

2nd International Conference on

Livestock Nutrition

July 21-22, 2016 Brisbane, Australia

Scientific Tracks & Abstracts Day 1



Livestock Nutrition 2016

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Subclinical mastitis caused by *Mycoplasma*-like bacteria in dairy cattle in South Australia

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The elevation of somatic cell counts SCC in affected quarters reflects the possibility of infection and is the standard method to discriminate between healthy and mastitis-infected cows. A total of 368 milk samples at cow level were collected from a single dairy farm located near Mount Gambier, South Australia. The farm had a history of chronic mastitis with poor response to antimicrobials and an increasing number of cows with high SCC. Most cows appeared clinically normal at the time of sample collection. A conventional microscopic culture method was used to detect *Mycoplasma* spp. Individual cow yield production parameters (e.g., volume, fat and protein percentage) and SCC for sampled and non-sampled cows was obtained by means of herd testing information. The effect of mastitis (*Mycoplasma* spp., or undifferentiated) was compared to the rest of the herd (assumed to be without mastitis) using analysis of variance (ANOVA). The SCC showed significant difference between sampled cows and the remainder of the herd. However, no significant difference was observed between cows with *Mycoplasma* spp., caused or undifferentiated mastitis. Milk production was significantly affected being 33.5 ± 0.2 and 29.9 ± 0.5 L/cow/day in cows with mastitis and the rest of the herd. The non-significant difference observed between *Mycoplasma* spp., induced mastitis and undifferentiated mastitis in this study, likely reflected the similarity in the influence of these pathogens on SCC. Correspondingly, milk yield was similarly affected by *Mycoplasma* spp.-like bacteria and undifferentiated pathogens. These findings point the importance of the detection of these bacteria amongst other common mastitis pathogens.

Biography

Abd Al-Bar Al-Farha has completed his Bachelor and Master degree in Veterinary Science from The University of Mosul and he is currently a PhD student at The University of Adelaide, School of Animal and Veterinary Science, South Australia. He is a Lecturer at The North Technical College in Iraq and has two papers published to his credit.

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Effect of different levels of BioSaf probiotic on performance, carcass characteristics and blood factors of Iranian Zandi lambs

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In order to evaluate the effect of different levels of BioSaf probiotic (yeast based) in diet containing medium concentrate (65%) on performance, carcass characteristics and blood factors of Zandi lambs, 27 male weaned lambs (29.9±0.28 kg, 90±5 days) were allocated to one of three treatment diets in a completely randomized design, including: Basal diet without probiotics (Control, C); Basal diet supplemented with 3 g probiotic per lamb (Low Probiotic, LP); Basal diet supplemented with 4.5 g probiotic per lamb (High Probiotic, HP). Basal diet was containing 2.59 MCal/Kg ME and 15.5% crude protein. Lambs live weights were measured at the beginning of the experiment and every two weeks interval. Dry matter intake (DMI) was measured daily. Water consumption offered ad lib. Blood sample were collected at the beginning of the trial, 42 and 84 days and analyzed for total protein, globulin, albumin, BUN, white blood cells and heterophil:lymphocyte ratio according to standard methods. At the end of experiment three lambs from each treatment were slaughtered, carcass characteristics were recorded and meat samples were taken between 9 to 11 ribs. Result shown DMI was unaffected by treatments ($P>0.05$). ADG was greater in HP group at first 4 weeks but total ADG was unaffected among treatment. Carcass traits and chemical composition of meat were not affected by treatments ($P>0.05$). Blood parameters were not significantly different among treatments ($P>0.05$) except BUN and total protein on 84 day which was highest in control group ($P<0.05$). It is concluded that addition of probiotic at the dose 3 gr/lamb is enough to enhanced growth performance, carcass characteristics and immune response of Zandi lambs.

Biography

Najafgholi Dabiri has completed his PhD from Massey University, New Zealand in 1994 and had a sabbatical leave in Cornell University in 2000. He has published more than 50 papers in Persian and English journals and has been serving as an Editorial Board Member of *Journal of Agriculture*. He had several administration activities in Chamran and Ramin Agricultural and Natural Resources Universities and is currently a Professor of Animal Science in Islamic Azad University, Karaj Branch.

