subgroups of 2 each for experimental replicates). One basal diet with a content of 22% crude protein, 2900 kcal/kg of metabolisable energy was used in the experiment. The energy levels of experimental groups were reduced as follows: Group I; 1,5 %(43,5 kcal/kg), Group II; 2% (58 kcal/kg), Group III; 2,5% (72,5 kcal/kg), Group IV; 3% (87 kcal/kg), Group V; 3,5%(101,5 kcal/kg), respectively. Moreover, 100 ppm of bacterial xylanase was supplemented to all the experimental groups. The control group received no enzymes. The experiment lasted 12 weeks. Feed and water were supplied ad libitum and artificial light was provided for 16 h per day. Significant differences among the groups were examined by one-way ANOVA followed by Tukey test. There were no statistical differences in egg production. Results of this study indicate that enzyme addition to corn-SBM-based basal diets can significantly improve energy utilisation ($P<0.01$).This result was supported with the findings in group IV which had a 3% decrease in energy. There were no statistical differences in terms of egg quality parameters between the groups.

Trace organic minerals as a replacement of inorganic sources for layers: effects on productivity and mineral excretion

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A study was conducted to evaluate Bioplex® , (Alltech Inc) a chelate of Cu, Zn, Mn and Fe, as an organic mineral source for laying hens. The aim was to evaluate the effectiveness of replacing an inorganic mineral dietary supplement (Cu, Zn, Mg and Fe), at low levels of dietary inclusion, with an organic mineral source (Bioplex®). One hundred and ninety- two Hy-Line laying hens, were individually housed from 30 to 70 weeks of age. Six replicate cages of eight birds were randomly assigned to one of four dietary treatments. Each treatment was consisting of 48 hens in 6 repetitions of 8 animals. Treatments consisted of feeding a control diet (100% inorganic: 15ppm Cu, 60ppm Zn, Mn and Fe) or one of three inclusion levels of Bioplex (8, 17 and 33 % of inorganic concentration as organics). Birds' performance, bone strength and mineral faecal excretion were measured. Data were statistically analyzed in a completely randomized block design by ANOVA, followed by post hoc pair wise comparison (Tukey-kramer test). Performance (laying percentage and feed conversion) was similar in all the groups. Control fed layers consumed significantly ($P < 0.05$) more feed than birds receiving 17% organic mineral supplement. A significant improvement in bone strength ($P < 0.01$) and a reduction of faecal minerals excretion ($P < 0.05$) was observed in the all organic supplemented treatments when compared to the control. The organic form maintained performance at a dosage 12 times lower compared to the commercial inorganic level.

Effect of Yeast (Saccharomyces cerevisiae) Cell Wall Components on the Growth Performance of Broilers

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An experiment was conducted to determine the effectiveness of yeast beta-glucans and mannano-ligosaccharides as a means to promote growth in broiler chickens, thereby providing an alternative to antibiotics. 900 male broilers were randomly assigned to 36 pens and were fed one of nine dietary treatments - no growth promotant, antibiotic, low mannanoligosaccharide (LM), high mannano-ligosaccharde (HM), beta-glucan (YBG), and their combinations (LMLY, LMHY, HMLY, HMHY). The birds received starter from 0 to 14 days (d), grower from d14 to d24 and finisher from d24 to d34. Birds were weighed on d0, 14, 24, and 34 and feed consumption was monitored throughout the study. Statistical analysis was performed using repeated measures in proc mixed of SAS. By day 34, birds receiving antibiotics or HMHY ($P<0.05$) were significantly larger (1728g and 1716g respectively) than those receiving no growth promotant (1584g). There were no differences among treatments for feed consumption or feed efficiency in any period. The results indicate that a combination of yeast cell wall derivatives have the potential to replace antibiotics as growth promotants for broilers.

Efficiency of a prebiotic and a plant extract on broiler performance and intestinal physiology

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The objective of this experiment was to evaluate the effects of a short chain fructo-oligosaccharide (scFOS) from sugar beet (PROFEED®), and a plant extract (XTRACT™), alone or mixed, on broiler performance up to 36d. Ileal histomorphometry, anaerobic sulphite-reducing bacteria count, intestinal and caecal pH, caecal volatile fatty acids production and litter score were also evaluated. Five supplemented diets were tested: scFOS 600 ppm (P); plant extract 100 ppm (X); P/X 600/100 ppm (XPH); P/X 450/75 ppm (XPM); P/X 300/50 ppm (XPL). These experimental diets were compared to a negative control (C) and a positive control with 10ppm avilamycin (AV). Compared to C, avilamycin improved broiler performance throughout the experiment while the effects of plant extract and prebiotic employed alone were noticeable during the finisher period (from 22 to 36d). At 36d of age, broilers fed AV, P or X were heavier than those fed C. Throughout the trial, the same broilers tended to have a better feed conversion ratio (FCR). When the two additives were mixed, from 1 to 36d of age, XPM or XPL improved the body weight gain as AV did, but only XPL improved the FCR compared to C. With the higher mixture dose (XPH), no broiler performance improvement was observed suggesting a negative associative effect of the two additives. No statistical effect was observed in any treatment for the other parameters measured. Based on these results, prebiotic and plant extract could be considered as potential alternatives to antibiotic growth promoters in broilers up to 36d of age, though further research is needed to understand the basis of their growth promoter effect.

Table 1 Effect of treatments on broiler performance

	Diets								
	C	AV	P	X	XPH	XPM	XPL	SEM[1]	p^2
BWG (g)									
1-11d	261^{a}	264^{a}	256^{b}	254^{b}	254^{b}	255^{b}	254^{b}	0.6	***
12-21d	583^{b}	594^{a}	577^{bc}	581^{b}	572^{c}	578^{bc}	582^{b}	1.1	***
22-36d	1237^{c}	1261^{b}	1284^{a}	1278^{ab}	1242^{c}	1271^{ab}	1261^{b}	2.5	***
1-36d	2084^{bc}	2121^{a}	2121^{a}	2115^{a}	2071^{c}	2105^{ab}	2097^{ab}	3.2	***
FCR (g/g)									
1-11d	1.15^{b}	1.10^{a}	1.15^{b}	1.14^{b}	1.16^{b}	1.15^{b}	1.15^{b}	0.004	**
12-21d	1.45^{b}	1.41^{a}	1.44^{b}	1.44^{b}	1.43^{ab}	1.44^{b}	1.43^{b}	0.003	**
22-36d	1.81	1.79	1.77	1.77	1.79	1.78	1.78	0.004	NS
1-36d	1.62^{c}	1.59^{a}	1.60^{ab}	1.60^{ab}	1.61^{bc}	1.60^{abc}	1.60^{ab}	0.003	†

a, b, c : Mean values on a same row with different superscripts differ significantly ($p \leq 0.05$).
1 Standard error of the mean.
2 Signification level: NS, non significant $P > 0.10$; †, tendency $0.05 < P < 0.10$; ** $0.001 < P < 0.01$; *** $P < 0.001$

The effect of probiotic supplementation on productive traits, egg quality and plasma cholesterol of broiler breeder hens

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The present study was conducted to investigate the effects of four different levels of dietary probiotic (protexin) on productive traits and egg quality of broiler breeder hens. One hundred sixty female 64-week-old broiler breeders (Hubbard classic) were involved in this experiment. The birds were divided into four dietary groups comprising 40 birds each. The birds were randomly assigned to control Group A (unsupplemented diet), Group B (0.25% protexin supplemented diet), Group C (0.5% protexin supplemented diet) and Group D (0.75% protexin supplemented diet) for 10 weeks. Results showed that addition of probiotic had not any significant effect on egg production, egg mass and feed conversion ratio but effect of probiotic on egg weight was significant ($P < 0.05$), The egg weight of control group was the highest and was higher ($P < 0.05$) than group B but was not statistically different from group C and group D. Furthermore supplementation of probiotic had no significant effect on percentage of egg shell, shell thickness, egg shell strength, specific gravity and haugh unit. Overall, it was concluded that dietary supplementation of probiotic had no positive effect on productive traits, egg quality and plasma cholesterol of broiler breeder hens.

Soy protein concentrate - processing and application in broiler pre-starter feed

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Soy protein is the most important plant protein source for poultry feed due to its amino acid profile and digestibility. However, raw soybeans need to be properly processed before they can be applied in poultry feed. Commercially available soy products are full fat soy flour, soybean meal with 44% or 48% crude protein, fermented/enzyme treated soy protein, soy protein concentrate and soy protein isolate. The nutritional value, i.e. protein content, amino acid digestibility and level of anti-nutritional factors, is closely related to the processing method used to produce these soy products. For growing and finishing broilers, the most commonly used soy product is high protein soybean meal (48% CP). However, newly hatched young chicks have low digestive enzyme activity and thus request feed of higher nutritional (protein) quality. High quality protein such as fish meal is commonly used in broilers pre-starter feed. Due to the limited supply, fish meal prices increased significantly. Soy protein concentrate (SPC) is characterized by high protein content (65%), high amino acids digestibility, low indigestible carbohydrates and low anti-nutritional factors and can serve as fish meal replacement in pre-starter feed for broilers.

In 3-week old broiler chicks, apparent ileal protein digestibility coefficient of SPC (0.86) is better than in fishmeal (0.83), soybean meal (0.83) and corn gluten meal (0.77) and only outpaced by casein (0.92). Apparent lysine digestibility coefficient of SPC compared with soybean meal at day 2, 7, 14 and 21 is 0.83/0.77; 0.91/0.89; 0.94/0.87 and 0.94/0.84, respectively. For other essential amino acids apparent digestibility is higher as well. The recommended inclusion level of SPC in broilers pre-starter feed is 3-5%.

Effect of selenium and vitamin E dietary supplementation of laying hens on selenium and vitamin E accumulation in eggs

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The aim of the present study was to evaluate the effect of increased Se supplementation in the form of Sel-Plex and its combination with vitamin E on Se and alpha-tocopherol concentrations in eggs. Seven groups of laying hens (50 birds in each group) were fed diets containing different levels of Se and vitamin E for 6 months. The control group were fed a diet supplemented with 0.2 ppm selenium in the form of sodium selenite and with 10 ppm vitamin E. Experimental diets were supplemented with Se in the form of Sel-Plex at 0.2, 0.3 or 0.4 ppm and vitamin E supplementations were 10, 20, 40 or 100 ppm. The highest egg production was observed in laying hens fed 0.3 ppm Sel-Plex in a combination with 20 ppm vitamin E being 2.5% higher than that in the control group. It was found that with 0.4 ppm Sel-Plex supplementation of the diet, the Se content in the egg increased from 12 up to 35 ug/egg over a period of 4 weeks. After this 4 week period, the Se concentration in the egg yolk and egg white stabilized and did not change significantly for the next 5 months of the experiment.

Efficacy of a Nucleotide Preparation in Broiler Chickens

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Availability of nucleotides may limit performance in fast growing animals. An experiment was conducted to determine the efficacy of a nucleotide preparation (Nucleoforce Poultry) in broiler chickens. Nine hundred and sixty day-old broiler chickens were allocated into 24 pens, and assigned one of 3 treatments: 0, 500 and 1000 mg of the nucleotide preparation/kg feed. Feeds were based on wheat, barley and soybean meal. The starter diet, till 21 days contained 21.5 % protein, the grower diet till 39 days 20 % protein, and the withdrawal diet 18 % protein. Performance was determined at 21 and at 42 days. Results were analyzed as a randomized complete block design. At 21 days, the nucleotide preparation at 500 mg/kg feed significantly improved body weight by 1 % and by 1.9 % feed to gain ratio, while at 1000 mg/kg there was no significant effect. There were no significant effects between 21 and 42 days but body weight and feed to gain ratio were numerically better in the treatments containing nucleotides. In the overall experiment, the nucleotides at 500 mg/kg significantly improved feed to gain ratio. Results suggest that the nucleotide preparation at 500 mg/kg significantly improves the performance of broiler chickens

A Microencapsulated Blend of Organic Acids and Natural Identical Flavours Reduces Necrotic Enteritis-Associated Damages in Broiler Chickens

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Six-hundred ROSS 308 broilers were allocated in 24 pens divided into 3 experimental groups (d0): the control diet (CTR), the control diet added with Galliacid®S at 300 ppm (GAL S), a microencapsulated blend of organic acids and natural identical flavours (EU patent 1391155B1; Vetagro srl, Italy), and the control diet added with a different blend of organic acids (WSB) added at 300 ppm. Birds were fed a wheat-based diet without coccidiostat and at d9 were inoculated with live vaccinal Eimeria oocysts; at d15 animals were infected with *Clostridium perfringens*. Mortality was registered and dead animals were analysed for necrotic enteritis (NE) lesions; growth performance of animals was calculated and analysed with 1-way ANOVA, whereas mortality analysis was run with chi-square test. At d21, following challenge, mortality was significantly reduced in the GAL S group (GAL S:21.8%; CTR: 37.4%; WSB: 43.6%; P<0.001). Feed conversion during the challenge period (15-21d) was significantly lower for GAL S than the other groups (GAL S: 2.4; CTR: 3.2; WSB: 4.7. P<0.05). Galliacid®S allowed to improve growth performance and reduce mortality in a NE challenge model when compared to a negative control diet and to wider spectrum blend of organic acids.

