W95 Identifying sources of *Salmonella* contamination in animal feed and pet food facilities. Andrea M. Jeffrey*[1], Cassandra K. Jones[1], Greg Aldrich[1], Anne R. Huss[1], and Carl Knueven[2], *[1]Kansas State University, Manhattan, KS, [2]Jones-Hamilton, Walbridge, OH.*

Salmonella is a potential biological hazard in animal food, and may contaminate livestock feed and pet food through cross contamination at manufacturing facilities. The FDA has evaluated *Salmonella* concentrations in classes of feed ingredients, but has not evaluated pathogen concentrations based on location throughout a facility. The objective of this experiment was to investigate sources of *Salmonella* contamination from various equipment and environmental locations in 2 livestock feed manufacturing plants and 2 pet food manufacturing plants on a specific sampling day. Up to 40 environmental swab samples were collected at each facility using sterile, prepackaged swab vials containing buffered peptone water. Samples were collected from a variety of equipment and structural surfaces, including concrete, dust, plastic, rubber, and broom bristles and analyzed for qualitative *Salmonella* determination as described by FDA's Bacteriological Analytical Manual. Data were categorized by facility (1 to 4), type (equipment or structural), and surface (concrete, metal, plastic, rubber, or dust) and analyzed using the GLIMMIX procedure of SAS. There were no interactions, so all were removed from the model ($P > 0.05$). There were no differences in *Salmonella*-positive samples among facilities, but facility 1, a livestock feed manufacturer, doubled the locations testing positive for *Salmonella* as compared with the other 3 facilities ($P = 0.11$; average positive-*Salmonella* concentration of 44.1, 20.1, 19.0, and 20.1% for facilities 1, 2, 3, and 4, respectively). There were no differences in percentage of *Salmonella* samples testing positive based on location of swab ($P = 0.57$; average *Salmonella* concentration of 22.9 and 28.7% for equipment and structural, respectively). Finally, there was a tendency for rubber and concrete to have greater *Salmonella*-positive samples than plastic, dust, or metal ($P = 0.10$; 40.9, 35.2, 24.4, 20.4, and 8.2%, respectfully). With these results in mind, it may be important to consider the types of surfaces present and the appropriate sanitation to best control *Salmonella* in livestock and pet food manufacturing facilities to prevent cross-contamination into animal food.

Key Words: *Salmonella*, animal feed, pet food

W96 Dog ownership increases the richness of the cutaneous microbiome. Celia S. Sobelman*[1], Jessica K. Suagee[2], and Cristina Caldari[1], *[1]Centenary College of Louisiana, Shreveport, LA, [2]The Ohio State University, Wooster, OH.*

Maintaining a normal microflora is imperative for the modulation of immune responses by the host and prevents the overgrowth of opportunistic microorganisms. Changes in cutaneous microflora could result in skin diseases. It has been shown that individuals that co-habitate harbor similar cutaneous microbial communities. The purpose of this study was to determine if humans that co-habitate with dogs have different cutaneous microbial richness compared with humans that are rarely exposed to dogs. Microbial richness was defined as the number of morphologically distinct colonies in a sample. Humans that co-habitate with dogs (dog owners) were defined as humans living with ≥1 indoor dogs. Humans having rare contact with dogs (non-dog owners) were defined as humans that were in contact with dogs ≤ once a week. Cutaneous microbial samples were obtained by using a sterile cotton swab to swab the top of the hands, forearms and foreheads of humans and the dorsal thoracic area, nose area, and chest of dogs. The cotton swabs were stored in sterile phosphate buffered saline (PBS) for 24 h after which time 100 mL of the PBS were plated onto a tryptic soy agar plate with 5% sheep blood. After a 48-h incubation period at 37°C, distinct microbial colonies were counted. Distinctness of the colonies was determined based on colony morphology, cell morphology and Gram staining. Microbial richness varied among dogs, dog-owners, and non-dog owners (Levene's test, P-value = 0.007), with dogs having the most variation and non-dog owners having the least variation. The average cultured cutaneous microbial richness was significantly higher in dogs and dog owners (6.73 ± 4.23 and 5.60 ± 3.20 microbial species, respectively) compared with non-dog owners (2.73 ± 0.96 microbial species; dog vs. non-dog owner: $P = 0.0001$, dog owner vs non-dog owner: $P = 0.002$). There was no significant difference in the cutaneous microbial richness of dogs and dog-owners. These results suggest that frequent contact with dogs leads to an increase in cutaneous microbial richness compared with infrequent contact with dogs. The implications of these findings on health and disease warrant further investigation.