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Changing how they eat influencing digestive physiology and metabolism by diet in livestock

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How is that two identical animals can eat the same diet yet have different production outcomes? Much of the answer lies in the animal's digestive physiology – its ability and mechanisms to digest, absorb and metabolise the diet consumed. Digestion, absorption and the motility of the gastrointestinal tract (GIT) are all controlled by intrinsic and extrinsic mechanisms designed to obtain the maximum nutritional benefit from the diet consumed. Some of these neurocrine and endocrine mechanisms are regulated from secondary tissues like the liver, pancreas and hypothalamus. Many more though are locally controlled through autocrine and paracrine secretions, focusing directly on the functioning of the GIT. It has long been known that dietary regulation and supplementation is capable of manipulating the regulation of the digestive physiology in livestock. The addition and extraction of key components of an animal's diet can have a profound effect on its ability to digest and absorb nutrients, impacting greatly on the animal's production performance. The purpose of this review is to investigate the neurocrine and endocrine regulators of digestive physiology and how they can be influenced by dietary manipulation to provide a greater production outcome.

Biography

Mark completed his PhD at the University of New England in ruminant physiology and nutrition investigating the impact of digestive physiology on methane production and nutrient utilisation in sheep. He then undertook a senior research fellowship assessing the effectiveness of a novel biological compound, designed to regulate key gut kinetic regulators, in mitigating methane production and improving nutrient uptake from ruminants. Mark has since developed a new technique for determining faecal concentrations of non-absorbable digesta kinetic and digestibility markers in sheep and cattle. Currently he is the Lecturer of Animal Nutrition at Charles Sturt University, Wagga Wagga.

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Nutritional evaluation of whole root and tuber crops as livestock feed

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The aim of the study is to investigate nutritional value of root and tuber crops as livestock feed resources. Fresh unpeeled Irish potatoes (P), sweet potatoes (SP), cassava (CA), yam (YA) and dalo (DL) purchased from the market were washed and cut into smaller pieces. The cut pieces were sub-divided into three equal parts. One part was analyzed as fresh samples, while remaining parts were sundried (SU) and oven dried. The oven dried and sundried samples were milled into meal using an electric grinder. Fresh, oven dried and sundried samples were analyzed for moisture, ash, crude protein, fat, crude fibre and soluble carbohydrate fractions. The experiment was designed as 5×3 factorial experiment and data expressed on as fed basis. Fresh root and tuber crops has comparative low DM contents (DL>YM>CS>SP>P) compared to those processed by sun drying and oven drying. Generally, the results showed that the two processing methods enhance ($P<0.05$) nutritive value of root and tuber crops compared to fresh samples. Sun drying is more effective ($P<0.05$) in raising NFE contents of root and tuber crops than oven drying. There were significant differences ($P>0.05$) in DM between different root and tuber crops processed by two methods, although both processing methods have no effect on potato DM content. However, oven drying improved ($P<0.05$) DM of SP, YM and DL, while sun drying improved ($P<0.05$) DM content of cassava only. The protein contents of root and tuber crops were enhanced ($P<0.05$) when processed but there were no significant differences ($P>0.05$) between protein contents of sundried and oven dried root and tuber crops. Sun drying improves ($P<0.05$) crude fibre of root and tuber crop samples than oven drying.

Biography

Bukola Babatunde has completed her PhD degree in Poultry Nutrition in 1999 from University of Ibadan, Nigeria and another PhD in Animal Nutrition and Immunity in 2009 from La Trobe University, Australia. She has worked at Institute of Agricultural Research & Training, Obafemi Awolowo University, Moor Plantation as Research Fellow in pig improvement programs and as Senior Lecturer in Animal Science at Federal College of Animal Health and Production Technology, Institute of Agricultural Research & Training. She is currently an Associate Professor and Head of Department of Animal Husbandry at Fiji National University. She has published more than 40 papers in reputed journals and is a Member of Editorial Board and Review Board of reputable international journal.

