

Nonruminant Nutrition Symposium: Breaking the Mold—Formulating Monogastric Diets Without Traditional Ingredients

501 Alternative ingredients for diets—A global perspective. R. G. Campbell*, *Pork CRC, Willaston SA, Australia.*

Global animal feed production approached 865 million tonne in 2012 with Asia the largest producer of compound feeds (170 million tonne) followed by the United States (161 million tonne). The USA has been reliant on corn as the main cereal in monogastric diets but alternative grains and in particular barley, sorghum and triticale are used throughout Asia and Europe. The by-products of wheat milling are also produced in large amounts and available globally as alternatives to cereals and will continue to be used in the future. Soybean meal is a by-product of the soybean crushing industry and can be regarded as the benchmark protein source for most livestock and is produced in large amounts in China, United States, Argentina and Brazil (total 142 million tonne) and will remain a staple ingredient into the future but it is not an essential component of animal diets and is rarely used in Australia. In Europe, Canada and parts of Asia, canola seed meal is widely and increasingly available as a cost effective alternative protein supplement for livestock diets. The alternative ingredient that has seen the greatest growth over the last 5–6 years is DDGS the production of which exceeded soybean meal in the USA in 2012. DDGS is used to replace both soybean meal and corn in livestock diets. Because they are produced in large amounts we will continue to rely on these alternatives or by-products and need to develop means of rapidly assessing their nutrient value, technologies for better utilizing each and define/extend the limits of inclusion in diets for different classes of livestock based on their cost effectiveness rather than animal performance per se. Potential new feeds are likely to become available in the form of biomass from algae systems used in bio fuel production and the sequestration of CO₂ and eventually from cellulosic ethanol production. There is also potential to use food waste as an animal feed though it carries with it some biosecurity and potential market/perception risks but a lot is available more consideration should be given to its potential use. At a local level liquid and dry by-products from various human-related manufacturing operations have long been used very successfully particularly by pork producers.

Key Words: alternative feedstuffs, global animal feed production, DDGS

502 Factors to consider when formulating diets with alternative ingredients. K. Adams*, *Akey/Cargill, Brookville, OH.*

Alternative ingredients can offer an opportunity to swine nutritionists to decrease feed costs. Nutritional valuation, cost, handling characteristics and other factors that affect usage need to be considered. By-products by nature are variable. Quality control processes may be lacking. Names are seldom descriptive of the nutritional value of alternative ingredients. It is imperative to determine percent moisture, protein, fat, ADF, NDF, calcium, phosphorus, sodium and ash. Amino acid analyses are also useful. NIR analysis offers a quick method of assessing nutrient content, but equations must be developed for each specific by-product. Distillers dried grains with solubles (DDGS) are one of the most common by-products fed to swine, but they can vary greatly in nutrient content and mycotoxin levels. Depending on the quality of DDGS, the level fed can also influence feed intake and carcass yield. Bakery by-products are another popular ingredient used in swine diets, but can contain up to 25% wheat middlings, DDGS, or corn germ, resulting in ADF levels ranging from 1 to 23%. Hominy and corn germ meal are highly variable in fat

and ADF content. Pet food fines can be made up of changing portions of cat, puppy, adult and senior dog food. Nutritionists may often find themselves using a “best guess” analysis for formulation. Complete feed processing can affect the level of by-products used in swine diets. Pelleting allows higher inclusions of less dense ingredients, but it can also result in higher iodine values in carcass fat. Some alternative ingredients are only available as liquids and need to be fed using liquid feeding systems or through water lines. Disposal of liquid by-products in a land fill or drying them to sell into the marketplace are both costly options, so companies producing them may offer attractive pricing. Many by-product ingredients are available to nutritionists and can help reduce cost of production. However, nutritional value of alternative ingredients needs to be evaluated carefully and the products used appropriately to support acceptable growth performance.

Key Words: by-product, alternative ingredient, swine

503 Controlling feed cost by including alternative ingredients into swine diets. R. T. Zijlstra*¹ and E. Beltranena^{1,2}, ¹*University of Alberta, Edmonton, AB, Canada,* ²*Alberta Agriculture and Rural Development, Edmonton, AB, Canada.*