Key Words: cutaneous microbiome, dog, dog ownership

W97 Effects of thiamine type, species meat versus livers, and sulfite addition on water-soluble B-vitamins in a canned cat diet. Shelby D. Trible*, Charles G. Aldrich, and Cassandra K. Jones, *Kansas State University, Manhattan, KS.*

There has been little work published concerning the effect of processing on the degradation of water-soluble B-vitamins in canned pet foods. The objectives of these experiments were to evaluate the effect of thiamine type (mononitrate vs hydrochloride), protein type (species meat and livers), and sulfite (yes or no) addition on B-vitamin retention. All diets were produced at a batter temperature of 60°C and moisture of 78%. The cook time was one hour at 121°C and 21psi. In Exp. 1 (n = 26) thiamine type tended ($P = 0.12$) to influence retention, wherein thiamine mononitrate retention (140.68 mg/kg) was higher than that of thiamine hydrochloride (128.37 mg/kg). In Exp. 2 (n = 14), protein type had an effect on retention of several B-vitamins. Thiamine retention was highest in fish relative to chicken or liver diets ($P < 0.05$; 202.26 vs 140.72, and 131.19 mg/kg, respectively). Riboflavin retention was highest in diets containing liver, intermediate with fish, and lowest for chicken ($P < 0.05$; 200.83, 153.46, and 113.66 mg/kg, respectively). Niacin was at its lowest retention in diets containing chicken compared with fish and liver diets ($P < 0.0015$; 238.42, 327.90, and 444.64 mg/kg, respectively). Pyridoxine retention was highest in diets containing fish versus those with liver or chicken ($P < 0.05$; 135.89 vs 113.34, and 100.59 mg/kg, respectively). Cobalamin retention was at its lowest in diets containing chicken, and intermediate for fish and highest for liver ($P < 0.05$; 0.45, 0.62, and 1.53 mg/kg, respectively). The addition of sulfites indirectly from dehydrated potatoes in Exp. 2 had a negative effect on pantothenic acid ($P < 0.05$; 234.80 mg/kg vs 360.29 mg/kg), and pyridoxine ($P < 0.05$; 108.02 mg/kg vs 134.34 mg/kg) relative to the controls, respectively. The dehydrated potatoes with sulfites tended to influence thiamine retention ($P = 0.07$; 137.80 mg/kg vs 188.22 mg/kg) and riboflavin retention ($P = 0.09$; 147.89 mg/kg vs. 188.25 mg/kg) relative to the control. Vitamin form, protein type, and presence of sulfites may influence their retention in canned pet foods.

Key Words: B-vitamin, wet pet food, sulfites

W98 Chemical composition, nutrient digestibility, and true metabolizable energy of commercially available protein sources using the precision-fed cecectomized rooster assay. Ping Deng*[1], Pamela Utterback[1], Carl Parsons[1], and Kelly Swanson[1,2], *[1]Department of Animal Sciences, University of Illinois, Urbana, IL, [2]Department of Veterinary Clinical Medicine, University of Illinois, Urbana, IL, [3]Division of Nutritional Sciences, University of Illinois, Urbana, IL.*

