M238 The effects of the dietary supplementation with essential oils from selected species of the Lamiaceae family on the performance of growing broilers chickens. L. Roldan*[1], C. Ariza-Nieto[2], G. Diaz[1], and G. Afanador[1,2], [1]*Universidad Nacional de Colombia*, *Bogota, Colombia*, [2]*CORPOICA*, *Bogota, Colombia*.

The effects of essential oils (EO) obtained from 3 Lamiaceae plants (*Thymus vulgaris*, *Rosmarinus officinalis* and *Ocimum basilicum*) on the performance of growing broilers were investigated. A total of 210 one-day-old Ross male broiler chicks were placed in 30 brooder cages and were randomly assigned to the 5 experimental groups: 1) control; 2) growth promoter antibiotic, 500 ppm Bacitracin; 3) 600 ppm of thyme EO; 4) 600 ppm of rosemary EO, and 5) 600 ppm of basil EO. Throughout the experimental period of 21 d, body weight gain and feed intake were recorded at 7, 14, and 21 d of age, and feed conversion ratios were calculated. Data were analyzed as repeated measures under a completely randomized design using the MIXED procedure of SAS (Ver. 9.0, SAS Institute, Cary, NC).The statistical model included the fixed effects of EO supplementation, age and the interaction. Random intercepts and slopes were included to account for within pen effect. A likelihood ratio test (LRT) was used to test which variance/covariance (compound symmetry, unstructured) structure fit better to the data using the residual maximum likelihood (REML) algorithm. Additionally, LRT was performed using the maximum likelihood (ML) estimating method to eliminate nonsignificant factors from the model. The final model was run using REML. Least squares means adjusted by Tukey method were used to compare means. Body weight gain and feed consumption were not significantly affected ($P > 0.05$) by EO supplementation. The supplementation of dietary basil EO resulted in a significantly ($P < 0.05$) lower feed conversion ratio (1.18) compared with the other groups; growth promoter antibiotic (1.26), control (1.25), rosemary EO (1.24) and thyme EO (1.28). This parameter indicated that basil EO exerted a growth promoter effect in broiler chickens.

Key Words: essential oils, Lamiaceae, broilers

M239 Effect of crude glycerin on the performance of female broilers chickens at high altitude. C. Ariza-Nieto*[1], Y. Avellaneda[1], and G. Afanador[1,2], [1]*CORPOICA*, *Bogota, Colombia*, [2]*Universidad Nacional de Colombia*, *Bogota, Colombia*.

This study evaluated the use of crude glycerin, a co-product of biodiesel production, in a feeding program for female broilers chickens maintained at high altitude. Six hundred forty 24-d-old Ross female broilers were randomly assigned to 1 of 4 glycerin levels (0, 3, 6, and 9% of the diet). The birds were placed in 16 pens during growth-finishing phase and their performance was determined every other week until slaughter. Data were analyzed under a completely randomized design as repeated measures on time using the MIXED procedure of SAS (Ver. 9.0, SAS Institute, Cary, NC, USA). The shadow price of crude glycerin was established using linear programming. Glycerin levels did not affect feed intake (average during the 18 d period female broilers was 135.6 ± 16.6 g/bird). Body weight gain was lower ($P = 0.0799$) in female broilers chickens fed 9% glycerin (64.9 g), compared those receiving 3% (68.3 g) or 6% (69.4 g), respectively. The level of inclusion of glycerin showed a quadratic effect ($P = 0.0177$), an inclusion level of 4.2% of crude glycerin maximizes body weight gain. Feed conversion of birds fed glycerin at 3% and 6% of inclusion were significantly lower ($P < 0.05$) compared with the control and 9% group. This ratio showed a quadratic effect and 3.88% of crude glycerin was the optimum. No significant effects on mortality were shown due to the inclusion of crude glycerin. Diets containing up to 4% of crude glycerin maximizes performance of female broilers at high altitude during growing-finishing phase.

Key Words: glycerin, female broilers, high altitude

M240 Vitamin E, herbs and spices in broilers diets: Evaluation of oxidative stability of pre-cooked meat balls. A. M. C. Racanicci*[1], J. F. M. Menten[2], and M. Nascente[1], [1]*University of Brasília (UnB)*, *Brasília, DF, Brazil*, [2]*University of São Paulo (ESALQ)*, *Piracicaba, SP, Brazil*.

The dietary utilization of natural antioxidants has been reported to improve oxidative stability of chicken meat and meat products. The objective of this study was to evaluate the dietary supplementation of resin oils from previously selected herbs and spices on oxidative stability of stored pre-cooked meat. Resin oil from 6 herbs (H: rosemary, thyme, oregano, sage, bay, and basil) and 3 spices (S: cinnamon, clove, and ginger) were microencapsulated (20% of resin oil) and fed to 80 male one-day-old Cobb chicks raised in 20 cages, randomly assigned to 8 treatments with 2 replications of 5 birds. Experimental treatments were CONT (basal diet with tocopherol from premix and feed ingredients); VITE (basal diet + 200 mg α-tocopheryl acetate/kg); H500 (basal diet + 100 mg of herbs/kg); H250 (basal diet + 50 mg of herbs/kg); S500 (basal diet + 100 mg of spices/kg); S250 (basal diet + 50 mg of spices/kg); HS500 (basal diet + 100 mg of herbs and spices/kg) and HS250 (basal diet + 50 mg of herbs and spices/kg). At 41 d of age, 5 birds of each treatment were slaughtered and breast meat collected, minced, pooled, and mixed to 0.1% of salt to produce meat balls (±30g). After vacuum-packaging, the balls were cooked, re-packed and stored in a cold and dark room for up to 8 d. TBARS were determined in duplicate in 3 samples per treatment on d 0, 1, 3, 6 and 8 to assess the degree of lipid oxidation during chilled storage. The supplementation of α-tocopherol (VITE) protected meat balls against lipid oxidation as shown by statistically lower ($P < 0.0001$) TBARS values at d 8 (30.3 μmol MDA/kg of meat) compared with all treatments (CONT 56.7, H500 70.0, S500 56.3, HS500 65.0, H250 61.1, S250 62.7 and HS250 71.4 μmol MDA/kg of meat). However, the supplementation of natural antioxidants (H, S or HS) showed an unpredicted prooxidant effect demonstrated by the increase ($P < 0.0001$) in TBARS values compared with CONT for both concentrations, except S500.

Key Words: natural antioxidants, tocopherol, TBARS

M241 Effect of technical grade glycerin on the performance of brown laying hens at high altitude. Y. Avellaneda*[1], D. Cifuentes[1], G Afanador[1,2], and C. Ariza-Nieto[1], [1]*CORPOICA*, *Bogota, Colombia*, [2]*Universidad Nacional de Colombia*, *Bogota, Colombia*.

Biodiesel production processes generate about 10% glycerin by volume as a waste co-product. In recent years production has increased exponentially, which have led to a reduction of its price, making this co-product an opportunity to reduce production costs of feed in the poultry industry. The aim of this study was to evaluate the use of technical grade glycerin (99.5% purity) in brown layer hens at high altitude. Eighty 24-wk-old Babcock Brown laying hens were randomly assigned to one of the 4 glycerin levels (0, 2.5, 5.0, and 7.5%). Hens were placed in 40 cages during 20 weeks and their performance was record every other week and during the study, they were fed ad libitum with a feed meal (2800 kcal AMEn/ kg, 19% CP, 0.86% digestible lysine, 4.0% Ca and 0.42%

P available) and drinking water was also available ad libitum. Data were analyzed under a completely randomized design as repeated measures on time using the MIXED procedure of SAS (Ver. 9.0, SAS Institute, Cary, NC). Feed intake, egg production, egg mass, feed conversion per dozen and feed conversion on an egg mass were not affected ($P > 0.05$) due to the inclusion of technical grade glycerin. On average feed intake, egg production, egg weight, feed conversion per dozen, and feed conversion on an egg mass basis were 111.5 g/d, 93.2%, 58.9 g, 2.4, and 1.5, respectively. In terms of quality of the eggs, the albumen height was not affected due to the inclusion of glycerin (6.21 ± 1.08 mm), but the eggs of hens 2.5% group showed a thicker eggshell compared with the 5 and 7.5% ($P < 0.05$). Pale-yolks were observed in eggs from hens fed 5.0 or 7.5% glycerin compared with the control. It is concluded that technical grade glycerin in diets for brown laying hens up to 7.5% did not affect productive performance, but egg quality related to the color of the yolk can adversely be affected when the inclusion level of glycerin increases from 5.0 to 7.5%.

Key Words: technical glycerin, performance, laying hen

M242 Effects of Korean herb supplementation (*Paeniae radix*, *Angelicae gigantis radix*, *Cnidium rhizome*, and *Polygoni multiflori radix*) on growth performance, nutrient digestibility, blood characteristics, meat quality and fatty acid content of meat of growing pigs. Q. W. Meng*, J. S. Yoo, H. J. Kim, J. P. Wang, J. H. Jung, and I. H. Kim, *Department of Animal Resource and Science, Dankook University*, *Cheonan, Choongnam, Korea*.

This study was conducted to investigate the effects of Korean herb mixture supplementation (*Paeniae radix*, *Angelicae gigantis radix*, *Cnidium rhizome*, and *Polygoni multiflori radix*) on growth performance, nutrient digestibility, meat quality and fatty acid content of meat produced by growing pigs. A total of 64 pigs (40.19 ± 1.42kg) were evaluated over 84 d. Dietary treatments included: 1) CON (basal diet), 2) KH (basal diet + 1% Korean herb mixture), 3) HKH (basal diet + 1% Korean herb mixture with heat treatment), and 4) HKHE (HKH + 0.2% β-mannanase). Each treatment consisted of 4 replicates with 4 pigs per pen in a randomized complete block design. The highest ADG, digestibility of dry matter (DM), nitrogen (N) and energy ($P < 0.05$) was observed in the HKHE group during wk 0–6. A decreased DM, N and energy digestibility were observed in the KH group when compared with other groups during wk 0–6. Moreover, dietary HKHE resulted in a higher HDL-cholesterol ($P < 0.05$) and lower LDL-cholesterol than the CON treatment at the end of the experiment. The meat pH was highest in the HKHE group and lowest in the KH group ($P < 0.05$). Pigs fed the KH diet showed the lowest marbling ($P < 0.05$) among treatments. The drip loss on the fifth day was higher ($P < 0.05$) in the CON group than the KH group. Of the fatty acids, the saturated fatty acid (SFA) levels were higher in the CON group ($P < 0.05$) than in the HKHE group. Polyunsaturated fatty acid (PUFA) was shown to be higher in the HKHE group ($P < 0.05$) than in the CON group. In conclusion, supplementation of the diet with Korean herb mixture improved growth performance, nutrient digestibility and meat quality.