Mortality and growth performance between d1-21.Values with different superscript within the same column are significantly different (P<0.05).

Treatments	Mortality (%)	ADG (g)	LW (g)	FCR
CTR	37.4	29.7	665.5	1.91^{ab}
GAL S	21.8	29.6	662.9	1.75^{a}
WSB	43.6	29.8	667.4	1.99^{b}
P value	*P*< 0.001	ns	ns	*P*< 0.01

Effect of dietary supplementation of protected organic acids on ileal microflora and protein digestibility in broiler chickens

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This experiment was conducted to investigate the effects of 3 diets containing different levels (0, 0.2 and 0.4%) of protected organic acids (formate and propionate) on the gut microflora and ileal protein digestibility in broiler chicks. One hundred and fifty six broilers in a completely randomized design with three treatments and four replicates for each treatment were employed. The experiment lasted for 42 days. Ileal pH and gut microflora at 24 and 42 days of age and ileal protein digestibility on day 42 were determined. The result showed that different levels of protected organic acids had no significant effects on ileal protein digestibility. The acidity of ileal digesta, colony count of Lactobacillus and Coliforms were significantly affected by protected organic acids ($p<0.05$). On days 24 and 42, increasing the level of protected organic acids, significantly decreased pH of digesta flow in ileum ($p<0.05$). Organic acids significantly ($p<0.05$) increased colony count of Lactobacillus and decreased colony count of Coliforms in digesta at 24 and 42 days of age. Colony counts of Lactobacillus and Coliforms were higher on day 42 compared to 24. The results showed that dietary supplementation of 0.2% of protected organic acids can improves proliferation of useful microflora and diminishes population of harmful bacteria in poultry gut contents.
Key words: Broiler chick, protected organic acid, ileal protein digestibility, microflora

Growth performance and digestive processes in broiler chickens fed diets supplemented with xylanase and fructooligosaccharides

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Objective: The effect of xylanase and fructooligosaccharides on broiler chickens body weight, feed conversion (kg feed/kg weight), caecal volatile fatty acids (VFA) concentration and glycolytic enzymes activity was investigated. Methods: Six hundred birds were divided into three groups and for 35 days were fed basal diet (control) and diets contained 0.1% xylanase and 2% fructooligosaccharides and a combination of both supplements. Body weight was recorded individually and feed conversion per group. The concentration of VFA in caecal digesta was measured by gas chromatography. The glycolytic activity in caecal digesta was measured by the rate of p- or o-nitrophenol release from their p- or o-nitrophenylglucosides. The results were analyzed using the one-way ANOVA test. Differences were considered significant at $P \leq 0.05$. Results: Addition of xylanase to the basal diet improved body weight 5% and feed conversion decreased 8%, compared to control. Body weight was increased 6% and feed conversion decreased 6% versus control in addition of xylanase and fructooligosaccharides. It was found xylanase addition to diet increased VFA, except valeric acid concentration. Supplementation of xylanase and fructooligosaccharides to diet increased acetic, propionic and isobutyric acid concentration. The glycolytic activity of the caecal digesta was generally alike in all groups.

Effect of Enzyme Supplementation on the Nutritional Value of Untoasted Guar Meal and its Use for Broilers

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Present experiment was conducted to investigate the effect of enzyme supplementation on nutritional value of guar meal in broiler diets. Two hundred and forty one day old broiler chicks (Hubbard breed) were randomly divided into twenty four groups. Eight isonitrogenous and isocaloric diets containing 1, 3, 5, and 7 % untoasted guar meal with or without enzyme (α-glactosidase and mannanase @ 250 g/ton feed) supplementation were fed to 3 groups each, for a period of four weeks. Data were collected for weekly weight gain and feed consumption to determine feed efficiency. Foregut digesta viscosity was determined during experiment. The results showed that, there was non significant ($P<0.05$) difference in the weight gain, feed consumption, feed efficiency and foregut digesta viscosity of birds fed on different experimental rations. It may be concluded that untoasted guar meal can be included in the diet of broilers and enzymes supplementation have non significant effect on the nutritional value of guar meal for broilers.

The impact of a modified processing technique for full-fat soybeans on their MEn-value for broiler chickens, meat turkeys and laying hens

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Whole, unextracted or "full-fat" soybeans are characterised by a high-quality protein content, a high energy value but also by the presence of anti-nutritional factors, which can be reduced to insignificant levels by adequate processing. Literature data show MEn-values ranging from 14.4 to 17.9 MJ/kg DM depending on the source of the bean and type of processing used. The objective of the present balance trial was to establish the efficacy of 2 types of processing on the nutritional value of full-fat soybeans for the main poultry species. The entire batch of untreated full-fat soybeans "SB" was split up for either a 1-step (to be considered as the classical system mainly based on heat) or a 2-step processing system (consisting of the classical system followed by an additional "more physical" treatment / this 2-step combination is called the "Danis"-system). Both types of processed SB were included at respectively 10 & 20%. The balance trial was carried out according to the European Reference Method. The MEn-values of both SB were calculated by MEn-difference between basal diet and the respective supplemented diets, thereby assuming additivity. The regression analysis (0-20%) showed a linear response for the 2-step SB only and curvilinear response for the 1-step SB. The MEn-value of SB depended on poultry species with MEn-values of 12.1, 13.3 and 12.5 MJ/kg for broiler chickens, laying hens & meat turkeys, respectively. The corresponding MEn-increases (%) after the additional processing were 9.0, 6.6 & 4.1%, respectively. The contribution of MEn from fat in the total MEn-increase accounted for nearly 100% in broiler chickens and meat turkeys and for about 35% in laying hens. The favourable impact by the additional "more physical" processing step is mainly related to the fat fraction.

The impact of co-processing partially dehulled full-fat soybeans & inulin on the zootechnical response in broiler chickens and turkey poults

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Feed technology may improve the nutritional value of feedstuffs, e.g. "Innofiber" is a finely crumbled new feedstuff after co-processing "Forta" & inulin in a 3:1-ratio. On the one hand, "Forta" is a partially dehulled and adequately 2-step processed soybean. On the other hand, inulin is considered as a potential alternative for the in-feed antibiotics after the EU-ban on the 1st jan. 2006. The practical application of inulin is, however, not without any technological problems and therefore Innofiber has been introduced into the feedstuff market by the Danis-Orafti consortium. The objective of the present study was to determine the nutritional value of Innofiber in comparison to a control mixture "Forta/glucose" in balanced starter diets for broiler chickens and turkey poults, respectively. For the broiler chickens, the substitution of the control by the alternative mixture resulted in a significantly higher body weight at 14 days of age (+8.4%) and a significantly better feed conversion (6.7%) with a non-significant effect on feed intake (+2.1%). For the turkey poults, the substitution of the control by the alternative mixture resulted in a significantly higher body weight at 28 days of age (+3.4%) and a significantly better feed conversion (4.0%) without any additional effect on feed intake. It might be concluded that the "alternative" diet is a very promising "up-grading" tool during the starter period because of its beneficial effect on the microbial-related physiology of the gastro-intestinal tract.

Efficacy trial with XYLANASES for male meat turkeys

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Livestock performance and feed efficiency are closely interrelated with several factors, such as genetics, environment, "intestinal" health status, nutrition in terms of major and minor nutrients; thereby NSP-enzymes might have a beneficial effect on digestion physiology and/or intestinal flora. The objective of this trial was to determine the efficacy of Hostazym® X on the performance of meat turkey males. The enzyme preparation was added at a dietary concentration of 175 mg/kg (1050 EPU/kg) in comparison with a zero control group. In total, 360 meat turkey males of the commercial strain BUT 9 were housed for a period of 112 days on a 4-fase feeding schedule. The two treatments were fed to six replicate pens of 30 turkeys each. All zootechnical results were comparable with the BUT-9 standards. The inclusion of Hostazym® X had a significant effect on feed conversion (-4.7%) during the starter period, final body weight (+2.2%) and feed conversion (-3.1%) of the entire period. Total loss in terms of mortality and culling was quite low (on average 4.4%) and not significantly influenced by dietary treatment. Production value was improved after Hostazym® X inclusion with 4.4% (P=0.19). It might be concluded that there was a tendency of a favourable impact of Hostazym® X on this global parameter, which combines weight gain, feed conversion and mortality.

The metabolizability of wheat and inedible pasta as affected by xylanase supplementation

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An adult rooster study was conducted to compare energy metabolizability of three energy feeds in response to enzyme addition. The corn, wheat and inedible pasta (wastes) samples, each from two sources, were force fed to 58-wk-old adult cockerels according to McNab and Blair procedure. To evaluate the effect of enzyme on improvement of metabolizable energy values, 1000 units/kg xylanase from a crude preparation was added to these various energy sources. The apparent DM digestibilities of these three feedstuffs were highly significantly ($P < 0.01$) different, with the highest values for inedible pasta. Enzyme addition of 1000 units/kg had no significant effect on DM digestibility. The apparent fat digestibility and nitrogen retention values were also different among these feedstuffs. The average AME values of corn, wheat and inedible pasta were determined to be 3060, 3069 and 3419 kcal/kg, respectively. The respective values for AMEn were 3464, 3304 and 3671 kcal/kg. The enzyme addition affected ($P < 0.05$) the metabolizability coefficients when ME values of corn samples were ignored, but when corn data were participated in calculations, the effect of xylanase was not apparent. The results show that the inedible pasta can be used in poultry diets as a good alternative energy source and enzyme supplementation additionally improves its feeding value.

The influence of enzyme supplementation on wheat and inedible pasta utilization in broiler diets

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This study was performed to investigate the effect of xylanase supplementation on wheat and inedible pasta substitution for corn in broiler diets. Prior to study, the xylanase and beta-glucanase activities of crude enzyme preparation were determined to be 1260 and 390 units/g, respectively. Three levels of either wheat or inedible pasta (20, 40 and 60% of diet) were included in a corn-soybean meal control diet supplemented with one of the three xylanase levels (0, 500 and 1000 units/g). A total of 1008 broiler chicks of 7 days-old were used to test these 21 experimental diets in a 7×3 factorial arrangement with 3 replicates of 16 birds. The type of basal diet (control vs. wheat or inedible pasta containing diets) had highly significant effect ($P < 0.01$) on FI in all stages, but the enzyme influence depended to growth stage. The average daily gains were affected ($P < 0.01$) by type of basal diet, enzyme level and interaction between them. Dietary treatments had significant effect on feed conversion ratios in the grower stage, with the best ratios assigned to birds fed on diets containing inedible pasta. Unlike the total mortality, periodical mortalities were not affected by given treatments. In summary, the present results show that the bird' response to feed enzyme dependent on age and dietary inclusion level of wheat and inedible pasta.