A wide variety of animal protein-based ingredients are commonly used in the pet food products. The raw ingredients and processing procedures used may greatly affect protein quality and digestibility. Testing the quality of alternative protein sources is necessary and contributes to the sustainability of pet foods. The objective of this study was to determine the chemical composition, nutrient digestibility, and nitrogen-corrected true metabolizable energy (TMEn) of 4 protein sources intended for use in dog and cat foods (pork peptone, calamari meal, chicken meal, and duck meal) using the precision-fed cecectomized rooster assay. Calamari meal and pork peptone had lower ash [4.4% and 3.6% of dry matter (DM), respectively], but greater crude protein (CP; 88.1% and 80.5% of DM, respectively) and gross energy (GE; 5.55 and 5.32 kcal/g of DM, respectively) compared with chicken meal (11.8% ash; 65.9% CP; 4.79 kcal/g) and duck meal (17.3% ash; 60.8% CP; 4.62 kcal/g). Acid-hydrolyzed fat (AHF) was lower in calamari meal (8.7% of DM) compared with the other proteins tested (15.5–15.9% of DM). Nutrient digestibility was variable among the protein sources [64 to 79% of DM, 76 to 83% of organic matter (OM), 86 to 92% of AHF, 83 to 89% of GE] with pork peptone having the highest DM, AHF, and GE digestibility, and calamari meal having the highest OM digestibility. Essential amino acid (AA) true digestibility was highest for calamari meal, with all AA having a digestibility greater than 90%. Except for histidine, all essential AA had a digestibility over 85% for pork peptone. All essential AA had a digestibility over 80% for duck meal, but chicken meal had 3 essential AA with digestibilities less than 80%. The TMEn of calamari meal (4.82 kcal/g DM; 86.8% of GE) was greater ($P > 0.05$) than that of pork peptone (3.83 kcal/g DM; 71.9% of GE), chicken meal (3.46 kcal/g DM; 72.2% of GE), and duck meal (3.46 kcal/g DM; 74.9% of GE). This study demonstrates the considerable variability that exists not only in the chemical composition, but also the nutrient digestibility, among protein sources intended for use in dog and cat foods.

Key Words: protein source, nutrient digestion, rooster assay

W99 The effect of low-bloom gelatin on physical properties of extruded pet food. Analena E. Manbeck*, C. Greg Aldrich, and Sajid Alavi, *Department of Grain Science and Industry, Kansas State University, Manhattan, KS.*

Gelatin is an animal-based protein that has been used to improve pellet quality. Previous work with low-bloom gelatin in extruded kibble demonstrated improved hardness and durability but decreased expansion. The objective of this experiment was to clarify the relationship of expansion on product hardness and durability resulting from gelatin inclusion. Two complete diets (30% protein) were produced: a control with no gelatin (OG) and another with 10% low-bloom gelatin (10G) added at the expense of chicken by-product meal. Diets were produced on a Wenger X-20 extruder through a circular die (4.6mm diameter). The extruder screw speed and throttle valve opening were adjusted to achieve 2 densities (HD and LD). Products were analyzed for bulk and piece density, radial expansion, specific length, hardness, and pellet durability index (PDI). Results were summarized with the aid of statistical analysis software (SAS 9.4). Hardness was not affected by treatment ($P > 0.05$). The main effect means of PDI decreased 33% with the inclusion of gelatin ($P < 0.05$; 77.57% v 52.25%) and decreased 20% between HD and LD ($P < 0.05$; 72.17% v 57.65%). The main effect means of radial expansion and specific length increased with gelatin inclusion ($P < 0.05$; 2.86 v 3.56mm^2/mm^2 expansion and 4.12 v 4.47cm/g length), but were unaffected by HD or LD. The main effect means of piece and bulk density were lower with gelatin inclusion (0.52 v 0.39g/cm^3 piece density and 351.8 v 280.7g/L bulk density) and also reduced from HD to LD (0.46 v 0.44 g/cm^3 piece density and 345.8 v 266.7g/L bulk density). The means for PDI were affected by the interaction of gelatin level and target density. PDI decreased from HD to LD within the OG diet ($P < 0.05$; 92.0% v 63.14%) and continued to decrease with the 10G diets. However, there was no difference between HD and LD for the 10G diets ($P > 0.05$; 52.34% v 52.16% for HD and LD, respectively). The decrease in PDI between 0G and 10G may be due to the increased expansion, but the gelatin may prevent a further decrease in PDI between HD and LD. Low-bloom gelatin may improve the physical properties of high protein pet food without compromising expansion.

