APPLICATION OF NIRS TO PREDICT CRUDE PROTEIN IN FEEDSTUFFS

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Abstract: The most wide spread use of near infrared spectroscopy (NIRS) has been for the determination of protein, moisture, starch, lipids and ash in feed ingredients. On-the-spot analysis of the whole sample, i.e. a non-destructive technique, allows simultaneous measurement of several parameters with high precision and high throughput making NIRS a low-priced technique. Cost effective use of feed ingredients is fundamental to the profitability of any livestock industry. To effectively utilize limited feed resources, it is essential that we identify those factors that can influence ingredient quality. To date, our ability to achieve this has been restricted. Given the variation that exists in the nutritional and physical quality of feed ingredients, these approaches are far from adequate. Development of the NIRS method for the prediction of these values demonstrates that this technology can be successfully applied as a rapid method in our laboratory.

Keywords: NIRS, protein, feed, prediction

INTRODUCTION

Near infrared reflectance Spectroscopy (NIRS) offers the potential for obtaining a rapid, nondestructive and accurate estimation of the chemical composition of feedstuffs. The technique has extensive application for the analysis of constituents of agricultural crops, feeds, and foods. During the last decade, leading feed companies in Asia began to employ near infrared reflectance spectroscopy as a rapid prediction tool to advance quality control of feed and nutrition.

The objective of this paper is to give an overview on the potential application of NIRS at the laboratory of Department of Veterinary Services Malaysia for the prediction of nutritional value in feedstuffs and a way towards more advanced studies in animal nutrition.

MATERIAL & METHODS

NIRS is one of the techniques belonging to vibrational spectroscopy. NIR spectroscopy utilizes the spectral range from 780 to 2500 nm and provides much more complex structural information related to the vibration behavior of combinations of bonds. The record of NIR region of the electromagnetic spectrum involves the response of the molecular bonds O=H, C=H, C=O and N=H. These bonds are subject to vibrational energy changes when irradiated by NIR frequencies, and two vibration patterns exist in these bonds including stretch vibration and bent vibration. The energy absorption of organic molecules in the NIR region occurs when molecules vibrate or are translated into an absorption spectrum within the NIR spectrometer. These special bonds also play an important part in the field of food and feed chemical analysis, and could extract information to analyze the chemical structures. The selection of wavelength regions, solution, scan speed, number, mode and sampling interval would influence the precision and repetition of the experiment. In order to extract valuable information on the chemical properties of samples, it is necessary to mathematically process spectral data by chemometric tools. The most important part in the development of an NIR method is building the predicting model generally called calibration. Calibrations are based on the statistical analysis, termed "chemometrics" of the relationship between mathematically transformed spectra and the frequency of chemical bonds in an organic matrix. Quantitative analysis by NIRS is based on the Beer-Lambert Law. Beer's law states that log (1/R) is proportional to the concentration of the chemical bond absorbing the NIRS energy. As a result the degree of absorbance can be used to determine the concentration of those molecules present in the samples. For calibration, various statistical models including Principal Component Regression Multiple Linear Regression and Partial Least Square Regression can be used. Each statistical model allows exploration of relationships of reflectance/absorption values of diverse sets of chemical bonds in the dried/wet sample and wet chemistry values of samples. The most widespread use of NIRS has been for the determination of protein, moisture, starch, lipids and ash in feed ingredients. NIRS has been accepted as an official

AOAC method for crude protein and ADF and for moisture. It has also been used for determining starch and non-starch polysaccharides, fat and oil, metabolizable energy, insect or weed seed contamination in feed grains and for the analysis of dried forages. It can be used to identify feeds and perform authenticity checks. In addition, heat damaged protein, fungal contamination and adulteration can be detected with modern pattern recognition software. The ultimate aim is to formulate diets for optimum animal productivity, cost effectiveness and the least environmental effects. Currently, wet chemistry assessment has been the only means to measure crude protein but is time consuming in relation to the true needs of the fast turn-over/large scale feed production of today.

CONCLUSION

In the light of the present situation of high competition in the feed industry, any change from the classical strategy of obtaining information on nutritional value could represent a differential market position. NIRS could bridge the gap between advanced nutritional scientific knowledge generated and application to practical feed formulation and rationing.

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