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The Mycotoxins Contamination In Corn Silage from Dairy Farms in Mexico

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Corn silage is the main forage available in the whole dairy cattle rations around the world; which can undergo a deterioration by the presence of fungi mainly *Aspergillus* sp, *Penicillium* sp and *Fusarium* sp. and their mycotoxins, with the loss of their nutritional value, commitment in health and animal production and public health. The aim of this study was to determine the presence of three mycotoxins in corn silage from three dairy farms located in Central region in Mexico. A total of twelve samples of corn silage, were collected. It was made a sampling at three levels of trench silo, upper, middle and edge was performed in duplicate. It was determined the physical forage quality using the particle size and pH parameters. Mycotoxins multiple technique by Aflatoxins, OcratoxinA(OA) and Zearalenone (ZEA) was used in thin layer (TLC) to determine the presence of mycotoxins. The physical quality results showed variations in dry matter content, with a lost half 15.78%, particle size upper to 5 cm, and pH in a range of 5.2-5.9. The pH founded it was ideal for the synthesis of mycotoxins, it was detected the simultaneous presence of type B aflatoxins (AFB1) and G (Aflatoxin G1), OA and ZEA in the upper layer and edge of the horizontal silo (trench silo). It is concluded that corn silage from two farms don't fulfill the physical quality and that all contain multiple mycotoxins. It is recommended to monitor the toxicological quality corn silage prior to administration to cattle.

Biography

Silvia Denise Peña Betancourt is a Veterinarian, completed her Master of Science from UNAM-FMVZ, Toxicology Specialist Clinic at Faculty Medicine Alexis Carrel and Doctor of Pharmaceutical Science at Faculty of Claude Bernard University. She currently works as a Research Professor at UAM-X, since 1991 to date and as Toxicology Laboratory Responsible at Department of Agricultural and Animal Production in UAM-X. She has written more than 30 research papers in national and international journals and is a Member of National Council of Animal Health and published books and books chapter in toxicology.

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The effect of microbial consortia from wild herbivores on goat rumen fibrolytic activity and browse fermentation

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Acacia species are often recommended as a protein supplement during the long dry season or winter because they are often available and maintain their protein content throughout the year. However, *Acacia* species or browses are often limited by their high tannin concentrations which are also detrimental to fibrolytic microbes hence decrease in digestibility especially in domesticated goats. Therefore this study evaluated the effect of *in vitro* inocula from wild herbivores (impala, kudu and giraffe) on *in vitro* fermentation, gas production and cellulases activities of domestic goats. Consortia were created by mixing fecal inoculum from impala, giraffe and kudu with that of goat (N1 (goat+impala, 1:1), N2 (goat+kudu, 1:1), N3 (goat+giraffe+kudu, 1:1:1) and N4 (goat+giraffe+kudu+impala, 1:1:1:1)). Crude protein enzyme extracts (CPZ) from fresh fecal samples were precipitated by 60% ammonium sulfate and assayed for exocellulase, endocellulase and hemicellulase activities by incubating with crystalline cellulose, carboxymethyl cellulose and xylan at 38°C with optimum pH of 5.5 to 6.5 for 1, 2 and 48 hours, respectively. *In vitro* degradability was carried out by transferring 33 ml of fecal inoculum into 67 ml salivary buffer containing 1 g of *Acacia sieberiana* and 10% tannin (substrate 6.2% was made up to 10% by adding 100 µL containing 3.8 mg tannic acid) before incubating for 72 hours at 38°C. Apparent degradability (APD), true degradability (TD), neutral detergent fibre digestibility (NDFdeg), acid detergent fibre digestibility (ADFdeg), cellulose digestibility (CELLdeg), hemicellulose digestibility (HEMdeg) and MY were calculated. Manipulation of goat enzyme activities with enzymes from the wild had a positive ($P<0.05$) influence on goat fibre degradability. Xylanase and endocellulase activities were highest ($P<0.05$) in N1 while N4 showed the highest exocellulase activity. Microbial ecosystem N3 had the highest ($P<0.05$) TD, NDFdeg and ADFdeg while N1 showed the highest degradability for hemicellulose and cellulose. Microbial yield also varied among the microbial ecosystems but was highest for N2, goat and N4. It was concluded that microbial activities from wild herbivores might have introduced new microbes that were able to survive on goat ecosystem and improve its fibrolytic potential *in vitro*. These results showed that microbial ecosystem from wild herbivores have a potential to improve browse utilization in domestic goat.

Biography

Fon Fabian Nde has completed his PhD (Ruminant Nutrition) from the University of KwaZulu-Natal (UKZN), South Africa and currently working as a Lecturer at the University of Zululand (UZ) after serving two years as a Post doctorate Researcher at UNIZULU and UZ. He is a Member of the South African Society of Animal Science, Golden Key International Honor Society and EAAP. His research is focused on improving forage digestion in ruminants especially with potential fibrolytic microbes from wild herbivores.