Effects of benzoic acid supplementation on performance of broiler chickens

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Organic acids their salts as well as the mixtures are common feed preservatives and anti bacterial agents. Benzoic acid is used as feed additives in fur animals, pigs and in forages for ruminants however there is limited information available about its effects in poultry. The objective of the experiment was to study the influence of pure benzoic acid on the performance of broiler chickens as well as the pH, dry matter and selected populations of bacteria inhabiting chickens gastrointestinal tract. Feeding experiment was carried out on 240 one-day old ROSS 308 cockerels. Birds were divided into three dietary treatments: (C) - no additives, B1 - 0.1% inclusion of benzoic acid, B2 - 0.2% inclusion of benzoic acid. The performance was similar in birds fed control diet and diet with 0.1% of benzoic acid. However comparing to control group in the starter period birds fed diets containing 0.1% inclusion of benzoic acid had better body weight gain and feed conversion ratio. The dietary inclusion of 0.2 benzoic acid per kg depressed growth ($P<0.05$). The dry matter of the digesta increased in crop and caeca after benzoic acid supplementation. The pH of the caecal contents decreased following benzoic acid supplementation and was lowest in B2 group. No differences were found in the pH of crop, ileal, gizzard and rectum digesta. Lactic acid bacteria populations were lowest in the caeca of the B1 group ($P<0.05$). Coliform bacteria decrease in the caeca contents following increased benzoic acid supplementation. The result of the present experiment may suggest that low (0.1%) inclusions of the benzoic acid may stimulate growth of the broiler chickens. Higher (0.2%) supplementation also may improve performance but only in the first period of broiler chickens growth (0-14d).

The effect of drying temperature and exogenous enzymes supplementation on the nutritional value of maize for broiler chickens

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A total of 480 male Ross 308 chickens were used in a 6 treatment and 10 replicate growth study. The chickens received a maize/soy-based mash diet ad libitum and all treatments were formulated to be isonitrogenous and isocaloric according to the following design: Starter - from day 1 to 14; Grower - from day 15 to 35. The experimental groups comprised maize grain: 80°C - in groups one and two, 120°C - in groups three and four and 140°C - in groups five and six. In edition diet in group II, IV and VI were supplemented with enzyme (Avizyme 1502, Danisco Animal Nutrition, UK).While birds in groups I, III and V were given diet without enzyme. The objective of the experiment was to estimate whether different drying temperature (80°C, 120°C, 140°C) of maize and exogenous enzymes inclusion influence the performance of broiler chickens. During the entire period, the worst production results were recorded in the groups V and VI. The effect of the applied enzyme was observed most strongly in the diets that contained maize dried at higher temperatures. The observed results in group four were better ($P<0.05$) in comparison with the results from group III. The lowest pH levels were observed in the ileum and caeca content in groups III and IV.

Effect of replacing inorganic minerals with lower levels of organic minerals on turkey's performance

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A study was conducted to evaluate BioplexTM, an organic mineral supplement in turkeys. The objective was to evaluate the effectiveness of replacing an inorganic mineral supplement with an organic source at low levels of dietary inclusion. Three hundred and fifty two (352) BUT male turkeys, were randomly assigned to one of the following dietary treatments: A): 15 ppm Cu, 60 ppm Zn, Mn and Fe (all inorganic sources); B): 1.25 ppm Bioplex Cu, 5 ppm Bioplex Zn, Fe and Mn; C) 2.5 ppm Bioplex Cu, 10 ppm Bioplex Zn, Fe and Mn and D) 5 ppm Bioplex Cu, 20 ppm Bioplex Zn, Fe and Mn. Birds were group housed and the trial lasted 19 weeks. Eight replicates pens per treatment were tested. Individual bird's body weight, feed intake and orts were recorded along the trial and birds live performance computed. Gait, foot lesions, feather and breast skin scores were carried out. Data were analysed by ANOVA followed by post-hoc pairs wise comparison. Birds' weight did not significantly differ between treatments. The lowest body weights were observed in turkeys fed treatment B, whereas the highest were observed in birds fed treatment D. No significant difference in weight gain was observed among treatments. However, during the fattening phase, turkeys fed treatments D showed numerically the best performance. No significant difference between treatments was observed for feed intake, feed conversion ratio or gait, foot, feather, etc scores tests. Results from this trial illustrates that trace organic elements, included at low levels in the diet, are able to maintain birds performance and health.

Comparison of commercial near-infrared reflectance spectroscopy (NIRS) calibrations and standard chemical assay procedures for prediction of crude protein levels in poultry feed ingredients

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Abstract
The objective of this research was to determine whether manufacturer supplied near-infrared (NIR) calibrations could produce analyses of crude protein in poultry feed ingredients as accurate as those obtained by Kjeldahl procedure. Twenty samples of each feed ingredient commonly used to prepare poultry feed (wheat, corn, rye, barley, oat, soybean and sunflower meals) where analyzed by Kjeldahl procedure and by NIRS (NIRS 6500 Feed-Forage Analyzer, using WinISI-III). Commercial calibration equations were for wheat(W): mean=14.92, Standard error of calibration (SEC)=0.39, r2=0.98, Standard error of cross validation (SECV)=0.42; corn(C): mean=9.49, SEC=0.33, r2=0.93, SECV=0.34; rye(R): mean=15.27, SEC=0.47, r2=0.98, SECV=0.58; barley (B): mean=12.53, SEC=0.31, r2=0.96, SECV=0.39; oat(O): mean=13.59, SEC=0.54, r2=0.91, SECV=0.62; soybean meal(SBM)mean=54.71, SEC=0.59, r2=0.92, SECV=0.61; sunflower meal(SM): mean=36.76, SEC=0.87, r2=0.97, SECV=0.91, respectively. Protein contents by NIRS and Kjeldahl methods were: mean=11.63 vs. 11.66 (r2=0.98) for wheat, mean=6.95vs. 7.29 (r2=0.89) for corn, mean=9.19 vs. 9.26 (r2=0.93) for rye, mean=10.97 vs. 10.80 (r2=0.99) for barley, mean=10.60 vs. 10.54 (r2=0.99) for oat, mean=43.33 vs. 44.05 (r2=0.98) for soybean meal, mean=31.32 vs.31.80 (r2=0.91) for sunflower meal, respectively. These results indicate that the accuracy of commercial calibration of NIRS could be very acceptable for prediction of crude protein levels to wet chemical methods.

Keywords: protein prediction; NIRS; Kjeldahl; feed ingredient

KJELDAHL W C R B O SBM SM Avr. 11.63 6.95 9.19 10.97 10.60 43.33 31.32 Min 9.65 6.01 7.56 9.03 8.95 38.16 22.33 Max 14.28 8.47 11.71 12.77 12.41 46.79 35.54 Sd 1.26 0.64 1.23 1.05 1.04 2.24 3.49 CV,% 10.88 9.28 13.38 9.52 9.78 5.17 11.14 NIRS Avr. 11.66 7.29 9.26 10.80 10.54 44.05 31.80 Min 9.72 6.16 7.66 8.57 8.53 39.35 25.93 Max 14.63 9.12 11.73 12.51 12.25 47.43 35.82 Sd 1.32 0.70 1.36 1.16 1.02 2.20 2.93 CV,% 11.30 9.67 14.67 10.74 9.68 5.01 9.23 Pr>F 0.9418 0.1158 0.8779 0.6142 0.8343 0.3435 0.6370

The Effect of a Pre- and Probiotic (Separate and in Combination) on the Performance of Broilers

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As an alternative for the banned antimicrobial growth promoters in poultry, pre-, and probiotics are used in practical broiler feeding. A trial was done by Schothorst Feed Research to test Vetmostan, an exocellular mannan oligosaccharide (MOS) produced by an intentionally cultured micro-organism, and a probiotic based on Bacillus subtilis spores added to a wheat/soya-based broiler diets. MOS was added as 2, 1 and 1 g/kg and the probiotic as 0.5, 0.5 and 0 g/kg to the starter, grower and finisher, respectively. 408 Ross male and 408 female day-old broilers were randomly allocated to 48 pens (17 birds/pen). Per sexe, each dietary strategy was tested with 6 replicate pens. MOS improved body weight gain (BWG) and feed conversion ratio (FCR) after 36 days significantly both with 1.9%, whereas Bacillus subtilis had no significant effect on BWG and FCR. The use of both products together improved BWG and FCR significantly with 3.0 and 2.1% respectively. Positive effects became significant after 14 days. No interaction between sexe and treatment was found. It was concluded that the addition of MOS to the diets was more effective stimulating broiler performance than the addition of Bacillus subtilis.

Estimation of the relative bioavailability of zinc sources for broiler chicks

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An experiment was conducted with 260 day-old male broiler chicks to estimate the biological availability of three sources of Zn, two Zn-montmorillonites (Zn-MONT-A and Zn-MONT-B) and MINTREX®Zn. Zinc sulfate ($ZnSO_4$) was used as the standard in the bioavailability assay. Chicks were allotted randomly to dietary treatments that included an un-supplemented corn-soybean meal basal diet (32 mg/kg Zn), or the basal diet supplemented with 10, 20 or 30 mg/kg Zn as either $ZnSO_4$ (40.5% Zn), Zn-MONT-A (1.3% Zn), Zn-MONT-B (1.85% Zn) or MINTREX®Zn (10% Zn). Dietary Zn level or source had no effect ($P>0.05$) on feed intake or body weight gain of chicks, which averaged 986 g and 801 g, respectively. Using the slope-ratio technique from the regression of tibia and toe Zn concentration on supplemental dietary Zn, and with Zn from $ZnSO_4$ set at 100%, the relative biological availability values using tibia Zn were estimated to be 73, 118, and 132% for Zn-MONT-A, Zn-MONT-B, and MINTREX®Zn, respectively. For toe Zn, the bioavailability values were 88, 101, and 111% for Zn-MONT-A, Zn-MONT-B, and MINTREX®, respectively. Data suggest that both modified MONTs provided a source of bioavailable Zn, but Zn from MINTREX®Zn was more available to broiler chicks than Zn from Zn-MONT-A.

Table: Main effects of source and level of dietary zinc on chick performance and tibia zinc.

	Feed intake (g)[1]	Weight gain (g)[1]	Feed Conv. (g:g)[1]	Tibia Zn (ppm)[2]
Level				
10	1002	818	1.23	133.7^{b}
20	981	798	1.23	145.4^{a}
30	987	799	1.24	147.8^{a}
Source				
$ZnSO_4$	982	795	1.24^{b}	141.6^{bc}
Zn-MONT-A	986	802	1.23^{b}	136.9^{c}
Zn-MONT-B	978	789	1.24^{b}	143.8^{ab}
MINTREX®Zn	1014	834	1.22^{a}	146.9^{a}

[1]Data are means of 4 replicate pens of 5 chicks each.

[2]Data are means of 4 replicate pens of 3 chicks each.

Values within columns with no common superscript differ significantly ($P<0.05$).

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A comparison of performance of coccidiosis vaccinated broilers fed a coated blend of essential oils, a coated blend of organic and inorganic acids with essential oils, or bacitracin methylene disalicylate

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The objective of the two studies was to determine the influence of RepaXol, a blend of double coated essential oils (EO), AciXol, an encapsulated blend of organic and inorganic acids along with EO (ACI) or bacitracin methylene disalicylate (BMD), an antibiotic, on the performance of coccidial vaccinated broiler chickens reared to 42 days of age. Both studies had a similar experimental design. The second study used built up litter with a higher level of coccidial oocysts and Clostridium. The stocking density was 0.23 sq. meters per male bird. All chicks were spray vaccinated with a commercial coccidial vaccine. A randomized block design with 8 replications was used. The test treatments were nonmedicated, EO 50 ppm (study 2) and 100 ppm, ACI 500 ppm (study 1), or BMD 55 ppm. Results showed a significant improvement in Day 42 performance, both feed conversion and weight gain with EO 50 and 100 ppm, ACI 500 ppm, and BMD 55 ppm compared to the nonmedicated controls. The feed conversion and weight gain for EO and BMD were not significantly different in either study. No matter the background challenge level, EO, ACI, and BMD improved performance of coccidial vaccinated broiler chickens.

