Technical News Feature

Comparison of Fatty Acid Content of Imported Peanuts[1]

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ABSTRACT

Variability in fatty acid compositions of peanuts imported from six different countries into the United States were studied to determine their effect on processing and storage conditions. The oil content ranged from 44.1 to 50.4%. Major fatty acids, palmitic acid (C16:0), oleic acid (C18:1), and linoleic acid (C18:2) ranged from 8.6 to 12.7, 35.9 to 61.1 and 21.7 to 44.2%, respectively. Oleic and linoleic acids together comprised ca. 78.0-83.0% of the total fatty acids. Highly significant differences ($P<.01$) in fatty acid compositions were obtained between samples and between locations (countries of origin). Indicators of stability of the peanut samples as measured by the oleic/linoleic acid ratio (O/L) and iodine value (IV) of the extracted peanut oils showed variable but significant differences ($P<.05$) between locations. Generally, higher O/L ratios corresponding to lower IV indicate better stability and longer shelf-life of the samples.

INTRODUCTION

Peanuts (*Arachis hypogaea* L.) are traditionally high in oil content and, compared with other major oilseeds, are relatively low in ash and carbohydrate (1). The high fat content of peanuts is a contributing factor to storage instability of products such as peanut butter, roasted nuts and others. Research on peanut genotypes has shown a high degree of variability in fatty acid composition. Fatty acid composition of peanut seed oils has been reported to be influenced by varietal and seasonal effects (2), genotypic variation (3), environment (4) and maturity (5).

It has been shown that oils obtained from different botanical types of peanuts differ considerably in tendency to develop oxidative rancidity and this tendency is attributed at least in part, to the content of linoleic acid (6-8). Worthington et al. (2) found large differences in fatty acid composition among 82 genotypes. They also found that the large differences in yearly variations in oil stability could not be accounted for by yearly variations in fatty acid composition. Worthington and Hammons (9) found an overall negative correlation between oil stability and linoleic acid which would indicate that the stability and shelf-life of peanut products could be improved by breeding or selecting varieties with lower levels of linoleic acid and higher levels of oleic acid. Young et al. (5) indicated in the study of eight varieties of peanuts that mature peanuts usually contain relatively more stearic (18:0) and oleic (18:1) and less linoleic (18:2) and other fatty acids. They also reported that the oleic/linoleic (O/L) ratios which are positively correlated with oil stability were also higher in mature peanuts. The O/L ratio has been suggested to be a good indicator of oil stability (4, 5, 8, 9), despite the apparent fact that there were additional factors other than fatty acid composition that influence the stability of peanut oils (4, 9).

Previous studies on the fatty acid composition in peanuts have been mostly confined to local US cultivars and varieties. The short peanut crop due to the drought in 1980 has caused more peanuts to be imported from overseas into the United States in 1981. It was of interest and importance from a standpoint of oil stability for both the United States and European peanut processing industries to know the fatty acid composition and thus the O/L ratio of their imported peanuts.

The primary purpose of the present study was to examine the variability in fatty acid compositions of several imported peanuts from several sources and to determine the O/L ratios and iodine values (IV) in an attempt to provide more information regarding the quality and implications to processing and storage. Current studies are being conducted to determine the sugar and amino acid composition of these imported peanut samples to assess the flavor potential and other quality factors.

MATERIALS AND METHODS

The peanuts for this study originated in the Peoples' Republic of China, Argentina, India, Sudan, Malawi and Egypt and were imported into the United States in 1981. The peanuts consisted of shelled, edible kernels which were officially graded and certified to have acceptable aflatoxin levels. The peanut samples were ground in a Krups coffee mill and stored in 20-mL scintillation vials at -18 C until analyzed.

Oil was extracted from 2 g of ground peanut samples as described by Oupadissakoon et al. (10) with the following modifications: diethyl ether was used as the solvent and the combined supernatants were evaporated, dried at 40 C, and cooled before weighing to determine to percent oil on a dry weight basis. The method of Treadwell (11) was used for extracting peanut oils and obtaining methyl esters of the fatty acids. Oils were extracted from a 400 mg ground peanut sample (duplicates) with 15 mL petroleum ether for 30 min with constant shaking. Fatty acid esters were preO pared by the saponification transesterification method using 0.5 N NaOH and boron trifluoride in methanol (Eastman Kodak Co.) as described by Metcalf et al. (12). The fatty acid esters were dissolved in hexane and were analyzed on a Shimadzu Mini-2 gas chromatograph equipped with a flame ionization detector. A 1.8 m × 2.0 mm (id) glass column packed with 10% altech CS-10 on 110/120 mesh Chrom W-Aw was used with a helium flow rate of 50 mL/

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TABLE I

Identification of Peanut Samples and Percentage Oil Content

Location	No. of samples	% Oil range	Mean % oil
China	38	47.3-50.4	48.51
Argentina	15	44.6-49.8	46.58
India	8	48.3-49.5	48.90
Sudan	5	46.1-51.8	49.64
Malawi	2	44.1-44.5	44.30
Egypt	1	50.4	50.40

Means with the same letter are not significantly different (P<.05).

min. The initial oven temperature of 190 C was held for 5 min, then programmed to 250 C at 20 C/min. The injection port and detector temperatures were both maintained at 260 C. Details and typical chromatogram profiles have been published previously (2,3,13). Fatty acid levels were calculated by normalization of peak areas using a Hewlett-Packard integrator and the values of each reported as relative proportions of the total fatty acids present. The IV of the peanut oils were determined using the equation by Cocks and Van Rede (14): IV = (%C18:1 × 86.01) + (%C18:2 × 173.21) + (%C20:1 × 78.54). The data on fatty acids, O/L ratio and IV were analyzed using the analysis of variance by Snedecor and Cochran (15) and Waller-Duncan multiple range test (16) as found in the computer programmed statistical analysis system (17).

