542   Effect of an enhanced-growth feeding program on gastrointestinal tract and spleen development. M. Terré*[1], M. Devant[1], A. Aris[1], and A. Bach[1,2], [1]*IRTA-Unitat de Remugants, Barcelona, Spain*, [2]*ICREA, Barcelona, Spain.*

Eighteen Holstein male calves (4.4 ± 1.85 d old) were arranged in 2 groups to study the effect of an enhanced-growth (EF) and conventional feeding program (CF) on gastrointestinal tract (GIT) and spleen development. Calves were fed a milk replacer (21% CP, 19.2% fat) at increasing rates during 4 d until reaching 4 l/d at 12.5% DM. Calves on CF received 4 l/d at 12.5% DM until weaning, and EF calves were fed 4 l/d at 15% DM from 5-11 d, 4 l/d at 18% DM from 12-18, 6 l/d at 18% DM from 19-38 d, and 3 l/d at 18% from 39-45 d. Calf starter was offered ad libitum until the end of the study (54 d). Individual calf starter consumption and BW were recorded. Half of the calves of each treatment were euthanized at 4 wk of study, and the rest at 54 d. Then, the spleen was dissected and weighed. Each anatomical part of the GIT was separated, weighed, emptied, weighed again, and pH of the contents of each GIT segment measured. Calves on EF grew faster (P < 0.05) than CF calves (0.82 vs 0.50 ± 0.089 kg/d, respectively). Starter intake was greater (P < 0.05) in CF than EF calves from 30 to 33 d, but lower (P < 0.05) from 48 to 54 d. Calves on CF had a greater (P < 0.05) rumen pH at 4-wk and 7-wk sacrifices (5.47 ± 0.056) and a lower abomasum pH (P < 0.05) at 4-wk sacrifice (3.01 ± 0.362) than EF calves (5.26 ± 0.056 and 5.04 ± 0.362, respectively). The spleen weight of EF calves was greater (P < 0.05) than that of CF calves (0.32 vs 0.24 ± 0.022 kg, respectively), but when expressed as a percentage of BW there were no differences between treatments. Abomasum weight expressed as a percentage of total GIT weight was greater (P < 0.05) in CF than in EF calves (11.0 vs 8.8 ± 0.54, respectively), but jejunum-ileum weight expressed as a percentage of GIT was greater (P < 0.01) in EF than in CF calves (50.4 vs 46.7 ± 0.98, respectively). Although EF calves grew faster, abomasum weight decreased and jejunum-ileum weight increased as a percentage of GIT when raising calves on an enhanced-growth feeding program.

Key Words: Calves, Enhanced-Growth, Gastrointestinal Tract

Animal Behavior & Well-Being - Livestock and Poultry: New Methodologies Symposium

543   Utilizing neural network analysis in animal behavior studies. W. B. Roush*, *USDA-ARS Poultry Research Unit, Mississippi State, MS.*

The objective of this presentation is to introduce the concept of artificial neural networks (ANN) and the related technologies of fuzzy logic (FL) and genetic algorithms (GA) to the analysis of animal behavioral responses. These technologies have been developed in the areas of Artificial Intelligence and Artificial Life for the study of Complex Systems. ANN were inspired by the biological neuron with inputs, a processing unit, and output(s). The concept for ANN is very similar to the concept of regression analysis. A fundamental difference is that regression analysis is philosophically linear; whereas, ANN are nonlinear. Most biological responses are nonlinear in nature and therefore a nonlinear analytical technique like ANN can more accurately and precisely be used to analyze the data. An example is the analysis of the effect of stressors (e.g., debeaking, coccidiosis, electrical shock, ammonia, heat stress, and noise) on the live gain response of birds. FL and GA are related computer techniques that can be used for analysis and optimization. FL can represent imprecise concepts such as hot, cold, heavy, light, comfort, and stress. The technique has been applied to the problem of defining stress of caged laying hens based on a FL representation of mortality, corticosterone level and egg production. Fuzzy Cognitive Maps (FCM), based on the principles of FL, can be used to define social conditions as defined by interactive matrices. An example is the structuring of a virtual world involving the interaction between sharks, fish and dolphins. GA optimize by evolving the inputs of a formula (e.g. ANN) into an optimal solution. Artificial intelligence and Artificial Life techniques such as ANN, FL and GA promise to provide powerful tools for the analysis of animal behavior studies.

