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Multiblock PLS-DA on fecal and plasma visible-near-infrared spectra for discriminating young bulls according to their efficiency.

Preliminary results

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1 Introduction

Ruminants are able to convert fibrous feeds, such as forages, into high-quality protein products. The efficiency of this conversion is variable between individual animals [1]. Consequently, the selection for increased feed efficiency could be possible. Feed efficiency in beef cattle has been traditionally measured by the feed conversion efficiency (FCE) index, defined as the ration between the animal body weight and the feed consumed. Between-animal variation in FCE seems to be determined mostly by digestion and metabolic mechanisms.

A major limitation to measuring feed efficiency is the time and cost involved. According to [2] cheap and rapid methods for predicting FCE are needed. Some authors have shown that near infrared spectroscopy (NIR) is able to predict animal responses as digestibility and/or intake [3] but its use for identifying efficient animals has not been explored. This task could be performed using NIR spectra obtained from feces as representative of the digestion process and from those of plasma as representative of metabolic processes.

The objective of this study is to evaluate the feasibility of fecal and plasma NIRS spectra for predicting FCE and to analyse the effect of combining both spectra types throughout multiblock analysis on the prediction of the FCE.

2 Material and methods

182 animals were tested for feed efficiency during a minimum length of 180 days. Individual feed intake was measured daily and the weight was recorded fortnightly during the experimental period. Animals were divided into two groups according to their FCE value: higher and lower than the median FCE respectively. More than half of the bulls (n=95) were fed a diet consisting of 70:30 grass silage and fibre rich concentrate whereas the rest (n=87) were fed maize silage and starch rich concentrate in the same proportions. Blood and feces samples were obtained four weeks before the end of the test. Near infrared spectra were obtained on ground dried feces whereas spectra of dried plasma according to the DESIR method [4] were recorded. Both spectra types were obtained in a

Foss NIRSystems model 6500 scanning VIS/NIR spectrometer (Foss NIRSystems, Silver Spring, MD, USA). Spectra were obtained using a 50mm diameter ring cup and they were scanned in reflectance mode at 2 nm intervals from 400 to 2500 nm. For feces, and plasma spectra sets separately, the raw reflectance spectra representing the two FCE groups underwent discriminant analysis using a partial least squares discriminant analysis (PLS-DA). Additionally, a multiblock PLS-DA was performed using both spectra types (feces and plasma) according to [5]. The models were selected and evaluated via a cross-validation procedure based on the prediction error rates.

3 Results and discussion

The error rates of calibration and cross validation procedures are presented in Table 1. The ERcv of different models for discriminating the FCE of young bulls varied between 0.22 and 0.33. The ERcv associated to the model developed on NIR spectra from feces was lower than that associated to the model built on NIR spectra from plasma. This result suggest that FCE would be better correlated to the digestion rather than to metabolic processes. The ERcv associated to the multiblock model on both types of spectra was similar to that of the model developed from feces. Furthermore, the multiblock model shown than the block of feces spectra was the most important in the group discrimination (BIPc = 0.86). These results suggest that the information related to the FCE contained in the feces and plasma spectra was similar and combining both types of spectra does not improve the discrimination results obtained from feces NIR spectra.

Table 1 – Error rate of calibration (ERc), error rate of cross validation (ERcv) and number of components (T) of the PLS-DA models for discriminating the feed efficiency conversion of young bulls using near infrared spectra from faeces, plasma or feces+plasma (F+P).

	ERc	ERcv	T
Faeces	0.23	0.22	2
Plasma	0.29	0.33	4
F+P	0.23	0.22	2

4 Conclusion

The results of the current study suggest that the discrimination of FCE of young bulls from feces NIR spectra can be interesting from a practical point of view. Furthermore, the spectra of plasma do not provide additional interesting information relative to that of fecal spectra. Finally, more research should be done in order to confirm these preliminary results using a greater number of animals and different diets. It would be also interesting to confirm that these results are maintained within diets.

5 References

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