Comparison of Selected High Oleic Acid Breeding Lines, Florunner and NC 7 Cultivars for Roasted Peanut, Sweet and Other Sensory Attribute Intensities[1]

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ABSTRACT

Peanut (*Arachis hypogaea* L.) breeding lines with the high oleic fatty acid trait, acceptable yield, and acceptable grade have shelf-life quality characteristics that are much better than existing cultivars, however, the effects of this changed fatty acid composition on peanut sensory attributes are not known. Sensory evaluation of roasted-peanut paste from four high oleic acid breeding lines (F1250, F1315, F1316, F1334), Florunner, and NC 7 indicates that improvement in fatty acid composition of peanut lines does not appear to be associated with changes in roasted peanut attribute intensity. The breeding lines had similar attribute intensity to an accepted industry standard, Florunner, and were significantly better than NC 7 (4.4-4.8 vs. 3.9, respectively). F1316 and F1334 had higher (though not significantly higher) roasted peanut intensities than the other high oleic acid breeding lines (4.8 vs. 4.4-4.7, respectively). Comparisons for other sensory attributes, fruity, sweet, bitter, stale, painty, tongue/throat burn, astringent, woody/hulls/skins, and sour were not significantly different from Florunner or NC 7.

Key Words: Roasted peanut quality, sensory, high oleic acid, genotypes.

The fatty acid composition of peanut (*Arachis hypogaea* L.) is under both genetic and environmental control. As breeders develop new cultivars, this composition must be a part of the selection criteria, as variation in the oil composition will change the shelf-life quality of peanut

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seed and products. Peanut seed are approximately 45% oil. Although eight fatty acids are present in peanut seed in quantities of 1% or more, three fatty acids make up 90% of the total. Palmitic acid (16:0) is present as approximately 10% of the oil, while oleic (18:1) and linoleic (18:2) acids together constitute about 80% of the oil (Ahmed and Young, 1982). Because linoleic acid is a direct product of oleic acid desaturation, the two fatty acids are inversely and highly correlated.

While unsaturated oil is desired for health reasons, large quantities of polyunsaturated fatty acids are associated with peanut oils that become rancid quickly. For these reasons, breeders desire peanut breeding lines that contain a high proportion of oleic acid.

In 1987, Norden *et al.* (1987) summarized previous known variability for fatty acid composition in peanut and reported further evaluation of 450 diverse breeding lines. Prior to this work, oleic acid contents above 70% or linoleic acid contents below 10% had not been reported. A breeding line, F435, was identified with 80% oleic acid and 2% linoleic acid. Further work with this material showed the trait was controlled by two recessive genes (Moore and Knauft, 1989), and that one of the genes was common in peanut germplasm (Knauft *et al.*, 1993).

Several techniques were used to place this characteristic into acceptable peanut runner- and virginia-market types. One procedure for rapid incorporation was a backcrossing of F435 and a component line of the Sunrunner cultivar. Many breeding lines were developed from these backcrosses. Although it has been shown that breeding lines with the high oleic acid trait, acceptable yield, and acceptable grade have shelf-life characteristics of the oil that are much better than existing cultivars (O'Keefe *et al.*, 1993), the effects of this changed fatty acid composition on peanut sensory attributes were not known. Limited prior work with the original F435 and an isogeneic line with normal fatty acid composition had shown no effect on peanut flavor (Moore *et al.*, 1989).

Materials and Methods

Genotype Resources. Four high oleic acid breeding lines (F1250, F1315, F1316, and F1334) produced from backcrosses of F435 with F519-9, a component line of Sunrunner, were selected in the BC_2F_4 or BC_3F_3 generation. Seed increase and agronomic testing were used to identify these lines as having desirable yield and market grade. The four lines, along with Florunner, and NC 7 were grown in tests at the Agronomy Farm near Gainesville, FL in 1992 and 1993. Each year recommended cultural, harvesting, and handling practices were used.

Sample Handling. Each year a 1000-g sample of the sound mature kernel (SMK) fraction from each replicate was shipped to Raleigh, NC in February following harvest and placed in controlled storage at 5 C and 60% RH until roasted.

Sample Roasting and Preparation. The peanut samples from each year were roasted in May using a Blue M "Power-O-Matic 60" laboratory oven, ground into a paste, and stored in glass jars at -20 C until evaluated. The roasting, grinding, and color measurement protocols were as described by Pattee and Giesbrecht (1990) and Pattee *et al.* (1991).

Sensory Evaluation. An eight-member trained roasted peanut flavor profile panel at the Food Science Dept., North Carolina State Univ., Raleigh, NC evaluated all peanut-paste samples using a 1-14 intensity scale. Panel orientation and reference control were as described by Pattee and Giesbrecht (1990) and Pattee *et al.* (1993). Two sessions were conducted weekly but never on consecutive days. Panelists evaluated four samples per session. Samples were presented in an incomplete block design to monitor variation between panel sessions. Sensory evaluation commenced the first part of June and continued until all samples were evaluated. Definitions of the sensory attributes of roasted peanut flavor presented are given in Table 1.

Table 1. Definition of selected sensory attributes of roasted peanut flavor.