Key Words: pet food, gelatin, extrusion

W100 Effects of age and diet on colonic mucosa microbiota of dogs. Ana Paula J. Maria*[1], Ping Deng[2], Hannah D. Holscher[2], Franz N. Yoshitoshi[3], Thaila C. Putarov[1], Kelly S. Swanson[2], and Aulus C. Carciofi[1], *[1]São Paulo State University (UNESP), Jaboticabal, SP, Brazil, [2]University of Illinois at Urbana-Champaign, Urbana, IL, [3]Endoscopet-Endoscopy and Surgery, São Paulo, SP, Brazil.*

The objective of this study was to identify the effects of age and diet, with particular focus on carbohydrate and protein sources, on the colonic mucosa microbiota of dogs. Thirty-six healthy beagles were used in a 3x2 factorial design. Dogs were separated in 2 age groups, young adult (2.6 ± 0.9 yr) and geriatric (10.2 ± 1.1 yr), and were assigned to 3 isonutritive kibble dietary groups containing: (1) a non-fermentable insoluble fiber (IF; 34% poultry meal; 8% sugarcane fiber); (2) a fermentable fiber (FF; 35% poultry meal; 10% beet pulp); and (3) soybean meal (SM; 30% SM; 11% poultry meal; no additional fiber source). Dogs were fed the experimental diets for 30-d, followed by sample collection on d 31. Mucosal biopsies from the colon were performed by colonoscopy procedure with dogs under anesthesia. DNA was extracted and the V4 region of the 16S rRNA gene was amplified and subjected to Miseq Illumina sequencing. Data analysis was performed using QIIME 1.8.0. The resulting operational taxonomic units (OTU) were aligned to the Greengenes 13_8 database (97% similarity threshold). Firmicutes (44.1%) was the predominant bacterial phylum, followed by Bacteroidetes (39.2%), Fusobacteria (6.5%), Proteobacteria (5.6%), Actinobacteria (4.3%) and Deferribateres (0.2%). There was an interaction between age and diet ($P < 0.05$) for *Prevotella*, *Sutterella*, and an undefined genus in the Mogibacteriaceae family. The abundance of *Slackia*, *Bacteriodes*, *Plesiomonas,* and an undefined genus in the Paraprevotellaceae family were lower ($P < 0.05$) in geriatric dogs compared with the young adult dogs. *Peptococcu*s and *Slackia* genus were in a higher ($P < 0.05$) abundance in dogs fed the IF and FF diets than those fed the SM diet. Dogs fed the IF diet had lower ($P < 0.05$) colonic mucosa *Megamonas* and *Suturella* abundance when compared with the dogs fed FF and SM diets. In conclusion, both dietary fiber fermentability and age may impact the microbial communities present on the colonic mucosa of dogs. More research is needed to identify the relevance of these microbial shifts in regards to gastrointestinal health.

Key Words: age, carbohydrates, microbiota

W101 Digestibility of the crude corn oil in dogs. Tabyta T. Sabchuk*[1], Karoline Vanelli[1], Larissa Barrile[2], Fabiane Y. Murakami[1], Alex Maiorka[1], Simone G. Oliveira[1], and Ananda P. Félix[1], *[1]Federal University of Paraná, Curitiba, Paraná, Brazil, [2]Cargil Agricola SA, Uberlândia, Minas Gerais, Brazil.*

There are many fat sources used in dog nutrition, such as poultry fat, beef tallow, and soy oil. In addition, there are several factors that can determine the choice of the fat source, such as price, availability, fatty acid profile, chain saturation. One alternative fat source can be the crude corn oil (CCO) that is a co-product of maize, produced worldwide. Besides, CCO has a large amount of linoleic acid, an essential fatty acid for dogs. Thus, the objective was to evaluate the apparent total-tract digestibility (ATTD) and ME of CCO in adult dogs. Three diets were evaluated: a control diet (with 8% beef tallow, CD), and 2 diets containing 92% of the ingredients of the CD and 8% of CCO and another with 8% poultry fat (PF). Diets were sprayed with the fat sources. Nine Beagle dogs were randomly assigned in 2 blocks (2 periods), totaling 6 replicates per treatment. The experimental diets in kibble form were offered for a 5-d adaptation period, followed by 5 d of total fecal collection per period. The ATTD and ME of the tested ingredients (CCO and PF) were calculated according to the substitution method. The results were submitted to Student's *t*-test ($P < 0.05$). The ATTD of DM (98.7% *vs* 96.0%), acid-hydrolyzed fat (AHF, 98.6% *vs* 97.4%), GE (99.7% *vs* 98.6%), and ME (38.08 MJ/kg *vs* 37.93 MJ/kg) of CCO and PF, respectively, did not differ ($P > 0.05$). Normally we evaluate the digestibility of diets and not the digestibility of the ingredient itself, such as in this study. Consequently, specific information on the nutritional quality of ingredients is lacking, particularly in fat sources to dogs. We found that the digestibility and ME of CCO was similar to the PF, which is the most frequently used fat source in dog nutrition. Thus, the CCO has high digestibility and can be a co-product with potential use in diets for dogs.