Effects of Methionine Sources and NSP Enzymes on Broiler Gut Microflora

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Management of gut microflora in poultry gains strong interest in Europe due to antibiotic growth promoter withdrawal. Methionine hydroxy-analogue, which can be assimilated to an organic acid, and NSP enzymes, through the changes in undigested fractions reaching the large intestine, can both impact gut microflora composition. The present experiment was conducted to evaluate the effects of dietary methionine source (DL-methionine or HMTBA) and the use of NSP enzymes (Penicillium funiculosum) on intestinal microflora composition (by RFLP of 16S rRNA methods) in broiler chickens. In overall experiment no significant differences between methionine sources were observed for any of the performance parameters evaluated. NSP enzyme addition significantly improved feed to gain ratio by 3.2% ($P<0.01$). Although differences did not reach statistical significance ($P<0.07$), birds fed DL-methionine presented a slightly higher biodiversity degree of their intestinal microflora, compared with birds fed HMTBA and results showed a strong effect of the block location on this parameter ($P<0.05$). NSP enzyme supplementation also tended to increase the biodiversity degree. There were differences between treatments in the frequency of detection of Campylobacter and Ruminococcus bacterial genus, being significantly reduced in birds fed HMTBA compared to DL-methionine.

Practical Selection of Alternatives to Antibiotic Growth Promoters

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A wide range of alternative products proposed to feed manufacturers to replace the antibiotic growth promoters in feeds , have been tested between 2000 and 2004 . Commercial diets supplemented with different alternatives (acidifiers , prebiotics , probiotics , essential oils and vegetal extracts , others) at different levels from day 1 to day 28 have been compared , alone or in combination , to a negative control and a positive control (avilamycin 10 ppm) in 8 experiments on broilers . These results indicate that in the good environmental conditions of an experimental farm , the antibiotic growth promoter and its substitutes can diversely affect the performances in comparison with the negative control , the average effects being rather low . Avilamycin being mostly active against gram-positive bacteria , these observations could be related to differences in the digestive flora of the birds in the different trials . These data confirm that the selection of susbtitutes is difficult to achieve in good sanitary conditions . The use of more discriminating experimental models can be recommanded , either on the field , or by the use of specific models , eventually with microbial challenges , to worse the sanitary conditions and simulate field conditions ; or by a combination of both.

Effect of Enterococcus faecium on the Performance of Broilers

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Due to the ban of antibiotic growth promoters in the EU there is a need for effective alternative products that will sustain high performance in animal husbandry. The present trial was conducted to evaluate the effects of feed application of a probiotic Enterococcus faecium preparation on broiler performance. 300 day-old broiler chickens (Ross-308) were randomly divided into three groups with 100 birds each. Diets were based on corn and soybean meal and the chicks were allowed ad libitum access to feed and water throughout the experimental period. The trial groups received the probiotic preparation in different concentrations, while the control group (CG) was given diets without the stated preparation. Trial group A (TG A) received Enterococcus faecium Biomin® IMB 52 with an inclusion rate of 2.5 x 108 cfu kg-1 feed and trial group B (TG B) received 5 x 108 cfu kg-1 feed The birds were kept under observation for 42 days and performance parameters like live weight and feed intake were measured on day 7, 14, 21, 28, 35 and 42. Furthermore daily weight gain, feed conversion ratio (FCR), mortality and animal health were recorded. Results showed that the live weight of birds which received Biomin® IMB 52 with an inclusion rate of 2.5 x 108 cfu kg-1 feed (TG A) and 5 x 108 cfu kg-1 feed (TG B) could be significantly improved ($P \leq 0.05$) by 5.1 to 4.9 % when compared to the control animals. Mortality could be reduced in all trial groups (CG: 9.26%, TG A: 4.95%, TG B: 3.92%). Through the addition of the probiotic feed additive efficiency of fattening was improved which resulted in an increased EPEF (European Production Efficiency Factor) in the treatment groups (CG: 255, TG A: 290, TG B: 279).

Effect of dietary level of a modified meat meal on the small intestinal morphology of broiler chickens

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A locally produced meat meal in Ardabil province in Iran is mixed with 15% wheat bran, 10% feather meal and 15% zeolite. Experimentally, this leading to an improvement in meat meal preservation characteristics. Experiment had a completely randomized design with a 2×6 factorial arrangement. The experiment factors were bird's sex at 2 levels and dietary modified meat meal at 6 levels, 2, 3.5, 5, 6.5 or 8 percent and a common commercial diet as control, without modified meat meal but containing 5% fish meal. Experiment carried out at 21 to 42 days of age. Birds fed the control diet and the diets with 6.5 or 8 percent of modified meat meal had a significantly higher villi height, crypt depth and crypt depth to villi height ratio, less goblet cell number and less epithelium thickness in duodenum. The same condition observed in jejunum section, with the exception of the goblet cell number that didn't affect. Ileum histological morphology didn't influenced by dietary manipulation. The only significant effect of sex was the higher jejunum epithelium thickness in females in compare with males. We couldn't detect any significant interaction between dietary modified meat meal content and birds' sex. It seems that the observed improvement in histological characteristics of small intestine mucosa in birds fed isoproteinous diets with different levels of modified meat meal can be attributed to the effect of animal protein supplied by meat meal. This suggests that meat meal as an animal protein source can affect nutrients absorption process.

Effect of a New Coating on the Bioefficacy of a Phytase Product in Broilers Fed Corn-Soybean Meal-Based Diets

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A study evaluated whether a coated (C) bacterially-derived, non-intrinsically thermostable, phytase product showed equivalent bioefficacy compared to the uncoated version of the same product (Phyzyme XP; 6-phytase, EC 3.1.3.26). Male Ross 308 chicks were assigned to three dietary treatments each with 6 cage replicates of 8 birds each The treatments were: Control (NC), NC + 500 U/kg phytase and NC + 500 U/kg C-phytase. Except for Ca and P, the basal corn-soybean meal diet was formulated to meet NRC (1994) requirement. Calcium and P levels were 0.58 and 0.22%, respectively. Birds were weighed on days 0 and 21, and on day 21 birds were sacrificed for ileal phosphorus digestibility and tibia ash determination. Data were analysed using the GLM procedure of SAS. No significant differences were observed between the two phytase treatments. Supplementation of the NC diet with phytase and C-phytase increased ($P<0.05$) tibia ash from 45.9% to 49.2% and 49.1%, respectively. There were no significant differences between treatments for 21-d body weight ($P>0.05$). Phosphorus digestibility significantly improved by 20.6 and 18.0 percentage units ($P<0.05$) with phytase and C-phytase supplementation, respectively. Addition of the new coating to the phytase resulted in similar bioefficacy to the original uncoated product.

Effect of Se supplementation on chick growth and development

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Se plays an important role in regulation of many different functions in the body. The aim of the present work was to evaluate effects of Se supplementation on growing chicks. Six groups (30 chicks in each group) of day-old broilers wee used. The control group (C1) was fed a commercial diet without Se or sun-flower oil supplementation; The second control (C2) group was supplemented with 3.5% of sunflower oil; Groups 3: C2 + 0.2 ppm of organic selenium (Sel-Plex®, Alltech Inc., USA) Group 4: C2 + 0.2 ppm Se (Sel-Plex) and 0.2 ppm Se (selenite); Group 5: C2 + 0.4 ppm Se (Sel-Plex) supplementation and group 6: C2 + 0.4 ppm Se (Sel-Plex) and 0.4 ppm Se (selenite). Cumulative feed consumption over the first 4 days of age was maximal in groups 3 and 5. For the first two weeks, both feed consumption and conversion followed the same pattern: the best feed conversion was achieved in groups 1 and 3, the worst in group 6. The relative mass of the intestine was similar in all groups except for group 3 were it was signifi-cantly higher. The relative mass of the duodenum in the intestine varied in relation to selenium level and form, with group 3 being significantly higher than group 1. It was concluded that the level and form of selenium may alter intestinal morphology in broiler chicks.

Effect of inclusion rate and form of zinc in broiler diets

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The aim of the present study was to evaluate the effects of inclusion rate and form of zinc (Zn) in broiler diets on chick growth and development. Eight groups of day-old chicks (42,0.45 g) with 35 birds in each group were fed commercial diets balanced for nutrients and containing either inorganic Zn (Zn sulphate) or organic (Bioplex Zn,Alltech Inc., USA) at different levels of inclusion. Groups 1-4 were supplemented with zinc in the sulphate form at 100, 70, 50 and 25 mg/kg and groups 3-8 were supplemented with zinc in the Bioplex form with the same rate of inclusion. At 35 days female body weights were (g): 1738.7±30.8; 1630.5±39.8; 1604.7±34.3; 1500.8±37.7 (groups 1-4) and 1749±39.2; 1743.5±46.1; 1741.7±33.0 and 1651.1±37.3 (groups 5-8) respectively. Similar trends were found in the body weights of males. Average daily gains in groups 1-4 were 52.2; 49.1; 47.5 and 45.2 g in groups 1-4 respectively and 53.3; 53.6; 53.4 and 50.3 g in groups 5-8 respectively. FCR was also affected by Zn supplementation being 1.80; 1.88; 1.96 and 2.02 in groups 1-4 respectively and 1.75; 1.74; 1.72 and 1.88 in groups 5-8 respectively. These results indicate that the inclusion of Bioplex Zn into the broiler diet at 50-100 mg/kg is associated with increased body weight and improved FCR.

Effect of the inclusion rate and form of manganese in broiler diets

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The aim of the present study was to evaluate the effects of manganese (Mn) in broiler diets on chick growth and development. Eight groups of day-old chicks with 35 birds in each group were fed commercial diets balanced for nutrients and containing either inorganic Mn (manganese sulphate) or organic (Bioplex Mn (Alltech Inc., USA)) at different levels of inclusion: groups 1-4 were supplemented with manganese in the sulphate form at 120, 90, 60 and 30 mg/kg and groups 3-8 were supplemented with manganese in the organic form (Bioplex Mn) with the same rate of inclusion. At 35 days, female body weights were (g): 1773.2±26.5; 1758.8±28.0; 1686.1±32.0; 1581.5±31.9 (groups 1-4) and 1811.9±33.7; 1820.4±34.8; 1737.2±24.5; 1645.5±27.3 (groups 5-8) respectively. Similar trends were found for the body weights of males: 1995,4±52,3; 1939,5±52,8; 1845.0±40.4 and 1874.5±60.1 (groups 1-4) respectively and 2029.3±60.1; 2042.5±47.1; 1933.4±47.5 and 1871.4±32.8 in groups 5-8 respectively. Average daily gains in groups 1-4 were 52.8; 51.8; 49.4 and 48.3 g in groups 1-4 respectively and 53.8; 54.1; 51.4 and 49.2 g in groups 5-8 respectively. FCR was also affected by Mn supplementation being 1.75; 1.77; 1.80 and 1.95 in groups 1-4 respectively and 1.71; 1.70; 1.71 and 1.92 in groups 5-8 respectively.

Effects of xylanase inhibitors on nutritive value of diets and performance of broilers fed wheat diets plus different xylanases

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The aim of trial was to evaluate the effects of different microbial xylanases added to wheat diets on their nutritive value for poultry and broiler performance. Six experimental treatments were tested, according xylanase enzymes used (inhibited or un-inhibited by proteinaceous xylanase-inhibitors present in wheat). 288 Ross 308 male broilers were used. A basal wheat diet in mash form was used. Six dietary treatments replicated 8 times were evaluated: T-1 (control diet), T-2 (wild xylanase 1), T-3 (un-inhibited xylanase 1), T-4 (wild xylanase 2), T-5 (un-inhibited xylanase 2) and T-6 (commercial xylanase). Performance parameters were recorded between 7 and 25 days. The AME of diets and nutrient digestibilities were evaluated at 21 days using titanium oxide as digestibility marker. Freeze-dried excreta were analysed for energy, starch and lipids while protein and viscosity were determined in ileal samples. Data were analysed as a randomized block design ANOVA (SAS). Treatment means were compared using Duncan multiple range test. Xylanase enzymes statistically increased feed efficiency ($P<0.001$), energy of diets ($P<0.0001$) and nutrient digestibilities ($P<0.01$) of diets. Intestinal viscosity of broilers fed xylanase 1 (wild or mutant) were higher than control, while intestinal viscosity measured in broilers fed commercial xylanase was significantly lower ($P<0.0001$). No differences were found between treatments including inhibited or un-inhibited xylanases.

