

Nonruminant Nutrition: Nutrition – Broilers, Layers, Guinea Pigs, Rabbits and Rats

W133 No absorption of ochratoxin A and fumonisin B1 in rat small intestine detected with Ussing diffusion chamber. V. Pizzamiglio¹, E. Grilli¹, L. Fabbri¹, A. Piva^{*1}, and B. Weström², ¹*Dipartimento di morfofisiologia veterinaria e produzioni animali, Ozzano Emilia (BO), Italy*, ²*Department of cell and organism biology, Lund, Sweden*.

Aim of the present study was to investigate *in vitro* absorption of ochratoxin A (OTA) and fumonisin B1 (FB1) in rat small intestine with Ussing chamber method. Male rats (n=10), Sprague-Dawley strain, weighing 350-400 g underwent laparotomy under ether anesthesia. Jejunum, 10 cm from the ligament of Treitz, was removed, immediately immersed in a modified oxygenated Krebs-Ringer buffer at room temperature; twelve pieces 2.5 cm long were cut, opened along the mesenteric border, and mounted in Ussing chambers. The experiments started, within 30 min after the anesthesia, when the buffer in the 12 mucosal reservoirs was exchanged with 5 ml buffer containing mycotoxins and/or marker molecules to monitor mucosal integrity (¹⁴C-Mannitol, FITC-Dextran 4400, and ovalbumin) as follow: chambers 1 and 7, OTA; chambers 2 and 8, OTA+M; chambers 3, 6, 9, and 12, M; chambers 4 and 10, FB1; chambers 5 and 11, FB1+M. At the onset of the experiments, the concentrations of the corresponding substances in the mucosal reservoir were: OTA=200 ppb, FB1=30 ppm, ¹⁴C-Mannitol=0.031 μ Ci/ml, FITC-Dextran 4400=1 mg/ml, ovalbumin=25 mg/ml. For 2 h, every 20 min, a 1 ml sample had been withdrawn from serosal reservoir for OTA, FB1, and marker analysis, and replaced with 1ml of fresh buffer. At 2 h, a 1 ml sample was withdrawn from mucosal reservoirs of mycotoxin containing chambers for analysis. The apparent permeability coefficients (P_{app}) for marker molecules revealed the integrity of the mucosal segments, and that OTA and FB1 separately did not influence mucosal permeability in mycotoxins and M containing chambers (2, 5, 8, and 11). OTA and FB1 analysis in serosal reservoirs revealed no presence of them; OTA and FB1 analysis of mucosal samples withdrawn at 2 h revealed concentrations similar to those at the beginning of the experiment. No passage of OTA and FB1 through intact rat small intestine mucosa was observed. Other studies are required to better explain mycotoxins uptake in other parts of rat gastrointestinal tract.

Key Words: Mycotoxin, Ussing chamber, Rat

W134 Dietary high-tannin sorghum increases growth rate in rats. R. Larraín* and J. Reed, *University of Wisconsin, Madison*.

High tannin sorghums (HTS) contain proanthocyanidins (condensed tannins), usually recognized as anti-nutritional factors. The objective of this study was to test if diets containing increasing amounts of HTS affect the growth of rats. Male Sprague Dawley rats were used in a factorial design with four diets and two feeding periods. Diets modified from NIH-07 contained corn and HTS at a ratio of 0:50, 20:30, 35:15 and 50:0 percent of the diet (S0, S20, S35 and S50, respectively). HTS had 37.6 mg/g proanthocyanidins (vanillin method). Feeding periods were 2 and 10 weeks (2W and 10W). Rats (n=9 or 10) were randomly assigned to diets within each feeding period. Rats in 2W and 10 W groups started the experiment at 13 and 5 weeks of age (329 and 151 g), respectively. They were killed by decapitation. ADFI and weight were measured and ADG and G:F calculated for d 1, 2, 3, 7, 10 and 14 in 2W groups and d 1, 2, 3, 7 and once a week thereafter for groups 10W. Data were analyzed as repeated measures with S0 as control. Differences were calculated using contrast within each day and feeding period. Group 10W-S35 had significantly higher ($p<0.05$) intake than