Key Words: companion animal nutrition, fat source, ingredient digestibility.

W102 A high protein intake allows the preservation of lean mass and prevents the increase of fat mass, compared with a moderate protein intake, in neutered cats. Agnès André[1], Isabelle Leriche[2], Gwendoline Chaix[3], and Patrick Nguyen*[1], *[1]Nutrition & Endocrinology Unit, National College of Veterinary Medicine, Nantes, France, [2]Virbac Nutrition, Vauvert, France, [3]Virbac Medical Department, Carros, France.*

Cats are strict carnivores and have a high dietary protein requirement. Rich-protein diets are often intended to prevent obesity or manage weight loss, as they help preserve the lean body mass. The aim of this study was to assess the effect of an experimental high-protein low-carbohydrate maintenance dry diet (HP) on body composition (BC), compared with a commercial moderate-protein high-carbohydrate dry diet (MP) in neutered cats. Twelve (12) young adult neutered cats (19.6 ± 0.4 mo old; 3.56 ± 0.2 kgBW) were randomized in 2 groups and received, for 20 weeks, either a HP (3,320 kcal/kg of DM; 50.2 CP %DM) or a MP (3,590 kcal/kg of DM; 33.7 CP %DM) diet. Main protein sources and amino acid content (DM basis) were: HP diet: meat meal, pea; Lys 2.3%, Met 1.0%, Try 0.4%, Thr 1.7%; MP diet: poultry meal, corn gluten meal, corn; Lys 2.0%, Met 1.0%, Try 0.3%, Thr 1.3%. Animals were fed according to their estimated energy requirement to maintain their BW. Body composition (BC) was determined using deuterium oxide dilution at the beginning then at the end of the study. Tukey's test was used to detect the effect of each diet and a Wilcoxon test to evaluate the differences between groups, with a 5% significance level. The mean protein intake during the study was 7.2 ± 0.6 g/kgBW/d in the HP group, and 4.6 ± 0.3 g/kgBW/d in the MP group. On d 1, the 2 groups were similar regarding their BW and BC. In both groups, no change in BW was observed. BC was unchanged in the HP group whereas body fat mass increased ($P < 0.05$) and lean body mass decreased ($P < 0.01$) in the MP group. The lean mass/fat mass ratio changed from 74/26 to 75/25 and from 77/23 to 69/31, in the HP and MP groups respectively. Although the protein content of the MP diet was higher than the recommended allowance (20% ME according to NRC 2006), it appeared not high enough to maintain lean body mass in these cats. Our results are in accordance with another study showing that adult cats would require at least 5.2 g protein/kg BW/d to maintain their lean body mass.

Key Words: cat nutrition, protein intake, body composition

W103 The effect of processing and elevated storage temperatures on omega-3 fatty acid stability in pet food. Alaina K. Mooney*, C. G. Aldrich, C. K. Jones, and S. Alavi, *Kansas State University, Manhattan, KS.*