Key Words: Korean herb mixture, meat quality, growing pigs

M243 Effects of dietary bamboo vinegar supplementation on growth performance, blood characteristics, meat quality, fatty acid content and fecal malodor emission in finishing pigs. Q. W. Meng*, J. H. Lee, H. D. Jang, T. X. Zhou, L. Yan, and I. H. Kim, *Department of Animal Resource and Science, Dankook University*, *Choenan, Choongnam, Korea*.

A 42 d trail with 60 [(Landrace × Yorkshire) × Duroc] pigs (79.66 ± 1.42 kg) was conducted to investigate the effects of bamboo vinegar (Bio-BV) supplementation in diets on growth performance, blood characteristics, meat quality, fatty acid and fecal malodor emission in finishing pigs. Pigs were randomly allotted to 1 of 3 dietary treatments in a randomized complete block design according to their sex and body weight (BW) (5 replicates with 4 pigs per pen). The experimental treatments included: 1) CON (basal diet), 2) BV1 (CON + 0.1% Bio–BV), and 3) BV2 (CON + 0.2% Bio-BV). BV1 and BV2 supplementation had higher ADG ($P < 0.05$) than CON group during 0–3 weeks as well as the overall period. Pigs fed diets with BV2 increased pH and sensory score (firmness) ($P < 0.05$) compared with the other groups. Moreover, the BV2 treatment improved sensory color and a* value ($P < 0.05$) compared with the control group. L* value was significantly improved ($P < 0.05$) when pig received control diet compared with BV2 treatment. In term of fatty acid, the total SFA level and stearic acid (C18:0) were improved ($P < 0.05$) in BV groups compared with CON group. Bio-BV supplementation decreased the total UFA and UFA/SFA ratio ($P < 0.05$) when compared with those fed CON diet. Pigs fed Bio-BV supplementation improved ($P < 0.05$) linoleic acid (C18:2n–6) concentration compared with CON. In fecal malodor emission, NH_3 emission was significantly reduced ($P < 0.05$) in BV2 group compared with CON and BV1 groups on the first and 5th day. On 10th day, CON treatment showed greater NH_3 emission ($P < 0.05$) than BV1 treatment. BV1 group had higher ($P < 0.05$) NH3 emission than BV2 group. Pigs fed control diet had higher ($P < 0.05$) H_2S and total mercaptan concentration than those fed BV2 diet. In conclusion, Bio-BV supplementation can exhibit beneficial effects on growth performance and meat quality, and concomitantly decreases NH_3, H_2S and Total mercaptan emission. Besides, Bio-BV administration increased certain unsaturated fatty acids while decreasing some saturated fatty acids.

Key Words: bamboo vinegar, meat quality, finishing pigs

M244 The effects of caper (*Capparis ovata* Desf.) on some hematological parameters and organs of Lohmann roosters. O. Yildiz-Gulay*[1], M. S. Gulay[1], A. Balic[2], and A. Ata[1], [1]*Mehmet Akif Ersoy University, Faculty of Veterinary Medicine*, *Burdur, Turkey*, [2]*Sakarya Toyota Hospital*, *Sakarya, Turkey*.

Caper (*Capparis* genus in the Capparaceae family) is a plant found in tropical/subtropical areas. Caper is consumed widely in most Mediterranean countries and can be consumed for long time periods. However, no detailed study has been performed concerning consumption of capers. Thus, the purpose of this study was to determine the effects of caper (*Capparis ovata* Desf.) on blood parameters, body weight (BW) changes, and organs of Lohmann roosters. Twenty-four week-old roosters were randomly assigned to control (C) and caper treatment (TR) groups (8 per group) and fed a standard diet (14% crude protein and 3000 kcal/kg metabolizable energy). Roosters in C received 10 mL of tap water, whereas roosters in TR received 1 g of caper per 1 kg of BW suspended in 10 mL of tap water. Experiment was lasted for 39 d and treatments were given by oral gavages. Roosters were weighed at the end of caper treatments and blood was taken from the vena brachialis. Organ weights were recorded after sacrifice. No negative effect of caper treatment was observed on hemoglobin (C = 15.6 ± 0.58 vs. TR = 15.2 ± 0.35 g/dL), hematocrit (C = 38.3 ± 1.13 vs. TR = 37.1 ± 1.21%), plasma protein (C = 5.3 ± 0.21 vs. TR = 5.6 ± 0.39 g/dL), red blood cell count (C = 2.97 ± 0.14 vs. TR = 3.18 ± 0.11 × 10^6/μL), white blood cell count (C = 27.1 ± 0.98 vs. TR = 25.6 ± 0.89 × 10^3/μL), BW (C = 2070.6 ± 35.8 vs. TR = 2022.8 ± 56.4 g), liver weight (C = 25.8 ± 0.88 vs. TR = 26.5 ± 1.63 g), kidney weight (C = 5.12 ± 0.24 vs TR = 5.14 ±

0.24 g), testis weight (C = 10.4 ± 1.33 vs TR = 10.9 ± 1.08g), pancreas weight (C = 3.83 ± 0.13 vs. TR = 3.91 ± 0.21 g) or heart weight (C = 9.65 ± 0.60 vs. TR = 9.45 ± 0.52 g). In addition, no apparent changes in liver, kidney, testis, pancreas and heart were detected by gross post mortem and histopathological examination to suggest toxic effects of oral use of caper for 39 d. Interestingly, Caper treatment increased the thrombocyte levels in treated roosters (C = 0.244 ± 0.26 vs TR = 0.377 ± 0.21× 10^5/μL; $P < 0.01$). In conclusion, the results suggest no toxic effect of capers in roosters. Moreover, high thrombocyte count due to caper treatment should be evaluated further for use in diseases causing low thrombocyte counts.

Key Words: rooster, hematological parameters, histopathology

M245 Safety evaluation of Event 5307 transgenic corn in broiler chickens. A. Sauvé[2] and J. T. Brake*[1], [1]*North Carolina State University, Department of Poultry Science, Scott Hall*, *Raleigh,* [2]*Syngenta Biotechnology, RTP*, *Raleigh, NC*.

A 49-d feeding study evaluated whether broiler diets prepared with Event 5307 transgenic maize (corn) had an effect on broiler livability, BW, feed conversion ratio (FCR), feed consumption, or carcass yield when compared with diets prepared with either non-transgenic, near-isogenic control corn or commercially available control corn (NC2007). The 5307 corn contained eCry3.1Ab and phosphomannose isomerase (PMI) transgenic proteins. The eCry3.1Ab protein is a chimera of modified Cry3A and Cry1Ab proteins and has insecticidal activity against certain corn rootworm species. The PMI protein acts as a selectable marker enabling the selection of positive transformants. Broiler males had a 49-d BW of 3,543 g while females weighed 2,898 g. Overall livability was 98%. Final 49-d BW, adjusted FCR, feed consumption, and livability of the 5307 transgenic, non-transgenic, and NC2007 groups did not differ. There were no statistically significant differences other than during the grower diet period, when the 5307 transgenic group had a lower FCR compared with the NC2007 group, with the non-transgenic group being intermediate. This difference was small in magnitude, resolved by the finisher diet period and was not considered adverse. There were no differences in carcass yield between groups on a gross BW basis. When compared on a percentage BW basis, the thighs of males in the non-transgenic group weighed more than those in the 5307 transgenic and NC2007 groups and the thighs and Pectoralis minor of females in the non-transgenic and NC2007 groups weighed more than those in the 5307 transgenic group. However, due to the lack of differences in other carcass parts these were considered incidental. Diets prepared with 5307 transgenic corn supported rapid broiler growth and excellent FCR without a significant impact on overall carcass yield. The results clearly indicate that the transgenic corn had no deleterious effects on bird health in this study.

Key Words: transgenic corn, transgenic maize, 6307 corn

M246 Effect of garlic extract (Garlicon) on piglet productive performance in the nursery period. J. Morales[1], R. López[2], P. Coscojuela[2], and C. Piñeiro*[1], [1]*PigCHAMP Pro Europa*, *Segovia, Spain*, [2]*Prebia Feed Extracts*, *Toledo, Spain*.

Intensive research has focused on the potential of phytogenic feed additives to replace antibiotics in piglet diets, mainly based on their potential to promote a beneficial gut microflora which protects the host against pathogens and helps to alleviate periods of stress. In vitro, the antimicrobial effect of some plant extracts, as in the case of garlic, is as consistent as the effect of antibiotics. However, their effect in vivo is not consistent compared with antibiotics. The aim of this study was to assess the effect of a plant extract based on garlic (GAR) in weaned piglets. Three different dietary doses of GAR were assessed (50, 100, and 150 ppm) in a 3-wk period, and compared with a negative control group and with a positive control group supplemented with gentamycin (20 ppm). For the experiment, 280 piglets were used (10.3 ± 1.81 kg BW) and allotted in 40 pens (8 per treatment). Average daily gain (ADG), feed intake (FI) and feed efficiency were controlled in the starter phase (42 to 70 d of age). A linear and quadratic effects were observed with GAR supplementation and groups supplemented with 50 and 100 ppm of GAR showed higher average daily gain (ADG) and final BW than the negative control and 150 ppm groups (532, 592, 592, 559 g/d ADG; $P < 0.01$ in control, 50, 100 and 150 ppm groups, respectively). Feed intake tended to be higher in GAR groups than in the control group ($P < 0.10$), while feed efficiency did not differ among groups. In comparison with gentamycin, productive performance was not different in the GAR supplemented piglets, being numerically higher performance in 50- and 100-ppm GAR than in gentamycin-supplemented piglets. No differences were found in feed efficiency between antibiotic and GAR groups. We conclude that GAR supplementation improved ADG, FI and, consequently, final BW in the nursery period, especially supplemented at 50- and 100-ppm. Furthermore, productive performance obtained by the GAR supplementation was as consistent as the one obtained by the dietary gentamycin.

Key Words: plant extracts, phytogenic additives, pigs

M247 Effect of different levels of substitution of maniçoba hay on the performance of free-range birds in the semi-arid region. P. E. N. Givisiez*[1], M. A. S. F. Campos[2], C. C. Goulart[1], F. G. P. Costa[1], and J. H. V. Silva[1], [1]*Universidade Federal da Paraiba*, *Areia, PB, Brazil*, [2]*Universidade Federal do Rio Grande do Norte*, *Natal, RN, Brazil*.