10W-S0 at d 1, 2, 3 and 7 (19.9 ± 0.37 , 20.1 ± 0.36 , 20.3 ± 0.36 and 21.0 ± 0.43 g vs. 18.8 ± 0.35 , 19.0 ± 0.34 , 19.2 ± 0.34 and 19.7 ± 0.40 g) and tended to be higher than 10W-S0 ($p<0.1$) at d 14 and 21. Similarly, 10W-S35 had significantly higher gain than 10W-S0 at d 1, 2, 3 and 7 (9.0 ± 0.46 , 8.8 ± 0.42 , 8.6 ± 0.38 and 7.8 ± 0.28 g/d vs. 7.6 ± 0.44 , 7.5 ± 0.40 , 7.4 ± 0.36 and 6.9 ± 0.29 g/d) and tended to be higher than 10W-S0 at d 14. 10W-S35 had significantly higher weight than 10W-S0 at d 70 (414.7 ± 8.66 g vs. 390.7 ± 8.21 g) and tended to be higher than 10W-S0 from d 21 to 63. G:F was not different between controls and HTS diets in 10W and 2W groups. Up to 50% HTS in the diet did not reduce ADG in rats. Furthermore, 35% HTS increased ADFI and ADG during the first week of feeding and produced animals with higher weight at d 70. Inclusion of moderate amounts of HTS in diets may have a positive impact in growth of rats.

Key Words: Proanthocyanidins, Sorghum, Growth rate

W135 Utilization of deglycosylated soy protein in monogastrics. B. C. Tooker and T. S. Stahly*, *Iowa State University, Ames*.

The effects of deglycosylating dietary soy protein on body growth, protein digestibility and biomarkers of allergenicity and gut inflammation in a monogastric animal were evaluated. Deglycosylated (Degly) and glycosylated (Gly) soy proteins were created by processing a single source of soy protein isolate in the presence or absence of a deglycosylating enzyme (Endo H). Each subunit (α' , α and β) of conglycinin, the major glycosylated protein in soy, was deglycosylated by enzyme exposure. Based on the MW shift (SDS-PAGE) observed for the deglycosylated subunits, a consistent portion of the mannose units in the N-linked oligosaccharide side chains were removed. The amino acid profiles of the proteins were not altered by Degly. To evaluate the two protein sources, rats (Sprague Dawley) from dams fed soy-free diets during pregnancy/lactation (to prevent allergenic priming) were used. Rats in each of fifteen littermate pairs were weaned (20 d), penned individually, randomly allotted within litter to one of the two diets and allowed to consume feed ad libitum for 20 d. The diets consisted of a 86:14 mix of a basal mix (starch, corn oil, cellulose, min, vit) and test protein sources. Body growth rates (d 0 to 20) and digestibility of dietary N (total fecal collection on d 17-20) were not ($P>.10$) altered by Degly. On d 20, intestinal gene (qRT-PCR) expression of PAR-2 and TNF α , biomarkers of intestinal inflammation, also were similar ($P>.10$) between protein sources. Based on these data, deglycosylating soy protein does not modify the digestibility or inflammatory potential of soy proteins.

Key Words: Soy protein, Deglycosylation, Digestibility Par-2

W136 A study of sweet (Surumi, Patacamya, Sayana, Chucapaca) and bitter (Real) Bolivian quinoa cultivars compared to corn, barley and oats on the lactation of improved guinea pigs. R. N. Pate¹, N. P. Johnston^{*1}, E. Rico², A. Bonifacio³, R. O. Kellems¹, and D. L. Kooyman¹, ¹*Brigham Young University, Provo, Utah*, ²*University of San Simon, Cochabamba, Bolivia*, ³*University of San Andres, La Paz, Bolivia*.

