NIR analysis
to reduce feeding costs

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Nutrition continues to be one of the most critical factors of animal production, with feed costs accounting for up to 80 percent of the total variable costs. Least-cost feed formulation software allows nutritionists to construct a diet that meets the requirements of the animal and considers feed ingredient cost and nutrient content. However, there is considerable variation of nutritional quality within an ingredient due to several factors including cultivar, soil quality and growing, harvesting and post-harvesting conditions. The extent of this variability and its potential economic impact is a challenge for feed manufacturers and producers.

Traditional analysis methods are costly and time consuming

The cost of wet chemistry analysis is prohibitive to large numbers of samples and as such it may not address the question of ingredient variability. Variability of nutritional quality of raw materials presents a risk of under or over estimating nutrients, leading to economic losses and/or poor animal performance. In addition to the cost of wet chemistry there is an average 1-2 week turnaround time to receive results after ingredient submission. Published references (NRC or Feedstuffs ingredient analysis table) are another resource nutritionist used to assign ingredient nutrient values. However, published references only present an average nutrient value and do not provide knowledge of ingredient variability, compositional differences between batches or changes over time.

New developments in NIR technology

With increased focus on ingredient knowledge and quality control, near infrared reflectance (NIR) manufacturers and software developers have introduced new products into the market that are able to help the modern day nutritionist better understand feed ingredient quality and variability. NIR uses near infrared reflectance to obtain a chemical profile of an ingredient sample and thus predict parameters such as moisture, starch, protein and fat. However it is also possible to build NIR calibrations beyond the usual proximate analysis to include analysis of reactive lysine, in vivo energy values and phytic-P. Such analysis has the potential to bring cost savings through formulation, supplier selection and ultimately animal performance. Hardware advances such as portable NIR devices can be used on-farm or in the feed mill, allowing greater flexibility, and software developments have allowed web-enabled analyses and programs that transfer NIR data directly into feed formulation software.

Measuring phytate levels to maximise phytase use

Phytate varies within raw materials and if this is not accounted for in formulation it has the potential to lead to variable phytate content of complete feeds. In Figure 1, it is clear that some raw materials are more variable than others, particularly those that we know to be inherently variable such as bakery meal. NIR technology can analyse phytate content, giving the nutritionist values for formulation and confidence that there is enough substrate for a phytase enzyme to act on in the complete feed.

NIR can be used as a tool to check the potential substrate for phytase in complete feeds, as demonstrated in figure 2. The presence of higher levels of phytate in broiler feeds means there is greater opportunity to make the phosphate in this phytate available by use of higher doses of efficient phytases.

Corn variability analysis

Advances in NIR technology can be used to predict the AME of cereals, including corn, which has been shown to vary by as much as 360 kcal/kg. NIR can help nutritionists better understand their corn variation, to optimize diet formulation and monitor incoming corn from suppliers. As shown in Figure 3, this technology can help track changes in nutritional value, for example in corn used in different countries. It also enables analysis results to be generated rapidly, allowing formulations to be adjusted in real-time to account for corn quality variation. Thereby delivering improved accuracy of formulation, greater consistency of nutrient supply and potentially substantial cost savings by reducing the need to 'over specify' diets.

The data in Figure 3 is broken down by country, using a box and whisker plot to show the full extent of the predicted AME variation. It highlights the extent of variation experienced in some countries and the differences between countries.

Potential for cost-savings

The potential for economic improvement comes when the total AME variability is large, such as in Argentina, where the range was found to be up to 400 kcal/kg. In those countries that are not corn producers, such as Indonesia, the variation could be representative of importing from different countries and is particularly interesting to not only the nutritionist but the raw materials buyer as well. Yet it is also important to recognise that even the 50-100 kcal/kg differences measured in countries such as Bolivia still represent considerable potential wins if effectively accounted for during diet formulation.

The reduced cost, quicker turnaround time and ease of use with NIR allow much more frequent analysis of cereal quality leading to greater strength in the numbers from which cost saving decisions can be made.

