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Correlation of Volatile Components of Raw Peanuts With Flavor Score

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ABSTRACT

The direct gas chromatographic procedure for analysis of the volatiles of peanut butter and other food products was applied to raw peanuts. A glass liner packed with ground, raw peanuts was placed in the heated inlet of a gas chromatograph and allowed to remain in place while the volatiles distilled out of the sample onto the head of a cool column. The liner was then removed and temperature programming was begun. Raw, Virginia type peanuts from the 1974 and 1975 harvests were analyzed, and some gas chromatographic data were correlated with flavor scores of the roasted peanuts. Ethanol was the predominant volatile component, and it tended to increase as flavor quality decreased. The correlation coefficients, significant at the 1% level, between the flavor scores and the ratios of ethanol-to-methanol and ethanol-to-total volatiles were −0.87 and −0.88, respectively.

Key Words: raw peanuts, flavor scores, volatile components, gas chromatography.

A simple, instrumental method for predicting the flavor quality of peanuts would be of value to plant breeders and peanut processors to replace or supplement taste panel evaluations. Fore et al. (3,4) prepared volatile profiles of peanut butters by a direct gas chromatographic (GC) technique and obtained good correlation between taste panel flavor scores and selected GC peak area ratios. Brown et al. (2) used the same technique to obtain volatile profiles from small samples of raw and roasted peanuts.

Pattee and co-workers (5-10) have done extensive work on the volatile components of raw peanuts, investigating the effects on the volatile profiles of such factors as variety, stage of maturation, and storage, curing, and blanching conditions. They have shown that flavor quality of the raw peanuts is related to levels of certain volatile components. Their method requires distillation of the volatiles from a fairly large sample of peanuts prior to GC analysis and would not be suitable for routine use.

The present paper explores the possibility of correlating data obtained by direct GC analysis of raw peanuts with flavor scores of the peanuts after roasting as a step toward the development of a practical, objective method of flavor evaluation.

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[2]It is not the policy of the U.S. Department of Agriculture to recommend the products of one company over those of any others engaged in the same business.

Materials and Methods

The peanut samples evaluated were:

(1) 5 cultivars or breeeding lines of raw, Virginia type peanuts grown in North Carolina in 1974, 2 samples each, harvested 9 days apart. These samples had been flavor scored, after dry-roasting, by an industrial taste panel, using the Cler Method.
(2) the same cultivars and lines, also with 2 harvest dates, grown in Virginia in 1974, but on which Cler scores were not available.
(3) a series of 9 raw, Virginia type peanuts from North Carolina and Virginia from the 1975 harvest and Cler scored, after dry-roasting, by an inhouse taste panel.

After curing and shelling, the 1974 peanuts were stored at below freezing temperatures until they were analyzed in August and September, 1975. The 1975 peanuts were stored at approximately 7 °C until analyzed in January and February, 1976.

Sample Preparation

A 40 g sample of raw, unblanched peanuts was ground in a 1-qt blender for 1 min and then transferred to a screw-cap jar. GC analyses were either run immediately or the ground samples were stored at −22 °C and analyzed within 2 days. At least 2 GC analyses were run on each ground sample. For analysis, 740 mg of the ground peanuts was weighed into a glass liner fitted with a glass wool plug at one end. Another plug was placed above the sample and about 40 mg of water was added to facilitate distillation of the volatiles onto the GC column.

Gas Chromatography Procedure

A Tracor 222 gas chromatograph equipped with dual flame ionization detectors, a Hewlett-Packard 3370 B integrator and a Westronics MT 22 recorder were used.[2] The construction of the inlet of the GC has been described elsewhere (3,4). The dual columns were 1/8 in. x 6 ft. stainless steel packed with Porapak P, 80/100 mesh. Nitrogen was used as a carrier gas, with a pressure of 60 psi on the regulator except where otherwise noted. Rotameter settings were maintained at 40 ml/min. The pressures and rotmeter settings for hydrogen and air were 30 psi, 45 ml/min and 50 psi, 566 ml/min respectively.

