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Short communication

Differentiation between carcasses from suckling lambs reared with ewe milk or milk replacers by near infrared reflectance spectroscopy of perirenal fat

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Abstract

Near infrared reflectance spectroscopy (NIRS) was used to discriminate between carcasses from Churra breed suckling lambs reared with ewe milk or milk replacers. Samples were scanned over the NIR spectral range (1100–2500 nm). The results showed that NIRS could be used successfully to discriminate the suckling lambs depending on milk source, with a 100% of correctly classified samples. NIRS technology would be a good method, since it is a rapid, economical and little complex method.

Keywords: Suckling lambs; Fatty acid composition; Near infrared reflectance spectroscopy (NIRS); Rearing system

1. Introduction

In markets of the European Mediterranean area, the presence of meat from suckling lambs 'lechales' with a slaughter age between 25 and 45 days and a carcass weight of less than 7 kg is common (Sañudo et al., 1998). The high edible quality of suckling lamb meat, on the basis of its tenderness, juiciness and palatability, has been recognized and, thus, protected by several Protected Geographical Indication (PGI) European Union's quality labels.

In sheep dairy farms, after a few day's feeding with the colostrum, suckling lambs usually remain with their mothers for suckling ewes' milk. However, sometimes suckling lambs are hand-reared with milk replacer (Sañudo et al., 1998). Actually, ewe milk rearing is required in regulations for several suckling lamb meat quality labels.

It has been found that the type of rearing has an influence not only on cost of feeding (Spanish Churra lamb breeding association—ANCHE, personal communication), but also on animal welfare (Sevi et al., 1999; Napolitano et al., 2002), growth performance (Lanza et al., 2006) and meat quality (De la Fuente et al., 1998; Napolitano et al., 2002; Lanza et al., 2006). One the one hand, artificial rearing may diminish the cost of feeding, but, on the other hand, a reduction in animal welfare and

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growth performance have been observed, and meat quality seemed to be adversely modified, mainly by means of decreasing fatty acid dietetic value (reducing $n-3$ series).

At the present time in Mediterranean Europe, due to common incorporation of vegetable fat in milk replacers (Napolitano et al., 2002), considerable differences have been repeatedly found between fat composition of ewe milk and commercial milk replacers (Napolitano et al., 2002; Osorio et al., 2006; Lanza et al., 2006).

With regard to the effect of dietary fat on fatty acid composition of fat depots, it has to be considered that suckling lambs are functionally monogastric, and therefore the potential of dietary variation of fatty acid content of its meat is higher than in older lambs (Hofmann, 1988; Nümberg et al., 1998; Lane et al., 2000). In this sense, significant differences in fatty acid composition of suckling lamb meat, which depended on fat composition of the corresponding milk source, have been observed (De la Fuente et al., 1998; Napolitano et al., 2002; Osorio et al., 2006; Lanza et al., 2006).

Near infrared spectroscopy (NIRS) has been successfully used for prediction of fatty acids in pork and beef fat samples (García-Olmo et al., 2000; González-Martín et al., 2003; Realini et al., 2004). In the case of suckling lambs, if the information contained in the NIR spectra could be used to discriminate suckling lamb meat originating from different nutritional regimes, this analytical procedure would supply the industry with a fast and economical method to be implemented in traceability programs. Therefore, the aim of this study was to demonstrate the potential of NIRS for discriminating between suckling lamb carcasses reared with ewe milk from those reared with milk replacer.

2. Materials and methods

2.1. Animals and sampling

Sampling was carried out at a regional slaughterhouse on 10 different days during a 5-month period among a total of c.a. 1000 carcasses from suckling lambs which had been reared exclusively with maternal milk in twenty of those farms (natural milk, N group), and c.a. 200 carcasses from suckling lambs reared with milk replacer from 3 to 5 days after birth to slaughter, in five of those farms, each one using a different milk replacer (artificial milk, A group). These both groups of carcasses were the same described in a previous study (Osorio et al., 2006), and originated from Churra-breed suckling lambs, bred and reared in years 2004 and 2005 at 25 farms affiliated to ANCHE Churra breeders association. Lambs were slaughtered with an age up to 35 days and live body weight ranging from 9 to 12 kg.

A set of 50 samples of perirenal fat (approximately 20 g each) were randomly collected among the carcasses of N group, as well as 48 perirenal fat samples for A group. Perirenal fat depot was chosen because, in contrast to the other fat depots, removing perirenal samples was considered to be a non-destructive sampling for carcasses. Fat samples were transported from slaughterhouse to laboratory under refrigeration and then immediately frozen and stored at −40 °C prior to NIR analysis.

Means and standard deviations of fatty acid content of perirenal fat depot from a set of carcasses belonging N and A groups as well as of the milk replacers used by the farmers was previously reported by Osorio et al. (2006).

2.2. Near infrared reflectance (NIR) spectroscopy measurement

Perirenal fat samples were homogenized in a domestic blender and aliquots of 4 g were extracted by a microwave technique (De Pedro et al., 1997) for 1 min. The liquid fat obtained was transferred to an Eppendorf® tube and frozen until analysis. In order to acquire spectra, the samples were melted in a water bath at 60 °C. The tubes were taken out from the water bath randomly to collect 0.5 mL of melted fat, which was directly poured into a gold cell covered with a quartz lid (Bran + Luebbe®) to measure the spectrum by transflectance. The cell was slightly warmed prior to each measurement in order to keep all the fat samples liquid and transparent until the end of each analysis. Then it was cleaned with ethanol (96%) between different samples, allowing complete evaporation before the next use.

A spectrophotometer model InfraAlyzer 500 (Bran + Luebbe GmbH, Norderstedt, Germany) was used for this experiment. The instrument was operated by the package SESAME software (Version 2.1, Bran + Luebbe, New York, USA). The samples were scanned at 2 nm intervals from 1100 to 2500 nm (701 data points) over a period of 7 different days. Each sample was scanned in two positions differing in 180°, thus resulting in two spectra per sample that were finally averaged.

The absorbance data were recorded as log (1/R), R being the reflectance. The raw spectra [log (1/R)] of perirenal fat were transformed by a second-order derivative (2D) to highlight the signals related to the chemical composition of the fat samples.

2.3. Statistical analysis

Discriminant analysis was performed using the dummy partial least square (PLS) regression analysis with The Unscrambler Version 7.0 (Camo, Trondheim, Norway) (Cozzolino et al., 2002; Cozzolino and Murray, 2004).

A partial least square (PLS) regression was applied to the NIR spectral data. Partial least square regression (PLSR) was used to obtain the mathematical model, and full cross-validation (leave one-out) was performed to validate this mathematical model and choose the optimal number of PLS components.