PILOT STUDY ON THE EVALUATION OF THE SPECTRAL PROPERTIES OF ANIMAL PROTEIN MEAL

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ABSTRACT

Livestock development has increasing importance in animal protein feed application. Such a high-protein products may bring essential amino acids in animal nutrients appropriate for certain species and for breeding purposes. The pricing of the products depends on the crude protein content, while the microbiological status is determined on the basis of moisture content, while the fat content influence the storage time. In order to meet the increasing demands it is important to maintain quality management and monitoring in production, the most accurate data should be provided as fast as possible and ass cheap as possible. In this study we investigated the possible determination of the chemical composition of animal protein meal was assessed by the optical properties measured.

The reflectance spectroscopy is a rapid, non-destructive, effective method that can be used for determining the composition of a number of agricultural and food products. This spectroscopic technique have been developed and are widely used to replace "wet chemistry" methods of analysis, which is very time consuming and labor intensive.

The experimental development focuses on the developement of fast spectral analysis method of animal protein meal evaluation in VIS-NIR range. During the research, spectral detection and identification system was developed based on reflectance properties. Identification of specific wavelength range values, spectral characteristics of feather, meat meal and blood meal were carried out.

Keywords: reflectance VIS-NIR, blood meal. meat meal, feather meal

1. Introduction

Importance of animal protein feed is growing increasingly by development of animal breeding. High-protein products may provide the higher level of essential amino acids in mixed animal feed as necessary for breeding purposes. Because of the increasing serious expectations we need to keep as precise as possible production and monitoring and provide data within a short time.

Spectroscopy is an attractive, fast method which requires minimal sample preparation for examine of meat quality and animal by-products. The method spread in the last 30 years and has proven effective. Not only in the visible range studies have been made in this area, but the NIR technique has been used by many researchers for examine meat and meat products as well.

Ben-Gera and Norris (1968) have already been examined fat and moisture content in meat products using near technology. A special spectrophotometer prepared by the authors was used to measure the linear equations between composition and transmission which describes the moisture content in the range of 45 and 75 wt % with 1.4 wt % error and the fat content in the range of 5 and 35 wt % with 2.1 wt % error. It was found that the main source of error due to the fluctuation in thickness of the sample and a low signal/noise ratio by the high degree of absorption. Reflection measurements can reduce both of the errors.

Kruggel *et al* (1981) and Arneth (1982) used Infra-Alyser-400 for determining the composition of meat products. Martens *et al* (1982) found a correlation between the parameters and the reflection values at various discrete wavelengths characteristic of meat products in composition using new mathematical methods.

Rosenthal (1973) reported a methodology, where near infrared (NIR) reflectance technique was applied to determine the fat content of meat products. This technique was fast and non-destructive method. Massie (1976) developed an instrument using Ga-Ar emitter for the same purpose. In 1970s began the widely developing of NIR technique-based for single-purpose.

Hauser and Weber (1978, 1980) determined water, fat, moisture, protein and ash content using commercially available single-purpose instruments.

Tena *et al*. (2014) examined the differentiation of meat and bone meal from fishmeal by near-infrared spectroscopy. They have performed a sterilisation process of the meat and bone and fish meal at 133°C. During the sterilization, moisture and fat contents were removed from the material. Then, dried materials were milled. Statistical analyses were performed in three steps. As a first step, partial least squares discriminant analysis (PLS-DA) was used. The spectral investigation was from 1655 to 2500 nm region. The PLS-DA model was applied on 259 wavelengths. Based on the spectroscopy analysis, absorbance in the 1720 nm wavelength was higher for meat and bone meal than for fishmeal.

By a recently published study the NIR-microscopy is one of the methods that is suitable for testing animal protein feed (Perez *et al*. 2009). Previous studies have shown the potential of this technology using in detection of animal feed. However, these researches were based on spectral libraries which are not only apply for animal products and that makes slightly difficult to built database of these products. Therefore we need researches as widest as possible in this field. The measurements were made by FT-NIR spectrometer among others. The animal origin ingredients was recognized in animal mixed feed by this method.

2. Materials and methods Icroscale Model description

The aim of this study to evaluate the spectral properties and spectral measurement possibilities of poultry feather, meat and blood meal, which can be a basis for spectral quality evaluation of protein meals.