The glass liner containing the sample was placed in the heated inlet of the GC at 135 °C and allowed to remain in place while the volatiles distilled out onto the head of the column. For the 1974 series of peanuts, the column temperature was held at 30 °C for 23 min during distillation of the volatiles onto the column. The spent sample was removed and the column temperature was quickly raised to 50 °C, then programmed at 3° per min to a holding temperature of 190 °C. Under these conditions, the most volatile components-methanol, acetaldehyde, and ethanol-eluted from the column before the sample liner was removed. Although there was no loss of volatiles, the procedure was modified for the 1975 series to avoid removing the sample liner during development of the chromatogram. In the modified procedure, the oven door was removed, a wet towel was wrapped around the columns to

maintain a temperature of approximately 25 °C, the nitrogen pressure was reduced to 30 psi, and the sample was inserted. After 22 min, the sample liner was withdrawn, the towel removed, the door replaced, and the nitrogen pressure increased to 60 psi. The column temperature was raised to 40 °C, held for 2 min, programmed at 3° per min to 185 °C and held until elution of volatiles was complete.

A gas chromatograph-mass spectrometer-computer system consisting of a Tracor 222 GC, a Hewlett-Packard 5930A MS and an Incos Series MS Data System, was used to identify some of the volatile components.

Results and Discussion

On analysis of the volatile components of 29 samples of raw peanuts by the direct GC method, the predominant and most significant component was ethanol. Chromatograms of 3 of the 1974 peanut samples (Fig. 1) illustrate the decrease in ethanol peak areas and ethanol-to-methanol ratios with increase in Cler scores, the higher Cler scores indicating better flavors. This trend is again evident in the chromatograms of the 1975 samples (Fig. 2).

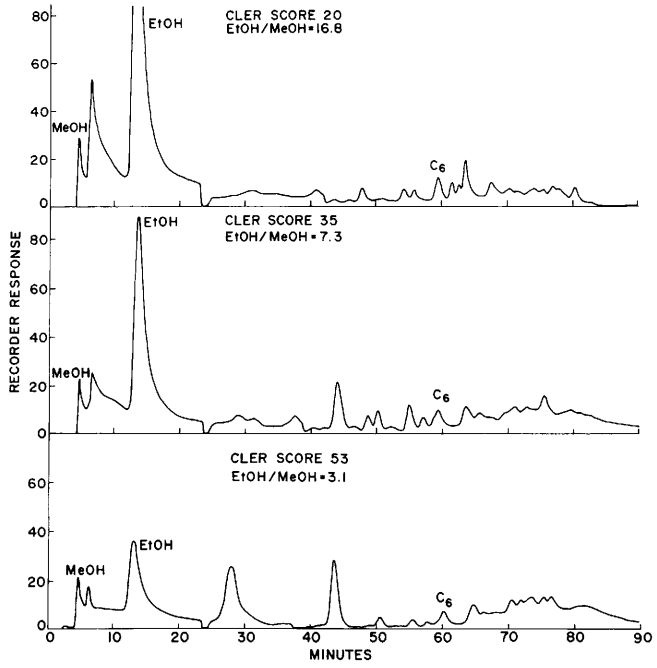

Fig. 1. Chromatograms of 3 peanut samples, 1974 crop. Column temperature, 30 °C, and nitrogen pressure, 60 psi during distillation of volatiles onto column. Timing begins immediately after insertion of sample in inlet.

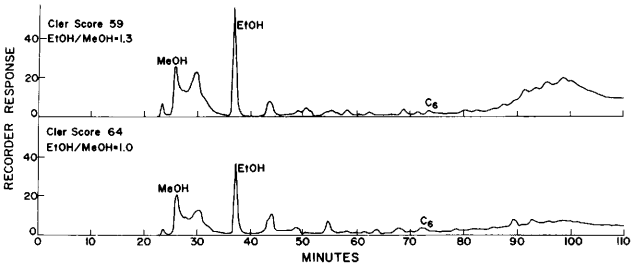

Fig. 2. Chromatograms of 2 peanut samples, 1975 crop. Column temperature, 25 °C, and nitrogen pressure, 30 psi during distillation of volatiles onto column. Timing begins immediately after insertion of sample in inlet.

The correlation coefficients between selected GC data and Cler scores for the combined 1974 and 1975 samples, significant at the 1% level, were: ethanol peak area, −0.79; ratio of ethanol-to-total volatiles, −0.88 (Fig. 3); ratio of ethanol-to-methanol, −0.87; and ln ratio ethanol-to-methanol, −0.95 (Fig. 4). The coefficient of variation was about 10% for duplicate analyses.