Effect of Sel-Plex in Broiler Breeder Diets on the Subsequent Day-old Chick Quality

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Quality of the day-old chick has big influence on the growth and final performance of the bird. Some of the recent research showed that there is a positive correlation betwen the length of the stretched chick at day of hatch and chick weight at day 7 as well as with the better heart, liver and spleen development. The aim of this work was to establish the influence of inorganic vs. organic selenium source in broiler breeder diets on the body weight and length of the subsequent day-old chicks. 24000 broiler breeders (Hubbard Classic) have been divided to two dietary treatments: Control (sodium selenite at 0.3 ppm Se) or Sel-Plex (Sel-Plex, Alltech Inc. USA at 0.3 ppm Se). At 50 weeks of breeder's age, 600 chicks from each group have been used for the body weight and body length measurements. Data were analyzed using StatSoft software (STATISTICA 7, 2005). The differences in body weight (40.4 vs. 41.06 g) and body length (18.32 vs. 18.58 cm) of the day-old chicks between Control and Sel-Plex group were statistically siginificant. That indicates that chicks coming from the Sel-Plex breeder flock were better developed and have a better start for future production.

Parameter	Control Breeders	Sel-Plex Breeders
Body weight, g	40.41 ± 0.26^{a}	41.06 ± 0.21^{b}
Average length, cm	18.32 ± 0.05^{A}	18.58 ± 0.04^{B}
Minimum length, cm	16.1	17.5
Maximum length, cm	19.8	20
Correlation BW/Length	0.30	0.22

* Means within row with no common superscript differ significantly ($P<0.05$)

Effects of 25-hydroxy-cholecalciferol and a Peniophora lycii phytase on the growth performance and the apparent utilization of Ca and P in broiler chickens fed basal diets low in phosphorus and with different levels of vitamin D3

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Effects of 25-hydroxy-cholecalciferol and a phytase on growth performance, utilization of Ca/P and bone mineralization in broiler chickens fed basal diets low in phosphorus content (4.1 g/kg feed) were studied in a cage trial from day 8 to 22. 576 birds were fed pellet diets based on maize and soybean meal. Three different basal diets were prepared with 200, 500 and 2000 IU of vitamin D3/kg (ROVIMIX D3-500), respectively. Beside the control treatments, the animals received the basal diets supplemented with 69 μg 25-hydroxy-cholecalciferol (Hy-D), 750 U phytase (RONOZYME® P5000) per kg feed or a combination of both products, respectively. At levels of 200 IU and 500 IU vitamin D3 per kg feed, the inclusion of Hy-D and the combination of Hy-D and phytase significantly ($p<0.05$) improved weight gain, FCR, utilization of Ca and P as well as tibia strength and tibia ash. Additionally, at 500 IU vitamin D3/kg, growth performance and utilization of Ca and P were significantly improved by the inclusion of phytase. At 2000 IU vitamin D3 per kg, significant effects on Ca and P utilization for all inclusions were noted. In general, the highest effects were found for the combination of Hy-D and RONOZYME® P5000.

Keywords: 25-hydroxy-cholecalciferol, phytase, broiler chickens, phosphorus utilization, growth performance

Effects of 25-hydroxy-cholecalciferol and a Peniophora lycii phytase on the ileal utilization of phosphorus in laying hens fed basal diets low in phosphorus and with different levels of vitamin D3

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The effects of 25-hydroxy-cholecalciferol and a phytase on ileal utilization of P in laying hens fed basal diets low in phosphorus content (2.9 g/kg feed) were studied in a cage trial over 4 weeks. The hens were fed mash diets based on maize and soybean meal. 128 laying hens ("ISA Brown", 22 weeks of age) were allocated at random to 8 treatments with two hens per cage. Two different basal diets were prepared with 300 and 2500 IU of vitamin D3 (ROVIMIX D3-500) per kg feed, respectively. Beside the control treatments, the animals received the basal diets supplemented with 69 μg 25-hydroxy-cholecalciferol (Hy-D) per kg feed, 450 U phytase (RONOZYME® P5000) per kg feed or a combination of both products, respectively. At levels of 300 IU vitamin D3 per kg a significant ($p<0.05$) improvement of the ileal utilization of phosphorus was obtained for the inclusion of Hy-D (+59%), RONOZYME® P5000 (+88%) and the combination of both products (+121%) compared to the control treatment. The highest effect was found for the combination of Hy-D and RONOZYME® P5000. At 2500 IU vitamin D3 per kg feed, ileal P utilization was numerically improved by about +15% over all treatments compared to the control.

Is It Possible to Come Out the Problem of Betaine Replacement for DL-Methionine?

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Choline Choloride (CC), DL methionine and betaine were added to the ration of six groups of broilers (n: 450) for 49 days. Treatment were 1) Basal diet + CC + DL methionine + No betaine,2) Basal diet + replacement of %100 of CC with betaine + DL methionine 3) Basal diet + CC +replacement of %15 of DL methionine with betaine 4) Basal diet + replacement of %100 of CCwith betaine + replacement of %100 of DL methionine with betaine 5) Basal diet + replacement of %100 of CC with betaine + replacement of %7.5 of DL methionine with betaine 6) Basal diet+ CC + replacement of %7.5 of DL methionine with betaine. The content of methionine in basal diet was 2.6 gr/kg. Daily gain and average feed intake were not different ($P>0.05$) between treatment groups. Death rate and yield index related to the total of experiment didn't change ($P>0.05$). A difference between treatments concern to carcass efficiency was revealed ($P<0.05$).The highest and lowest carcass efficiency observed for treatments 6 and 3 respectively ($P<0.05$).These results shows that replacement of all Choline Choloride and replacement of %7.5 of DL methionine added to ration with betaine don't have negative effect on the broilers growth. Keywords: Betaine; DL-methionine; Choline Choloride

Bioefficacy of a probiotic feed additive in broiler diets

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Three experiments were conducted to evaluate the effects of a probiotic supplement on the performance of broiler chickens. In each experiment, two treatments were applied during both the starter (1-21d) and the grower (22-42d) phases: a basal diet, and the basal diet supplemented with 10^9 CFU/kg *Enterococcus faecium* CECT 4515. Diets were presented as mash (Experiments I and II) or pellets (Experiment III) following local custom, and were based on wheat, barley, maize and soybean meal. 18, 12 and 16 replicates of 22, 60 and 40 Ross-308 birds per treatment were used in Experiments I, II and III, respectively. In all the Experiments, probiotic supplementation increased feed intake at 21 d (53.3 *vs* 55.3 g/d; 46.4 *vs* 47.9 g/d; 41.0 *vs* 46.8 g/d; $P<0.050$). In addition, probiotic supplementation also increased growth in Experiments I and III (36.3 *vs* 37.8 g/d; 26.6 *vs* 30.1 g/d; $P<0.050$), and in Experiment II (28.0 *vs* 28.7 g/d; $P<0.100$). Over the whole period, significant differences were also observed for growth and feed intake in Experiment III, but only for feed intake in Experiment I, and were absent in Experiment II. These results suggest that the probiotic tested improves the performance of birds especially between 1 and 21 d.

Effect of Rovimix Hy.D in laying hen production

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Two trials were run to determine the effect of adding Rovimix® Hy.D® (at 3g/t feed, supplying 37.5 ug/kg of 25-hydroxycholecalciferol) to partly replace vitamin D3 in layer's feed, on production parameters of Lohmann Brown laying hens. The first trial was run from 44 to 70 weeks of age. Hens in the second trial were fed Rovimix® Hy.D® from 18 weeks of age until the end of the cycle (73 weeks). Production parameters were monitored throughout the trials. In trial 1, laying percentage of the control hens averaged 86.7% during the 26-week-period, whereas that for of the Rovimix® Hy.D®-fed hens averaged 87.8% (an increase of 1.4%). The number of eggs per hen housed increased during the trial period from 151 in the control group to 152 in the treated group. In trial 2, using Rovimix® Hy.D® also helped maintain egg production. During the 55-week-period, laying percentage increased by 1.51% (83.8% and 85.3% for control and HyD-fed hens, respectively). The number of eggs per hen housed increased from 323 in the control group to 328 in the treated group. That means 5 more eggs/hen housed. Feed intake was slightly decreased by feeding Rovimix® Hy.D® so that feed conversion was improved by 1%.

Keywords: Lohmann Brown hens; 25-hydroxy-vitamin D3; laying percentage; feed conversion

Performance of Broilers Fed on Barley-based Diets Supplemented by Two Sources of Commercial Probiotics

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This study was conducted to evaluate the effects of barley cultivars and probiotic supplementation on performance of broiler chicks fed on barley soybean meal-based diets. Three hundred and sixty 1-day old Ross broiler chicks as a mixture of both sexes were utilized for 49-day experimental period. The chicks were randomly allocated to 36 pens containing 10 chicks each with six replicates and assigned to receive one of the six dietary treatments in a 2×3 factorial arrangement. Two barley varieties (Sarurood-1 as a rain-fall cultivar and Karoon-dar-Kavir as an irrigated cultivar) and two types of commercial probitic (Biosaf® contains Saccharomyces cerevisiae and Bioplus 2B® contains Bacillus subtilis and Bacillus licheniformis plus a control group (with no supplemental probiotic) were tested. A commercial dietary enzyme (Safizyme® GP 800) with β-glucanase activity was added to all six experimental groups. The used commercial probiotics had no beneficial effects on body weight gain ($P>0.05$). The experimental treatments affected feed intake of chicks during finishing period. Birds fed on Sarurood-1 barley cultivar consumed more feed than the group fed on Karoon-dar-kavir included diets ($P<0.05$).). Barley variety affected FCR during the growing period. Feeding Sarurood-1-based diets improved FCR compared to KaroonDarKavir. The used commercial probiotic decreased feed intake of chicks comparing to the control group during the finishing period ($P<0.05$).

Effect of Multi-Enzyme Systems with Increasing Levels of Protease Activity on Broiler Performance

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An experiment was conducted using day-old Hubbard broiler chicks. The effect of multi-enzyme supplementation with increasing levels of protease activity (Nutrikem Dry®, Kemzyme Plus® and Kemzyme MS®) in corn-soy diets was tested on performance. The three enzyme mixtures were applied to 3 stages experimental diets containing corn, corn-gluten meal and soybean meal. Non-supplemented and experimental diets were fed ad-libitum to 2000 day-old broiler chicks of both sexes (4 treatments x 5 replicates x 100 broilers in 20 floor pens). Feed consumption and body weights were recorded weekly. At 42 d of age 100 birds from each treatment (20 birds per replicate) were slaughtered and subjected to carcass traits. Results show that live body weight, weight gain and feed conversion ratio were significantly affected ($P<0.05$) in response to enzyme supplementation for all experimental diets. At the end of the trial, all enzyme treatments significantly increased ($P<0.05$) breast weight compared to the control group. Furthermore, the three enzyme mixtures recorded positive effects on broiler performance compared with the non-supplemented group. In addition, slaughter characteristics recorded a significant ($P<0.05$) increase in dressing weight as well as breast muscle weight in Kemzyme MS®- fed group compared to the non-supplemented one and the other treated groups probably due to a more efficient protein utilization. Results suggest that the supplementation of typical corn-soy diets with multi-enzyme mixtures that include higher levels of protease activity could be used to improve broilers performance.