Sustained price increases for traditional feedstuffs such as cereal grains, protein meals, and fats have forced the pork industry to consider dietary inclusion of alternative feedstuffs. The 2012 US drought reduced crop yields and escalated feed commodity prices beyond those triggered by the expansion of the biofuel industry. Crops may serve as feedstuffs but are also processed into human food, fuel, and bio-industrial products. Together with these products, feed co-products such as distillers dried grains with solubles (DDGS), canola meal (expeller-pressed, solvent-extracted), canola and camelina cake, and crude glycerol are produced. As omnivores, pigs are ideally suited to convert these non-human edible co-products into high quality food animal protein. Thereby, co-products can partially offset increases in feed cost provided their price is less per unit of energy (NE) or lysine (SID), but also present risks and feeding challenges. First, processing of co-products adds variability in macronutrient profile beyond the intrinsic variability of crops. Thus, feed quality evaluation to profile digestibility of energy, AA, and P is as important as the energy and AA system selected for feed formulation. Moreover, rapid evaluation (NIRS) is needed to manage the risk of variation among batches of individual feedstuffs. Second, fermentation and heat processing affect AA and P availability. Overheating reduces lysine availability due to Maillard reactions, reduces heat-labile anti-nutritional factors, but combined with fermentation, may increase mineral availability. Third, co-products may contain chemical residues and mycotoxins such as deoxynivalenol that survive or are augmented by processing that reduce voluntary feed intake. Finally, co-product use may affect carcass characteristics and pork quality. Inclusion of high fiber co-products reduces dressing percentage. Inclusion of high unsaturated fatty acid co-products softens pork fat. In conclusion, the feeding of co-products may reduce feed costs per unit of pork produced, but also provides challenges to achieve cost-effective, predictable growth performance, carcass characteristics, and pork quality.

Key Words: co-product, nutritional value, pig

504 Maintaining high quality swine and poultry diets with non-traditional ingredients. J. D. Hancock*, M. E. Morts, R. S. Beyer, and C. K. Jones, *Kansas State University, Manhattan.*

For decades, focus among US nutritionists has been on alternative protein sources, amino acid concentrations, and amino acid ratios that might be used to improve growth performance in swine and poultry. However, we are in unprecedented times. During the past 7 years energy costs for swine and poultry diets have soared in the US and abroad and this has ushered in a new emphasis on non-traditional feedstuffs that might be used to control diet costs while maintaining growth performance. Use of alternative cereal grains such as wheat and sorghum are commonplace in the United States and especially in the High Plains. Here at Kansas State University, we have experimented with use of rice flour, cassava, triticale, and molasses, having good success in swine diets. To further control diet costs, co-products from the milling, baking, and ethanol industries cannot be discounted. Of particular importance in global swine and poultry diets are co-products from the wheat flour and ethanol industries with use of 20 to 30% wheat middlings and 30 to 40% distillers dried grains with solubles (DDGS) being real possibilities. Use of such alternative ingredients is not without potentially problematic changes in feed manufacturing, diet flowability, feed intake, and carcass characteristics. Also, these products are in transition (e.g., low-oil DDGS) as these industries mature. However, the need for cheap sources of calories may finally have trumped the need for comfort allowed with feeding a simple corn-soybean meal diet. The challenge for nutritionists will be to stay abreast of changes in physical and nutritional characteristics of co-products and to stay open to use of new and alternative ingredients to formulate high quality, affordable diets.

Key Words: swine, poultry, diet ingredient

505 Algae, a by-product of the biofuel industry to replace soybean meal in swine and poultry diets. X. G. Lei*, *Cornell University, Ithaca, NY.*

The fast growing worldwide population and diminishing arable land have made food security and nutrition a major challenge. While animal agriculture provides 25% of total calorie intake, the traditional feeding regimen directly competes against human consumption of high energy and protein staples. Apparently, alternative ingredients are needed to replace corn and soybean meal for sustainable animal production. Microalgae have recently been explored as a new exciting source of biofuel, and the defatted residual biomass contains high levels of protein and other nutrients. Since 2009, our laboratory has conducted a total of 12 feeding experiments to determine whether the defatted microalgal biomass could replace a portion of soybean meal or a combination of corn and soybean meal in diets for laying hens, broilers, and weanling pigs. The defatted biomass derived from 3 different microalgal species (Cellana, Kailua-Kona, HI) was supplemented at 7.5 to 25% in corn-soybean meal diets for the 3 types of animals. The feeding experiments lasted as short as 3 wk for the starter period of broilers or as long as 15 wk for the full cycle of egg production of layer hens. With appropriate supplementations of amino acids and manipulations of other nutrients, inclusions of various levels of the defatted microalgal biomass to substitute for soybean meal did not alter growth performance or a series of plasma biochemical indicators of the animals. Intriguingly, animals fed the microalgal biomass appeared to have lower plasma uric acid or urea-nitrogen concentrations than those fed the control diets. In conclusion, our research has demonstrated the feasibility of using the defatted microalgal biomass from the biofuel production to replace a portion of soybean meal in diets for poultry and swine. Supported in part by a USDA/DOE Biomass R&D Initiative grant.

Key Words: microalgae, soybean meal, animal nutrition