weaken or fail to be established if the animals do not meet the expectations of the people with whom they interact. The behavioral component of animal welfare is particularly important in this regard, and requires significant attention, as owners of companion animals are often intolerant of behavior problems. These include behaviors characterized as nuisances, such as excessive vocalizations, those that result in aggression toward people or other companion animals, or behaviors that result in injury to the animal or damage to property. Problem behaviors are among the most commonly stated reasons for cat and dog relinquishment, abandonment and euthanasia. Thus, understanding key factors that impact behavioral well-being in these species is important whether the animals are maintained in or intended to be rehomed from breeding programs, shelters, rescues or elsewhere. Consequently, a comprehensive assessment plan for meeting the needs of animal companions that includes their mental and behavioral well-being is necessary to protect the human–animal bond. It is therefore imperative to develop and validate key metrics of companion animal welfare that are practical for field as well as laboratory purposes. Considerations and challenges in developing such metrics will be reviewed, using the development of care and welfare standards for breeding dogs for illustrative purposes.

Key Words: behavior, companion animal, well-being

0433 2015 Corbin Award Winner: Behavior and training of companion and zoo animals.

C. L. Morris*, *Iowa State University, Ames.*

Activity or behavior varies tremendously across taxa and activity itself separate plants from animals. Regardless if we consider a dog competing on an agility course or a hyena standing for voluntary jugular blood collection, we must understand the science of behavior, the natural history and the instinct of the animal in order for successful training to occur. Repeated behaviors result from either positive or negative reinforcement, whereas behaviors diminish with application of positive or negative punishment. Once we identify reinforcements or punishments relevant to the behavior and specific animal, training and behavior modification become more black and white. This science and theory of animal training are well rooted in the work of Skinner and Pavlov. However, difficulties in animal training occur when trainers or animal managers fail to understand what motivates or reinforces a specific animal or the relevant species-specific natural histories. Animal trainers typically use food to motivate or train animals; however, the animal must want that food item for it to be of value. Subjects of same species may not find similar value in reinforcement items. In addition, failure to understand instinctive behavior patterns typically related to obtaining food or social structures may lead to limitations in training or behavior modification. The term "Instinctive Drift" occurs when animals have been trained to a new learned behavior that ultimately drifts back toward an instinctive behavior. Often this behavioral drift can be mislabeled by animal trainers as disobedience or misbehavior but is frequently related to instinctive behaviors associated with feeding or obtaining food or other inate insticts such as herding. Similarly, some aggression issues in dogs may be prevented or mitigated at a young age if owners had increased awareness of the dynamic social structure of dogs. Stereotypic behaviors are typically thought of as negative repetitive behaviors that originate from artificial environments that do not allow animals to satisfy their normal behavior repertoire, and these behaviors can be difficult to modify. While the science and theory of animal training and behavior are critical to excelling as an animal trainer and manager, it is equally critical to understand natural history, instinctive behaviors and motivation. Therefore, great animal trainers not only understand the science and theory of behavior, they also consider the uniqueness of individual animals they manage.

Key Words: training, behavior, companion animals, zoo animals

COMPANION ANIMAL SYMPOSIUM: FUNDAMENTALS OF PROTEIN NUTRITION

0434 Global protein supply: Present and future considerations and availability.

D. L. Schaefer*, *Cargill, Wichita, KS.*

A key differentiator in the development and marketing of pet food is the source of protein. Producers and marketers are reaching further and using more creativity in product development. This presentation will focus on global trends in the availability of protein for the use in pet diets.

Key Words: protein, companion animal, global source

0435 Alternative protein supplies for petfood.

G. Bosch*, *Wageningen University, Netherlands.*

The combination of a growing human population, increasing standards of living and urbanization in developing countries fuels global demand of protein sources for consumption by humans and animals. Increasing food production is, however, highly challenging as required resources such as land, water and fossil energy are limiting and the environmental impact of crop and livestock production already needs to be minimized. Various efforts are focused on changing the demand as well as on the production of proteins. Global food supplies can be increased by improving production efficiencies. Production of underperforming crop and livestock production systems can be improved through management and new technologies. In addition to increased production of conventional foods, alternative and sustainable foods are being developed. It is therefore clear that also the landscape of available ingredients for the pet food industry will change further the coming years. The additional