Effects of Dietary Probiotic Supplementation on Performance of Broiler Chicks Fed on Full-fat Sunflower Seed-included Diets

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The present study was conducted to evaluate full-fat sunflower seed (FFSS) as a source of protein and energy and determine the effect of supplemental probiotic on the nutrient value of FFSS-based diet. Three hundred and sixty day-old Cobb broiler chicks were divided into 36 pens. Eight pens of birds were randomly assigned to each of four dietary treatment groups. A corn-wheat-soybean-based control diet (A) was formulated and three other iso-caloric and is-onitrogenous corn-wheat-soybean-based diets containing FFSS were prepared with and without two various commercial probiotics and named diet B (with no probiotic), C (Bioplus 2B®-supplemented diet), and D (Biosaf®-supplemented diet). Body weight (BW) and feed intake (FI) was measured on 21, 42 and 49 days of age. Data were subjected to analysis of variance as a completely randomized design using the GLM procedure of SAS. Body weight of chicks fed on FFSS-based diets was higher than those fed on control diet on day 49 of age. Chicks fed on FFSS-based diets had better feed conversion ratio (FCR) than chicks in control group during 3-49 days of age. Probiotic had no statistically significant effect on BW, BWG, FI and FCR.

Evaluation of Dietary Replacement of Soybean Meal by Canola Meal Supplemented by ß-mannanase (Hemicell) on Performance of Broiler Chicks

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To investigate the replacement value of canola meal (CM) for soybean meal (SBM) in broiler diets supplemented with Hemicell (containing β-mannanase activity) on performance of growing broiler chicks, three hundred sixty unsexed 1-d-old chicks were randomly allocated to 4 treatments, each of which had 9 pens of 10 chicks per pen. Four iso-energetic and iso-nitrogenous diets were fed ad libitum as starter (days 0-21), grower (days 22-42) and finisher (days 43-49). All diets included a high proportion of corn as the main cereal component. The diets with CM included (15, 15 and 5%) CM in place of SBM in starter, grower and finisher diets, respectively. Experimental groups were: control group (Corn-SBM), corn-SBM with Hemicell, corn-SBM-CM without Hemicell, and corn-SBM-CM with Hemicell. The inclusion of CM in place of SBM reduced feed intake (FI) and body weight gain (BWG) of birds and increased feed conversion ratio (FCR) compared with birds fed on control diet. The addition of Hemicell to CM-included diets improved FI, BWG and FCR; however, only improvement in BWG and body weight (BW) compared with CM-included diets with no enzyme was statistically significant. Enzyme inclusion in SBM based diets improved BW,BWG and FCR.

Effects of Substituting Enzyme-supplemented Sorghum for Maize in Broiler Diets with Two Dietary Crude Protein Levels on Performance of Chicks

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The possibility of overcoming any detrimental effects of sorghum anti-nutritive factors on the growth rate and feed efficiency of broiler chicks by supplementing the diets with dietary enzymes and extra protein level was studied in 7-week feeding trail. Six iso-energetic diets with or without sorghum were evaluated. Each sorghum-based diet was supplemented with phytase (Natuphos) or glycosidase (Grindazyme GP 15000) or no enzyme. Enzyme supplemented sorghum-based diets were tested in two crude protein levels (100% and 110 % of NRC-recommended). Four hundred thirty two unsexed 7-day old Ross broiler chicks were divided into 36 pens. Six pens of birds were randomly assigned to each of six dietary treatment groups. Body weight (BW), feed intake (FI) was measured on 21, 42 and 49 days of age. Data were subjected to analysis of variance as a completely randomized design using the GLM procedure of SAS. Birds fed sorghum-based diets decreased BW and increased feed to gain ratio than control group. Dietary enzyme and extra protein supplementation improved BW and feed to gain ratio. From the results of this study, it can be concluded that replacing corn by sorghum may decrease broiler performance and extra protein level would be helpful in partially ameliorate its detrimental effects.

Use of Dietary Enzyme Inclusion and Seed Germination to Improve Feeding Value of Sorghum for Broiler Chicks

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Several methods have been employed to reduce anti-nutritive factors of sorghum and improve nutritional value of it to use as an energy source in poultry feed. A study was conducted to assess the effects of enzyme supplementation and seed germination on the feeding value of sorghum for broiler chicks. Four iso-nitrogenous and iso-energetic NRC-recommended diets with and without sorghum (intact or germinated seed) were evaluated. Intact sorghum-included diet was tested with or without phytase and glycosidase. Four hundred 3-day old unsexed Ross broiler chicks were randomly distributed into 20 pens. Five pens of birds were randomly assigned to each of four dietary treatment groups. Body weight, feed intake was measured on 21, 42 and 49 days of age. Data were subjected to analysis of variance as a completely randomized design using the GLM procedure of SAS. Dietary treatment had no significant effect on body weight gain of chicks except for growing period. Chicks fed control (corn-) and germinated sorghum-based diets had higher body weight gain than other dietary treatment groups. Germination significantly improved feed to gain ratio of chicks. Enzyme supplementation had no statistically significant effect on chicks' performance.

Effects of Dietary Phytase Supplementation on Performance of Broilers Fed on Low Phosphorous and Low Protein Barley-based Diets

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In the purpose to reducing excretion of nitrogen and phosphorous without the influence of growth performance in broiler chicks, a feeding trial were conducted. Two hundred and forty day-old Ross chicks of both sexes were housed in 40 floor pens and allocated to ten replicates of four iso-caloric corn-barley-soybean based diets. Treatments were based on: two different concentrations of crude protein (CP) and non-phytate P (NPP) with or without phytase (Ronozyme®). Decreasing dietary CP or NPP negatively influenced BW. The adverse effects were not overcome by the addition of phytase. There were no significant differences in FI between C and L diets during 0 to 21 and 43 to 49 days of age. In addition, there were no significant differences in FI between C and LP diets during 43 to 49 days of age. Decreasing dietary CP or NPP had no negative effects on FCR during 0 to 21 days of age. However, phytase supplementation did not improve FCR of birds fed on low protein and low P diets. In general, dietary inclusion of phytase could partially ameliorate the adverse effects of decreasing P on FI or FCR, but not in case of low CP and NPP diets.

Evaluation of Dietary Replacement of Soybean Meal by Chickpea Supplemented by Enzymes on Performance of Broiler Chicks

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This experiment was carried out to determine the effect of dietary inclusion of chickpea seeds with or without two commercial enzyme products on the performance of broiler chicks. A total of 396 unsexed day-old Cobb broiler chicks were randomly distributed in 36 floor pens of 11 birds each. Six replicates were allocated to one of six iso-energetic and iso-nitrogenous experimental diets. Chickpea were included in corn-soybean based diets at 100 g/kg as a partial replacement. Diets used were diet 1, a corn-soybean based diet; diet 2, a low phosphorous corn-soybean based diet supplemented with Ronozyme (phytase activity); diet 3, a corn-soybean based diet supplemented by Hemicell (β-mannanase activity); diet 4, a corn-soybean-chickpea based diet; diet 5, a low phosphorous corn-soybean-chickpea based diet supplemented with Ronozyme ; diet 6, a corn-soybean-chickpea based diet supplemented by Hemicell. Partial replacement of soybean meal by chickpea had no detrimental effects on BWG, FI and FCR. The addition of Hemicell to chickpea-included diets improved BWG; however, the effect of enzyme was not statistically significant in soybean meal-based diets. Performance of birds fed low P level plus phytase supplementation had no statistically significant difference with chicks fed soybean- or chickpea-included control diets.

Evaluation of Phytase Nutrient Equivalency Values for Layer Hens

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An experiment was conducted to determine the effect of phytase supplementation on layer hens performance and compare using phytase nutrient equivalency values in feed formulation with those fed conventional diet. In this experiment, 288 Hy-line W-36 hens were used from 60 to 72 wk of age. The treatments consisted of a control diet (C) with no addition of phytase, control diet supplemented with 300 FTU/kg phytase over the top (C+P), and the third diet contained 300 FTU/kg phytase which calculated phytase nutrient equivalency values in feed formulation (PE). Total and non phytate phosphorus concentration in C, C+P and PE diet was 0.51, 0.51 and 0.4%, 0.3, 0.3 and 0.19%, respectively. Supplementation of phytase to diet and calculation of the nutrient equivalency values of phytase in feed formulation, decrease percent hen day egg production and egg mass output (g/hen per day) in hens fed PE diet ($P<0.05$). As egg production declined, FCR increased significantly ($P<0.05$). There were no significant differences in egg shell thickness, shell breaking strength, shell and toe mineralization among dietary treatments. Results suggested that addition of phytase improved phosphorus availability but had no effect on energy and protein utilization in old layer hens.

Keywords: phytase; nutrient equivalency; performance; layer hens

Session V
Nutrition and Consumer Expectations: Safety and Quality

Invited Papers

Perception of poultry feeding by European consumers

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Abstract not Available

Nutrition to Improve Sensorial Quality

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Dietary nutrients play a significant part in determining growth rate and meat yield. It is known that the compositions of protein and total amino acids of meat are invariable by feeding treatments, hence the meat taste is considered to be invariable. However, the relationship of taste components of meat with nutrients is not fully elucidated, and there have been few reports on the effect of feeding treatments on taste-active components of chicken meat. Previously, restricted feeding and dietary low metabolizable energy levels decreased the free Glu contents of meat, and the meat taste was deteriorated (Fujimura et al., 1997, 2001). In the present study, the effect of dietary CP and amino acid levels before marketing on broiler meat composition, i.e., free amino acids and ATP metabolites, and sensory score were studied using female broilers. As a result of this study, free Glu and sensory score in meat were increased in high CP diet, and free Glu contents increased by dietary CP levels for 3 to 10 days. Dietary BCAA also affected the free Glu and improved the meat taste. These results the dietary components are one of the important factors affecting the meat taste of chickens.

Natural Antioxidants in Poultry Nutrition: new developments

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Optimal nutrition is a milestone for modern poultry production. Chicken diets include a range of natural antioxidants. For example, there are 8 vitamin E-related compounds: 4 tocopherols and 4 tocotrienols. Carotenoinds comprise a group of more than 600 individual compounds while flavonoids include more than 8,000 compounds. Recently the concept of the total antioxidant system of the body has been developed. In accordance with this concept, every antioxidant in the body has its own role to play, but all of the antioxidants are interacting with each other forming an integrated antioxidant system. For example, vitamin E is the "headquarter", selenium is the "chief executive", carotenoids are "communicating services" and vitamin C is the "special force" of the antioxidant system. Recently twenty five selenoproteins have been characterised in human and animal cells. Indeed, glutathione peroxidase (GSH-Px), known for 30 years as a major selenoprotein, in fact is only one of the big family of selenoproteins and probably is not the most important. However, Se requirements of human and animals have been developed based on the GPH-Px activity in response to Se supplementation. Recently it has been shown that when GSH-Px activity is maximum, activities of other selenoproteins such as selenoprotein P and thioredoxin reductase are not at the maximum expression level. This means that old data should be reconsidered and that the Se requirement should be re-evaluated based on the new developments in this area. Natural antioxidants are considered to play crucial roles in reproduction, immunomodulation and antiviral defence, protection against various stressors and the maintenance of high food (meat) quality. Recent developments in the areas of nutrigenomics and maternal programming in relation to antioxidants are very promising and poultry science and production will certainly benefit from the knowledge generated in these exciting areas of research.

Short Communications

Modification The n-3 Fatty Acid Profile of Meat- and Liver-type Geese Tissues

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Since n-3 fatty acid content of foods plays an important role to decrease the incidence of coronary heart diseases in humans, the aim of the present study was to investigate the effect of feeding linseed on the n-3 fatty acid profile of tissues and some production traits of meat- and liver-type goose. 26 week old meat-type geese (Kolos) were fed maize or a mixture of 90% maize and 10% linseed for 6 week. In a second experiment 9 week old liver-type geese (Grimoud G36) were force fed for 20 days either maize or the same mixture of maize and linseed as described above. Linseed incorporation into maize in meat-type geese significantly decreased final body weight, the relative liver weight and abdominal fat pad content, but failed to change the fat content of liver, breast meat and the relative abdominal fat percentage compared to maize. Feeding linseed however, increased significantly the total n-3 fatty acid content of liver, breast meat. Among n-3 fatty acids significant increase was detected only in the case of linolenic acid and DHA contents of liver. Force feeding 10% linseed decreased significantly, by 51% the fatty liver weight and the by 50% the fat content of liver. No significant effects of treatments were found in the breast meat fat and abdominal fat contents. Using linseed during force-feeding increased the total n-3 fatty acid, linolenic acid, DPA and DHA contents of liver by 4-8 times and total n-3 fatty acids and linolenic acid content of breast meat by 2 times. According to these results n-3 fatty acids inhibit hepatic lipogenesis dramatically in overfed liver-type geese. The modification of fatty acid profile of goose tissues can be more successful with meat-type birds.