Quinoa is an Andean grain that is noted for its amino acid profile which is especially high in lys. Traditionally the production of bitter (saponin-containing cultivars) has prevailed. However, many new sweet cultivars that are saponin-free now exist but there is little information as to their feeding value. A trial was conducted to evaluate

the feeding value during lactation of the sweet quinoa cultivars Surumi, Patacamaya, Sayana and Chucapaca and the bitter cultivar Real using the improved Andean guinea pig as the animal model. The quinoa-based diets were compared to those based on corn, barley and oats. The bitter variety Real was fed as-is (saponin containing) or washed (saponin free). Growth and F:G of the nursing progeny were used as parameters to indicate the impact of diet on lactation. Thirty-six pregnant females were divided into nine treatment groups. The trial began following parturition and continued for two weeks at which time the progeny were weaned. The net progeny gains from feeding the sweet quinoa cultivars (136 to 148g) and oats (134g) were similar ($P>0.05$) but greater ($P<0.05$) than feeding the bitter cultivar (Real) (93g), corn (100g) and barley (74g). Gains from Real-washed (110g) were similar ($P>0.05$) to those from Real. Feed consumption was reduced ($P<0.05$) from feeding Real and barley. The sweet cultivar treatments Sayana (3.75:1) Patacamaya (3.88:1), and Chucapaca (4.17:1) supported the conversion of F:G more efficiently ($P<0.05$) than Real-washed (5.45:1), corn (5.43:1) and barley (5.45:1). The feeding value of sweet quinoa cultivars appeared very promising. Feeding any of the sweet cultivars during lactation resulted in superior progeny gains and better feed conversion than the bitter cultivar (saponin- containing or free). Their feeding value was also superior to corn or barley but similar to oats.

Key Words: Quinoa, Guinea pig, Lactation

W137 Level of soluble fiber and medication influence the presence of intestinal pathogen microbiota in young rabbits. M. S. Gómez-Conde¹, A. Pérez de Rozas², I. Badiola², S. Chamorro¹, G. G. Mateos^{*1}, J. C. De Blas¹, J. García¹, and R. Carabaño¹, ¹Universidad Politécnica, Madrid, Spain, ²CreSA (UAB-IRTA), Bellaterra, Spain.

The aim of this work was to study the effect of the level of neutral detergent soluble fiber (NDSF) and medication with 200 ppm apramycin sulphate and 120 ppm tylosine tartrate in drinking water on frequency of detection (FD) of *Clostridium perfringens*, *Clostridium difficile* and *Campylobacter* spp. at ileum and cecum. Three isonutritive diets (33% NDF, 20% CP, 20% starch) were formulated. Differences in NDSF were obtained by a partial substitution in the control diet of alfalfa hay (28% of inclusion and 10.3% NDSF) with either oat hulls (14.7% and 7.9% NDSF) or a mixture of sugar beet and apple pulps (15+5% and 13.1% NDSF). Eighteen rabbits/treatment weaned at 25 d were slaughtered at 35 d to collect intestinal digesta for characterizing microbiota population by restriction fragment length polymorphism. Data were analyzed by using the proc mixed of SAS including NDSF level, medication, and intestinal site as main effects and their interactions. Rabbit was considered as a random effect. Rabbits fed the lowest NDSF concentration had a higher FD of *C. perfringens* (39.4 vs. 24.3%; $P = 0.016$), *Campylobacter* spp. (50.0 vs. 27.8%; $P = 0.001$) and *C. difficile* (33.0 vs. 21.6%; $P = 0.090$) compared to diets with a higher NDSF levels. *Clostridium difficile* ($P = 0.001$) and *Campylobacter* spp. ($P = 0.081$) were more frequently detected in cecum than in ileum. Intestinal site did not affect FD of *C. perfringens*. Medication decreased FD of all the bacteria studied ($P < 0.001$). An interaction between level of NDSF and medication ($P = 0.023$) was detected for the FD of *C. perfringens*. When non-medicated rabbits were fed the low NDSF diet, they showed the highest FD of *C. perfringens*, but this effect was not detected with medication. In conclusion, the FD of intestinal pathogen bacteria might be partially modulated by NDSF.

Key Words: Rabbit microbiota, Soluble fiber, Medication

W138 The effect of xylanase enzyme and fat type on growth performance of broilers fed wheat-based diets. Z. Nemati, A. Taghizadeh*, and G. A. Moghaddam, Tabriz University, Tabriz, East Azarbayjan, Iran.