Local resources should be evaluated as potential ingredients to be used in poultry feeding in alternative or organic systems. This study evaluated the effect of partial substitution of conventional corn-soybean meal diet by maniçoba hay (*Manihot pseudoglaziovii*) on the performance and cut yields of free-range birds in the semi-arid region of Brazil. Eighty-four Paraiso Pedres birds were randomly distributed into 3 treatments and 4 repetitions of 7 birds (4 males and 3 females). Diets for the growing (30 to 42 d) and final (43 to 73 d) phases were partially substituted by 0, 10 and 20% of maniçoba hay. Body weight (BW), weight gain (WG) and feed:gain ratio (F:G) were determined for each phase. Two birds per repetition were killed at 73 d to determine carcass weight, absolute (g) and relative weight (%) of cuts and abdominal fat. Data were submitted to ANOVA in a completely randomized design, with 3 treatments and 4 repetitions for performance parameters and 8 repetitions for carcass and cuts analyses. Means were compared by Tukey's test at 5% probability. BW, FI and WG were not affected by the use of maniçoba hay until 42 d. Conversely, weight gain (42 to 73 and 30 to 73 d), body weight at 73 d and FC were negatively affected by increasing maniçoba levels, probably as a result of higher crude fiber levels in the diet and lower AME and AMEn. Carcass, breast and drumstick weights (g) were decreased ($P < 0.05$) by increasing levels of maniçoba, as well as breast yield (%). Therefore, maniçoba hay should not be used if cuts are to be commercialized. On the other hand, the majority of free-range birds are commercialized as live birds or whole carcasses, and levels up to 10% would not impair gain. In conclusion, maniçoba hay may be used up to 10% for free-range birds reared in the semi-arid region without affecting profit.

Key Words: dietary fiber, free-range birds, performance

M248 Performance of broilers fed mash or pellet diets containing whole or ground pearl millet. T. R. Torres[1], M. C. M. M. Ludke*[1], J. V. Ludke[2], C. B. V. RAbello[1], M. A. M. Faria[1], E. M. S. R. Andrade[1], E. J. O. Souza[1], and M. R. Lima[1], [1]*Universidade Federal Rural de Pernambuco*, *Recife, Pernambuco, Brasil*, [2]*Embrapa Suínos e Aves*, *Concordia, Santa Catarina, Brasil*.

The effect of whole or ground millet grain inclusion at level of 20% into mash or pellet diets on performance of male broilers reared during 21 d was evaluated. The trial was established in 2 nutritional phases: from 1 to 7 and 8 to 21 d of age. A randomized block design in a factorial 3 × 2 with 3 diets (without millet -CSBM, with whole -WMG or ground millet grain -GMG) and 2 physical forms (mash, m, or pellet, p) were established containing 5 replicates per treatment and 10 birds per experimental unit. Parameters evaluated were feed intake, weight gain -WG, feed to gain ratio -F:G and feed efficiency (energetic - FE and proteic - EP) in both phases and during entire trial. Broilers fed mash diets had higher feed consumption than those fed pellet diets: 153 g x 144 g in period 1 to 7 d ($P < 0.05$, CV = 4.46%), 986 g x 944 g in period 8 to 21 d ($P < 0.05$, CV = 3.57%), 1170 g x 1117 g in total period ($P < 0.05$, CV = 3.18%). Feed to gain ratios were better for pellet diets than for mash diets: 1.24 × 1.33 in period 8 to 21 d ($P < 0.05$, CV = 2.62) and 1.27 × 1.18 in total period ($P < 0.05$, CV = 2.13). The proteic efficiency was higher for pellet diets than for mash diets in period 8 to 21 d: 3.82 × 3.57 g/g ($P < 0.05$, CV = 2.64%). In Table 1 were presented the mean values of parameters whose interactions between factors were significant ($P < 0.05$). Pearl millet may be used either in whole grain or ground when fed in pellet diets.

Table 1. Mean values of the evaluated parameters with significant interaction between physical form of diets and diet type

From 1 to 7 days	Physical form	WMG	GMG	CSBM
F:G g/g	mash	1.07^{a}	1.03^{a}	1.03^{a}
	pellet	0.94^{b}	0.98^{b}	0.94^{b}
WG, g	mash	141.5^{b}	151.1	147.8
	pellet	154.5^{a}	148.9	150.8
EE, g/g	mash	0.314^{b}	0.322^{b}	0.323^{b}
	pellet	0.356^{a}	0.340^{a}	0.359^{a}
PE, g/g	mash	4.24^{b}	4.40^{b}	4.40^{b}
	pellet	4.80^{AB,a}	4.62^{B,a}	4.86^{A,a}

^{a,b}Different lowercase letters within a column were different ($P < 0.05$).

^{A,B}Different uppercase letters within a row were different ($P < 0.05$).

Key Words: diet physical form, feed efficiency, poultry

M249 Using marine algae *Chlorella vulgaris* as a prebiotic alternative on broiler chicks. M. Rezvani*, M. Zaghari, M. Shivazad, and H. Moravej, *University of Tehran*, *Karaj, Tehran, Iran*.

To evaluate the effects of chlorella on broiler chick performance, an experiment was conducted by using 80 Ross 308 male broiler chicks. The experiment was accomplished in completely randomized design including 5 treatments with 4 replication and 4 mail chicks in each. The basal diet based on corn-soybean meal and without any additives was formulated. A graded level of chlorella (0.07, 0.14, and 0.21%) was added to basal diet to formulating diets 2, 3 and 4 respectively. To comparing the effects of chlorella with commercial prebiotics an extra diet (diet 5) was formulate by adding a commercial prebiotic to the basal diet. Data was analyzed by using GLM procedure of SAS software means were compared by Duncan multiple range test. Results showed that there were no significant differences in weight gain between the treatments in all ages. While the chlorella treatments in compare with the control treatment had numeral increasing in this trait. Feed conversion ratio significantly decreased by adding the chlorella and commercial prebiotic to the basal diet at 42 d of age ($P < 0.05$). Evaluation of ceca content showed an increasing in lactobacillus population and improving the ratio of lactobacillus to coliform population by increasing the chlorella in the basal diet. The results of this experiment indicated that chlorella have prebiotic properties and even have better performance in some quality to compare the commercial prebiotics.

Key Words: broiler, chlorella, prebiotic

M250 Effects of mung bean waste on pelleting characteristics, growth performance, nutrient digestibility and carcass quality in broilers. N. Amornthewaphat*, P. Rungcharoen, Y. Ruangpanit, S. Rattanatabtimthong, and S. Attamangkune, *Kasetsart University*, *Bangkok, Thailand*.

Series of experiments were conducted to determine the apparent metabolizable energy of mung bean waste in broilers and effects of mung bean waste inclusion in broiler diets on growth performance and nutrient digestibility. In Exp. 1, 120 male broilers (28-d of age; 10 chicks per metabolic cage; 6 cages per treatment) were randomly fed 2 experimental diets consisting of corn soybean basal diet and 20% mung bean waste substituted basal diet. The apparent metabolizable energy of mung bean waste for broilers was 1,844.71 ± 130.71 kcal/kg. In Exp. 2, a total of 1,200 broilers were used in a 42-d growth assay with 3 phase-feeding programs (50 chicks per pen; 6 pens per treatment). Treatments were mung bean waste inclusion of 0%, 5%, 10% and 15% in the experimental pelleted diets and arranged in a randomized completely block design. Sex was a block factor. Increasing mung bean waste resulted in increased palm oil inclusion in the diets. These resulted in linearly decreased pelleting energy consumption and pellet durability index ($P \leq 0.001$). Increasing mung bean waste in the diets decreased ($P \leq 0.05$) body weight gain of starter chicks from 612 to 583 g and linearly suppressed ($P \leq 0.001$) feed conversion from 2.25 to 2.35. There was no difference in growth performance for a grower and a finisher period. For the carcass quality, decreased abdominal fat ($P \leq 0.001$) and increased gizzard weight ($P \leq 0.05$) were observed in chicks fed mung bean waste diets. In Exp. 3, 96 male broilers were used in a 10-d total excreta collection assay (6 broilers per metabolic cage; 4 cages per treatment). Treatments used were the same as in Exp. 2. There was linear decrease ($P \leq 0.05$) dry matter from 80.07 to 77.41% and fiber utilization from 26.83 to 13.59% with increasing mung bean waste. In conclusion, the recommendation of mung bean waste inclusion in the broiler diets should less than 5% to achieve optimum growth performance and nutrient digestibility of broilers.

Key Words: mung bean waste, broilers, growth performance

M251 Effects of dietary grape seed polyphenols on plasma lipid and mineral contents, and intestinal microflora in broiler chicks. A. Viveros*[1], S. Chamorro[2], A. Brenes[2], C. Romero[3], I. Arija[1], and C. Centeno[2], [1]*Facultad de Veterinaria, UCM, Madrid, Spain*, [2]*Instituto del Frio-ICTAN, CSIC, Madrid, Spain*, [3]*Escuela Tecnica Superior de Ingenieros Agronomos, UPM, Madrid, Spain*.

Grapes contain a large array of phenolic compounds which have been showed to have hypolipidemic and anti-microbial effects as well as to act as antioxidant by scavenging reactive oxygen species (ROS) and chelating metal ions which promote the generation of ROS. An experiment was conducted to study the effect of the inclusion of grape seed extract (GSE) and vitamin E in broiler chicks diets on performance,

plasma lipid and mineral contents, and ileal and cecal microflora at 21 d of age. Experimental diets were as follows: 1) Control wheat-soybean diet (WS); 2) WS + vitamin E (200 mg/kg); 3) WS + 50 mg/kg tetracycline; 4, 5, 6 and 7) WS + 0.025, 0.25, 2.5 and 5.0 g/kg GSE, respectively. Each treatment was randomly assigned to 7 pen replicates (5 birds each). Performance was not affected by dietary treatments except in the case of birds fed the highest GSE diet which showed a decrease of body weight. The inclusion of graded concentrations of GSE in the chicken diets lowered the concentration of plasma cholesterol and LDL-cholesterol and increased the content of plasma triglycerides and HDL-cholesterol in a dose-dependent manner. Plasma VLDL-cholesterol was not affected by dietary treatment. Compared with the vitamin E diet, the GSE diet increased the concentration of plasma triglycerides and reduced the contents of plasma HDL and LDL-cholesterol. Regarding plasma mineral contents, the addition of increasing concentrations of GSE in the chicken diets reduced the concentrations of copper, iron and zinc compared with those fed the control and vitamin E diets. In the ileal content, birds fed the lowest concentration of GSE had a lower population of *E. coli* than in any other treatment group. Compared with the control diet, the GSE diet reduced the populations of *E. coli* and coliformes in the cecal digesta. In conclusion, dietary GSE reduced the iron and copper status of broiler chick which could play an important role in the antioxidant processes. GSE has showed to have hypocholesterolemic effect and caused a decrease in the populations of *E. coli* in the intestinal microflora.