RESULTS AND DISCUSSION

The variation in oil content for the peanut of different geographical origins in shown in Table I. The 38 different samples from the Peoples' Republic of China which constituted the largest group had a percent oil range of 47.3-50.4 and a mean percent oil content of 48.51. The major fatty acids found in the peanut oils were palmitic acid (C16:0), C18:1 and C18:2 whose compositions ranged from 8.6 to 12.7, 35.9 to 61.1 and 21.7 to 44.2%, respectively, in all the samples analyzed (Fig. 1). Oleic and linoleic acids comprised ca. 78.0-83.0% of the total fatty acids. The O/L ratios ranged from 0.8 to 2.8%. The degree of unsaturation in the peanut oils as expressed by the IV, ranged from 88.7 to 109.8.

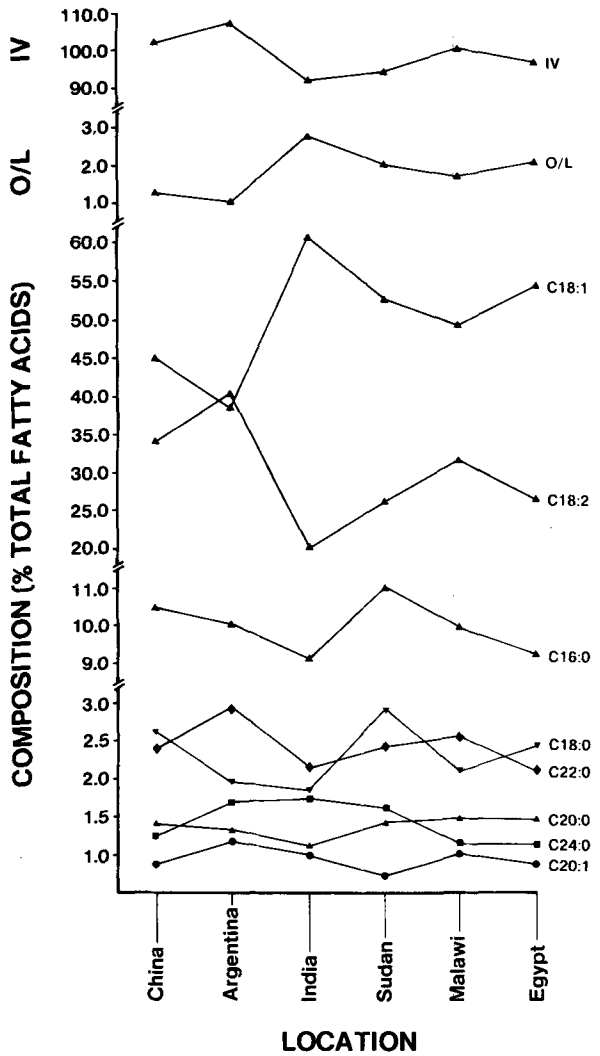

FIG. 1. Effect of location (countries) on mean fatty acid composition, O/L, and IV of six imported peanut sources.

The analysis of variance in Table II shows highly significant differences in fatty acid composition between samples and between locations (countries). Highly significant location by sample interactions were obtained for all the fatty acids except C20:0 which was only significantly different

TABLE II

ANOVA of Fatty Acid Compositon, O/L and IV of Imported Peanut Samples

	Analysis of variance with mean squares				
Source	Sample	Location	Loc × Sample	Error	Grand mean
	68	5	63	69	–
C16:0	1.97^b	7.70^b	1.51^b	0.05	10.48
C18:0	0.41^b	3.13^b	0.19^b	0.004	2.45
C18:1	112.19^b	1055.72^b	36.53^b	0.31	46.62
C18:2	88.02^b	882.30^b	24.00^b	0.46	34.30
C20:0	0.14^b	0.38^b	0.11^a	0.07	1.31
C20:1	0.064^b	0.030^b	0.488^b	0.0034	0.89
C22:0	0.26^b	1.44^b	0.16^b	0.02	2.50
C24:0	0.108^b	0.715^b	0.060^b	0.013	1.44
O/L	0.681^b	7.56^b	0.133^b	0.003	1.47
IV	55.53^b	582.25^b	13.72^b	0.68	100.21

^{a,b}Analysis of variance component is significant (P<.05 and highly significant (P<.01).

($P<.05$). The small error term indicated that most of the variability was accounted for in the model. The error term consisted of duplication within samples.

Figure 1 shows the range of variations in fatty acid compositions, O/L and IV of the 69 peanut samples as affected by countries of origin. Linoleic acid, which is of particular interest as an indicator of oil stability, was lowest in the peanuts imported from India; the highest was observed in the Argentine samples. The Chinese samples which constituted the largest group had a mean of 35.3% as compared to 22.3% in the Indian samples. Thus, from a standpoint of oil quality, the Indian samples in this study would be preferred since lower 18:2 content was positively correlated with longer oil stability (9). A higher O/L ratio which implied that the proportion of oleic acid was relatively higher than linoleic acid, could also be an indicator of maturity (5).

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