This study was carried out to determine the effect of xylanase enzyme and fat type on growth performance and intestinal viscosity of broiler fed wheat based diet. An experiment was carried out using 384 seven-d Arian 110 chickens in a 4x2 factorial design with 5% different fat sources [Beef tallow, soybean oil, blend fat [soybean oil (37.5 g/kg diet) + Beef tallow (12.5 g/kg diet)] or other blend fat [soybean oil (12.5 g/kg diet) + Beef tallow (37.5 g/kg diet)], which were termed T, S, ST1 and ST2, respectively and Nutrex® enzyme addition [none or enzyme (0.5 g/kg diet)] to a wheat (60%) based broiler diet. All of the diets were isocaloric and isonitrogenous with considering the difference between fat sources and enzyme supplementation (NRC, 1994). At 42 d of age, one bird per replicate was killed and carcass of them was analyzed. Body weight (BW), feed intake (FI) and coefficient feed ratio (FCR) were recorded weekly with pen as the experiment unit. The intestinal viscosity was measure by centrifuging of collected the first fraction of small intestinal contents (12000 rpm) and determining of the supernatant phase viscosity using viscometer. Results showed that enzyme supplementation improved body weight, body weight gain and feed/gain ratio of broiler fed diet contains enzyme ($p<0.01$). Where as the chickens fed diet no enzyme supplementation have lower feed intake but showed no significant differences. Although no significant difference was found between performance of broilers fed different fat source, performance of broiler fed soybean oil was better than the other groups. Except of feed intake, no interaction was observed between fat type and enzyme supplementation. In addition, supplementation of diets with the enzyme reduced the intestinal viscosity of broilers. Using xylanase enzyme in broiler improved growth performance and weight of carcass. It is evident from the present studies that the addition of xylanase could eliminate negative effect of non-starch polysaccharide content in wheat grain, however, its application with different fat sources required further research.

Key Words: Xylanase, Fat, Broiler

W139 Effect of protease supplementation selected from mud flat microorganism on growth performance, nutrient digestibility, total protein and BUN concentration in broilers. H. J. Kim*, B. J. Min, J. H. Cho, Y. J. Chen, J. S. Yoo, Q. Wang, and I. H. Kim, Dankook University, Cheonan, Chungnam, Korea.

This study was conducted to investigate the effect of protease supplementation selected from mud flat microorganism (*Bacillus clausii* I-52) on growth performance, nutrient digestibility, total blood protein and BUN concentration in broilers. A total of 480 broiler chickens were randomly allocated into four treatments with six replications and fed for 5 wk. Dietary treatments included 1) HND (high nutrient density diet), 2) HNP (high nutrient density diet + 0.1% protease), 3) LND (low nutrient density diet) and 4) LNP (low nutrient density diet+0.1% protease). Through the entire experimental period, weight gain (1551.53, 1549.71, 1521.81 vs. 1402.90 g) and F:G (1.66, 1.64, 1.68 vs. 1.81) were improved in treatments of HND, HNP and LNP compared with treatment of LND ($P<0.05$). DM digestibility (71.69, 72.68, 71.83 vs. 70.32 %) was improved in pigs fed HND, HNP and LNP treatments compared with pigs fed LND treatment ($P<0.05$). N digestibility (69.81 vs. 65.94 %) was improved in treatment of HNP compared with treatment of LND. Total blood protein content (3.68 vs. 2.93, 3.05, 2.91 mg/dl) in the broilers fed the HND treatment was

higher than the broilers fed HNP, LND and LNP treatments ($P < 0.05$). In conclusion, protease selected from mud flat microorganism was effective for improving weight gain, nutrient digestibility and total blood protein concentration in broiler chickens.

Key Words: Protease selected from mud flat microorganism, Growth performance, Total protein

W140 Effect of protease supplementation selected from mud flat microorganism on egg quality, nutrient digestibility and total protein concentration in laying hens. H. J. Kim*, B. J. Min, J. H. Cho, Y. J. Chen, J. S. Yoo, Q. Wang, and I. H. Kim, *Dankook University, Cheonan, Chungnam, Korea.*