Key Words: chicks, grape polyphenols, blood parameters and intestinal microflora.

M252 Comparison of dietary supplementation of cumin essential oil and prebiotic on humoral immune response, blood metabolites and performance of broiler chickens. M. Aami-Azghadi, A. Golian*, H. Kermanshahi, and M. Sedghi, *Ferdowsi University of Mashhad*, *Mashhad, Khorasan Razavi, Iran*.

Five hundred day-old male Ross broiler chicks were divided into 50 groups of 10 birds each and randomly assigned to 10 dietary treatments with 5 replicates each. Two corn-soybean meal-based diets were first provided to meet 100% and 95% of recommended digestible amino acids (RDAA) for starter (1–14 d), grower (15–35 d) and/or finisher (36–49 d) periods. Each starter diet was subdivided into 5 parts and supplemented with 0 and 2 g/kg Fermacto and 0.2, 0.4 and 0.8 g/kg cumin essential oil (CEO). The grower diets contained half of the same supplementation in the starter diets and each of the un-supplemented finisher diet was fed to the corresponding birds. The performance parameters were determined during all periods and carcass yields and relative organ weights measured on d 28 and 49. The blood metabolites, cell differentiation and total anti-SRBC, IgG and IgM titers measured on d 26 in birds fed 100% RDAA diets. The CEO and Fermacto did not have a significant effect ($P > 0.05$) on performance in the starter and finisher periods but higher BWG was observed in birds fed diet with the lowest level of CEO in the grower period. Birds fed diet with 100% RDAA and Fermacto had higher feed: gain ratio in the growing period compared with those fed diet of similar AA and 0.2 g/kg of CEO. A 5% decrease in the RDAA had no adverse effect ($P > 0.05$) on the overall FI and BWG, but FCR was increased ($P > 0.05$). Carcass yields and cuts were not influenced ($P > 0.05$) by CEO, Fermacto or DAA levels. There was not a significant difference ($P > 0.05$) in total anti SRBC, IgG and IgM titers The inclusion of Fermacto or various levels of CEO in diets did not affect ($P > 0.05$) serum metabolite (mg/dL) at d 28, although triglyceride and VLDL concentrations was lower ($P < 0.05$) in chicks fed starter diet contained 0.4 g/kg CEO.

Key Words: cumin essential oil, humoral immune response, chickens performance

M253 Effect of ginger root and ginger oil on antioxidant status and meat quality of broilers. G. F. Zhang[1], Z. B. Yang*[1], Y. Wang[2], W. R. Yang[1], and S. Z. Jiang[1], [1]*Shandong Agricultural University*, *Tai-an, Shandong, China*, [2]*Agriculture and Agri-Food Canada, Lethbridge Research Centre*, *Lethbridge, AB, Canada T1J 4B1*.

A total of 720 broilers were used to investigate the effects of ginger root and ginger oil on antioxidant status and meat quality of broilers. The birds were randomly distributed into 6 treatments with 3 pens of 40 each. Dietary treatment included 1) BD(basal diet), 2) BD+ antibiotics (40 mg/kg bacitracin zinc and 8 mg/kg colistin sulfate), 3) BD+5 g/kg ginger root, 4) BD+10 g/kg ginger powder, 5)BD+20 g/kg ginger powder, 6) BD+100 mg/kg ginger oil (essential oil from ginger). Broilers were fed starter rations from d1 to 21 and finisher rations from d22 to 42. Blood and liver samples were obtained to determine the antioxidant status. Breast muscle samples were collected to determine meat quality of broilers. Supplementation of ginger powder or ginger oil all increased ($P < 0.05$) the activities of total superoxide dismutase (TSOD), glutathione peroxidase (GSH-Px), as well as total antioxidant capability (TAOC), and decreased ($P < 0.05$) the MDA content in serum of chickens compared with the control group at 21 and 42 d of age. Broilers addition of 10 or 20 g/kg of ginger had higher ($P < 0.05$) serum TSOD (145.37, 141.73 vs. 129.10 U/mL at 42d) and GSH-Px activities and lower MDA content (6.25, 6.17 vs. 8.86 nmol/mL at 21d) than the antibiotics group. In liver, addition of ginger significantly elevated ($P < 0.05$) TSOD (21d) and GSH-Px (21d) activities and improved the TAOC (21d and 42d) in contrast to the control. Significant increases ($P < 0.05$) of Hunter a* values and decreases ($P < 0.05$) of drip loss and water loss rate of breast muscle were observed in broilers supplemented with ginger powder and ginger oil in contrast to the control or the antibiotics group. There was no effect on pH value. It was concluded that diets supplemented with ginger could improve meat quality by increasing the antioxidant status of broilers. Ginger powder and ginger oil can be used as a potential additive substituted for antibiotics.

Key Words: ginger, broilers, antioxidant status

M254 Utilization of Mexican sunflower (*Tithonia diversifolia*, Hemsley A gray) leaf meal on the average production cost and returns of broiler chicks. A. H. Ekeocha*[1], A. Akinfemi[1], O. A. Adu[1], and O. A. Adebiyi[1], [1]*Department of Animal Science University of Ibadan*, *Ibadan, Oyo State, Nigeria*, [2]*Faculty of Agriculture P.M.B.135, Nasarawa State University*, *Shabu - Lafia Campus, Nasarawa State, Nigeria*, [3]*Department of Animal Production and Health, Federal University of Technology*, *Akure, Ondo State, Nigeria*, [4]*Department of Animal Science, University of Ibadan*, *Ibadan, Oyo State, Nigeria*.

One hundred and fifty, white, day old Arbor Acre broiler chicks were used in evaluating the utilization of Mexican sunflower meal on the economics of broiler chicks. The broiler chicks were randomly assigned to 5 treatments A, B, C, D, and E. Treatment A served as the control and treatments B, C, D, and E received Mexican sunflower leaf meal at 2.5, 5.0, 7.5, and 10.0% levels replacing maize and soymeal respectively. Feed and water were provided ad-libitum and routine vaccinations and medications administered. Performance characteristics measured were feed intake and net profit. The results of the experiment showed that there were significant differences ($P < 0.05$) in the live weight and feed intake. However, birds on treatment A performed best by attaining a live weight of 2610.30 g in 8 weeks with feed intake of 4,680.56g per bird.

The same birds yielded the highest net profit of N182.42 or $1.586 per bird on dressed weight unlike a deficit of N63.29 or $0.55 per bird on birds in treatment E (10% MSLM) and N306.75 or $2.667 per bird on live weight and a profit of N18.74 or $0.163 per bird in treatment E (10%MSLM). Birds in treatments B(2.5% MSLM), C (5.0% MSLM) and D(7.5% MSLM) have appreciable level of profits which suggest that in the absence of conventional feed stuff, nonconventional feeds such as MSLM at 2.5% to 7.5% can be optimized in the diets of broilers.

Key Words: lesser known sunflower, production cost, broiler chicks

M255 Dietary supplementation of medicinal plants and organic acid on serum lipid profile in Ross broilers. H. Ziaie*[1], A. Zeinali[2], G. H. Hadarbadi[1], M. A. Karimi Torshizi[4], M. Bashtani[3], and H. Farhangfar[3], [1]*Agriculture and Natural Resources Research Center*, *Birjand, South Khorasan, Iran*, [2]*Ferdowsi University*, *Mashhad, Iran*, [3]*Birjand University*, *Birjand, Khorasan, Iran*, [4]*Tarbiat Moddares University*, *Tehran, Iran*.

This study evaluated the supplementation of medicinal plants and organic acid on the serum lipid profile in a feeding program for broilers maintained at commercial condition. Two hundred and 40 1-d old Ross male broiler chicks were placed in 16 cages under a completely randomized design. Cages were randomly assigned to 4 treatments: 1) control diet based corn and soybean meal without supplementation; 2) control + antibiotic, 150 ppm of Virginiamycin; 3) control + 450 mg medicinal plants Digestrom /kg diet; and T4) control diet + 400 mg organic acid Formycine /kg diet). At d 28 and 42 of the experiment, 4 birds from each replicate were randomly selected and blood samples taken from the wing vein into syringes. The blood samples were then centrifuged at 2,000 × *g* for 10 min and the serums were transported into aseptically treated vials then at 20°C for further analysis. Serum samples were analyzed for determining the total cholesterol, triglyceride, HDL cholesterol, and LDL cholesterol by enzymatic diagnostic kit (Sigma kit). Experimental units were treated under T3, which was found to have the lowest cholesterol, triglyceride, and LDL cholesterol concentrations. This treatment also resulted in an increased HDL/LDL ratio compared with T1 and T2. Supplementation diets with medicinal plants and organic acid had no significant effect on HDL cholesterol. In addition, treatment 4 reduced serum total cholesterol and LDL cholesterol concentrations in broilers during 42 d. Generally, the results indicated that the medicinal plants and organic acid as an alternative antibiotic have a hypolipidemic effect in broilers.