During our research, the technological methodology was elaborate to fast spectral analysis of hemoglobin blood products, which enables automated manner in the future to measuring dry matter content in the hemoglobin blood product and the three product can be distinct spectrally. In this research, we can measure the capabilities of laboratory analyzes spectral measurement of feather meal, meat meal and blood meal capabilities.

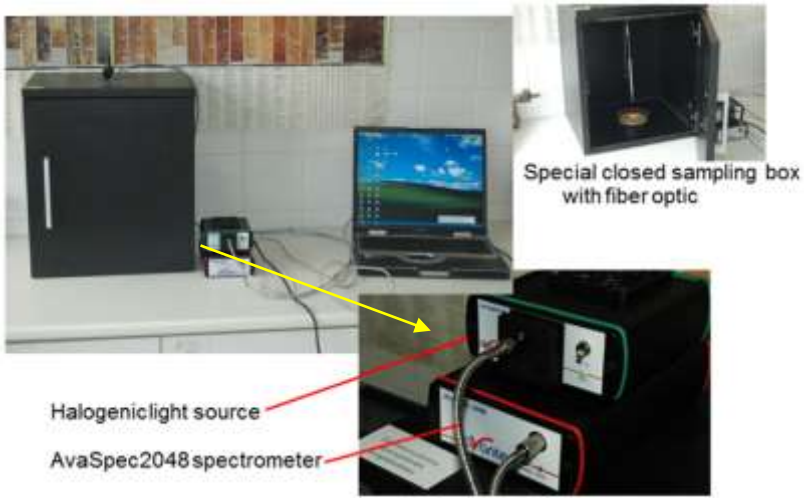

Figure 1: AvaSpec 2048 system during measurement, and special sampling box

The spectral detectability of soil moisture contents were analyzed in laboratory conditions. The spectral profiles (reflectance) were measured by laboratory scale AvaSpec 2048 spectrometer at 400 – 1000 nm wavelength interval with 0.6 nm spectral resolution. The AvaSpec 2048 system consists of one spectrometer, AvaLight-HAL halogen light source which are joined by a fibre optic with 8 µm diameter. The halogen light source provides a constant emission of 400 – 1000 nm wavelength interval, which ensures a standard intensity of incoming energy in the whole range of measurement. However, laboratory measurements is disturbed by lot of factors such as the changeable lighting conditions, neon lights, due to the wavelength specific emissions of fluorescent lamps. To ensure accurate measurements, a self-innovated, special sampling box were used to isolate samples in order to provide dark for measurements. The spectral profiles of the soil samples was measured at various moisture conditions.

3. Results

There are significant differences between spectral profiles of protein meals. Based on the spectral characteristics of blood, meat and feather meal samples regardless of the type reflectance was low (3-10%) at the 400-420 nm range. Increase in reflectance was measured from mainly 480 nm, and reached its maximum at 980-1000 nm in NIR range around 50-55%, except the blood meal. Different protein meals possess different spectral characteristics. The difference between the feather, meat and blood meal manifested mainly in the extent of reflectance. While reflectance curve of meat and feather meal increases linearly with the wavelength, the gradual increase become more emphasized in the case of meat meal, thus between 530 750 nm the differences between them was up to 10 %. In the case of blood meal the reflectance value increases from 1 to 5% from 400nm to 630 nm, then a significant increase could be detected. The changes was 10% from 630 to 730 in RED, which is due to the dark red colour of the blood meal In NIR zone a there is a moderate continuous growth in reflectance with a reflectance maximum of 25%.