Key Words: Behavior, Artificial Neural Network, Fuzzy Logic

544   Identification of QTL affecting disposition in *Bos indicus* influenced cattle. C. A. Gill*, C. R. Boldt, C. A. Abbey, M. A. Wegenhoft, D. K. Lunt, J. E. Sawyer, A. D. Herring, and J. O. Sanders, *Texas A&M University, College Station.*

Disposition was measured in 2 resource populations: 614 progeny from 40 *Bos indicus* (Brahman or Nellore) x Angus reciprocal backcross families and 3 F_2 families (Angleton herd); and, 465 progeny from 17 Nellore x Angus F_2 families and paternal half-sib families produced by natural service (McGregor herd). In the Angleton study, disposition scores were taken twice (weaning and slaughter) using a 1 to 5 scale. In the McGregor study, overall disposition and 4 component traits of behavior (aggressiveness, nervousness, flightiness, and gregarious) were measured 1 mo after weaning by a panel of 4 evaluators using a 1 to 9 scale. Steer progeny were scored again about 1 wk prior to slaughter by a single evaluator and overall disposition was scored prior to slaughter. The MIXED procedure of SAS was used to analyze disposition with fixed factors of sire, family nested within sire, birth year-season combination and sex x family within sire interaction, plus sequence within pen within birth year-season combination for the McGregor study. Mendelian and partially imprinted QTL for overall disposition were detected following interval mapping by linear regression under a line-cross model using residuals from the Angleton study. Three QTL on BTA 5, 17 and 25 affecting disposition at weaning and 2 QTL on BTA 1 and 18 affecting disposition prior to slaughter were estimated to have additive effects. Three QTL on BTA 4, 9 and 25 affecting disposition prior to slaughter were estimated to have dominance effects. A QTL affecting disposition at weaning on BTA13 was estimated to be partially maternally imprinted, while a QTL on BTA8 affecting disposition prior to slaughter was estimated to be partially paternally imprinted, and a QTL on BTA16 was estimated to be partially maternally imprinted. Only the QTL on BTA25 appeared to affect both weaning and final disposition. We have begun to characterize candidate genes for these QTL. We expect to validate these QTL in the McGregor study and to identify QTL for the 4 component traits of behavior.

Key Words: Disposition, Bovine, QTL

545   Mathematical modeling and analysis of use of space. M. C. Christman*[1], C. P. Miller[1], and I. Estevez[2], [1]*University of Florida, Gainesville*, [2]*University of Maryland, College Park.*

Spatial confinement imposes behavioral restrictions on animals because of limitations in movement and use of space. Such limitations are particularly exacerbated in farm animals that are maintained in intensive commercial production systems. Despite the important consequences of space availability/quality on the health and welfare of farm animals, many existing studies do not include study of patterns of movements because of the lack of adequate statistical methods for descriptors for movement and behavior in confined space. We describe a complex computer simulation of individual-based movement in confined space and its application. Our objective is to obtain a process model simulating animal movement and behavior that can be used to study statistical methodology as it relates to testing hypotheses about the effects of varying density and available area for confined animals. Our animal model is the domestic fowl Gallus gallus domesticus although the model can be used with other species that are found in limited or confined habitat. We simulate movement as a correlated random walk with additional controls to allow for the ability to manipulate the reaction of the animal to boundaries, the tortuosity of its steps, and the degree to which it avoids areas already visited. In addition, the model can be modified to allow for behavior that changes through time such as might occur with age and to incorporate behavior in response to new resources or to other animals within its space. Using this model, we have developed new descriptors of movement and use of space in confined regions. For example, we have developed new measures of tortuosity and core areas that are useful for distinguishing among the effects of varying environments. The model can also be used to do power analyses in order to determine adequate sample sizes and sampling regimes such as the interval between observations of a focal animal. We demonstrate use of these new methods using data from an experiment on domesticated fowl in which density and pen size was varied and show that our new methods are better than those originally developed for animal studies in unconfined space.