Key Words: hypolipidemic, probiotic, prebiotic

M256 Changes of internal egg quality during cold storage when hens fed diets containing cottonseed meal treated with sodium bentonite. A. Gilani, H. Kermanshahi, A. Golian*, and A. Tahmasbi, *Ferdowsi University of Mashhad*, *Mashhad, Iran.*

This experiment was designed to determine interactive effects between dietary sodium bentonite (SB) containing ferric oxide and free gossypol (FG) on internal egg quality during cold storage. In a 3 × 3 factorial arrangement in a CRD with 9 dietary treatments in 4 replicates consisting of 3 levels of SB (0, 1, and 2%) and 3 levels of CSM (0, 10, and 20%) were tested. Nine mash diets were fed to 288 commercial Hy-Line W-36 hens from 51 to 62 wk of age after 1 wk of acclimatization. Each experimental unit consisted of 2 cages with 4 birds per cage. The 4 eggs were randomly chosen in each experimental unit from the eggs laid during the 4 consecutive days at every 28-d period (total 3 periods) and then were stored at 4°C for 1, 2, 3, and 4 wk to enhance yolk discoloration, respectively. After storage, eggs were individually opened, and the degree of yolk discoloration was scored based on egg yolk scoring protocol. After determination of albumen spread, the yolk was separated from the albumen and the pH of yolk and albumen was measured. Data were analyzed using the GLM procedure of SAS 9.1. Tukey's Studentized Range (HSD) test was used to compare means ($P < 0.05$).Yolk score significantly ($P < 0.01$) increased with increasing of CSM and significantly ($P < 0.01$) diminished with increasing of SB in the diet during cold storage. There was no significant effect of dietary treatments on spread of albumen, but albumen quality gradually decreased during 4 weeks. Generally, pH of yolk and albumen increased after cold storage. There was no significant effect of dietary treatments on pH of yolk or albumen. Egg discoloration in the current research was limited to that associated with gossypol. No eggs were observed to have developed pink albumen. In this study, cloudy white was sometimes observed after cold storage in all treatments. The yolks of eggs laid by hens consuming CSM became rubbery, viscous, and pasty in appearance after cold storage. Under the conditions of this experiment, SB in the diet was useful for reduction of yolk discoloration.

Key Words: cottonseed meal, sodium bentonite, internal egg quality

M257 Sensory characteristics of table eggs from laying hens fed diets containing hemp oil or hemp seed. E. Goldberg*, D. Ryland, N. Gakhar, J. D. House, and M. Aliani, *University of Manitoba*, *Winnipeg, MB, Canada*.

Hemp seed contains approximately 30% oil, and this oil is rich in α-linolenic acid (17% of total fatty acids). As such, hemp seed and its' oil can be used in poultry diet formulations to produce eggs enriched with these essential fatty acids. Ideally, enriched eggs should maintain the characteristic sensory attributes of non-enriched eggs to remain acceptable to consumers. The concern with omega-3 eggs in the past has been the potentially deleterious effects on sensory attributes including off-flavor and off-odor, and altered texture. The current study was designed to assess the sensory attributes of eggs procured from hens consuming diets containing hemp seed products. Forty-eight individually caged Bovan hens received 1 of 6 isonitrogenous and isoenergetic diets containing 0, 4, 8, 12% hemp oil or 10, 20% hemp seed for a 12 week period. Trained panelists (n = 8) evaluated 6 aroma and 7 flavor attributes of cooked eggs. Attributes that were measured included "egg," "salty," "sour," "milky," "creamy" and "buttery," with "sweet" as the additional flavor attribute. No significant differences in aroma or flavor ($P > 0.05$) were found between eggs from different dietary treatments. For yolk color, L*, a* and b* values (mean ± SD) for control (0%) eggs were 61.0 ± 0.3, 1.0 ± 0.1, and 43.2 ± 0.4, respectively. Addition of either hemp seed or hemp oil led to significant ($P < 0.05$) reductions in L*, and significant ($P < 0.05$) increases in a* and b*, with the largest changes observed in the 20% hemp seed treatment (L* = 58.7 ± 0.1; a* = 5.3 ± 0.1; b* = 60.0 ± 0.3). The results provide evidence that hemp oil or seed use in poultry diet formulations leads to increased yolk color intensity, but does not have adverse effects on flavor and aroma profiles of the cooked eggs.

Key Words: sensory, egg, hemp

M258 Effect of guar meal as a source of protein on laying hens performance. P. Soleimani, A. Golian*, H. Kermanshahi, and M. Sedghi, *Ferdowsi University of Mashhad*, *Mashhad, Khorasan Razavi, Iran*.

An experiment was conducted to evaluate guar meal (GM) as a source of protein on laying (58 weeks of age) performance and egg quality. Two hundred 20 8 laying hens (58 weeks of age) were fed diets containing

0, 3, 6 and 9% guar meal with/without β-mannanase (Hemicell) for 12 weeks. A complete block randomized design with 4 × 2 factorial arrangement were used to have 8 diets of each fed to 4 replicate hens of 9 each. Daily egg production and weekly egg weight and feed consumption were recorded. Three eggs from each replicate were used to measured egg components each other week. Hen-day egg production was significantly decreased when hens fed diets contained 6 and 9% GM in first week and only 9% GM at second week of experiment as compared with 0 and 3% GM fed birds. Whereas hen-day egg production was not influenced when hens fed up to 9% GM after third week. Egg mass was significantly lower when hens fed 9% GM during the experimental periods compared with control and 3% GM fed birds (46.8 vs. 50.8 or 52.4, respectively). Feed conversion ratio (FCR) in 3 initial weeks of experiment was significantly higher in 9% GM fed birds. Feeding of GM did not affect specific gravity, percentage wet albumen and wet yolk based on percentage of whole egg weight and shell weight and thickness. Feed consumption, hen-day egg production, egg mass, FCR and egg quality were not affected by Supplementation of β-mannanase during the experimental periods. The results of this study showed that 6% GM may be added to the diet of laying hens with no adverse effects on performance.

Key Words: guar meal, egg production, laying hen

M259 Effect of dietary supplementation of licorice extract on egg quality and performance of hens. M. Sedghi, A. Golian*, and P. Soleimani, *Ferdowsi University of Mashhad*, *Mashhad, Khorasan Razavi, Iran*.

The objective of this study was to determine the effects of various levels of dietary licorice extract on egg production, egg weight, specific gravity, feed conversion ratio, egg shell quality and egg yolk color. One hundred 20 8 laying hens (58 weeks age) were divided to 4 groups with 4 replicates (8 hens each) in a complete block randomized design. Data were analyzed using ANOVA and means were separated using Tukey's HSD ($P < 0.05$). The experimental diets were supplemented with 0, 2, 4 or 6 g/kg of diets licorice extract. Daily egg production, weekly egg weight and feed consumption were recorded. Three eggs in each replicate were used to measured egg components each other week. Daily egg production in hens fed diet supplemented with 4 g/kg of licorice extract numerically increased ($P = 0.06$) when compared with the control diet in the entire experiment. Hens fed diet 4 g/kg licorice extract had significantly increased ($P < 0.05$) shell thickness compared with those fed diets supplemented with 6 g/kg (389 vs. 374 mm). Percentage of abdominal fat pad was significantly decreased ($P < 0.05$) in birds fed diet containing 6 g/kg licorice extract compared with control diet (0.83 vs. 1.49%). Performance parameters (feed consumption, feed conversion ratio), egg parameters (egg weight, dry shell weight, egg-specific gravity, percentage of wet albumen and wet yolk based on percentage of whole egg weight) and organ weights were not influenced ($P > 0.05$) by licorice supplementation. It seems that licorice extract at the level of 4 g/kg may have positive effects on egg production, shell quality and decreases abdominal fat pad at 6 g/kg level.

Key Words: licorice extract, egg production, laying hen

M260 Effects of fermented garlic powder supplementation on production performance, egg quality and blood characteristics of laying hens. J. S. Yoo*, H. J. Kim, J. P. Wang, X. Ao, J. H. Jung, and I. H. Kim, *Department of Animal Resource and Science, Dankook University*, *Cheonan, Choongnam, Korea*.

The effects of fermented garlic powder on the production performance, egg quality and blood characteristics of laying hens were studied in a 35–d experiment. A total of 240 (ISA brown) 41-wk-old layers were allocated into the following 4 treatments: 1) CON (basal diet), 2) G1 (CON + 0.005% fermented garlic powder), 3) G2 (CON + 0.01% fermented garlic powder), and 4) G3 (CON + 0.02% fermented garlic powder). There were no differences ($P > 0.05$) in the egg production, egg weight, eggshell breaking strength and eggshell thickness among groups throughout the entire experimental period. However, the yolk height increased significantly ($P < 0.05$) in response to the addition of fermented garlic powder during the 5th week. Additionally, the yolk color was greater ($P < 0.05$) in the CON and G3 groups than in the G1 and G2 groups during the 5th week. The Haugh unit value was higher ($P < 0.05$) in groups that received the fermented garlic powder treatments during the 5th week than in the CON group. None of the treatments had a significant effect on the total protein, albumin, and IgG levels in blood throughout the experimental period ($P > 0.05$). There was a significant ($P < 0.05$) reduction in the serum cholesterol concentration when the dietary level of fermented garlic powder was increased from 0.005 to 0.02%. Overall, this study demonstrated that the addition of fermented garlic powder to the diets of laying hens reduced the serum cholesterol concentration without any adverse effects on production performance. In conclusion, dietary fermented garlic powder supplementation improved yolk height and Haugh unit, and reduced serum cholesterol concentration laying hens.

Key Words: fermented garlic powder, egg quality, laying hens

M261 Effects of marine algae (*Spirulina platensis*) on egg yolk color and laying hens performance. N. Zahroojian, H. Moravej*, and M. Shivazd, *University of Tehran*, *Karaj, Tehran, Iran*.

Egg yolk color has always been regarded as an important egg quality characteristic. There are some synthetic pigments for produce an aesthetically pleasing yolk color of egg, but consumers often prefer eggs that were enriched by natural materials. It seems that the algae as a natural pigment can be useful for produce an aesthetically pleasing yolk color. Therefore, in this experiment, a total of 128 Hy-line W36 hens, 63 weeks of age were used. Hens were put at random into 4 treatment groups (4 replicates and 32 hens per treatment). The hens were fed 4 diets; 3 diets with different levels of spirulina (1.5%, 2% and 2.5%) and one control group based on wheat and soybean meal that received no spirulina in the ration. Egg production, feed conversion ratio, feed intake, egg weight and yolk color were compared with control group. Egg yolk color was measured by the BASF *Ovo-color* fan. Our Results indicated that egg production, feed conversion ratio, feed intake and egg weight did not show any changes with the spirulina addition ($P < 0.05$), while a significant increase in egg yolk color was observed in the treatments that received the spirulina comparing to control diet ($P < 0.0001$). Yolk color scores of control group and different levels of spirulina (1.5, 2, and 2.5%) were 1.5, 10.5, 11.4, and 11.6 in BASF color fan, respectively. There were no significant differences between the treatments with 2% and 2.5% of spirulina, so we can suggest using 2% spirulina in the egg industry to produce an aesthetically pleasing yolk color.