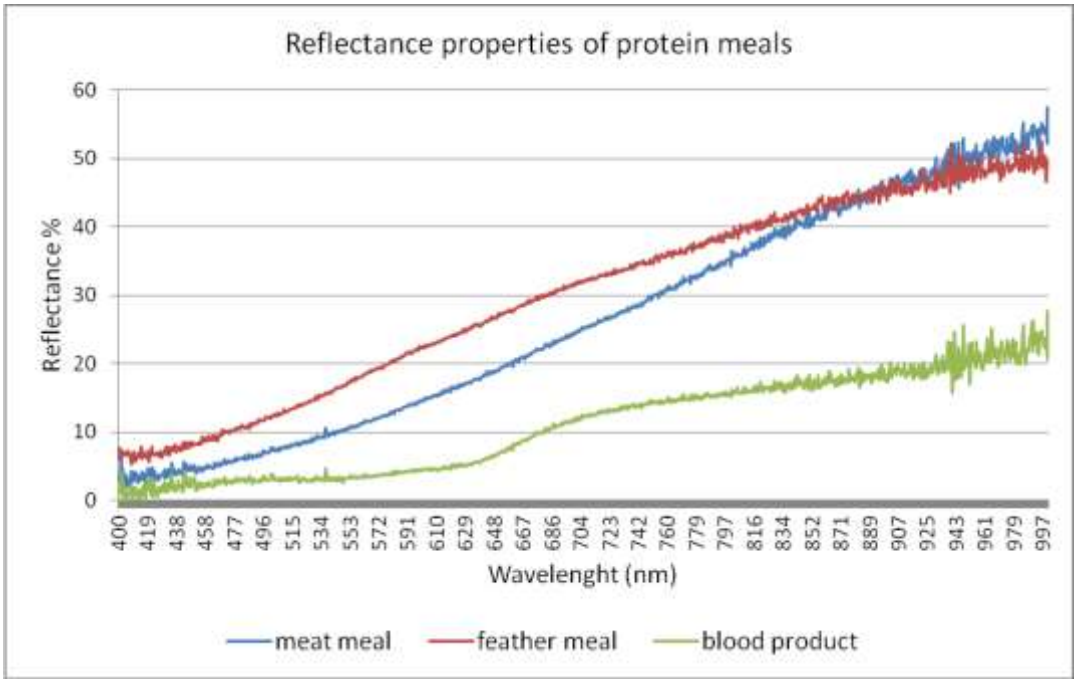

Figure 2: Reflectance properties of blood, meat and feather meal meals

However, in practice, raw reflectance data can not be used without any limitation or filtering at the whole spectral, since reliable reflectance data with low noise (standard deviation below 3%) are obtained at 450-870 nm wavelength intervals. In order to utilize the whole interval, noise filtering by method of higher integration times should be used during the measurements, thus the significant 6-8(10) percent spectral fluctuation in the near infra-red (NIR) range decreased to 1-3% (Figure 3).

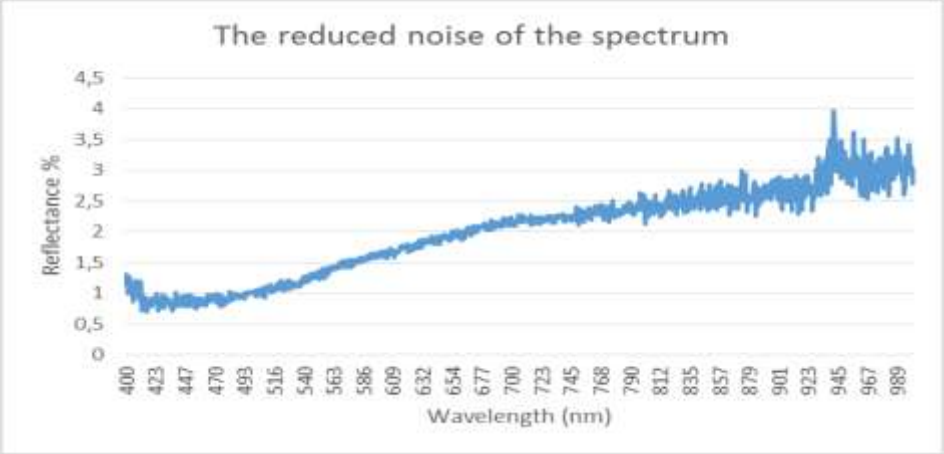

Figure 3: Reduced noise of the feather meal spectra

4. Conclusions

Based on our results, the blood, meat and feather meal were well separated. Detection and identification system will be developed based on monitoring of the spectral properties, which on the basis of the reflectance values of different indices of dry matter content / moisture content of meat meal and hemoglobin blood product can be measured on specific wavelength range, so the two products can be automated separated in the future.

ACKNOWLEDGEMENT

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