ANALYSIS OF MEAT PRODUCTS (FRANKFURTER SAUSAGES) BY NIT-SPECTROMETRY

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Introduction

The consumption of meat products in Germany amounts about 30 kg per head and year, so it has a considerable importance. Approximately 1200 different products with very different receipts provide the spectrum of the substrates to be analysed. Moreover, the respective composition of the rawmaterial meat varies with regard to protein, fat, connective tissue, water and additives and thus grades the meat products by sort and quality.The quick chemometric method of **N**ear-**I**nfrared-**T**ransmission-(**NIT**) was introduced at many companies for quality control. This measuring technique is suitable as a screening-method to control single samples from the current market supply. The NIT-analysis is particularly suitable to determine complex quality parameters, because it is a scanning system that uses a grid-monochromator, delivering a higher density of measuring data, thus a higher amount of information about the sample. The aim of the investigation was to adapt a practicable method for the quick and unerring determination of the decisive quality criteria of meat products.

Materials and Methods

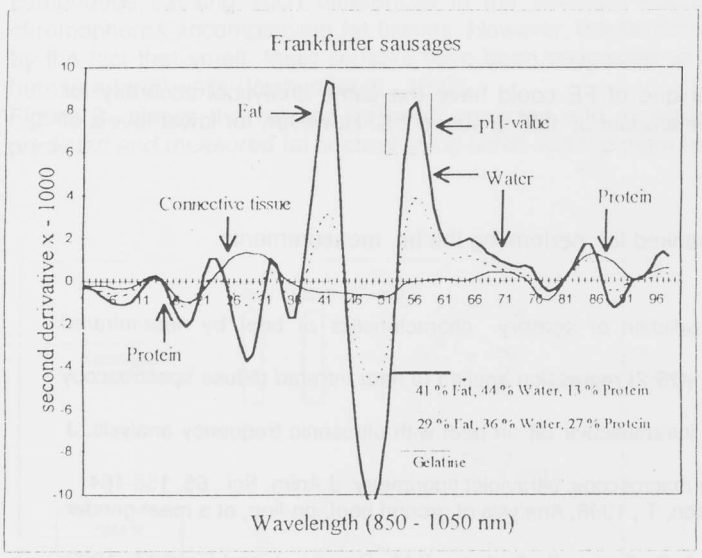
For the NIT-measurements a Food and Feed Analyzer, Modell Infratec 1255 (Perstorp Analytical Ltd., Sweden) was used. The NIT-Spectroscopy bases on the well-known principle of varied infrared absorption of the functional molecular groups like fat, water and protein in the wavelength range of 850 to 1050 nm (see also at BERG and KOLAR, 1991; FREUDENREICH, 1992).

78 kinds of frankfurter sausages from german shops were used to obtain the probes. The test material was stored frozen at -30°C. An appropriate amount, according to the labor-capacity, was thawed overnight in the refrigerator and afterwards homogenised in a Mouli-nette machine. After the conventional analysis (see parameters in Tab. 1) ca. 100 g of the sample homogenate was filled in a plastic tray (layer thickness 15 mm) and „flood" with near infrared light. The hereby produced and stored 100 measuring values (Scans) per sample, together with the conventional analysis data are the basis for two calibrations.

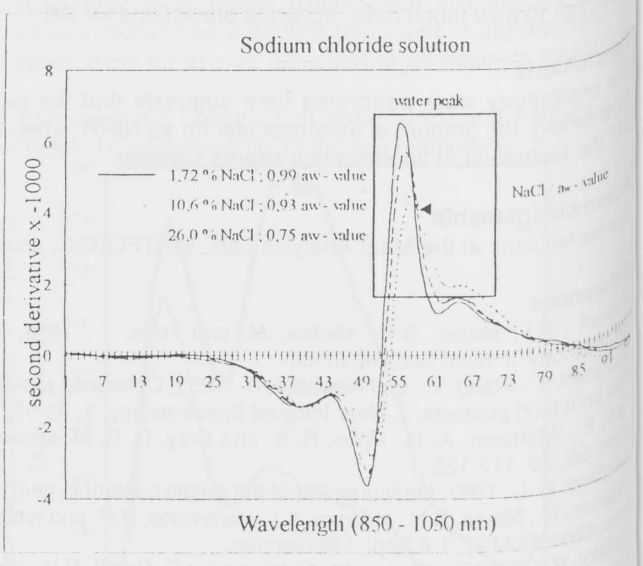
Calibration I concernes the estimation of the main substances fat, water, protein, ash and connective tissue free meat protein, calibration II implies pH-value, a_w-value (activity of water) and the common salt content (NaCl). A maximum of 5 parameters can be measured simultaneously in about 2 minutes. The such elaborated calibrations have been proved for accuracy. A validation was carried out on a testing set of samples each containing 25 specimen. The precision of the calibration curve depends on the reliability of the reference method applied.

