Technical Note -

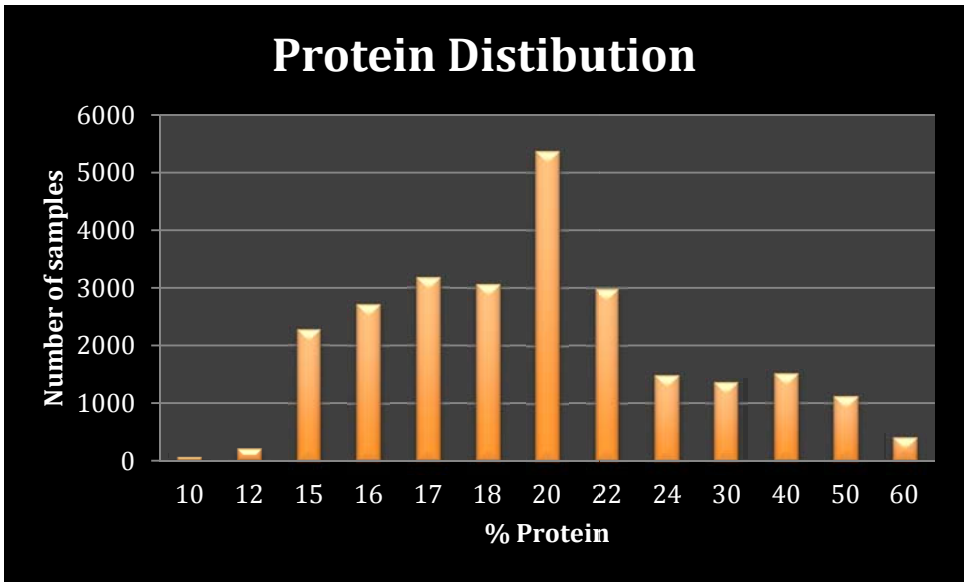
Finished feed variability and NIR

The practice of ingredient interchange, known as 'least-cost formulation', is widely practiced within the commercial feed industry for production animals. Least-cost formulation works on a matrix of nutritional specification, production constraints and raw material costs to provide a recipe that meets the animals' requirements at the lowest cost of feed production. When the cost of one ingredient increases, a lower cost ingredient may be used in order to produce a feed that meets the specification; thus providing the customer with the most economical feed.

However this practice does cause concern to some when it comes to the use of NIR in predicting finished feeds. Can an NIR calibration be capable of predicting a feed that can change in composition on a regular basis?

At Aunir we have been working on this issue for many years and can be confident that finished feed calibrations do work and work well if there is enough data in the calibration database. Our finished feed calibrations contain over 32000 samples, with a large distribution across all nutrients. Figure 1 below shows the Ingot sample distribution for finished feeds based on protein value.

Figure 1: Sample distribution for finished feeds based on protein value.

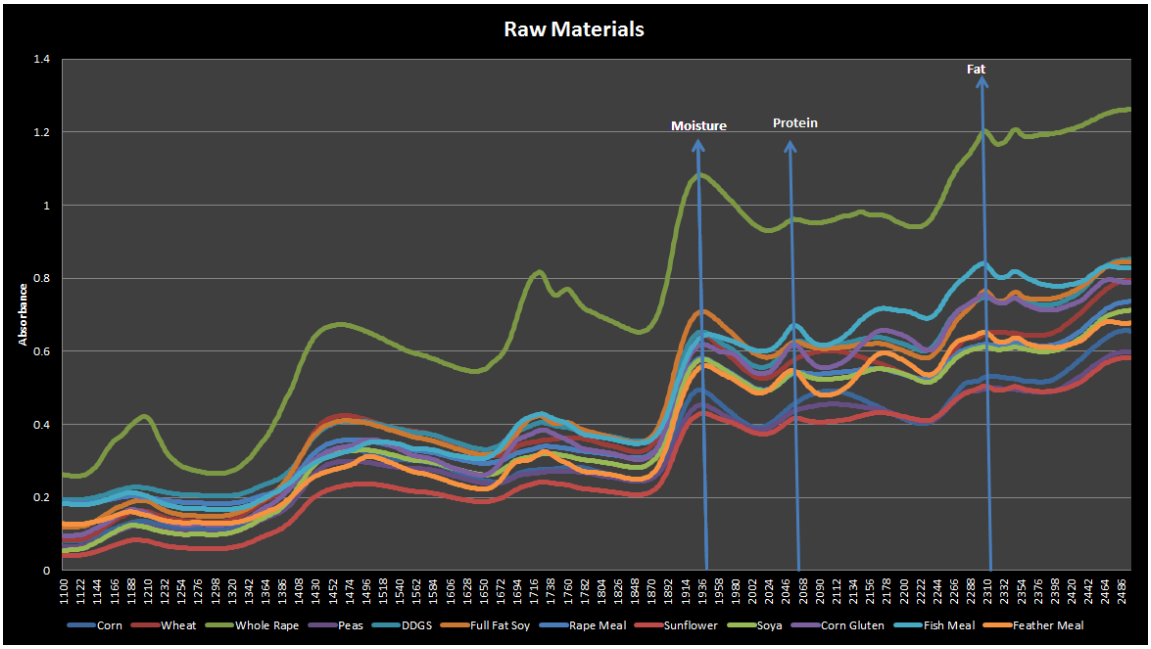


Atoms in compounds are held together by chemical bonds. Depending on the configurations of these compounds they will show characteristic vibrations when excited. When Near Infra-red energy is added to the system, the bonds will vibrate; the laws of physics constrain the vibrations that can occur so only vibrations at certain frequencies are permitted.

Different chemical bonds (for example organic O–H, C–H and N–H bonds) vary in strength and consequently the amount of energy required to make the bonds vibrate. This difference in energy requirement will be seen in a spectrum as a series of absorptions at different energy wavelengths (see Figure 2 below).

We can use information from the spectrum to build up a picture of the structure of the molecule. If we can identify O-H, C-H and N-H bonds from the spectrum we can deduce that the sample being analysed is protein. The basic make-up of protein is the same for all the different raw materials (C-O-H-N) therefore we can be confident we are measuring protein rather than the raw material.

Figure 2: The NIR spectra of different raw materials showing key molecular structures at specific wavelengths.



In fact the combination of this large data base and highly variable nutrients provides an ideal matrix for NIR modelling and the resulting calibration gives excellent performance as seen below in Figure 3.

Figure 3: Protein NIR predictions (x axis) versus wet chemistry reference results for crude protein in finished feeds.