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Replacement of maize with cassava flour as an alternative source of energy in the diet of African mud catfish *Clarias gariepinus* (Burchell 1822) fingerlings

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A feeding trial was conducted to determine the effect of cassava flour as an alternative source of energy in *Clarias gariepinus* fingerlings. A total of 300 fingerlings of average weight 3.01 g were randomly distributed into five treatments, each treatment had three replicates. Twenty fingerlings were distributed into each bucket of 50 liters, which was filled with 40 liters of water. Five diets containing 35% crude protein were formulated in which maize was replaced with cassava flour meal at different level: Diet 1 (100% cassava), Diet 2 (75% cassava), Diet 3 (50% cassava), Diet 4 (25% cassava) and Diet 5 (0% cassava) which serves as the control diet. They were fed at 5% body weight per day for 10 weeks. The results showed that cassava flour was suitable as an alternative source of energy in *Clarias gariepinus* fingerlings. Diet 3 (50% cassava) has the highest mean followed by Diet 4 (25% cassava), Diet 5 (0% cassava), Diet 2 (75% cassava) and Diet 1 (100% cassava) respectively. There were no significant differences ($P>0.05$) in the growth response of *Clarias gariepinus*. It is therefore concluded that cassava flour is a cheap source of non-conventional energy source which could be successfully used to replace maize (50% inclusion levels) as an energy source in the diets of *Clarias gariepinus* fingerlings.

Biography

Dalmeida Lucas Oluwaseun is a Lecturer in the Department of Agricultural Education, Adeniran Ogunsanya College of Education, Nigeria. He has completed his Master's degree in Fisheries and Aquatic Biology and currently pursuing PhD in the same field in Lagos State University, Nigeria.

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Nutrigenomics in livestock: Emerging face of molecular nutrition to improve animal health and production

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Nutrition and health are closely linked, but despite decades of study, the intricate interactions between diet and many aspects of human and animal health is poorly understood. The advent of high-throughput technologies to study an animal's genome, proteome and metabolome constituted a setback to the use of reductionism in livestock research. More recent development of "next-generation sequencing" tools was instrumental in allowing in-depth studies of the microbiome in the rumen and other sections of the gastrointestinal tract. Omics, along with bioinformatics, constitutes the foundation of modern systems biology to enhance understanding of the complex biological interactions occurring within cells and tissues at the gene, protein and metabolite level. Genomic revolution has propelled the development of several new technologies that can be applied in nutritional sciences. Molecular nutrition in terms of nutrigenomics will serve as a new tool for nutritional research in mitigating the problems related to animal health and production. The innovations in nutrition research with use of various molecular technologies will indubitably update our basic understanding of nutrient gene interrelationship and help to define new methods for managing animal production. Finally by targeting the specific gene through nutritional manipulation, it may be possible to get the desired livestock performance in terms of health as well as production. I present examples of new knowledge generated through the application of functional analyses of transcriptomic, proteomic and metabolomic data sets encompassing nutritional management of dairy cows, pigs and poultry. Published work to date underscores that the integrative approach across and within tissues may prove useful for fine-tuning nutritional management of livestock. An important goal during this process is to uncover key molecular players involved in the organism adaptations to nutrition.

Biography

A K Thiruvankadan has completed his PhD in Animal Genetics and Breeding from Tamil Nadu Veterinary and Animal Sciences University, India and actively involved in teaching and research in the field of Animal Production. He is the Professor and Head of Mecheri Sheep Research Station, India (affiliated to Tamil Nadu Veterinary and Animal Sciences University, Chennai) and involved in research activities related to animal nutrition and animal genetics. He has presented several invited papers in the national and international conferences and has published more than 75 papers in reputed journals and has been serving as an Editorial Board Member of scientific journals.