alternative proteins can originate from biomass sources previously left as waste. Leaf proteins present in by-products from crops like sugar beet or from grass are already available in large volumes. Technologies are being developed that can extract these leaf proteins yielding colorless protein isolates for (pet)food applications. Various sources of organic waste can be converted by insects (e.g., black soldier fly larvae), which can be used as a high quality and sustainable protein source. Additionally, alternative proteins can also originate from "novel" ways of production. Production systems of aquatic protein sources (microalgae, duckweed, seaweed) are rapidly advancing and do not compete for good agricultural land. These protein sources have a high water content, however, and require separation technologies that are still costly and energy consuming, therefore, requiring further development. Acceptability of vegetable proteins can be facilitated by transforming them into fibrous structural patterns of meat. In the long run, laboratory cultured meat using muscle stem cells may even replace meat from conventional livestock. These examples illustrate that there are multiple alternative protein supplies for future petfoods, although still considerable time is required to further develop the products and reach production volumes for large-scale applications. Furthermore, ingredients still require evaluations beyond chemical characterization including in vivo testing of nutritional and (dys)functional properties as well as safety attributes. Finally, acceptance of alternative ingredients by pet owners may be difficult in some areas of the world. However, awareness of owners regarding global food security continues to grow, which will facilitate the application of these ingredients in petfoods.

Key Words: food security, novel proteins, sustainability

0436 Amino acid requirements and protein digestibility and assessment in dogs with considerations for cats. A. K. Shoveller*, *University of Guelph, ON, Canada.*

Dietary protein remains a key focus for pet food manufacturers; however, few properly designed amino acid (AA) requirement studies have been conducted in adult dogs. Data examining the effects of dietary protein in dogs exist, but few studies provide an understanding of the dietary AA provided or the digestibility and metabolic availability of those AA when different ingredients are utilized. Furthermore, there is a dearth of data on the effects of different food processing parameters on AA bioavailability in dogs. Effects of processing are important as new regulatory requirements for food safety have been implemented. Previous estimates of AA requirements used chemically defined diets and long adaptation periods and may have resulted in AA requirements that are lower than what is required to support protein synthesis. Carbon oxidation approaches have been developed to measure AA requirements of dogs using more appropriate adaptation periods and common ingredients. In addition, secondary measures of AA adequacy, such as taurine status and immune function, also should be investigated to further optimize dietary approaches for dogs. Greater knowledge of AA requirements will lead to better overall protein quality in commercial dog food and provide a better basis for formulation of diets for canine clinical cases.

Key Words: amino acid, requirements, protein, dogs, digestibility, metabolic availability

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0437 Idiosyncrasies of amino acid metabolism in dogs and cats. D. L. Harmon*, *University of Kentucky, Lexington.*

Both the dog and cat have been domesticated for thousands of years yet they retain some unique metabolic nuances. While both are classified as members of the order carnivora they each have nutritional and metabolic requirements that differ from the majority of domestic species. The dog is considered a nutritional omnivore adapting to a wide range of foods and nutrient sources, whereas the cat is a strict carnivore showing little nutritional or metabolic adaptation with changes in diet. The cat has little ability to adapt amino acid degrading enzymes to dietary protein restriction and conservation of protein and shows little change in urea cycle activity with changes in diet. This contrasting adaptability leads to differences in the nutrient profiles required by each. In addition to requiring greater quantities of dietary protein, the cat requires a dietary source of taurine because of its obligate use of taurine for bile acid conjugation and a limited ability to synthesize taurine from sulfur amino acids. Although taurine is not strictly required in the diet of dogs, it has been suggested that taurine may be required in the diets of certain large breed dogs. Like cats, dogs also use taurine for bile acid conjugation, but they have a greater taurine synthetic ability and can adapt for use of glycine for bile acid conjugation. Both the dog and cat require a dietary source of arginine with the cat being extremely sensitive to its absence. This occurs as a result of the limited ability of cats to endogenously synthesize ornithine and citruilline to maintain urea cycle activity because of low intestinal enzyme activities compared with omnivores. The cat also has a limited ability to use tryptophan to synthesize niacin. Again this occurs from evolutionary adaptations in enzyme levels. Additional nuances include higher requirements for sulfur amino acids in the cat because of needs for hair and felinine synthesis. Overall, the cat appears somewhat unique but metabolically and nutritionally it appears similar to other strict carnivores.

Key Words: feline, companion animal