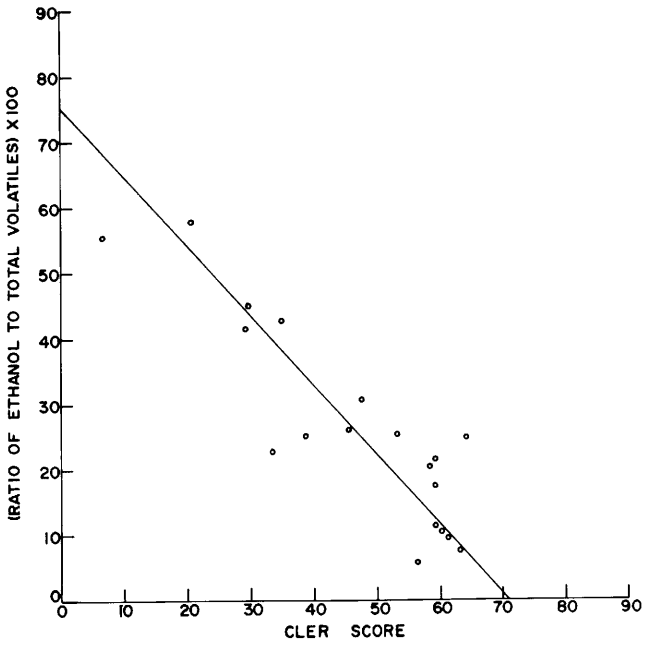

Fig.3. Linear regression line of plot of Cler score against (ratio of ethanol-to-total volatiles) x 100 for 1974 and 1975 peanuts.

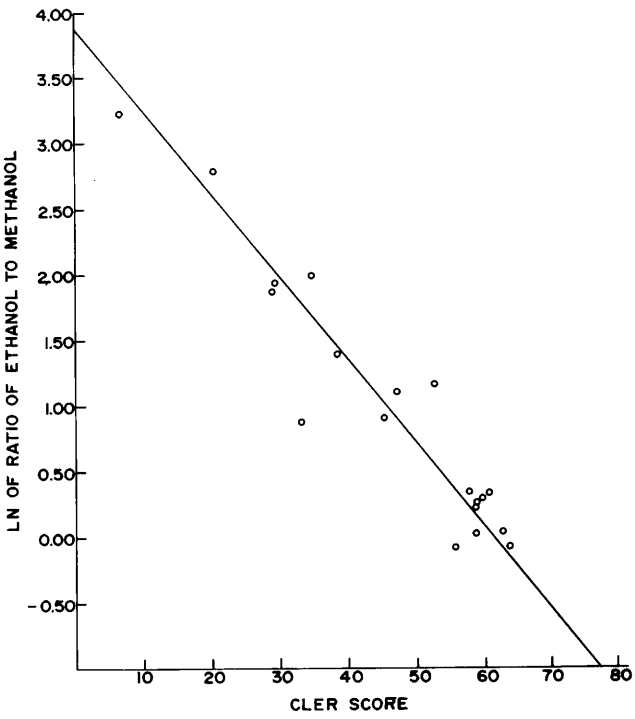

Fig.4. Linear regression line of plot of Cler score against ln of ethanol-to-methanol ratio for 1974 and 1975 peanuts.

Table 1 shows how the ethanol content, expressed as integrator counts/mg sample, varied with location and date of harvest for the 1974 crop. In the samples from both locations, the levels of ethanol tended to be lower in the more mature peanuts, although this was more pronounced in the North Carolina crops. For the early harvest, the ethanol content was essentially the same for a given cultivar or line, regardless of the location in which it was grown.

Table 1. Ethanol content of raw, Virginia type peanuts, 1974 crop

Cultivar or breeding line	Ethanol, integrator counts/mg sample*			
	Early harvest		Late harvest	
	Va.	N.C.	Va.	N.C.
Va 7324	80	90	80	30
Va 7326	120	120	70	40
NC 6	120	150	100	50
Florigiant	210	240	90	50
NC 17165	370	350	230	40

*Average of at least 2 GC runs.

The hexanal peak (labeled C_6 in the figures), which has been associated with off-flavors in peanut butters, was small in most of these raw peanut samples and did not show a statistically significant correlation with flavor scores. Other peaks in the chromatograms which were identified by GC-MS were acetaldehyde, eluting between methanol and ethanol, and acetone-pentane, eluting just after ethanol. The fairly large peak at about 43 minutes in 2 of the profiles of Fig. 1 was chloroform, present as a contaminant in some of the samples.

In this preliminary work, the emphasis has been on the relationship between the ethanol content of 2 series of raw peanuts, as measured by a specific GC technique, and the flavor quality of the roasted peanuts. In other peanut samples of different types or with different histories there may be additional factors which override the ethanol-flavor score correlation. This will be investigated in future work. The procedure is presented as a potential method for evaluating the flavor quality of peanuts.

Acknowledgments

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