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Concentration and distribution of sialic acid in sow milk during lactation

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Sialic acids (Sia), a family of 9-carbon acidic sugar molecules are key monosaccharide units of brain gangliosides and glycoproteins and a major component of sialylated glycocone in human milk. Human milk Sia has been proposed as a bioactive compound promoting immune function, gut maturation and neurodevelopment of the newborn. Porcine milk however has received little attention. The aims of the present study were to quantify and compare the levels of N-acetyl neuraminic acid (Neu5Ac), N-glycolylneuraminic acid (Neu5Gc) and keto deoxy nonulpsonic acid (KDN) in oligosaccharide, glycoprotein and glycolipid in sow milk during course of lactation. Milk samples from 22 sows were collected by manual expression on 3 occasions, day 1 (colostrum), day 3 (transition milk) and day 15-21 (mature milk) respectively. The concentrations of Neu5Ac, Neu5Gc and KDN were analyzed using UHPLC. The results showed that sow milk contained significant amounts of Sia with the highest concentration found in colostrum (1238.50 mg/L) followed by transition milk (778.32 mg/L) and then mature milk (347.21 mg/L). Most of the Sia in sow milk was conjugated to glycoproteins (41-46%), free oligosaccharides (31-42%) and then glycolipid (12-28%) throughout the course of lactation. Neu5Ac was the major form of Sia (93-96%) and then Neu5Gc (3-6%), KDN however contained as little as 1-2%. This distribution was common to each milk fraction and to each time point in lactation. In conclusion, porcine milk contains a rich source of sialylated glycan in the forms of glycoproteins, free oligosaccharides and glycolipids. The high concentrations of Sia in porcine milk suggest that Sia is an important nutrient that may contribute to the optimization of immune function, neurodevelopment and growth and development of piglets.

Biography

Marefa Jahan is currently a PhD student in School of Animal and Veterinary Sciences, Charles Sturt University, Australia. She is working for better health and nutrition of the livestock.

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Effects of different dietary energy and protein levels at fixed slaughter weight on performance and carcass characteristics of Arabi fattening lambs

Najafgholi Dabiri

Islamic Azad University, Iran

Forty eight Arabi fattening ram lambs with similar initial weight (18.72 ± 0.604 Kg) and age (90 ± 5 days) from a flock of Arabi sheep of Ramin Agricultural and Natural Resources University were randomly allocated to six dietary treatments in a 2×3 factorial experiment using completely randomized design. The treatments included low (EL=2.4 Mcal/KgDM ME), medium (EM=2.6 Mcal/KgDM ME) and high (EH=2.8 Mcal/KgDM ME) levels of dietary energy in combination with low (PL=16% cp) and high (PH=18% cp) levels of dietary protein. The body weight (BW), average daily gain (ADG), average daily feed (ADF) and feed conversion ratio (FCR) of lambs were measured two weeks interval until the end of experiment. Carcass components were recorded at the end of trial. The ADG of lambs in EH, EM and EL treatments were respectively 271, 244 and 206 g/d and differences between them were significant ($p < 0.05$). The same trend was found for feed efficiency. The ADG was also significantly greater ($p < 0.05$) for lambs fed diets containing 18% protein than for lambs fed diets containing 16% protein (254 vs. 216 g/d). The FCR also had the same trend (4/47 vs. 5/37). The differences for other traits for dietary containing different Energy and Protein levels were not significant. The interactions between protein and energy treatment levels were not significant for none of traits. In general, with increasing level of energy the performance of lambs particularly for ADG and FCR was improved for either of protein levels. The lowest ADG (150 g/d) and worst FCR (6/36) was belong to the treatment containing the lowest energy and protein levels and differences between them and other treatments were significant ($p < 0.05$).

Biography

Najafgholi Dabiri has completed his PhD from Massey University, New Zealand in 1994 and had a sabbatical leave in Cornell University in 2000. He has published more than 50 papers in Persian and English journals and has been serving as an Editorial Board Member of Journal of Agriculture. He had several administration activities in Chamran and Ramin Agricultural and Natural Resources Universities and is currently a Professor of Animal Science in Islamic Azad University, Karaj Branch.

