Control of colouring power of red paprika with an automatic analyzer

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At the 27th Congress of European Meat Researchers in Vienna we reported on the determination of red paprika of ethylene oxide, a compound dangerous from the aspect of health. In the present lecture we describe a new automatic analytical procedure for the determination of the colouring power and dye content of red paprika. We have been unable to find mention of an automatic determination of the colouring power of red paprika in the literature.

A knowledge of the colouring power of red paprika is essential from the point of view of the production of certain meat products. This colouring power is due to coloured constituents of paprika: the red and yellow carotenoids. These coloured compounds or their mixtures can be determined by means of traditional manual analytical procedures; thus, the ASTA is widely used in the USA, and the modified BENEDEK procedure in Europe. The total carotenoid content is measured at 460 nm in an acetone extract of the paprika in the ASTA procedure, and at 477 nm in a benzene extract of the paprika in the BENEDEK procedure.

The procedure we have developed is an automatic one. The absorbance of an extract of the paprika in any organic solvent can be measured in the visible wavelength range.

The following examinations were performed in connection with the elaboration of the automatic measurement of the colouring power of red paprika:

1/ Establishment of the absorption curves and absorption maxima of the red and yellow carotenoids of the paprika in verious organic solvents.

2/ Construction of a suitable automatic analyzer.

3/ Comparative measurements with automatic and manual procedures.

The investigation extended to the following organic solvents: Hydrocarbons: n-hexane, benzine, petroleum ether /100-120/, cyclohexane, benzene. Halogenated derivatives: carbon tetrachloride, trichloroethylene. Alcohols: ethanol, isopropanol, n-propanol, isobutanol. Ketones: acetone, methyl ethyl ketone. Esters: ethyl acetate, n-butyl acetate. Other compounds: dimethylformamide, dimethylsulphoxide.

The absorption curves of extracts of red paprika in the various organic solvents are different. In the following solvents the absorption curve is broad and flat, and the peaks of the red and yellow components are not separated from one another: ethanol, isopropanol, n-propanol, isobutanol, ethyl acetate, butyl acetate, dimethyolformamide, dimethylsulphoxide, carbon tetrachloride, trichloroethylene, methyl ethyl ketone.

In contrast, extraction of red paprika with the following organic solvents leads to well-reproducible intense absorption curves, with well-separated peaks for the red /capsanthin/ and yellow /β-carotene/ constituents: n-hexane, petroleum ether /100-120/, benzine, cyclohexane, benzene, acetone. These findings are in good agreement with the literature data /CURL, 1962; DRDAK et al., 1981; PÜSPÖK, 1981/.

With these solvents the absorption maxima were found at the following wavelengths:

	n-hexane	petroleum ether /100-120/	benzine	cyclohexane	benzene	acetone
I	472	473	473	474	485	470
II	452	451	451	455	465	450

Absorption maximum I is characteristic of the red carotenoids /capsanthin, capsorubin/, while II corresponds to the yellow ones /mainly β - carotene/.

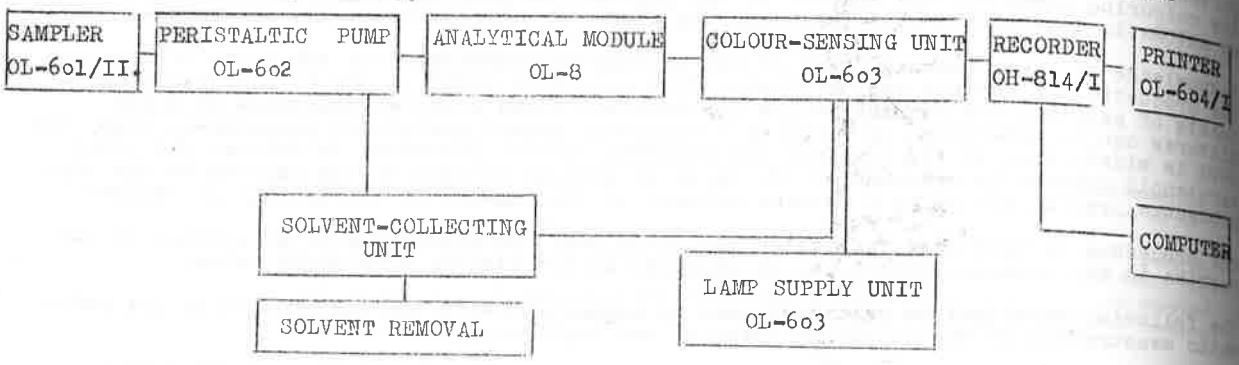
The visible colour of red paprika and foodstuffs containing it is a result of the presence of 25-45 % yellow, and 55-75 % red carotenoids. The red constituents are of particular importance: the different degrees of the "fiery" red colour have a great influence on the quality of the milled product and on the taste. The following correlation holds for a benzene extract of milled paprika: $E = aP + c$, where E is the absorbance, P is the price of the product, and a and c are experimental constants. For comparative purposes, 0,1 g milled paprika is extracted mechanically with 100 cm^3 benzene for 10 minutes /SCHUSZTER et al., 1974/.

The quality of paprika used in meat products may be controlled either before manufacture of the meat product or in the ready product. The premanufacture quality may be determined with any of the solvents found suitable: a given quantity, e.g. 0.1 g, of the milled paprika is extracted with 100 cm^3 solvent, and the absorbance of the extract is measured at

the appropriate wavelengths /460 nm in the ASTA, and 477 nm in the modified BENEDEK procedure; in the range of 1 g dye/1000 g milled paprika, 1 BENEDEK unit = 32.4 ASTA units/.

For control of the quality and quantity of paprika in meat products, extracts are prepared with benzene or acetone. These two solvents are optimum for the extract preparation, for the coloured constituents of the pepper also present do not dissolve, and hence do not disturb the absorbance measurements. /The quantity of pepper may be determined by measurement of the absorbance of an ethanol extract, when the carotenoids do not interfere./

In the factory control of the colouring power of paprika, a large number of analyses must be performed both before manufacture of the meat products and on the ready products. Determination of the quantity of paprika in meat products is also suitable for the simple and rapid control of the uniformity of mixing. We have constructed an automatic analyzer convenient for carrying out large numbers of analyses. A block scheme of the automatic instrumentation is as follows:



The units of the automatic analyzer are made from special solvent-resistant materials. The feed-in of the washing fluid and the lead-off of the waste solvent were solved in one system whereby the solvent content of the equipment and the risks of fire or explosion were reduced to a minimum.

This automatic analyzer is capable of analyzing 40 samples per hour. The solvent requirement is 6 cm^3 per sample. The reproducibility is better than 1.5 %.

As regards the reproducibility and accuracy of the automatic analyzer, comparative measurements were made with the modified BENEDEK procedure as the control method. This led to the following results:

Quality	No. of measurements	Automatic analyzer Mean ± S.E.M. g/kg		Manual control procedure Mean ± S.E.M. g/kg	
"Csemege" paprika	10	3,13	0,028	3,13	0,029
	5	3,99	0,026	3,99	0,018
"Édesnemes" paprika	5	3,09	0,038	3,10	0,031
"Félédes" paprika	5	2,19	0,024	2,21	0,037
"Rózsa" paprika	5	1,21	0,025	1,19	0,019

To summarize, it may be stated that the proposed automatic procedure has the same accuracy as that of the manual control method. The advantages of the automatic analyzer from the aspects of performance /320 samples in 8 hours/ and solvent requirements are indisputable. The apparatus and the given procedure are suitable for the factory control of the colouring power of red paprika both before the manufacture of meat products and in the ready products.

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