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Evaluation of White-Testa Peanut Genotypes For Potential Use As Food Supplements[1]

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ABSTRACT

While searching for peanut (*Arachis hypogaea* L.) genotypes that could compete both nutritionally and economically with other plant proteins in the United States market, a white-testa peanut was examined. This genotype had low concentrations of flatus-producing sugars, lacked flavor, and had a high calcium content. Production costs could be reduced because blanching would not be required to produce a high quality, cream-colored flour. Since the initial study, samples of four additional white-testa genotypes have been obtained. All five were examined for possible use as protein supplements in food. Flours and isolates were prepared and evaluated chemically for protein content, amino acid pattern, and gel- and immuno-electrophoretic patterns. Experimental field plots were grown to determine seed germination potentials and yields. The results indicated that two of the genotypes had good biochemical profiles and produced well in the field. These two Spanwhite and P. I. 288160. have been selected for further study.

Key Words: Peanut, groundnut, white-testa, genotypes, chemical evaluation, crop yeild.

During recent years the nutritional and economic advantages of using plant proteins in human food have become apparent. The leguminous oilseeds — peanuts (*Arachis hypogaea* L.) and soybeans (*Glycine max* (L) Merrill) — are among the more accepted plant proteins for food use. Peanuts have some properties equal to or better than soybeans, but their higher price makes them less attractive to the United States food processor. In searching for genotypes that could compete with soybeans both nutritionally and economically a white-testa peanut was examined. This genotype was similar in composition to the more common red-testa cultivars, but it lacked flavor. Although the bland flavor would make the white-testa peanut undesirable for use in candy and peanut butter or for consumption as fresh or roasted peanuts, it could be an advantage in certin applications, *i.e.*, food or beverage supplementation. One important advantage of a white-testa peanut is the potential reduction in processing costs. Since the testae would not have to be removed, blanching would be unnecessary possibly reducing production costs of the flour by two to four cents per pound.

Good chemical composition and lowered production costs, however, are not the only criteria for evaluation of new peanut cultivars. Germination potentials and crop yields must be considered. Therefore, a cooperative study was set up between the Southern Regional Research Center (S.R.R.C.) and the Georgia Coastal Plain Experiment Station. Five white-testa peanut genotypes were compared. Results of chemical evaluations made at S.R.R.C. and of production evaluation made of experimental field plots planted in Georgia are reported.

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[4]Use of tradenames does not imply endorsement by the U. S. Department of Agriculture over other products not mentioned.

Materials and Methods

Five peanut genotypes were obtained in 300-400 g lots from the Coastal Plain Station. Flours and isolates were prepared as described by Conkerton *et. al.* (3). Nitrogen was determined by the Kjeldahl procedure; sulfur and phosphorus by X-ray diffraction.

Sugars were extracted as described by Conkerton and Ory (2) and determined by thin-layer chromatography (TLC). Pre-coated TLC plates, SilG-25 from Brinkman Instruments, Inc.[4], were spotted with standards of glucose, sucrose, raffinose, and stachyose (4μ g each) and equivalent aliquots from each sample. Three successive ascending developments were made using chloroform:methanol :: 60:40. The plates were air dried after each development. Visualization was accomplished by spraying with naphthoresorcinol-sulfuric acid and heating 5-10 min at 100-105C (6).

Amino acids were determined by gas chromatography according to Conkerton (1). Methionine was determined directly on the flours by the method of Finlayson and Mackenzie (5).

Electrophoretic mobility of the proteins was determined on 10% polyalcrylamide gels by the method of St. Angelo and Ory (9). Immunochemical comparisons were made according to Daussant *et al.* (4).

Experimental field plots of each genotype were grown at the Coastal Plain Station to determine crop yield in comparison to a commercial cultivar.