This study was conducted to investigate the effect of protease supplementation selected from mud flat microorganism (*Bacillus clausii* I-52) on egg quality, nutrient digestibility and total protein concentration on laying hens. A total of 252 laying hens were randomly allocated into three treatments with seven replications for 8 wk. Dietary treatments included 1) CON (basal diet), 2) PRO1 (basal diet + 0.05% protease) and 3) PRO2 (basal diet + 0.1% protease). Through the entire experimental period, hen-day egg production (94.69, 94.66 vs. 92.71 %) was improved in CON and PRO2 treatments compared with PRO1 treatment ($P < 0.05$). Egg shell breaking strength, egg shell thickness, yolk color unit, yolk height, yolk diameter, egg yolk index, albumen height, egg weight and Haugh Unit were not different among the treatments ($P > 0.05$). DM digestibility (73.27, 72.67 vs. 71.36 %) was improved in CON and PRO2 treatments compared with PRO1 treatment ($P < 0.05$). N digestibility (73.63 vs. 71.70 %) was improved in PRO2 treatment compared with CON treatment ($P < 0.05$). Total blood protein concentration was not different among the treatments ($P > 0.05$). In conclusion, protease selected from mud flat microorganism was effective for improving daily egg production and nutrient digestibility.

Key Words: Protease selected from mud flat microorganism, Egg quality, Nutrient digestibility

W141 Performance of broilers on nutrients restriction at different stages of growth. Y. H. Shim, J. D. Lohakare, J. H. Yun, Z. Jin, S. O. Lee, J. Y. Choi, and B. J. Chae*, *Kangwon National University, Chunchon, Republic of Korea.*

In two experiments, day-old Ross broilers were fed energy and protein restricted diets at different stages of growth. In Exp. 1, the energy and protein were restricted to 10 and 20% respectively, less than control during starter phase (0 to 3 wk). The diets were: Control (3200 kcal ME and 22% CP), T1 (2880 kcal ME and 22% CP), T2 (3200 kcal ME and 17.60% CP), and T3 (2880 kcal ME and 17.60% CP). During finisher phase (4 to 6 wk), they were fed a common diet (3200 kcal ME and 20% CP). In Exp. 2, birds were fed a common diet during starter phase (3200 kcal ME and 22% CP), but during the finisher phase, the treatment diets were restricted by 10% energy and 10% CP than to control. In short, the diets were: Control (3200 kcal ME and 20% CP), T1 (2880 kcal ME and 20% CP), T2 (3200 kcal ME and 18% CP), and T3 (2880 kcal ME and 18% CP). Each treatment had 5 replicates with 42 birds each in both experiments. During Exp. 1, final BW and G:F ratio were improved ($P < 0.05$) in control group (2,175g and 1.80) than T1 (2,119g and 1.91), T2 (2,043g and 1.94) and T3 (2,070g and 2.00). The dressing and breast meat percentages were higher ($P < 0.05$) at 3 wk in T1 than T2 and T3, but not different from the control. Also at 3 and 6 wk, serum urea N and triglyceride levels were not influenced by dietary treatments; however, serum cholesterol and total blood protein

levels were lowered ($P < 0.05$) in T3 than control. During Exp. 2, BW and G:F ratio were higher ($P < 0.05$) in control group than in birds fed the treatment diets at 4 wk, however, it was similar to T2 at the end of 6 wk. The abdominal fat percent, expressed as percent of BW, was the lowest ($P < 0.05$) at 6 wk in T1 among the control, T2 and T3, but dressing percent, liver weight, heart weight and breast meat percentages were not affected ($P > 0.05$). Also at 6 wk, serum levels of urea N, triglyceride, and cholesterol were not influenced by dietary treatments; however, serum glucose was higher ($P < 0.05$) in control than others. It is concluded that nutrient restriction during starter phase affects broiler performance, but 10% CP restriction during the finisher phase presents an option in economizing production.

Key Words: Broilers, Nutrient restriction, Growth performance

W142 Determination of endogenous amino acid flows at the terminal ileum of broiler chickens fed various protein sources using the homoarginine technique. V. Ravindran*¹, G. Ravindran¹, and W. L. Bryden², ¹Massey University, Palmerston North, New Zealand, ²University of Queensland, Gatton, QLD, Australia.