Table 1. Effect of treatments on egg production, feed conversion ratio, feed intake, egg weight and yolk color

Spirulina level (%)	Egg production, n	Feed conversion ratio	Feed intake	Egg weight	Yolk color
0 (control group)	74.168[a]	1.562[a]	100.275[a]	63.923[a]	1.55[c]
1.5	78.333[a]	1.550[a]	97.803[a]	63.198[a]	10.55[b]
2	82.083[a]	1.520[a]	96.495[a]	63.598[a]	11.43[a]
2.5	73.645[a]	1.532[a]	97.393[a]	63.473[a]	11.66[a]
P-value	0.2083	0.7552	0.4059	0.8403	<0.0001
SEM	2.7	0.03	1.36	0.8	0.11
CV%	6.98	3.77	2.76	2.53	2.35

[a–c]Means in a column with different superscripts differ significantly.

Key Words: egg yolk color, marine algae (*Spirulina platensis*), laying hen performance

M262 Use of salvage pet food in diets of weaned pigs. J. P. Holt and S. J. Gasca*, *Illinois State University*, *Normal*.

The United States pet food industry produced over 8 million tonnes of pet food in 2008 and continues to grow. A by-product of this industry, salvage pet food (SPF), is often available to swine producers. Two experiments were conducted to determine the effects of adding SPF as an alternative ingredient in weaned pig diets. SPF, an expired, extruded dog food product, was ground and added to conventional weaned pig diets at 0 (CON), 10, 25, or 40%, substituting corn and soybean meal. SPF had the following nutrient composition: 22.7% CP, 3.7% CF, 8.9% crude fat, and 7.2% ash. Two dietary phases were mixed. Barrows (n = 24) were placed into metabolism crates and fed phase 2 experimental diets for 10 d, with 3 d of total feces collection. Feed and fecal samples were analyzed for GE using bomb calorimetry and nitrogen using the combustion method. For a growth assay, 348 pigs, blocked by weight and sex, were placed into 48 nursery pens. Pigs were fed a common pre-starter for 4 d followed by their respective experimental diets for 28 d (14 d per phase). Pig weight and feed disappearance were measured weekly and used to calculate ADG, ADFI, and G:F. Blood samples were collected weekly, from one pig per pen, for analysis of blood urea nitrogen (BUN). Diets containing 40% SPF were found to have a greater energy density than anticipated. However, GE intake of pigs was not different ($P > 0.05$) between treatments during the metabolism trial. There was no effect ($P > 0.05$) of SPF inclusion on energy and nitrogen digestibility of pigs fed experimental diets. Analysis of growth data revealed that pigs fed diets containing 25 and 40% SPF had an increased ($P < 0.05$) G:F compared with pigs fed the CON diet. Pigs fed diets containing 40% SPF tended ($P = 0.07$) to have increased BUN in comparison to pigs fed either 0 or 10% SPF. Results of these experiments show that SPF is a quality ingredient for use in weaned pig diets; when included at high levels, pigs displayed a greater efficiency of feed utilization.

Key Words: pet food, swine

M263 Effect of meat powder supplementation on growth performance, nutrient digestibility and blood characteristics of growing pigs. S. M. Hong*, J. H. Lee, J. P. Wang, Q. W. Meng, B. W. Yang, and I. H. Kim, *Department of Animal Resource and Science, Dankook University*, *Cheonan, Choongnam, Korea*.

A total of 48 [(Duroc × Yorkshire) × Landrace] pigs (25.67 ± 1.13 kg) were used in a 42–day trail to investigate the effects of dietary meat powder on growth performance, nutrient digestibility and blood characteristic in growing pigs. Pigs were allotted into 3 dietary treatments in a randomized complete block design according to sex and initial BW. Dietary treatments included: 1) CON [basal diet], 2) M2 [basal diet + 0.2% meat powder] and 3) M4 [basal diet + 0.4% meat powder]. Each treatment had 8 replicates with 2 pigs per pen. Pigs were housed in an environmental controlled, slatted-floor facility in 24 adjacent pens (1.80 × 1.80 m2) and were allowed ad libitum access to feed and water through a self-feeder and nipple waterer throughout the experimental period. In the current study, dietary meat powder did not affect the growth performance (ADG, ADFI and G/F ratio). Nutrient digestibility (DM, N and energy) were not affect by the inclusion of the meat powder, although a numerically increase was observed on the N digestibility in the M2 treatment compared with the CON treatment. In addition, pig fed the dietary meat powder diets had a decreased (Linear $P = 0.006$) BUN concentration in serum with the increasing meat powder level, which suggested that the meat powder could exert positive to the protein utilization. However, no effect was observed on the creatinine concentration among the treatments. In conclusion, dietary meat powder could improve the protein utilization and have a tendency to increase the nutrients digestibility.

Key Words: meat powder, growth performance, growing pigs

M264 Effects of fermented garlic powder on growth performance and blood profiles of weanling pigs. J. P. Wang*, J. H. Lee, H. J. Kim, L. Yan, S. M. Hong, and I. H. Kim, *Department of Animal Resource and Science, Dankook University*, *Cheonan, Choongnam, Korea*.

The overall objective of this study was to evaluate the growth performance and blood profile responses of pigs fed diets supplemented with fermented garlic powder. Garlic (*Allium sativum*) has several beneficial effects for either human or animals having antimicrobial, antioxidant, as well as antihypertensive properties. The growth performance and blood profile responses of 144 weanling pigs (5.5 ± 0.4 kg) fed dietary supplementation of fermented garlic powder were evaluated in a 5-wk trial. Pigs were randomly allocated to the following 4 dietary treatments: CON (basal diet) and CON with fermented garlic powder added at 0.05% (G0.05), 0.10% (G0.1) or 0.20% (G0.2). There were 6 replications with 6 pigs per pen. Throughout the experimental period, no effect on G:F was observed ($P > 0.05$). However, during wk 1–3, the ADFI was higher ($P < 0.05$) in the G0.05 group than the other treatment groups. In addition, the ADG was improved during wk 3–5 ($P < 0.05$) in response to fermented garlic powder treatments, while only the ADFI in the G0.05 group was increased ($P < 0.05$). Overall (0–5 wk), G0.05 treatment increased the ADG by 10% and the ADFI by 12% ($P < 0.05$) when compared with the CON group. Furthermore, the IgG, RBC and lymphocyte levels were greater ($P < 0.05$) in the G0.1 and G0.2 treatment groups at the end of the trial. In conclusion, the addition of fermented garlic powder improved the ADG in weanling pigs and partially benefited the immunity.

Key Words: fermented garlic powder, growth performance, weanling pigs

M265 Evaluation of algae meal from *Nannochloropsis oculata* as a protein source for non-ruminant animals. B. A. Howe*[1], I. N. Roman-Muniz[1], B. D. Willson[2], and S. L. Archibeque[1], [1]*Colorado State University, Department of Animal Sciences*, *Fort Collins*, [2]*Colorado State University, Department of Mechanical Engineering*, *Fort Collins*.

A study was developed to explore the safety and potential use of algae meal that remained after the oil was extracted from the algae species

Nannochloropsis oculata for biodiesel production. This algae meal was included at 10% (DM basis) to a test diet that was isocaloric and isonitrogenous to the control diet (as analyzed by proximate analysis). Twenty-four adolescent male Sprague-Dawley rats were used (n = 12/treatment). The rats were fed ad-libitum for 36 d and body weights were recorded every 7 d. Blood was drawn via a lateral venous tail puncture, and analyzed for metabolites on d 0, and 21 of the study. A nutrient balance trial was conducted from d 21 through d 28, measuring all food and water consumed, as well as all feces and urine produced. On d 36 of the study, the rats were killed, blood was collected via a heart puncture, at the same time the organ weights were recorded, and tissue samples for histology were taken of the kidneys, liver and spleen. The ADF (11.08 vs. 7.51 g/d) and NDF (25.10 vs. 21.14 g/d) intake of rats fed the algae meal diet was greater ($P < 0.01$) than those fed the control diet. Subsequently, apparent DM and CP digestibility was slightly lower ($P < 0.03$) in the algae fed rats then the controls There were no apparent differences ($P > 0.10$) in final body weight, or CP balance. There were no differences in blood glucose ($P = 0.15$), base excess ($P = 0.79$) or BUN ($P = 0.69$). Additionally, there were no apparent differences ($P > 0.10$) in histology of the kidneys, livers or spleens of rats fed either the control or diet with algae meal. These data indicate that the algae meal of *N. oculata* may be a safe alternative protein source for non-ruminant animals, yet the digestibility may be limited by the increased fiber content of the algae meal.

Key Words: algae, biodiesel, digestibility

M266 The effect of supplementation with ginger on dietary oxidation stability. X. Zhao and Z. B. Yang*, *Shandong Agricultural University*, *Tai-an, Shandong, PRC*.

The experiment was conducted to evaluate the effect of supplementation with ginger on dietary oxidation stability. Treatments included control diet without ginger supplementation and test diets supplemented with 5, 10, 15, 20 g/kg of ginger. All of the diets were placed in plastic air-tight envelope that were distributed randomly in a 20°C oven for 60-d experimental period. Lipid was extracted from samples at 10-d intervals using the method of Soxhlet extraction (<45°C). The peroxide value (PV) was determined on the extracted oil using the AOCS method Cd 8–53 (Walker, 1989). The anisidine value (AV) was measured using the official IUPAC method (Paquot, 1979). Supplementation with ginger in poultry diets caused a greater ($P < 0.05$) increase in PV than the control diet during the first 30 d. But after that time, the PV showed no difference ($P > 0.05$) until last except the 0, 5g/kg of ginger supplementation diets were lower ($P < 0.05$) at Day 60. In contrast to the PV, the control diet caused the fastest ($P < 0.05$) rate of oxidation, whereas the 20 g/kg of ginger supplementation diet showed the lowest ($P < 0.05$) rate of oxidation during the first 30 d and then no significant differences ($P > 0.05$) in AV between the control and the test diets. Further analysis showed that AV of all the diets were linearly ($P < 0.05$) and tended ($P < 0.05$) to quadratically increased. In conclusion, AV and PV of the diets were strongly affected by time. Supplementation with ginger in poultry diets can decrease AV but increase PV. As all know, both PV and AV are important characteristic of the edible oils quality and appears as an indicator of the lipid oxidation and oil properties deterioration. PV measures the first products, hydroperoxides and peroxides, which are transient and decompose to aldehydes and ketones, whereas AV measures these secondary oxidation products. Through above analysis, ginger supplementation in poultry diets may effective to restrain the conversion of first oxidation products to secondary ones.