Essential fatty acid research has shown that omega-3 fatty acids such as eicosahexaenoic acid (EPA) and docoshexaenoic acid (DHA; 22:6n3) may help maintain normal body structure, function and aid in long-term health and wellbeing. Common sources of omega 3 fatty acids include flax seed, fish oil, fishmeal, and more recently, purpose grown algae. This commercially produced source of omega 3 fatty acids has been evaluated as a supplement to animal diets and for its impact on metabolism; however, questions regarding the effect of processing and storage in pet foods are unanswered. The objective was to determine the effect of processing on stability of an algal source of DHA, (DHAgold S17-B; DSM Nutritional Products) added to the diet by premix, extrusion-drying processing, and extended storage. Three nutritionally complete pet diets at protein levels 21.7, 25, and 30% CP (Low, Medium and High, respectively) were produced with equal levels of DHA supplied by DHAgold S17-B, fishmeal and fish oil. Diets were produced on a Wenger X-20 single screw extruder (Wenger Mfg, Sabetha, KS) and dried at 104°C for 10 min at each pass in a triple pass dryer (Wenger Mfg, Sabetha, KS). Samples from each treatment were analyzed immediately following production for moisture and fatty acids. Shelf-life samples were collected in whirlpaks with a pin-hole and stored at 40°C and 75% relative humidity for analysis at 3, 6, 12, 18 and 24 weeks following production. Retention of EPA and DHA at production time was not affected by CP level ($P > 0.05$), but was impacted by DHA source ($P < 0.05$). The total omega 3 fatty acids were affected by DHA source and CP level ($P < 0.05$). As time in storage progressed through 0, 3, 6, 12, 18 and 24 weeks EPA ($P < 0.05$; 12.53, 10.45, 10.19, 8.9, 8.4, and 8.2 mg/kg, respectively) and DHA ($P < 0.05$; 7.7, 7.2, 6.9, 6.1, 6.4, and 6.0 mg/kg, respectively) declined slightly; but, total omega 3 fatty acids ($P < 0.05$; 35.6, 47.7, 47.9, 44.4, 43.3, and 41.8 mg/kg, respectively) were greater at all times than the start. These results suggest that elevated temperatures during storage for 24 weeks could result in slight EPA and DHA sacrifice. DHAgold S17-B appears to be a stable source of DHA when compared with fish oil and fishmeal.

Key Words: extrusion, pet food, omega-3 fatty acid

W105 The impact of rendered protein meal level of oxidation on shelf life and acceptability in extruded pet foods. Morgan N. Gray*, Charles G. Aldrich, Cassandra K. Jones, and Michael W. Gibson, *Kansas State University, Manhattan, KS.*

Increasing pressure has been put on ingredient suppliers to assure a low level of oxidation, as measured by a low peroxide value. Our objective was to determine the effect of increasingly oxidized protein meals on

the shelf life of extruded pet foods. Approximately one metric ton each of unpreserved chicken by-product meal (C) and unpreserved beef meat and bone meal (B) were collected and left unpreserved (U) or preserved with either ethoxyquin (E), or mixed tocopherols (T). These were allowed to oxidize at ambient conditions (25°C and 51% RH) while being monitored for peroxide value (PV) and anisidine value (AV) until they plateaued (41 and 63 d, respectively) at a PV of 88.44, 4.43, 2.22 mEq/kg and AV of 1.08, 0.55, 0.00 g/g for CU, CT, CE, respectively and at a PV of 86.42, 8.88, 2.23 mEq/kg and AV of 12.23, 7.14, 0.00 g/g for BU, BT, BE, respectively. Each meal was then incorporated into a model extruded cat food diet (~30% protein). Samples of kibble for each treatment were collected and stored at an elevated temperature and humidity (40°C and 70%) for 18 weeks. At time 0, PV and AV were greater for CU and BU ($P < 0.05$; 14.41, 10.07 mEq/kg and 15.56, 10.08 g/g, respectively) versus the preserved treatments CT, CE, BT, and BE (2.78, 2.22, 2.22, 2.22 mEq/kg and 3.85, 1.79, 9.62, 3.03 g/g, respectively). At elevated storage temperatures, the PV for CE remained low (4.44 mEq/kg), CT was intermediate (23.21 mEq/kg) and CU increased to 53.15 mEq/kg by 18 weeks ($P < 0.05$). The AV for C followed a similar pattern. The PV of B under elevated temperatures behaved differently; wherein, BE was low (3.33 mEq/kg), but BT had the highest PV (15.48 mEq/kg) and BU was intermediate (6.66 mEq/kg) by 18 weeks ($P < 0.05$). BE had the lowest ($P < 0.05$) AV and BT and BU were greater, but did not differ from each other (average 16.75 g/g) at 18 weeks. The results from this study demonstrate that oxidation occurred regardless of treatment; but, was rapid and extensive in meals without preservative. The ingredient oxidation levels were diluted by food production and their oxidation may not completely account for later food product deterioration.

Key Words: pet food, oxidation, rendered protein meals