Attribute	Definition
Roasted peanut	A roasted peanut aroma or flavor
Fruity	Characterized by fermentation (alcohol) and/or reminiscent of fruit; includes immature peanuts; fruity like black walnuts
Sweet	Taste produced by substances such as sucrose when solubilized
Bitter	Taste produced by substances such as quinine or caffeine when solubilized
Stale	Old, cardboardy, straw-like note
Painty	Painty aromatic note as from an old paint can or linseed oil; includes rancid
Tongue/throat burn	A burning sensation felt on the tongue and/or in the throat
Astringent	Sensations of shrinking, drawing or puckering of the skin surfaces of the oral cavity, leaving a dry feeling in the mouth
Woody/hulls/skins	Aromatics associated with base peanut character similar to dry wood, peanut hulls and skins; also dusty
Sour	Taste produced by substances such as citric acid when solubilized

Statistical Analysis. Statistical analysis on all data sets was performed using procedures in the SAS (1987) system, version 6. The averages of individual panelists' scores on sensory attributes were used in all analyses. The findings of Pattee *et al.* (1994) on genotype-by-environmental interaction in roasted peanut flavor mean values indicated that four observations, two replications over 2 yr, would provide reasonable estimates of the experimental error in the mean values.

Results and Discussion

Pattee and Giesbrecht (1994) indicated that the first step in making comparative evaluations of roasted peanut sensory data should be to evaluate for the roast color and fruity attribute effects. The means for these two attributes across the four high oleic acid genotypes, Florunner, and NC 7 are presented in Table 2. Analysis of variance indicated that the effects of roast color and fruity attribute on roasted peanut attribute were nonsignificant and that no adjustment in the roasted peanut intensity data was required. However, the least significant difference comparison for Florunner and NC 7

Table 2. Means for roast color and fruity attributes from four high oleic acid genotypes, Florunner, and NC 7.

Genotype	Roast color (CIELAB L')	Fruity
F1250	58.5	2.7
F1315	58.3	2.6
F1316	58.8	2.9
F1334	58.1	3.0
Florunner	57.5	3.2
NC 7	59.5	2.9
LSD_{05}	1.2	0.9

indicates a difference at the P = 0.05 level. However, since the roast color difference between NC 7 and the high oleic acid breeding lines was not significant, it was felt that this difference had no effect on the level of sensory differences observed between NC 7 and the other genotypes in Table 3.

The sensory intensity means for the roasted peanut (Table 3) from the four high oleic acid genotypes, Florunner, and NC 7 provide the first opportunity to make a quantitative evaluation of the high oleic acid lines' flavor quality. The general linear model (GLM) analysis of these data is presented in Table 4. Year effects in the data were highly significant, and this in agreement with the observations of Pattee *et al.* (1994). Germplasm effects were significant at the 5% level. To observe the effect of years on the data, least square means (Table 3) were computed using the GLM in Table 4. The largest adjustment occurred in the Florunner mean. Comparing the mean roasted peanut values, differences at the 5% level were observed between NC 7, F1316, and F1334. In the least square means comparisons, Florunner and F1315 are different from NC 7 at the 5% level. Thus, these data suggest that the high oleic acid lines of choice would be F1316 and F1334. The breeding lines F1250 and F1316 are currently being increased for possible release.

Other sensory attributes of interest for these high oleic acid lines are sweet, bitter, stale, painty, tongue/throat burn, astringent, woody/hulls/skins, and sour. Response levels for these attributes are presented in Table 5. None of the genotypes in this study show any significant differences for these attributes. One trend in the data, which may warrant further evaluation, is the higher stale responses in Florunner and NC 7. Such responses might be indicative of resistance to 'flavor fade' among the high oleic acid lines and are supportive of the longer shelf-life times for these lines (O'Keefe *et al.*, 1993).

Table 3. Means for roasted peanut attribute from four high oleic acid genotypes, Florunner, and NC 7.

Genotype	Roasted peanut	LS mean
F1250	4.4	4.3
F1315	4.7	4.6
F1316	4.8	4.6
F1334	4.8	4.9
Florunner	4.4	5.0
NC 7	3.9	3.6
LSD_{05}	0.9	

Table 4. General linear model analysis of roasted peanut attribute of four high oleic acid breeding lines, Florunner and NC 7.

Source	df	Type III sum of squares	Mean squares	F
Roast color(lin)	1	0.0531	0.0531	0.39
Roast color(quad)	1	0.0566	0.0566	0.37
Fruity	1	0.0116	0.0116	0.09
Year	1	2.1696	2.1696	16.13**
Germplasm	5	2.3058	0.4611	3.43*
Germplasm x year	5	1.1186	0.2237	1.66

*,**Significant at P=0.05 and 0.01, respectively.

Table 5. Means for selected sensory attributes from four high oleic acid genotypes, Florunner, and NC 7.

Attribute	Genotype					
	F1250	F1315	F1316	F1334	Florunner	NC 7
Sweet	2.9	2.9	3.0	3.0	3.1	2.8
Bitter	3.7	3.6	3.5	3.8	3.5	3.7
Stale	2.9	2.6	3.0	2.7	3.1	3.1
Painty	1.1	1.1	1.1	1.0	1.2	1.0
Tongue burn	3.4	3.6	3.3	3.6	3.6	3.5
Astringent	3.2	3.3	3.0	3.2	3.7	3.5
Woody	3.4	3.5	3.3	3.7	3.6	4.2
Sour	2.9	2.5	2.4	2.5	3.1	2.6

LSD_{05} for
Sweet = 0.7 for comparisons between genotypes
Stale = 0.9 for comparisons between genotypes

Conclusions

Sensory evaluations of roasted-peanut paste from four high oleic acid breeding lines (F1250, F1315, F1316, F1334), Florunner, and NC 7 indicate that improvement in fatty acid composition of peanut lines by increasing oleic and decreasing linoleic acids does not appear to be associated with changes in roasted peanut attribute intensity. The breeding lines had similar attribute intensity to an accepted industry standard, Florunner, and were significantly better than NC 7. The lines F1316 and F1334 had the highest roasted peanut intensities. Comparisons for other sensory attributes, fruity, sweet, bitter, stale, painty, tongue/throat burn, astringent, woody/hulls/skins, and sour were not significantly different.

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