Rapid Authentication of Caprine Milk Powders With NIRS Fingerprinting

Vicky Manti, Grishja van der Veer, Mary Smiddy, Rob Frankhuizen, Martin Alewijn and Saskia van Ruth

Introduction

Consumers show an increased interest in milk of non-bovine origin for various reasons. The seasonal production and the higher prices of caprine milk in comparison to bovine milk make them susceptible for the admixture of with bovine milk.

Aim

The aim of this study was to create additional value out of NIRS data generated in routine compositional milk powder measurements by using the data as fingerprint for caprine milk powder authentication.

Materials and Methods

Milk powder samples from numerous manufacturers included 51 cow's milk powders and 45 goat's milk powders with various fat contents. They were analyzed in duplicate with the FOSS 6500 NIRS Analyzer. The reflectance spectrum at the visible and near infra red were recorded using the rotating cup sample holder. The measurements were subjected to multivariate data analysis (Principal Component Analysis (PCA) and Partial Least Square Discriminant Analysis (PLS-DA; Pirouette 4.01). The optimization was performed with the software R version 2.11.1 using package "chemometrics" and "plsgenomics".

Results and Discussion

The 96 samples were analysed by NIRS. Representative spectra are presented in Fig. 1. The peaks due to fat discriminate the whole milk from the skimmed milk samples. The differences in the milk colour (ie brown chocolate) relate to the wavelengths in the visible area.

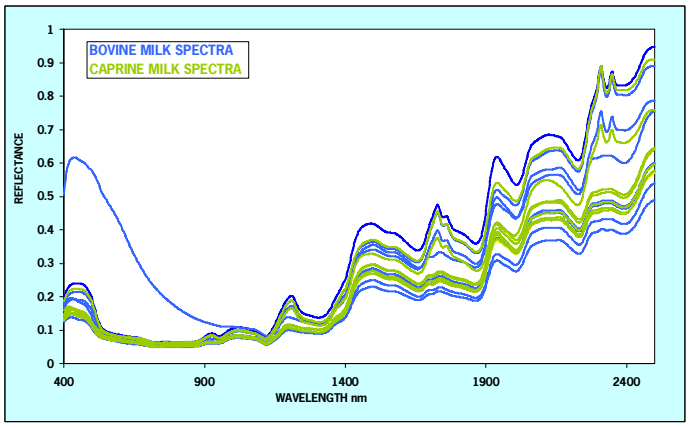

Figure 1. The VIS/NIR spectrum of various caprine and bovine milk powders

The NIRS spectra were subsequently subjected to PLS-DA in order to predict the identity of the milk powders from their fingerprints applying a multivariate model. Three outliers were removed.

Optimization of the data pre-processing resulted in the selection of the 2nd derivative and mean-centering as pre-processing methods. The performance of the model was evaluated by a leave-10%-out cross validation. The results are shown in Table 1.

Table 1. Identity predictions of caprine and bovine milk powder by their VIS/NIRS full fingerprints applying a PLS-DA

Predicted	Correct class	Incorrect class
Bovine Milk	43	0
Caprine Milk	46	4

In order to optimize/simplify the PLS-DA model, the most relevant wavelengths were selected by generation of 1 million model realizations using a randomly selected set of 10 response channels. The best performing variables set predicted the identity of 85% of the milk powders correctly. The 10 optimal wavelengths were 452, 456, 696, 760, 774, 994, 2240, 2262, 2382, 2418 nm The number of latent components was optimized which resulted in a 5 component final model. To evaluate the optimized PLS-DA model, 1000 model realizations were generated using a random prediction of samples into caprine and bovine milk powder classes. Fig. 2 shows reasonable performances according to sensitivity (0.64 +/- 0.17 (2SD) and specificity scores (0.73 +/- 0.20 (2SD). The upper limit shows the true classification (0.85/0.98). The results show that it is promising to use of the routinely generated data simultaneously for milk powder authentication. In the present study focus was on replacement, in future studies admixtures will be considered.

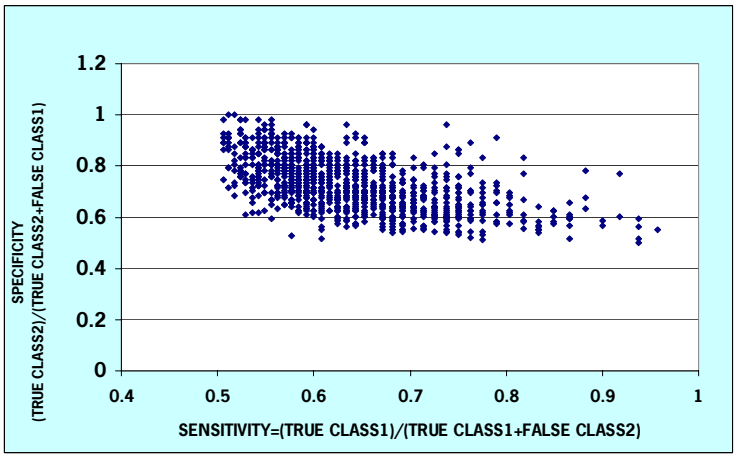

Figure 2. The specificity and the sensitivity of the classification model for 1000 randomly generated classes

Conclusion

In the present study promising prediction models for caprine milk powder authentication were developed from the NIRS data generated in routine compositional analysis.

[1] **RIKILT – Institute of Food Safety**
P.O. Box 230
NL-6700 AE Wageningen, The Netherlands
Phone: +31 317 48 02 56
Internet: www.rikilt.wur.nl
* Corresponding author: saskia.vanruth@wur.nl