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Short communication

Detecting and quantifying meat meal or meat and bone meal contamination in fishmeal by visible and near infrared reflectance spectra

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Abstract

The use of animal protein feeds such as meat meal or meat and bone meal (MMBM) play an important role in the feed manufacturing industry, but their safe and healthy use in animal feeds is of public concern in order to prevent the spread of bovine spongiform encephalopathy (BSE). The objective of the present work was to develop a technique using near infrared reflectance spectroscopy (NIRS) that would be suitable for detecting and quantifying contaminating levels of MMBM in fishmeal. To this end, a partial least squares (PLS) discriminant analysis and a modified partial least squares (MPLS) quantitative analysis, using visible and NIRS, were developed using a calibration

Abbreviations: BSE, bovine spongiform encephalopathy; MBM, meat and bone meal; MMBM, meat meal or meat and bone meal; MPLS, modified partial least squares; NIRS, near infrared reflectance spectroscopy; PLS, partial least squares; R^2, coefficient of multi-determination in calibration; R^2_{cv}, coefficient of multi-determination in cross-validation; RPD, ratio of the S.D. of the validation set to the SEP; S.D., standard deviation; SEC, standard error of calibration; SECV, standard error of cross-validation; SEP, standard error of prediction; SNV, standard normal variate.

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set of 186 samples including 90 samples of pure fishmeal and 96 samples adulterated with MMBM at levels ranging from 10 to 320 g/kg. An external validation set, comprised of 39 pure samples and 54 adulterated samples, was used to validate the calibration model. A PLS discriminant analysis model developed with mathematic pretreatment 1,4,4,1, successfully detected fishmeal adulterated with MMBM. External validation indicated that all samples were discriminated correctly. A MPLS quantitative model, developed with mathematic pretreatment 1,4,4,1, also successfully predicted the MMBM in fishmeal with standard error of cross-validation (SECV) of 27.89 g/kg and ratio of the standard deviation of the validation set to the standard error of prediction (RPD) of 3.37. The calibration and validation results confirm that NIRS could provide the feed industry and inspection bodies with a rapid, non-destructive and non-invasive technique for the detection and quantification of MMBM in fishmeal.

Keywords: Fishmeal; Near infrared reflectance spectroscopy; Meat meal or meat and bone meal; Qualitative; Discrimination; Quantitative

1. Introduction

The use of animal protein feeds such as meat meal or meat and bone meal (MMBM) play an important role in the feed manufacturing industry, but their safe and healthy use in animal feeds is of public concern in order to prevent the spread of bovine spongiform encephalopathy (BSE). Because the use of MMBM in animal feeds has been banned (EC, 2000), large amounts of MMBM are being produced as slaughter wastes that have no economic value. In contrast, fishmeal has never been suspected of transmitting diseases, but is still banned from ruminant feeds, but not from pig and poultry diets (EC, 2000). Fishmeal is a high value protein rich by-product and commands a high market price. Consumers and the feed industry need to have appropriate methods available to ensure that fishmeal is free of any contamination or adulteration with MMBM.

Several methods presently exist to detect banned ruminant tissue in feeds including techniques based on optical microscopy, immunological method and polymerase chain reaction (Ansfield et al., 2000; Bellagamba et al., 2001; Frick et al., 2002). However, these methods are costly and time consuming, and are inappropriate for routine testing of the large amounts of feed traded globally (Murray et al., 2001). In addition, accuracy can often be affected by thermal damage to protein and deoxyribonucleic acid (Murray et al., 2001).

Near infrared reflectance spectroscopy (NIRS) offers advantages over existing methods in terms of convenience and the ability to provide an instant response when detecting contaminated specimens. NIRS has been already widely used in the feed industry for routine chemical analysis (Pérez-Marín et al., 2004; Garrido et al., 2002). In addition it has been widely used to detect contamination of various feedstuffs with animal tissues (Pérez-Marín et al., 2004; Termes et al., 2004).

The objective of the present work was to demonstrate the ability of NIRS to detect and quantify contaminating amounts of MMBM in fishmeal.