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Effects of sundried sweet potato (*Ipomoea batatas*) whole tuber meal on dressed carcass weight, hematology and spermatozoa quality of commercial cocks

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Nasarawa State University, Nigeria

There is paucity of information on utilization of sweet potato in feeding cockerels/cocks hence, this study examined the carcass weight, hematology and spermatozoa quality of commercial cocks fed graded levels of sundried sweet potato whole tuber meal (SSPWTM). Twenty cocks at 10 months old weighing about 2.5 kg were randomly allotted five per treatment designated as: D1 (0.0%), D2 (10%), D3 (15%) and D4 (20%). After 10 weeks of feeding, semen samples were collected by massage technique for semen pH, active motile and live spermatozoa evaluations. Blood samples were collected by severing the jugular vein for hematological evaluation and the dressed carcass was weighed to obtain carcass weight. Results indicated no statistical differences ($P>0.05$) in live and dressed carcass weights, hemoglobin and platelet values among the treatments. Total relative testes volume, semen pH, active motile and live spermatozoa values differed significantly ($P<0.05$) among the treatments. Live weight value was highest (2.64 ± 0.06 kg) in D2 followed by D4 (2.6 ± 0.06 kg), D1 (2.58 ± 0.06 kg) and D3 (2.56 ± 0.05 kg). Dressed carcass weight value was highest in D1 and D2 with 2.3 ± 0.06 kg followed by D4 (2.28 ± 0.04 kg) and D3 (2.26 ± 0.05 kg). Similar trend was observed in hemoglobin whereas, semen pH value was highest (8.66 ± 0.18) in D3 followed by D4 (8.28 ± 0.38), D1 (8.22 ± 0.41) and D2 (6.98 ± 0.52). Active motile spermatozoa values were $93.2\pm 1.28\%$, $92.4\pm 1.5\%$, $81.2\pm 0.58\%$ and $61.8\pm 0.44\%$ in D1, D4, D2 and D3 respectively. Live spermatozoa values were $94.4\pm 1.5\%$ (D1), $84.8\pm 0.86\%$ (D2), $84.2\pm 3.17\%$ (D4) and $71.6\pm 5.1\%$ (D3). Since the observed values were similar to those given in normal cocks, SSPWTM could be utilized at 20% or more inclusion level in cocks nutrition.

Biography

Idahor Kingsley Omogiade is a Registered Animal Scientist with a License (RAS 000206) to practice as a Lecturer, Researcher and Consultant. At the moment, he is running a PhD program at the University of Ibadan, Nigeria. He is an active Member of several professional associations and a Reviewer to several reputable journals. His focus is on Animal Physiological and Bioclimatological studies. He has published 35 peer-reviewed articles in renowned journals and presented 30 papers at scientific conferences of which one earned him "Best Poster Presentation Award" at Jeju, South Korea.

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Special Session Day 1



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Replacement value of raw soybean meal for commercial soybean meal in diets for broiler chickens

Soybean meal (SBM) is the premier vegetable protein source for poultry. It is typically heat-treated prior to feeding to improve its quality. In a series of studies, we investigated the potential of replacing commercial SBM (at up to 30 %) with raw meal (RSBM, about 13498 TIU/g) in diets that were further supplemented with a novel protease and phytase. Both enzymes improved the digestion, *in vitro*, of RSBM. The RSBM over a short feeding period (14 days) reduced feed intake (FI) and body weight gain (BWG) and this response was worse on steam-pelleted diets. In a longer feeding trial, increasing the level of RSBM reduced BWG in early life but not over 1-35 days. Extra-dosing with microbial protease improved the FI and BWG of birds during the early period (1-10 days period) but only marginally over 1-35 days. In another experiment, increasing the inclusion rate of RSBM in the diets significantly increased ($p < 0.001$) the loss of undigested and unabsorbed ileal CP, leading to a reduction in both apparent ileal digestibility and standardized ileal digestibility of CP and most amino acids. There were no major effects of RSBM on intestinal lesions, footpad dermatitis, tibia bone quality or mortality of the birds when the material replaced 25% of SBM. Protease supplementation improved these variables. Litter N contents increased with increase in dietary RSBM level but were slightly reduced with protease supplementation. Other mechanisms assessed in the studies, including visceral organ weight; intestinal mucosal morphometry and digestive enzyme activities, responded in various ways to RSBM and the test protease. Overall, it can be concluded that RSBM can replace commercial SBM at up to 25%, if supplemented with the test protease and/or phytase, without compromising productivity or health of broiler chickens.

Biography

Paul A Iji is a Professor of Animal Science at the University of New England (UNE), Australia. He has studied in Nigeria, Scotland and Australia and has previously worked in similar positions in Nigeria and South Africa before taking up his current position at the University of New England, Australia. His main area of research is poultry nutrition with specialization in gastrointestinal physiology. He has supervised and currently supervising several postgraduate students and has published over 200 in peer-reviewed journals and conference proceedings.

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