The interactive impact of dietary PUFA on the deposition of DHA in the egg yolk

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Both total daily intake and fatty acid composition of dietary fat has a clear effect on some chronic diseases in the "western society". A better balance between the n-6 and n-3 fatty acids induces a more appropriate balance of both their respective LC-PUFA (AA vs EPA & DHA) and eicosanoids with specific and opposite metabolic and immunologic properties. Since the fatty acid profile of eggs is strongly influenced by the fatty acid composition of dietary fat in layer feed, eggs are an excellent target foodstuff to increase LC-PUFA in the human diet. This trial consisted of 9 treatments where a low fat layer diet was supplemented with 3% oil composed of a combination of flaxseed oil, soy oil, high EPA or DHA fish oil, so creating a relative wide variation in dietary PUFA-concentration. Bifactorial response surface modelling was used to relate the egg yolk DHA-% to dietary concentrations of C18:2, C18:3, EPA and DHA. Dietary lipid composition had a major impact on egg yolk fatty acid profile, whereby yolk DHA varied from 0.8 up to 4.1%. The bi-factorial analysis revealed that (1) yolk DHA was positively related to dietary C18:3, EPA & DHA but inversely related to dietary C18:2, (2) C18:3 was a less efficient DHA-precursor than EPA and (3) the "transfer/conversion" of EPA to DHA was relatively limited at higher dietary DHA-concentration.

Enrichment of conjugated linoleic acid (CLA) in the eggs of laying hens fed pure isomers of CLA or vaccenic acid

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Conjugated linoleic acid (CLA) is a complex mixture of positional and geometric conjugated isomers of linoleic acid. Dairy products are principal dietary CLA source with cis-9, trans-11 CLA (9,11 CLA) the predominant isomer derived from vaccenic acid (VA,trans-11C18:1). Due to potential human health benefits attributed with CLA intake, several studies have attempted to enrich eggs with CLA. Results are consistent with Δ-9 desaturase inhibition by trans-10, cis-12 CLA isomer (10,12 CLA) in CLA mixtures. We supplemented laying hens diets with relatively pure forms of 9,11 CLA and 10,12 CLA, determined the transfer efficiencies of these isomers into egg yolk and examined endogenous conversion of VA to 9,11 CLA in hens. Treatment diets were supplemented with 0, 0.5, 1.0 and 1.5 g/d of CLA or VA and fed to three hens per treatment for 21 days. Transfer efficiencies of 9,11 CLA and 10,12 CLA in egg yolk total lipids of 21 and <1%, 24 and 12%, 20 and 9%, respectively were measured per CLA source. Regression showed that 74% of VA available for desaturation was converted to 9,11 CLA. Studies examining other limitations of VA transfer to the liver and availability for conversion by Δ-9 desaturase are envisaged.

The effect of different levels of choline and betaine on broiler performance and carcass characteristics

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An in vivo experiment was conducted to determine the effect of dietary betaine supplementation (Betafine) as a replacement for choline on broiler performance and carcass characteristics. The four betaine levels at 0, 33, 66 and 100% in replacement for choline were added to two various basal diets (without or containing 2.5% oil) in a 2×4 factorial arrangement with four replicates of 10 birds. Three hundred-twenty day-old broiler chicks were fed with the experimental diets from 0 to 49 days of age. At 49 days of age, one bird per replicate was selected randomly for blood sampling and comparison of carcass characteristics. Betaine replacement for choline had mainly no effect on FI, BW gain and feed conversion ratio (FCR), but the significant differences ($P < 0.05$) in BW gain (at 0-3 and 3-6 weeks of age) and FCR (at 0-3 weeks of age) were observed among the experimental diets. Replacing choline with betaine increased breast and reduced abdominal fat percentages ($P < 0.05$), but had no significant effect on thigh, liver, and liver fat percentages and blood lipoproteins level. The present findings indicated that although dietary addition of betaine instead of choline did not significantly improve the performance parameters, but resulted to favourable changes in abdominal fat and breast meat percentages.

Posters

Effects of dietary fat type and different levels of vitamin E on performance and some of eggs characters of broiler breeder

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The study carried out to evaluate the effects of fat type and different levels of vitamin E on the performance and some of the egg characters of broiler breeding hens. 90 broiler breeder hens (Ross 308 strain) at 27 week of age were fed in a 2 ×3 factorial trial (4% Canola oil and Tallow with 0, 75 and 150 mg/kg of vitamin E) in an 8 weeks period. At the end of the experiment significant differences were not found in body weight, feed intake, feed conversion rate, number and weight of eggs, laying percentage and hatchability variables between fat type and vitamin E treatments. The difference between levels of eggs vitamin E, linoleic and linolenic acids ($P<0.01$), total fat percentage and oleic acids ($P<0.05$) were significant, while in eggs arachidonic and stearic acid there were no significant difference. The results showed that eggs fatty acids profile were significantly influenced (mainly in the linoleic and linolenic acids) by fat type and vitamin E levels of diet. In a conclusion, it was found that the fat type and vitamin E levels could be effective in the eggs fatty acid profile and vitamin E content, and fat source do not limit vitamin E absorption, although they may increase its degradation in the gastrointestinal tract. However increasing levels of vitamin E had affect in it's deposit in Canola oil content groups ($P<0.05$).

Collagen content in fowls musculature in relation with age, sex and anatomic region

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Collagen is a scleroproteid similar to the two components of the conjunctive tissue: elastine and reticuline. Collagen represents 15-50% from the total conjunctive tissue and 30-35% from the total protein of the body. Quantitative and qualitative modifications are highly important in the understanding of different biologic processes such as growth and development or pathologic processes with the implication of this protein, which is spread very much in the body. The collagen contents of the organism of adult animals is in generally constant, but in some physiological states and especially in physiopatological ones, marked modifications of it take place, both quantitatively and qualitatively. Determination of the collagen content in pectoral and shank musculature in broilers at age of: 42, 49, 56, 63 days, which has been administrating the diet 21/1 (romanian recipe). Collagen determination was carried out by indirect biochemical method, which considers hydroxyproline dosing in accordance with the method described by Neuman and Logan. At the ages of 42, 49, 56 and 63 days demonstrate a tendency to increase the collagen content in the breast musculature appears in both sexes. The same tendency of collagen content increase is also observed in the thigh musculature of female chickens, while in males was observed a slight diminution. Comparing the collagen content of the breast musculature, no significant differences between the sexes could be established, excepting the 49 day old chickens, where values were higher in the females than in the males. In the thigh musculature significant differences ($P<0.01$) were observed only at the age of 42 days, when values were smaller in the females (3.65 ± 0.23 g/100 g protein) than in the males (4.61 ± 0.09 g/100 g protein). In both sexes there was a higher content in the thigh musculature than in the breast.

Selenium-enriched eggs on the Eastern European Market: prospects and limitations

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The aim of the present work is to analyse prospects and limitations in the commercial production of Se-eggs in Russia and Ukraine. The technology of producing Se-enriched eggs first originated from the Scottish Agricultural College in 1998. Today there are about 20 poultry farms in Russia producing Se-eggs commercially. They are situated in various regions of the country ranging from St. Petersburg up to Siberia and the Far East. In most instances, these eggs are sold with distinguishable names and brands including "Rejuvenating", "Aksais's sun", "Spring of Cheerfulness", "Universal", "Oval Wonder", "Strong eggs", "Activita", "Selena", "Healthy Selenium". The level of Se delivered in a single egg varies from 20 up to 35 μg. Prices for Se-enriched eggs vary and are usually higher by 10-50% in comparison with normal table eggs. In general, about 38 billion eggs were produced in Russia in 2006 and about 40% of them were eggs with modified composition (containing increased levels of various vitamins, omega-3 PUFAs and selenium). The egg under the brand "Bag of Life" are produced at the level of 1.2 million eggs daily in Ukraine and sold all over the country.. The technology of the egg production is protected by the Ukrainian patent. One important advantage for Russia and the Ukraine in terms of Se-egg production is that they do not need to comply with EU feed additive legislation for local use and they also have strong marketing support. A major limitation in Se-egg production is a lack of public knowledge concerning the beneficial effects of selenium in relation to human health.

The efficacy of 25-OH-cholecalciferol in combination with different dietary Ca-P concentrations for laying hens

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The two most important factors in the consumer's selection of a fresh egg are product "yolk colour" appearance and "shell quality". The objective was to investigate the efficacy of 25-OH-D3 in combination with different dietary Ca-P concentrations in terms of layer performance, egg shell quality and tibia characteristics. This trial was designed 2-factorially with 3 Ca-P combinations (a control and 2 alternatives where a low Ca was combined with either low or normal P) and 2 types of vit. D3 supplied as either 3000 IU vit. D3/kg or a combination of 1500 IU vit. D3+1500 IU 25-OH-D3/kg (20-68 weeks of age). The impact of dietary Ca & P was clear on egg mass and more pronounced on egg shell quality than on final tibia characteristics. Compared with vit. D3 the dietary supplementation with 25-OH-D3 resulted in (1) a significant improvement of the egg shell quality and (2) moreover a tendency for a higher lay-%, a lower feed intake and a better feed conversion rate with some significant effects on tibia characteristics. In general, it can be concluded that 25-OH-D3 had (1) a more pronounced effect on shell quality than on performance, (2) a compensating efficacy for the dietary differences in Ca & P and (3) a beneficial impact on the economic return in the layer husbandry.

Effect of medium chain fatty acids on (1) layer performance and (2) yolk fatty acid profile in combination with different dietary lipid sources

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The objective of this trial was to determine the impact of medium chain fatty acids "MCFA" (on the market as Aromabiotic) on (1) the layer performance and (2) on the yolk fatty acid profile in combination with different dietary lipid sources. The zootechnical trial consisted of 3 treatments "control and 2 types of Aromabiotic at 1 kg/ton". The "fatty acid" trial consisted of 9 treatments with 3 types of fat each combined with the control Aromabiotic at resp. 1 & 5 kg/ton. At the quite high performance for the given layer cycle, the effect (1) on daily egg mass was significant for 1 type of MCFA and (2) on feed conversion was significant for both types of MCFA. There was, however, no clear difference in efficacy between both types of Aromabiotic. The impact of Aromabiotic might be more important at lower laying performance (with advancing age of the flock) and/or imbalances of microbial-related physiology of the gastro-intestinal tract. The response in yolk fatty acid profile can be summarized as follows : higher SFA-levels in the coconut group (C14:0), higher MUFA-levels in the lard group, higher N-6-& N-3-levels in the soy oil group and no deposition of the medium (C8-10)-FA. So, there is no enrichment of the egg yolk with medium chain fatty acids by means of the addition of MCFA in the feed.

Fatty acid composition in breasts of Zagorje turkeys from free range rearing

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Zagorje turkey became known in Croatia during the past four and a half centuries. The content of total fat and composition of fatty acids in breast muscle (m.pectoralis superficialis) were measured in Zagorje turkeys from free range rearing and free choice feeding. 144 young turkeys were divided into two groups (C and E), each comprising of 72 birds (36 males+ 36 females). For the first four weeks turkeys were fed a starter diet (25% protein), then grower diet (23% protein) for the next four weeks. From week 9 to 24 of age turkeys were free choice fed whole corn grain (C) or grounded corn (E) plus soybean meal with vitamin-mineral mix. At the same time birds grazed on pasture. Total lipids and fatty acids composition of breast meat of 10 samples (5 male+5 female) were analyzed. Absolute values of majority of fatty acids in the experimental birds are similar to those in commercial hybrid turkeys. Level of decosahexaenoic (C22:6n3) acid was for approximately 100% higher in breast muscles of female Zagorje turkeys, when compared to commercial hybrids. Effect of sex and treatment on level of n-3 polyunsaturated fatty acids was established in breast of Zagorje turkeys.