Key Words: ginger, poultry diets, oxidation stability

M267 Effects of dietary wild ginseng adventitious root meal on egg quality, egg production, and fatty acid content of yolk in egg produced by laying hens. H. J. Kim*, J. S. Yoo, J. P. Wang, Q. W. Meng, B. W. Yang, and I. H. Kim, *Department of Animal Resource and Science, Dankook University*, *Cheonan, Choongnam, Korea*.

This study was conducted to evaluate the effects of dietary wild ginseng adventitious root meal on the egg quality, egg production and fatty acid content of yolks in egg produced by laying hens. A total of 240 ISA Brown laying hens 55 wk of age were used in this 5–wk feeding trial. Dietary treatments included 1) CON (basal diet), 2) WGR1 (basal diet + 1% wild–ginseng adventitious root meal), and 3) WGR2 (basal diet + 2% wild–ginseng adventitious root meal). The laying hens were allotted into 3 dietary treatments with 40 replicate pens and 2 laying hens per pen in a completely randomized design. Evaluation of the egg quality revealed that the egg shell thickness, egg yolk color, egg yolk height and Haugh unit had no significant different among treatment groups ($P > 0.05$). Egg production was also significantly increased in the WGR1 and WGR2 groups when compared with the CON group ($P < 0.05$). The fatty acid content of yolk, palmitic acid, stearic acid, saturated fatty acid content and the saturated fatty acid/unsaturated fatty acid ratio were significantly lower in the WGR1 and WGR2 groups when compared with the CON group ($P < 0.05$). The linoleic acid, eicosenoic acid and unsaturated fatty acid content in the WGR group was higher than in the CON group ($P < 0.05$). In conclusion, the addition of wild-ginseng adventitious root meal improved egg quality, egg production and fatty acid content of yolk.

Key Words: wild ginseng, egg quality, laying hens

M268 Effect of a mixture of turmeric and capsicum oleoresins and of a garlic botanical on broiler chickens performance and intestinal histology. D. Bravo*[1], T. G. Petrolli[2], L. F. T. Albino[2], and H. S. Rostagno[2], [1]*Pancosma*, *Geneva, Switzerland*, [2]*Federal University of Viçosa, Department of Animal Science*, *Viçosa, Brazil*.

Our objective was to evaluate the effect of a mixture of turmeric and capsicum oleoresins (PF, Proflora) and of a garlic botanical (GB) on the performances and small intestine villus height and crypt depth of broiler chickens fed a corn soybean meal diet. One day-old male broiler chicks were distributed in a completely randomized block design with 6 treatments, 8 rep. and 20 birds per rep. (floor pen) in the starter (1–21d) and grower/finisher (21–40d) phases. T1 was the nonsupplemented control (positive control, PC, 3000 kcal/kg ME, 1.263% Lys, 0.574% Met). T2 (negative control, NC) was T1 with reduction of 75 kcal ME/kg and 2% AAs. T3 was T2 + 100 ppm of XT. T4 was T2 + 75 ppm of GB. T5 was T2 + 150 ppm of GB. Birds and feed were weighted at d1, 21 and 40. At d21, 1 bird of each rep. was sacrificed and a portion of jejunum was collected to determine villus height (VH), crypt depth (CD) and villus/crypt ratio (VC). The data were subjected to one-way ANOVA. Treatments effect was tested by the Newman Keul's Test ($P < 0.05$). From d 1 to 21, BWG and G:F were decreased by NC (−7.9%, −5.3%), improved by either XT (+5.3%, +3.6%), or 75 and 150 ppm of GB (BWG = +6.5%, +8.8%; G:*F* = +3.5%, +4.1%) and similar between T3, T4, T5 and PC. From d1 to 40, BWG and G:F were depressed by NC (−4.2%, −2.3%), improved by XT (+1.9%, +1.1%, $P > 0.05$) and by 150 ppm of GB (+5.3%, +3.4%). The NC diet decreased VH (−2.9%) and increased CD (+3.0%, $P > 0.05$). When compared with NC, birds fed XT improved VH (+19.5%) and reduced CD (−5.8%, $P > 0.05$), which was a 20.8% improvement of VC ratio. GB improved VH (−12.2% for 150 ppm, $P > 0.05$) and decreased CD (+8.9% for 75 ppm, $P > 0.05$). The results indicated that broilers on the NC diet had poorer performance and intestinal histology than those fed the PC diets (T1) and the NC plus

additives (T3, T4, T5). XT, and GB improved chicks BWG, G:F and intestinal histology to values similar to those fed the PC diets.

Key Words: essential oils, gut health, broilers

M269 Effects of dietary medicinal plants (Artemisia, Acanthopanax, and garlic) on productive parameters in pigs. J. H. Jung*[1], H. D. Jang[1], T. X. Zhou[1], S. H. Oh[2], R. C. Noble[2], and I. H. Kim[1], [1]*Department of Animal Resource and Science, Dankook University*, *Cheonan, Choongnam, Korea*, [2]*Department of Animal SCience, North Carolina A&T State University*, *Greensboro, North Carolin, United States*.

This study was conducted to determine the effect of supplemental medicinal plants (Artemisia, Acanthopanx and garlic) on productive parameters in pigs. In experiment 1, Three days before parturition, a total 90 multiparous (4.5 ± 0.3) sows were used in a 21–d performance assay. Sows fed treatments included 1) CON (basal diet; Control), 2) BM1 (CON + 0.1% medicinal plants) and 3) BM2 (CON + 0.2% medicinal plants). We detected the initial, final body weight, backfat and estrus interval of sows. Litter's average of birth and weanling weight and average dairy gain were checked. Backfat thickness difference from farrowing to weaning was significantly increase ($P < 0.05$) in CON treatment compared with medicinal plants treatments. The piglets weigh gain was higher ($P < 0.05$) in the medicinal plants treatments than in control. In experiment 2, a total of 60 finishing pigs [(Landrace × Yorkshire) × Duroc, 65.21 ± 1.04 kg average initial body weight] were used in a 56–d performance assay to determine the effects of supplemental medicinal plants (Artemisia, Acanthopanx, and garlic) on growth performance and carcass characteristics in finishing pigs. Finishing pigs fed treatments included 1) CON (basal diet), 2) BM1 (CON + 0.1% medicinal plants) and 3) BM2 (CON + 0.2% medicinal plants). During 4~8weeks and overall period, ADG was higher ($P < 0.05$) in the medicinal plants treatments than in control. CON treatment was higher pH of loin after 24 h of storage and cooking loss than BM1 treatment ($P < 0.05$). Water holding capacity and Drip loss after 1 d of storage were affected by the dietary BM treatments ($P < 0.05$). In conclusion, the results obtained from this feeding trial suggest that the medicinal plants mixture supplementation in diets for finishing pigs improved ADG, water holding capacity, cooking loss and sow decreased backfat loss and litter weight gain improved.

Key Words: medicinal plants, sow, finishing pigs

M270 Effects of cassava on production performance and relative organ weight in Korean native broilers. J. H. Lee*, H. D. Jang, J. P. Wang, T. X. Zhou, and I. H. Kim, *Department of Animal Resource and Science, Dankook University*, *Cheonan, Choongnam, Korea*.

This study was conducted to evaluate the effects of cassava for energy source on the performance and relative organ weight in Korean native broilers. A total of 528 broilers were allocated into the following 4 treatments: 1) CON (basal diet), 2) C5 (5% of cassava diet), 3) C10 (10% of cassava diet), and 4) C20 (20% of cassava diet). The broilers were allotted into 4 dietary treatments with 6 replicate pens and 22 chicks per pen in a completely randomized design and studied in a 9-wk experiment. During 9 wk, weight gain and feed intake was not affected by treatments ($P > 0.05$), however, feed/gain ratio was higher in C10 and C20 treatments compared with C5 treatment ($P < 0.05$). In liver, abdominal fat, leg and carcass percentage were not difference was observed. However, in breast meat percentage was higher in CON compared with C10 treatment ($P > 0.05$). In conclusion, this study demonstrated that the cassava for energy source in Korean native broilers can be used at up to 20% without negative effect on performance.

Key Words: cassava, relative organ weight, Korean native broilers

M271 Effects of cassava on production performance and egg quality in laying hens. J. H. Lee*, H. J. Kim, J. P. Wang, T. X. Zhou, and I. H. Kim, *Department of Animal Resource and Science, Dankook University*, *Cheonan, Choongnam, Korea*.

This study was conducted to evaluate the effects of cassava for energy source on the production performance and egg quality in laying hens. A total of 240 (ISA brown) 47 week old layers were allocated into the following 4 treatments: 1) CON (basal diet), 2) C5 (5% of cassava diet), 3) C10 (10% of cassava diet), 4) C20 (20% of cassava diet), and 5) C30 (30% of cassava diet). The laying hens were allotted into 5 dietary treatments with 24 replicate pens and 2 laying hens per pen in a completely randomized design and studied in a 35-d experiment. Egg production was significantly decreased in the C30 treatment when compared with other treatments ($P < 0.05$). Evaluation of the egg quality revealed that the egg weight, eggshell thickness, eggshell breaking strength, egg yolk height and Haugh unit was not affect by treatments ($P > 0.05$). However, in egg yolk color, C20 and C30 treatments were dramatically decreased from 2nd and 1st week ($P < 0.05$). In conclusion, this study demonstrated that the cassava for energy source in laying hens can be used at up to 20% without negative effects on performance, however consider pigment for yolk color.

Key Words: cassava, egg quality, laying hens

M272 Inclusion of shrimp heads meal (*Litopenaeus* spp.) and red crab meal (*Pleuroncodes planipes*) in rations for laying hens, and its effect on the egg physical and sensorial quality, at different time and temperature of storage. E. M. Carranco*[1], L. Sangines[1], E. Morales[2], E. Avila[3], B. Fuente[3], R. Ramirez[3], S. Carrillo[1], C. Calvo[1], and F. Perez-Gil[1], [1]*Instituto Nacional de Ciencias Medicas y Nutricion Salvador Zubiran*, *Mexico, D.F., Mexico*, [2]*Universidad Autonoma Metropolitana*, *Mexico, D.F., Mexico*, [3]*Universidad Nacional Autonoma de Mexico*, *Mexico, D.F., Mexico*.