Fig. 1: Second derivative NIT - spectra (850 - 1050 nm)

a



b



Results

Both valuable contents and accompanying quality parameters can be identified using of the second derivatives of NIT-scans of the different samples (Fig. 1). The classical contents fat (930 nm), water (960 bis 1010 nm) and protein (875, 1025 nm) show significant absorption peaks (Fig. 1a), also connective tissue shows an absorption maximum at the test substance „gelatine" (at 908 nm). Comparative measurements of accompanying quality criteria at frankfurter sausages are of particular interest at the quick analysis by NIT. The pH-value, a_w-value and the common salt (NaCl) can only be determined from the water spectrum. The determination of different pH-values is possible, though there is no specific absorption peak recognizable. Investigations with different buffer solutions show, that the pH-value affects the water peak at 960 nm. Different salt solutions (1,7 % to 6 % NaCl) cause significant changes on the water peak in the wavelength range of 960 to 1010 nm, thus they can also be differentiated by NIT-measurements (Fig. 1b). For the height of the a_w-value is characteristic a defined amount of salt in water. Since both water and salt can reliably be determined by the NIT-measuring technique, the a_w-value is also determinable.

The NIT-method is an empirical relative method, where absorption bands will be correlated with results of chemical and physical analyses (reference methods). This measuring technique requires an extensive examination of the estimation accuracy of an independent random sample, the results of which are listed in Tab. 1. In consideration of the means, standard deviations and ranges of the examined quality parameters of sausages, the estimation errors (SEP) show the deviations between NIT-measurements and the reference values. These are for the fat content 0,60, for the water content 0,61 and for the protein content 0,53. Thus, the estimation accuracy of these contents is slightly beyond the error limits of the conventional analysis. The estimation accuracy of connective tissue free meat protein shows with 0,61 at a range of 16,4 a good result. The same is valid for the pH-value with 0,13, for the a_w -value with 0,002 and for the NaCl-content with 0,15. Obviously, these results of the NIT-estimation show, that even at very low concentrations and small ranges a high accuracy of estimation can be achieved.

Tab. 1: Validation statistics for the measurement of meat products Frankfurter sausages by NIT - spectrometry

Parameter		N	Average	Std.Dev.	Range	R[1]	Bias[2]	SEP[3]
Fat	%	60	22	7,8	32,7	0,99	0,0320	0,60
Moisture	%	60	60	6,2	26,5	0,99	-0,2852	0,61
Protein	%	38	17	40,3	16,9	0,99	0,0868	0,53
Ash	%	38	3	0,9	4,5	0,96	0,0035	0,25
Beffe[4]	%	38	15	4,3	16,4	0,99	-0,1100	0,61
pH - Value		60	6	0,2	0,9	0,71	-0,0681	0,13
NaCl	%	60	1,9	0,3	1,4	0,85	-0,0030	0,15
a_w - Value		60	0,97	0,004	0,02	0,86	0,0003	0,002

[1]R - multiple correlation coefficient
[2]Bias - average difference in validation set
[3]SEP - standard error of prediction
[4]BEFFE - connective tisssue free meat protein

Conclusions

NIT-measurements provide an important completion of the analytical technique for the practice. However, the capacity of the method is still under examination, especially with respect to further quality factors. On a random sample of meat products (frankfurter sausages) the classical contents fat, water and protein showed largely comparable estimation errors with those of the conventional analysis. It is also possible to determine pH-value, a_w-value and NaCl by NIT-measuring technique with low estimation error.

References

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