Addition of purified sources of fiber to diets has been shown to increase the flow of undigested endogenous protein leaving the small intestine of pigs and poultry. No reports exist on the effects of high levels of fiber naturally occurring in feedstuffs, because until recently no suitable method was available to estimate the ileal endogenous recovery associated with specific feedstuffs. In the present study, the homoarginine technique was employed to determine the ileal endogenous flow of AA in broilers fed diets containing casein, soybean meal (SBM), canola meal (CM) and cottonseed meal (CSM). The four feedstuffs were guanidinated. Assay diets based on dextrose and the guanidinated ingredients were offered ad libitum to three pens of 5-wk old (Cobb) broilers for 7 d and digesta from the terminal ileum was collected. Endogenous flow was calculated using the homoarginine: AA ratios. The analyzed neutral detergent fiber contents in SBM, CM and CSM were 89, 237 and 366 g/kg, respectively. The ileal endogenous flow of N and most AA were similar ($P > 0.05$) between casein and SBM. The flow of N, asp and glu were greater ($P < 0.05$) in CM diets compared to those in SBM diets. The flow of N and most AA in casein were lower ($P < 0.05$) than those in CM. The endogenous AA flows in birds fed CSM diets were higher ($P < 0.05$) than those fed diets with other protein sources. Amino acid N as a percentage of total N in ileal flow was lower ($P < 0.05$) in CM and CSM diets, which may suggest increased mucus glycoprotein secretion with these fibrous protein sources. These results showed that ileal endogenous flows of N and AA were increased by protein sources with high fiber contents.

Key Words: Homoarginine, Endogenous amino acid flow, Broiler

W143 Evaluation of Neem (*Azadirachta indica*) leaf meal on performance, carcass characteristics and egg quality of laying hens. B. O. Esonu*¹, O. O. Emenalom¹, A. B. I. Udedibie¹, A. Anyanwu¹, U. Madu¹, and O. A. Inyang², ¹Federal University of Technology, Owerri, Imo State, Nigeria, ²Micheal Okpara College of Agriculture, Umuagwo, Imo State, Nigeria.

12-week feeding trial was conducted to evaluate the effect of Neem (*Azadirachta indica*) leaf meal on the performance, carcass characteristics and egg quality of laying hen. Neem (*Azadirachta indica*) is one of the indigenous tropical plants predominant in Nigeria. It is commonly known as Neem and popularly called "Akum-shut-up"

in Ibo land and "Dogoyaro" in Hausa. The leaves were harvested, chopped to facilitate drying until the material became crispy while still retaining its greenish colouration. The material was milled using a hammer mill to produce leaf meal. Four layer diets were formulated to contain the leaf meal at 0%, 5%, 10% and 15% dietary levels respectively. One hundred and twenty (120) Shikha Brown layers already ten months in lay were divided into four groups of thirty birds each and randomly assigned to the four treatment diets in a completely randomized design (CRD). Eggs were collected twice daily and the internal characteristics of the eggs measured. At the end of the feeding trial, three birds were selected from each treatment group, slaughtered and eviscerated for dressed carcass weight determination. There were significant ($p < 0.05$) differences in feed intake, hen day egg production and egg yolk colour among the groups. However, there were no significant ($p > 0.05$) differences in body weight gain, feed conversion ratio, Haugh unit, shell thickness, yolk index, albumen index, egg circumference and dress carcass weight characteristics among the groups. Results from this experiment suggests that 15% inclusion level of Neem (*Azadirachta indica*) leaf meal in laying hen diet has no deleterious effects on the birds.

Table 1. Proximate composition of Neem leaf meal (DM Basis)

Nutrients	%Dm
Dry matter (in air dry meal)	92.42
Crude Protein	20.68
Crude fat	4.13
Ash	7.10
Crude fiber	16.60
Nitrogen free extract	43.91

Key Words: Neem leaf meal, Performance, Layers

W144 Effects of dietary delta-aminolevulinic acid and chitoooligosaccharide on egg production, egg quality and hematological characteristics in laying hens. Y. J. Chen^{*1}, B. J. Min¹, J. H. Cho¹, H. J. Kim¹, J. S. Yoo¹, J. D. Kim³, H. R. Kim², D. K. Kang¹, and I. H. Kim¹, ¹Dankook University, Cheonan, Chungnam, Korea, ²Pukyong, Busan, Korea, ³CJ Feed Co., Incheon, Korea.