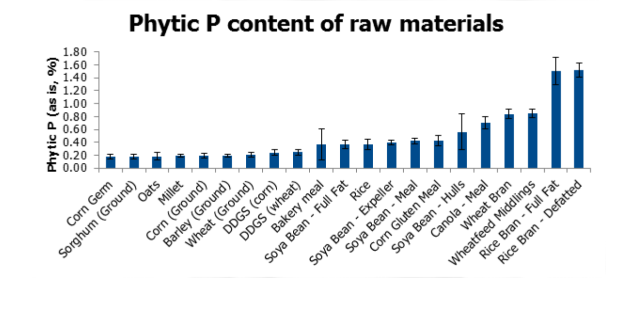

Figure 1: Variability of Phytic P levels in raw materials (n>78000). *Source: AB Vista*

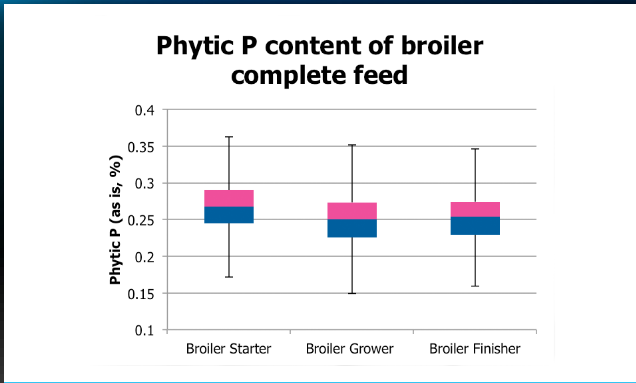

Figure 2: Variability in Phytic P in broiler complete feeds (n>11500). *Source: AB Vista*

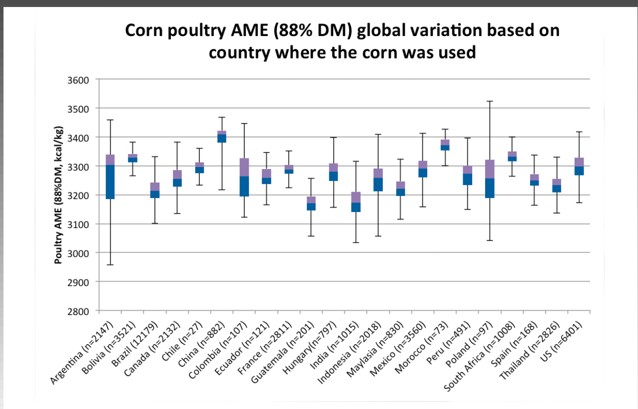

Figure 3: Figure 2 – Box and whisker plot showing the large variation of poultry AME content in over 43,000 global corn samples (88%DM, kcal/kg). The narrow grey bar shows the full extent of variability (excluding outliers), the wide grey box the range for the 50% of samples closest to the median and the white line indicates the median. *Source: AB Vista, 2017, n=43,412*

Lysine content

Heat damage during processing of protein meals can also affect the precision and cost effectiveness of diet formulation. As lysine is heat-processed, it loses its nutritional value through the formation of Maillard products. Reactive lysine can be measured by NIR as an indicator of heat damage; with reactive lysine content being reduced with over-processing. Whilst it is not currently possible to formulate to reactive lysine requirements, it is certainly a tool that could be used for supplier selection.

Making NIR easily accessible

NIR technology can be used to determine the nutrient content of feedstuffs and feeds in a cost effective and timely manner. Latest software and hardware developments can help nutritionists better understand their feed ingredients.

Emerging technologies such as centrally maintained on-line calibrations, pay-as-you-use calibrations; portable NIR and affordable in-line NIR installations are making NIR technology more accessible across the entire feed industry. The subsequent expansion in the number of NIR-analysed results available for industry-wide interpretation brings additional potential benefits, as the main trends in feedstuff variability become both clearer and more accurate.