Key words: fatty acids; composition; Zagorje turkey; breasts; free range rearing

Figure 1. SFA/MUFA and PUFAn-6/PUFAn-6 ratio in breast meat of turkeys fed a control (C) and experimental (E) diets, respectively.

Supplementation of exogenous enzymes to laying hen diets containing alfalfa: Influence upon performance and egg yolk cholesterol and pigmentation

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The aim of the present study was to determine the effects of inclusion of alfalfa in Hy-line W36 laying hen diets meal with and without exogenous enzyme supplementation on production performance and egg yolk cholesterol content and pigmentation. One hundred and eight laying hens were allocated to three treatments as follow: 1) a commercial layer diet as a control without alfalfa meal, 2) a diet included 10% alfalfa meal without enzyme mixture, and 3) a diet included 10% alfalfa meal with enzyme mixture. Enzyme mixture consisted of ß-glucanase and arabinoxylanase activities. The results showed that the inclusion of alfalfa meal had no significant effect on egg production, egg weight, egg mass, feed conversion ratio, shell thickness, albumen height, shell resistance against breaking and egg shape index. However the use of alfalfa meal caused a significant reduction in egg yolk cholesterol content ($P<0.05$). The inclusion of alfalfa meal increased the pigmentation degree of egg yolk color (4 vs 6). Application of enzyme in alfalfa diet had no significant effect on aforementioned criteria.

Effect of Dietary Organic Selenium on Egg and Tissue Selenium and Glutathione Peroxidase in Broiler Breeders

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An experiment was conducted to compare the effect of selenium sources on performance, Se incorporation into certain poultry tissues (blood, liver and breast muscle) and eggs, hatchability, glutathione peroxidase activities in tissues and eggs in broiler breeder. Broiler breeder hens were allocated to six diet treatments factorially arranged with three selenium sources (Sodium selenite, Selenium-yeast, and B-TRAXIM®Se) and two levels of each source (0.1 and 0.3 ppm). Egg production was higher ($P<0.01$) in hens fed 0.3 ppm Se. Selenium contents in egg, liver, and breast meat were higher ($P<0.01$ or 0.05) in hens fed the higher level of selenium. Selenium content in yolk was highest in hens fed B-TRAXIM®Se, whereas selenium content in albumen was highest in hens fed selenium yeast. However, there was no difference in combined selenium contents of yolk plus albumen. Selenium contents in liver and breast meat were higher in hens fed Se-yeast compared to hens fed other sources of selenium. Glutathione peroxidase activity (GPX) in liver and plasma was affected by selenium source but not by level. GPX in liver was higher in hens fed selenite or selenium yeast, and in plasma was higher in hens fed selenite compared to B-TRAXIM®Se or selenium yeast.

Effect of Dietary Mannan-oligosaccharide on Campylobacter challenged broilers

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The aim of this trial was to evaluate the effect of mannan-oligosaccharide (MOS) on Campylobacter challenged broilers. Fifty cobb-500 male broilers were randomly distributed into 12 isolation chambers (6 replicates) with 4 birds each. The dietary treatments were as follows: Control and MOS supplemented (2 kg/ton of Bio-Mos®, Alltech, Inc.,USA). On day 7 all birds were infected per os with a Campylobacter jejuni culture (0.5 mL/bird) containing 5x106 cfu/mL. The clinical symptoms and growth performance were recorded along with bacteriological examination (Campylobacter concentration in small intestine, cecum and carcass wash). All birds survived after the infection without significant clinical symptoms even though a tendency to more wet litter was noticed in the control group. Final body weight was significantly higher in the MOS than the control group (1686 g vs. 1488 g; $P < 0.001$). The effect of MOS on Campylobacter concentration is shown in table 1. At intestinal level, no significant difference between treatments was found in the number of Campylobacter positive animals. However, MOS supplementation significantly reduced the frequency of Campylobacter positive carcass wash from 100% to 8.3%). The present data suggest that MOS (Bio-Mos®) supported broiler growth performance and can help in reducing Campylobacter carcass contamination.

Effect of antioxidant natural extract on oxidative stress and antioxidant status of broilers

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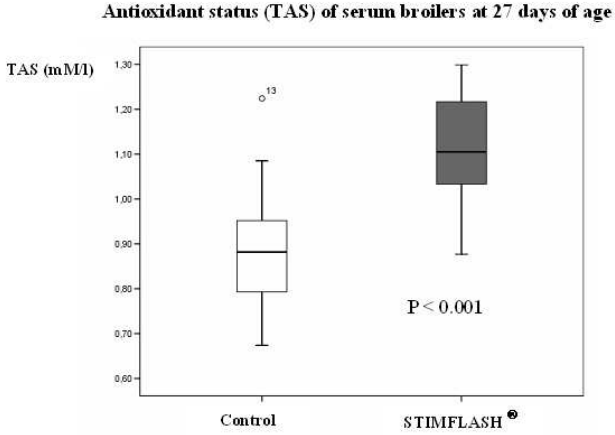
The aim of this trial was to study the effect of a natural product riche in polyphenols - STIMFLASH® (DELTAVIT - France) - on performance, oxidative stress and the antioxidant status of broilers (ROSS PM3). The experiment was carried out in experimental station with 35 broilers : 4 cages of 5 broilers each for control treatment and 3 cages of 5 broilers each for trial treatment. STIMFLASH® was distributed through the drinking water in trial treatments during days 7 to 10 at 1.5ml/l , then during days 24 to 27 at 2.0ml/l. Blood samples were taken from each broilers at 27 days of age. Oxidative stress (TBARS) and total antioxidant status (TAS) of animals were determined at this age too. There was statistically significant difference observed in oxidative stress (5.2 vs 8.7μM/l) between the experimental and the control groups of animals (P>0.001). Moreover, with STIMFLASH®, TAS in experimental group was significantly higher (1.11mM/l) than in control groups (0.89mM/l) (P>0.001). These two results could explain the better daily gain of weight (+1.6g) observed in the experimental group. These TBARS and TAS results confirm STIMFLASH® effect observed on previous trials in free range chickens and rabbits.



The effects of different levels of L-carnitine and fat on performance and egg quality of laying hens

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L-carnitine is used as feed additive in poultry diets to increase yield and to improve feed efficiency. The major role of L-carnitine appears to be the transport of long-chain fatty acids into mitochondria for oxidation. This experiment was conducted to study the effect of two levels of fat (10 and 30 g/kg) and two levels of L-carnitine (0 and 250 mg/kg) on performance and egg quality of laying hens in a factorial arrangement (2×2) with completely randomized design with six replicates and four laying hens in each replicate. During the experiment feed intake, egg weight, egg production, feed conversion ratio, and blood parameters (triglyceride, cholesterol, LDL. HDL), egg quality (albumen height, shell thickness, shell breaking strength), and cholesterol content of eggs were measured. Results indicated that supplementation of L-carnitine in diets hadn't significant effect on performance, cholesterol content of eggs, but decreased the levels of triglyceride, cholesterol, LDL in blood serum and increased albumen height of eggs significantly($P<0.05$). Supplementation of fat significantly increased feed intake and egg weight ($P<0.05$), but hadn't significant effect on blood serum parameters, egg quality and cholesterol content of eggs. Keywords: L-carnitine, fat, egg quality, cholesterol, laying hens

Effects of canthaxanthin supplementation in the ROSS breeder diet on oxidative stress of chicks

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A field trial was run with the objective to determine the effect of 6 ppm canthaxanthin in ROSS breeders feed (throught supplementation with 60 ppm CAROPHYLL® Red) on the anti-oxidant status of their progeny. The 1 day chicks have very variable antioxidant status and could partly explain differences on their performances. The canthaxanthin is a carotenoid studied for its antioxidant activity. Two experimental batches (2 X 9000 breeders) on the same site of breeding of a hatchery were integrated into the test. The experimental ROSS PM3 Yellow breeders received the canthaxanthin during 12 weeks, from 27 to 38 weeks of age. The feed was heat treated, wheat, corn and soya meal based. Blood samples were taken from 75 chicks resulting from breeders from each batch. The antioxidant status of sera of 1-day chicks were significantly higher and the TBARS level significantly lower with 6 ppm canthaxanthin in the breeder feed. These results indicated that maternal supplementation with canthaxanthin (6ppm) enhances antioxidant capability and depresses oxidative stress in chicks.

Improving the Breast Meat Quality and Carcass Characteristics of Heat-Stressed Broilers by Feeding Chromium Supplementation

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In this experiment 240 one-day-old male broilers (Ross 308) in heat stress condition (33±3°C) were allocated to four treatments in a completely randomized design. Treatments were supplemented with 0 (control), 500, 1000 or 1500 ppb chromium (Cr) in the form of Cr nicotinate. Twelve chicks from each treatment were slaughtered at 42 d, carcass and abdominal fat pad were removed, and weighed. Breast meat was skinless, deboned and some muscles from the breast were immediately stored at −20 °C for assessing intramuscular fat and crude protein content, and others were stored individually in plastic bags at 4 °C in refrigerator for 2 and 6 days to measure malonaldehyde and tyrosine value as the indicator of lipid peroxidation (oxidative stability) and proteolysis, respectively. At 12 h after slaughter the breast muscle pH was determined. Chromium supplementation increased carcass yield and protein content of meat ($P<0.01$). Moisture, intramuscular fat content pH and meat proteolysis were not affected by supplemental Cr. Storage time increased lipid peroxidation and proteolysis of breast meat ($P<0.01$). Supplemental Cr decreased abdominal fat content and lipid oxidation of breast muscle for 2 days of storage ($P<0.05$).

Camelina sativa Cake in Poultry Diets

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The effects of Camelina sativa cake (CSC) on poultry performance were examined in 38-day broiler (2,880 Ross 508) and 52-week laying hen (280 LSL, 21-wk-old) experiment. Broiler diets contained 0, 5, 10, 15, 20, or 25% CSC. In layer diets 0, 25, 50, 75 or 100% of soybean meal was replaced with CSC. Broilers' weight gain decreased and feed conversion rate (FCR) impaired with increasing dietary CSC. Increasing dietary CSC decreased the mortality of broilers. Broiler breast meat omega-fatty acid content increased with increasing dietary CSC, while the omega-6/omega-3-ratio decreased. Dietary CSC had no effect on the sensory quality of broiler meat. Laying rate and FCR of hens was unaffected by dietary CSC. Increased dietary CSC decreased feed consumption and egg weight. Mortality was unaffected by CSC, but weight gain decreased with increasing dietary CSC. Yolk omega-3-fatty acid content increased and omega-6/omega-3-ratio decreased with increasing CSC in diet. Dietary CSC had no systematic effect on sensory quality of eggs. In conclusion, 5-10% CSC in broiler diets and 28% CSC in layer diets has no remarkable effects on poultry performance or on product sensory quality, but will enhance the fatty acid composition of egg yolk and broiler meat.

Effect of linseed oils with different fatty acid pattern in the diet upon the content of fatty acids in chicken meat

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Effects of 1, 3, 5 or 7 % of linseed oil on the content of fatty acids in breast and thigh meat were studied in an experiment with broiler chickens. Oils made either of the linseed cultivar Atalante (A) with a high content of α-linolenic acid or of the cultivar Lola (L) with a predominating content of linoleic acid were used. The diets were formulated to maintain a constant energy/protein ratio. When feeding A, contents of all n-3 PUFA were significantly higher, those of n-6 PUFA were lower, and the ratio of n-6/n-3 PUFA was narrower ($P<0.001$) than when L was fed. With the exception of docosahexaenoic acid, the contents of all fatty acids in breast meat were lower ($P<0.001$) and the n-6/n-3 PUFA ratio was from human health point of view better than that observed in thigh meat. The narrowest n-6 to n-3 PUFA ratio (0.77:1 and 0.93:1 in breast and thigh meat, respectively) was observed at the content 36 g of α-linolenic acid (58 g A) per kg of the diet while the widest one (13.63:1 and 17.22:1 in breast and thigh meat, respectively) at 2 g of α-linolenic acid (70 g L) per kg of the diet.

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