Opportunities and challenges in implementing NIR grain calibrations for the feedlot industry

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A major objective of the "Premium Grains for Livestock Program" is to develop rapid tests, suitable for the site of grain collection and/or use, to measure the nutritional value of grains so that they can be priced in accordance with their suitability as an animal feed. The feedlot industry, as a major user of grain, is well aware of the relationship between the quality of a feedlot ration and animal performance, but routine grain testing has frequently been limited to constituents such as moisture and protein.

This project has sought to identify and measure "functional properties" of grains as well as the major constituents. One such property is metabolisable energy (ME), which is one of the most important indicators of nutritional value, but is very difficult to measure directly. NIR has been used for many years to predict digestibility (used in turn to calculate ME) of forages, and to a lesser extent grains and mixed feeds. However, in most cases indirect chemical, \textit{in vitro} or enzymatic measurements have been used as the basis of NIR calibrations. An alternative approach is to base an NIR calibration directly on \textit{in vivo} digestibility, avoiding any intermediate laboratory method and the associated additive errors. In the case of forages, this has proved successful in the UK and Europe, where research has shown that direct NIR calibrations were as accurate or better than a range of commonly used laboratory methods. In Australia, digestible energy of grains for pigs has also been calibrated against NIR in this way. The major limitation of this approach is the difficulty and expense in obtaining enough samples with \textit{in vivo} data for a robust calibration (preferably at least 100) and the ongoing need for validation and testing of the calibration.

\textit{In vivo} dry matter digestibility (DMD) has now been measured at Hamilton on a total of 74 diverse grains, mostly using sheep, but a limited number also with beef cattle, using a standard protocol. DMD values ranged from 61.9\% to 92.3\%. NIR calibrations for DMD and other parameters have been derived and results will be presented.

It is one thing for a successful or promising NIR calibration to be derived in one laboratory. It is quite another for this calibration to be implemented across a given industry or geographical region. A number of technical and other issues must be resolved before this can happen. The potential benefits and drawbacks of different procedures for transferring calibrations between instruments will be outlined.

The direct NIR calibration of \textit{in vivo} digestibility (and hence ME), in particular, is expected to be of considerable benefit to the feedlot industry. Whilst it is far preferable to transfer NIR calibrations for measurements such as DMD only among spectrally standardised instruments of the same type, it may be possible to do so using other instruments which utilise a restricted wavelength range, provided it is clearly understood that accuracy could be considerably lower. In order to adequately validate, further refine and upgrade this calibration, it is strongly recommended that \textit{in vivo} DMD be measured on additional grains. This is time-consuming and expensive, but overseas studies demonstrate that it is well worth the effort.