Key Words: Correlated Random Walk, Behavior, Domestic Fowl

546   Major pitfalls in animal welfare research. J. J. McGlone*[1], L. E. Hulbert[1], N. Krebs[1], M. A. Sutherland[1], and J. W. Dailey[2], [1]*Texas Tech University, Lubbock*, [2]*USDA Livestock Issues Research Unit, Lubbock, TX.*

Animal welfare researchers are obligated to provide the best quality of research possible to meet scientific standards and society concerns. The conclusions derived from studies can have major consequences on animals and the animal industries. However, major pitfalls are far too common in animal welfare research. The following potential problems (not in priority order) associated with these specialized types of investigations include: 1) Lack of statistical replication/duplication within studies, lack of simultaneous inter-institution replication and related ethical considerations of inappropriate sample sizes, 2) Lack of a defined biological or applicable control, 3) Lack of including both physiology and behavior data collected in a study, which then requires an entire new study to gather the missing information, 4) Lack of collaboration between research competitors, some of which have special skills, 5) Ambiguity, inaccuracy, lack of precisions and insufficient depth of behavioral and physiological measures, 6) A reliance solely on incomplete electronic data bases and inattention to early, valuable work that is relevant or directly answers the question at hand, 7) Inconsistent behavioral definitions, setting up a difficulty in comparing and interpreting research. 8) An inability to understand the meaning of changes in behavior or physiology (sometimes simply due to this neonatal science), 9) Lack of agreement on appropriate measures/standards of animal welfare, 10) Inappropriate anthropomorphism. While it is important that scientists have empathy and show compassion for animals, the necessary leap from human perception to animal perception should be executed with caution and discretion. All of these tribulations could result in flawed conclusions, which could have detrimental effects on regulations and actual animal welfare.

Key Words: Animal Welfare, Methods, Behavior

Animal Health - Livestock and Poultry: Bovine II

547   New frontier in monitoring, early diagnostics and prevention of ketosis in dairy cows. K. L. Ingvartsen*, N. C. Friggens, and T. Larsen, *University of Aarhus, Faculty of Agricultural Sciences, Tjele, Denmark.*

The objective of this presentation is to give a status on the opportunities for prevention of e.g. ketosis in dairy cows using future monitoring systems. Although the incidence of clinical ketosis is generally low, sub-clinical ketosis is important as it occurs more frequently. It may increase the risk of other diseases, involuntary culling and impair production and reproduction. The large between-cow variation in e.g. β-hydroxybutyrate (BHBA), calls for proactive prevention of ketosis by identifying and changing e.g. nutrients to 'high risk cows'. Such cows may be in imbalance - situations where the regulatory mechanisms are insufficient for the animals to function optimally leading to a high risk of disease. We have developed a model for the prediction of the risk of ketosis in dairy cows using in-line measurements of BHBA in milk (Nielsen et al., JDS 88, 2441-2453). The model is designed to function solely on the basis of milk BHBA but other data can be included as additional risk factors for ketosis. Outputs of the model are the risk of ketosis (value between 0 and 1, where 0 = no risk and 1 = full blown ketosis) and how many days until the next milk sample should be taken and analyzed for BHBA. Prototype sampling systems for in-line measurement of e.g. BHBA in milk that utilize the above model have been developed. Such systems open up for 'Status oriented strategies based on risk management' that allow, on farm and at individual cow level, adjustment of feeding and management based on automatically registered indicators to reduce the risk of diseases but at the same time improve production and reproduction (Ingvartsen 2006, Anim. Feed Sci. Tech. 126: 175-213). A challenge in building such strategies is to better understand the biological basis of the imbalance measured and thus to be able to predict individual animal responses to changes in e.g. nutrient supply or management to overcome the imbalance. Progress towards a better understanding will come through a combination of classical physiology, metabolic network mapping (e.g. proteomics) and quantitative modeling.

Key Words: In-line Monitoring, Ketosis, Disease Prevention