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Short communication

Instantaneous determination of crude proteins, fat and fibre in animal feeds using near infrared reflectance spectroscopy technology and a remote reflectance fibre-optic probe

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Abstract

In the present study we address the development of a rapid technique – near infrared reflectance spectroscopy (NIRS) technology and the use of a remote reflectance crude fibre (CF)-optic probe (fitted with a 5 cm × 5 cm quartz window) – to perform instantaneous analysis of quantitative parameters such as the ether extract (DM), crude protein (CP) and crude fibre in animal feed and fodder. The technique does not involve the destruction or treatment of the sample because it is based on direct application of a fibre-optic probe on the feed (with different physical characteristics, such as commercialisation in the form of meal, tablets and granules) given to cattle, swine, sheep, birds and rabbits that is used in different stages of animal development—juvenile development, growth, fattening, etc. The regression method employed was modified partial least squares (MPLS). The calibration results using 72 samples permitted the determination of crude protein, the ether extract and crude fibre. This calibration is applicable within the ranges for crude protein of 5–495 g kg^{-1}; the ether extract, 16–66 g kg^{-1}; crude fibre, 23–111 g kg^{-1}, with multiple correlation coefficients (RSQ) for crude protein, the ether extract

Abbreviations: CF, crude fibre; CP, crude protein; DM, ether extract; MPLS, modified partial least squares; MSC, multiplicative scatter correction; NIRS, near infrared reflectance spectroscopy; RSQ, multiple correlation coefficients; SEC, standard error of calibration; SECV, standard error of cross-validation; SEPC, standard errors of prediction corrected

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and crude fibre of 0.991, 0.932 and 0.848, respectively. The standard errors of prediction corrected (SEPC) for the above parameters in g kg^{-1} were 12.5, 2.09 and 6.05, respectively. The robustness of the analytical method was confirmed by applying it to 10 samples for external validation.

The results obtained indicate that NIRS with a fibre-optic probe can be used as a quality control method in animal feeds and fodder for the determination of crude protein, the ether extract and crude fibre.

Keywords: Animal feeds; Near infrared spectrometry; Fibre-optic probe; Determination

1. Introduction

Generically, feeds are natural materials and elaborative products of any origin that, either alone or suitably mixed, are able to provide adequate animal nutrition. The main quality factors of feeds are the energy value, the amount of crude fibre (CF) (which is very important in regard to digestibility), crude protein (CP) (whose contents are important for the balance and digestibility of essential amino acids) and the ether extract (DM), together with the different additives that may be present.

Regarding animal feed, traditional analytical methods continue to be used, although there are some studies on feed composition using NIR; nevertheless, none of them have used a fibre-optic probe. Such studies have addressed the composition of feed for rabbits (Xiccato et al., 1999), pigs (Chen et al., 1987), poultry (Valdes and Leesson, 1992) and dairy cows (Purnomoadi et al., 1999), and in all of them the authors analysed the amount of crude fibre, crude protein or the nutritional value of the feed. There are also many works on fresh forage (Barton and Windham, 1988; Norris et al., 1976; Shenk and Westerhaus, 1995a; Murray, 1996), and silo-fermented feed (Gordon et al., 1998). Other studies have used NIR to measure how the composition in crude protein, crude fibre and energy is affected by freezing, grinding or paste-heating processes (Deaville and Givens, 1998; Alomar et al., 1999a), and there are also studies on cereals (Alomar et al., 1999b; Bruno-Soares et al., 1998), oats, barley, wheat and rye and soy in which the content of crude protein or crude fibre was predicted.

The aim of the present work was to evaluate the usefulness of the NIRS technique employing a remote reflectance fibre-optic probe for the control of feed quality in regard to crude protein, the ether extract and crude fibre (since despite being a parameter that is not accepted in feed science it continues to be used in the context of feeds in Spain) by direct application of the probe on the feed samples used for pigs, cattle, sheep, poultry and rabbits.

2. Methods

2.1. Samples

Seventy-two samples of animal feeds and fodder (for cattle, swine, sheep, poultry and rabbit) used in different stages of animal rearing (juvenile development, growth, fattening,