Delta-aminolevulinic acid (ALA), which is synthesized by the condensation of glycine and succinyl-CoA, is the committed step of the heme synthesis pathway. Chitoooligosaccharide (COS), made from chitin or chitosan, was suggested to have some similar physiological effects with ALA. An 8 wk experiment was conducted to evaluate the effects of ALA and COS in layer diets on egg production, egg quality and hematological characteristics. Two hundred seventy 21 wk old (Hy-line brown) layers were randomly assigned to five treatments with nine replications (six layers in adjacent three cages). Dietary treatments were 1) CON (Control diet), 2) ALA1 (CON + ALA 2 ppm), 3) ALA2 (CON + ALA 4 ppm), 4) COS1 (CON + COS 0.1%) and 5) COS2 (CON + COS 0.2%). All diets were formulated met or exceeded NRC (1994) recommendation for laying hens. Egg production and egg shell breaking strength were not affected by supplementation of either ALA or COS ($P > 0.05$). Egg weight was higher in ALA1 treatment than CON, ALA2 and COS2 treatments ($P < 0.05$). Egg shell thickness was higher in ALA1 and COS1 treatments than CON treatment ($P < 0.05$). Yolk color unit was increased in ALA1 treatment compared with COS1 treatment ($P < 0.05$). Egg yolk index was also increased in ALA and

COS treatments compared with CON treatment ($P < 0.05$). Haugh unit was not significantly affected among all the treatments ($P < 0.05$). No effects were observed on RBC, lymphocyte, Hb, total protein, albumin and total iron binding capacity with the supplementation of ALA and COS ($P > 0.05$). WBC was increased in ALA1 treatment compared with CON treatment ($P < 0.05$). Iron concentration was higher in ALA2 treatment than CON and COS1 treatments ($P < 0.05$). In conclusion, dietary supplementation of ALA has beneficial effects on egg quality in laying hens.

Key Words: Delta-aminolevulinic acid, Chitoooligosaccharide, Laying hens

W145 Effect of phytase supplementation on the calcium and phosphorus retention in layers. L. Babinszky^{*1}, J. Tossenberger¹, C. S. Szabó¹, B. Mészáros¹, and I. Kühn², ¹University of Kaposvár, Hungary, ²AB Enzymes GmbH, Darmstadt, Germany.

A trial was conducted with Hy-Line Brown layers during the first 84 days of the laying cycle to evaluate their Ca and P retention (intake - excretion in excreta) at different production levels (45 - 75 - 95 % of final production peak). The 32 layers evenly distributed over 4 treatments were fed a corn soybean meal based diet. The Ca content of the diets was identical across all treatments (38.4 g/kg). The dietary P level of treatment 1 (P+) was 4.7 g/kg total P with no added phytase. Dietary P was reduced from the level of P+ to 3.7 g/kg in treatment 2 (P-) which contained no added phytase either. Dietary P levels of treatment 3 and 4 were the same as in P- but these diets were supplemented with phytase (type 3-phytase produced by *Trichoderma reesei*) at the level of 250 PPU/kg (P-²⁵⁰) and 500 PPU/kg (P-⁵⁰⁰), respectively. Trial data were analyzed with GLM (SAS, 1999). Ca retention increased with higher production levels ($P \leq 0.05$). Ca retention decreased when dietary P was lowered ($P \leq 0.05$), but was not affected by phytase supplementation (data not shown). P retention increased significantly with the level of production in case of P- and P-²⁵⁰ (see table). Phytase supplementation at 250 PPU/kg improved the P retention of layers significantly ($P \leq 0.05$) when the dietary P level was low. Increasing the phytase supplementation to 500 PPU/kg had no further effect on P retention, which is in accordance with published data. The 20% reduction of the dietary P was a reduction of 40% in non phytate P. This extreme reduction could not be fully compensated by phytase supplementation. In conclusion it is not possible to reduce the dietary P level by 20% in layer diets without adversely affecting the Ca and P retention, even if phytase supplementation is applied.

Table 1

Production level, %	P retention, mg/day				RMSE
	P+	P-	P- ²⁵⁰	P- ⁵⁰⁰	
45	145 _x	74 _y ^a	107 _z ^a	114 _z	12
75	136 _x	84 _y ^{ab}	113 _z ^a	118 _z	15
75	136 _x	84 _y ^{ab}	113 _z ^a	118 _z	15

^{a,b} Means in a column differ ($P \leq 0.05$); ^{x,y,z} Means in a row differ ($P \leq 0.05$)

Key Words: Layer, Phosphorus, Retention