The aim of this study was to determine if the inclusion of shrimp heads meal (SM) and red crab meal (RCM) in laying hen diets has an effect on the egg physical and sensory characteristics when is stored at 4°C and 20°C during 15 and 30 d. One hundred thirty-five laying hens were distributed in 3 treatments: Control diet, SM (20%), and RCM (4%). At the end of the trial, 250 eggs were taken: 50 fresh eggs were analyzed, 100 eggs were stored at 4°C and 20°C/15 d and another 100 at 4°C and 20°C/30 d. Egg physical quality and pH were measured, while the egg flavor and yolk color where evaluated, too. The results were analyzed using a 3 × 3 × 2 factorial design; the comparison among means was done with the multiple range test of Duncan ($P < 0.05$). There were no statistical differences ($P > 0.05$) in productive parameters, weight of shell and sensory evaluation. It was found that egg weight decreased at longest time and lowest temperature ($P < 0.05$). The albumen height and Haugh Units increased in old treatments in egg at 0 d at SM and RCM at 20°C, but decreased when eggs were stored at 4° and 20°C during 15 and 30 d. The yolk color decreased with SM and RCM at 15 and 30 d (20°C). Eggshell thickness presented the great loss at 30 d/4°C ($P < 0.05$). The pH was increased as the time was longer by itself. It was concluded the inclusion of SM and RCM in laying hen diets did not affect both productive variables and the sensory characteristics in eggs at 0 and 15 d (4° and 20°C) but the physical quality and pH were affected.

Key Words: egg quality, shrimp heads meal, red crab meal

M273 The effect of medicinal plants and plant extracted oils on broiler duodenum morphology and immunological profile. L. Stef*[1], G. Dumitrescu[1], D. Drinceanu[1], D. Stef[1], D. Mot[1], C. Julean[1], R. Tetileanu[1], and N. Corcionivoschi[2], [1]*Banat's University of Agricultural Sciences and Veterinary Medicine, Department of Animal Science*, *Timisoara, Romania*, [2]*University College Dublin*, *Ireland*.

It was previously reported that essential oils from aromatic plants have antimicrobial activity against many bacterial pathogens. We have conducted an in vivo experiment to study the effect of some aromatic plants and in particular to investigate the effect of oils extracted from these plants at the immune level and duodenal morphology. During the experiment 90 broiler chicken were divided in 3 experimental groups: control group (C), group 1 (G1) and group 2 (G2). Broilers from group G1 had received feed with 0.05% incorporated oils extracted from savory (*Satureja hortenis*), mint (*Mentha piperita*) and sea-buckthorn (*Hippophae rhamnoides*). Group G2 received a premix of plants (savory, mint, and sea-buckthorn) during daily feeding. The control group (C) received normal feed with no supplements. The amount of lysozyme detected at group G1 was doubled (28.55 μg/cm^3; $P < 0.05$) comparing G2 (13.2 μg/cm^3; $P < 0.01$) and the control (11.42 μg/cm^3; $P < 0.005$). The incorporation of extracted oils in food determine a powerful stimulation of intestinal mucous membrane, manifested by development of intestinal villi, the hypertrophy of villi, hyperplasic hypertrophy of capillary network and the stimulation of leukocytes infiltrate. The muscular hypertrophic processes and of leukocytes infiltrates are visible in the endomysium and perimysium of the muscular tunic. The microscopical images taken from the duodenum sections were sampled from the G2 group suggest the stimulation of angiogenesis ($P < 0.05$). The processes are however of smaller intensity comparative with experimental lot G1 ($P < 0.001$). This work shows that essential oils extracted from plants improve the immune response and also are able to determine changes of the duodenal mucosa with beneficial effects for the animal.

Key Words: medicinal plants, plant oils, broiler nutrition

M274 Effects of dietary polyphenol-rich grape products on gut morphology and intestinal microflora in broiler chicks. A. Viveros*[1], S. Chamorro[2], M. Pizarro[1], W. Siqueira[3], C. Centeno[2], I. Arija[1], and A. Brenes[2], [1]*Facultad de Veterinaria, UCM*, *Madrid, Spain*, [2]*Instituto del FRIO-ICTAN, CSIC*, *Madrid, Spain*, [3]*Faculdade de Veterinaria, Universidade Estadual do CEARA*, *Fortaleza, Brasil*.

Grapes have high amounts of phenolic compounds which can modulate the gut activity as well as to modify the structure and function of the gastro-intestinal tract. An experiment was conducted to study the effect of the inclusion of grape pomace concentrate (GPC) and grape seed extract (GSE) in broiler chick diets on performance, intestinal morphology (jejunum), and ileal and cecal microflora at 21 d of age. Dietary treatments included an antibiotic-free diet (CTL-), a positive control (CTL+, 50 mg/kg of avoparcin), and an antibiotic-free diet containing GPC (60 g/kg) or GSE (7.2 g/kg). Each treatment was randomly assigned to 5 pen replicates (5 birds each). Jejunum histology was examined to determine the villi height, crypt depth, villi-height-to-crypt depth ratio, and muscularis layer thickness. Ileal and cecal contents were assayed for *Escherichia coli*, lactobacilli, enterococci, and *Clostridium perfringens*. Performance was not affected by dietary treatments except in the case of birds fed GSE diet which showed a decrease of weight gain. CTL- fed birds had longer villi and deeper crypt depth than birds in any other treatment group. The best villi height: crypt depth ratio corresponding to birds fed GPC diet and the worst to those fed CTL- diet. Muscularis layer thickness was not affected by dietary treatment except in the case of CTL- group which was reduced. In the ileal content, birds fed CTL- and GSE diets had the highest population of lactobacilli. Compared with the CTL- diet, the CTL+, GPC and GPS diets increased the populations of enterococci and decreased the counts of *C. perfringens* in the ileal content. There were no differences in the ileal population of *E. coli* among all dietary treatments. In the cecal digesta, birds fed GPC and GSE diets had a higher population of *E. coli*, lactobacilli, enterococci, and *C. perfringens* than in any other treatment group. Based on the results of the present study, it can be stated that dietary polyphenol-rich grape products modify the intestinal microflora and gut morphology in broiler chicks.

Key Words: chicks, grape pholyphenols, gut morphology and intestinal microflora

M275 Effects of hemp oil on the expression of FADS1, FADS2, and ELOVL5 in laying hens. M. Jing*, N. Gakhar, E. Goldberg, and J. D. House, *University of Manitoba*, *Winnipeg, Canada*.

Hemp seed and oil products are rich and balanced sources of omega-3 and omega-6 polyunsaturated fatty acids (PUFAs). Hemp contains about 17% α-linolenic acid (ALA) and 56% linoleic acid (LA), which are precursors for omega-3 and omega-6 PUFAs, respectively. In conjunction with studies designed to evaluate the transfer efficiency of dietary ALA to table eggs, the present study investigated the effects of dietary hemp oil (HO) inclusion on 3 principal biosynthetic genes involved in PUFA metabolism: FADS1 (Δ5 desaturase), FADS2 (Δ6 desaturase), and ELOVL5 (elongation of very long chain fatty acids protein 5). Bovan White laying hens (n = 8 per diet) received wheat-barley-soy-based diets containing 12% supplemental oil as either corn oil (CO; 0% HO), blend of 33:67 (4% HO) or 67:33 HO:CO (8% HO), or HO (12% HO), with a gradual decrease in the LA:ALA ratio as HO inclusion increased. The hens were fed over a period of 12 weeks. All the diets were formulated with equal protein and energy. Liver tissue was freshly harvested at the end of the experiment and used for RNA isolation. The mRNA expression profile of the 3 genes was assessed by semiquantitative real-time PCR. Results revealed that the mRNA levels of FADS1 were significantly reduced by 39.48% ($P < 0.05$) in hens fed the diet containing 12% of HO, and FADS2 mRNA was decreased by 45.18% and 51.32% ($P < 0.05$) in hens fed the diet containing 8% and 12% of HO in comparison with the basal diet, respectively. However, the expression of ELOVL5 was unaffected ($P > 0.05$) by the treatment of HO. Overall, this study demonstrates that 2 desaturase genes including FADS1 and FADS2 are downregulated by the supplementation of hemp oil in laying hen diets, and these changes may be related to the ratio of the prevailing dietary fatty acids.

Key Words: hemp oil, gene expression, laying hens

M276 Dietary supplementation effects of oregano essential oils on intestinal digest microbial community in broilers under high altitude conditions. L. Betancourt*[1,2], V. Phandanouvong[3], F. Rodriguez[3], C. Ariza-Nieto[3], M. Hume[4], D. Nisbet[4], and G. Afanador-Téllez[2], [1]*Universidad de La Salle*, *Bogotá, Colombia*, [2]*Universidad Nacional de Colombia*, *Bogotá, Colombia*, [3]*CORPOICA*, *Bogotá, Colombia*, [4]*USDA, ARS, FFSRU, College Station*, *TX*.

Microbiota impact broiler health and production. Essential oils have been shown to play a significant role in the modulation of gut microflora and the colonization of pathogenic bacteria. The aim of this study was to test the effect of oregano essential oils (OEO) on the microbial community on broiler chickens reared at high altitude. Seven hundred and fifty 1-d-old Hybro male broiler chicks, maintained at high altitude, were placed in 30 brooder cages under a completely randomized design. Six treatments

were evaluated: 200 ppm of OEO from 3 varieties produced and ground in Sabana of Bogota-Colombia 1) *O. vulgare* H. (OH); 2) *O. vulgare* L. (OL) and 3) *O. majorana* (OM); 4) 50 ppm of EO from O. vulgare H. ground in Greece (OG); 5) 500 ppm Chlortetracycline (AB) and 6) control (C). Template DNA was isolated from pooled duodenal, ileal, and cecal contents of 5 chickens in each group, respectively, and analyzed by denaturing gradient gel electrophoresis (DGGE). Dendrogram analysis of amplicon profiles from duodenum, ileum and cecal bacterial DNA revealed 2 main groups, OEO-treated chicks and non-treated control chicks at 14 and 35d. The highest similarity coefficient (CS), CS > 90%, was observed for OM and AB in jejunum (21d), ileum (3 and 21d), cecal (3, 7 and 21d) and colon (7 and 21d). OM and AB presented the highest body weight at 21d. Comparison of bacterial DNA profiles from different gut compartments revealed diverse bacterial populations between duodenum, jejunum and ileum compared with cecal and colon. The results suggest that digestive microbial populations of these broilers from the Sabana of Bogotá (2650 AMSL) can be altered by addition of OEO in the diet. *O. majorana* essential oil was associated with increased body weight gain. A possible association was observed between the bacterial DNA profile of the intestine and body weight of broilers.

Key Words: DGGE, DNA bacterial, gut