

Quality control of table sauces by near infrared spectroscopy

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Introduction

Mayonnaise, a mixture of egg, vinegar, oil and spices, is probably one of the oldest and most widely used sauces in the world today. Traditionally mayonnaise and other table sauces are oil-in-water emulsions, despite containing a high percentage of fat. In order to establish the quality control of these emulsions, a wide number of parameters are monitored, including % fat, moisture, dry matter, pH, acidity and salt content. In this study, near infrared (NIR) spectroscopy has been tested for its potential to provide simultaneously all of these parameters, related to the quality of different table sauces.

Materials and methods

A total of 500 table sauce samples were used in the study: 250 for each group of samples, i.e. mayonnaise, and special sauce groups. For each group, 150 of the samples were included in the calibration set and the remaining 100 were used as the validation set. NIR absorbance spectra were collected in reflectance mode [$\log(1/R)$] using an InfraXact instrument (FOSS, Hillerød, Denmark), in the wavelength region between 570 and 1850 nm, at 2 nm intervals, adding approximately 30 ml of sauce in a small sample cup.

Data analysis was performed using WinISI software, version 1.50 (FOSS NIRSystem Inc., Laurel, MD, USA). Modified partial least squares (MPLS) equations were developed to predict quality parameters. Signal pretreatments included standard normal variate and detrending methods for scatter correction, and different derivative treatments to obtain the best fit for each parameter. Cross-validation was used to select the optimal number of factors, and avoid over-fitting. Finally, the best equation for each parameter was chosen by applying the model to the validation set of samples and evaluating the different statistics, such as *SEP* and r^2 .

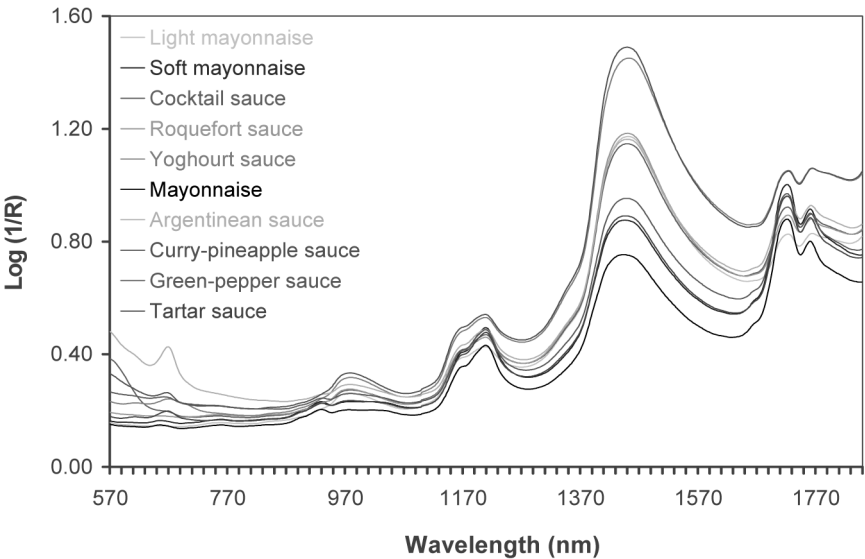


Figure 1. Average NIR spectra of different types of table sauces.

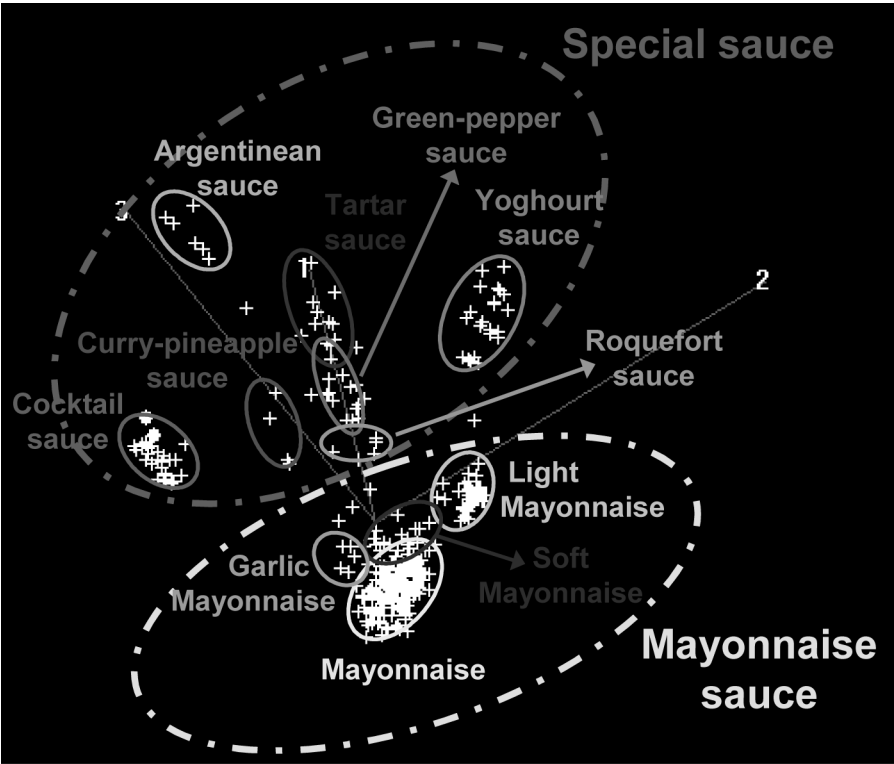


Figure 2. Score plot of three principal components of the different table sauce spectra.

Table 1. Statistics for the prediction of quality parameters in table sauces.

Mayonnaise sauce						Special sauce					
Parameter	<i>N</i> ^a	Mean ^a	Range ^a	SEP ^b	<i>r</i> ^{2c}	Parameter	<i>N</i> ^a	Mean ^a	Range ^a	SEP ^b	<i>r</i> ^{2c}
Acidity	147	0.43	0.20–0.88	0.09	0.64	Acidity	142	0.63	0.20–1.15	0.10	0.81
Salt content	148	0.80	0.32–1.47	0.12	0.76	Salt content	146	1.18	0.48–1.92	0.14	0.87
pH	150	3.65	3.31–3.91	0.12	0.58	pH	147	3.79	3.33–4.17	0.12	0.64
Moisture	141	32.1	16.3–63.8	1.7	0.98	Moisture	144	42.7	16.0–62.2	1.6	0.99
Fat	144	63.7	23.9–84.8	2.3	0.98	Fat	141	46.6	23.1–85.5	2.5	0.97

^a*N*, Mean and Range of the calibration set; ^bStandard error of prediction; ^ccoefficient of determination for prediction.

Results and discussion

The NIR spectra of different table sauces seemed to be similar, although some differences related to water and fat bands can be observed (see Figure 1).

As a result, two different groups were created (see Figure 2), the mayonnaise group consisted of mayonnaise, light mayonnaise, soft mayonnaise and other mayonnaise-based sauces, whereas the other group included special sauces, such as yoghurt, roquefort, Argentinean, green-pepper or tartar sauces, among others.

Quantitative models were developed for the determination of the quality parameters (pH and % acidity, salt content, moisture and fat) of the two groups of table sauces, and a good correlation between reference data and NIR prediction values was observed (see Table 1).