Results and Discussion

The five white-testa genotypes are identified in Table 1. Flours from all samples represented approximately 50% by weight of the original seed. Protein contents of the flours were similar, but WP-1 seemed to have slightly lower concentrations of sulfur and phosphorus than the others. Yields of isolates from flours varied from 38% for WP-4 to 49% for WP-2. All isolates contained approximately 16% nitrogen.

Genetic differences or relatedness of seeds can be determined by immunochemical or electrophoretic techniques. Specific proteins not readily distinguishable by other chemical means can be detected by immunochemical procedures. In gel-electrophoresis, the seed proteins are separated into thin bands for comparison of migration through a polyacrylamide matrix. As can be seen from Figures 1 and 2, these five peanut genotypes were similar both in immunochemical response and gel-electrophoretic patterns.

Semi-quantitative estimation of sugars showed sucrose to be the major component with glucose, raffinose, and stachyose present in all samples. The density of each of the spots in WP-2 and WP-3 seems to be less than in the other three samples. Since all samples were applied at a similar concentration, this would indicate a lower total sugar concentration in WP-2 and WP-3. Stachyose and raffinose contents of WP-1 and WP-5 appear to be higher than for the other three genotypes. Stachose, raffinose, and verbascose are the

Table 1. Identification and Comparison of Five White-testa Peanut Genotypes.

Sample	Genotype	Composition: Oil %	Flour: Flour %	Flour: Nitrogen %	Flour: Protein* %	Flour: Sulfur %	Flour: Phosphorus %	Isolate: Yield from 100g Flour G	Isolate: Nitrogen %
WP-1	P.I.306220	46.8	53.2	9.3	50.8	0.72	0.52	47	15.8
WP-2	P.I.288160	49.2	50.8	9.4	51.3	0.89	0.73	49	15.7
WP-3	Spanwhite	49.3	50.7	9.2	50.2	0.83	0.68	40	16.1
WP-4	Pearl	49.2	50.8	9.3	50.8	0.84	0.78	38	15.6
WP-5	Pearl Early Runner	49.7	50.3	9.7	53.0	0.77	0.82	48	15.8

*Protein = % N x 5.46

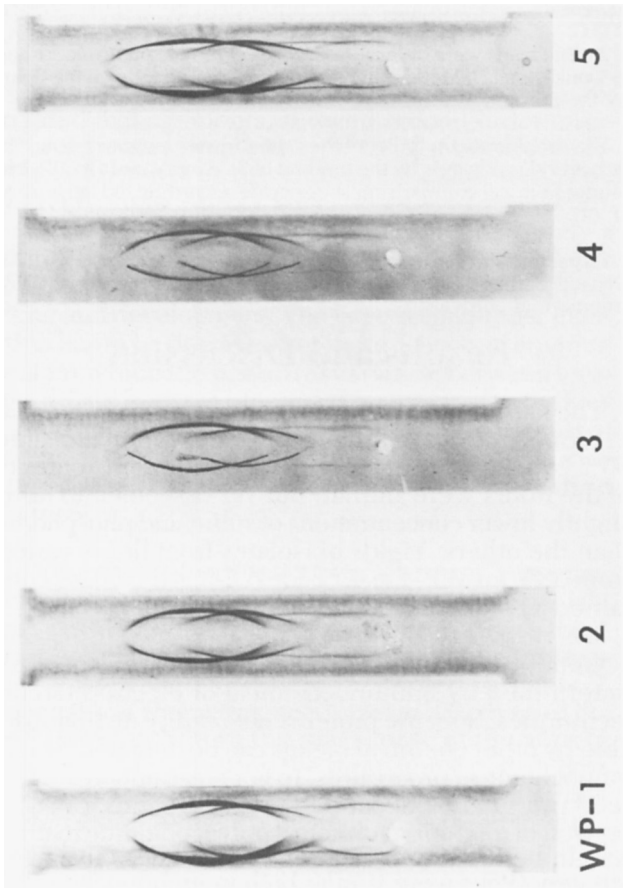

Fig. 1. Immunoelectrophoretic patterns of proteins from five white-testa peanut genotyeps.

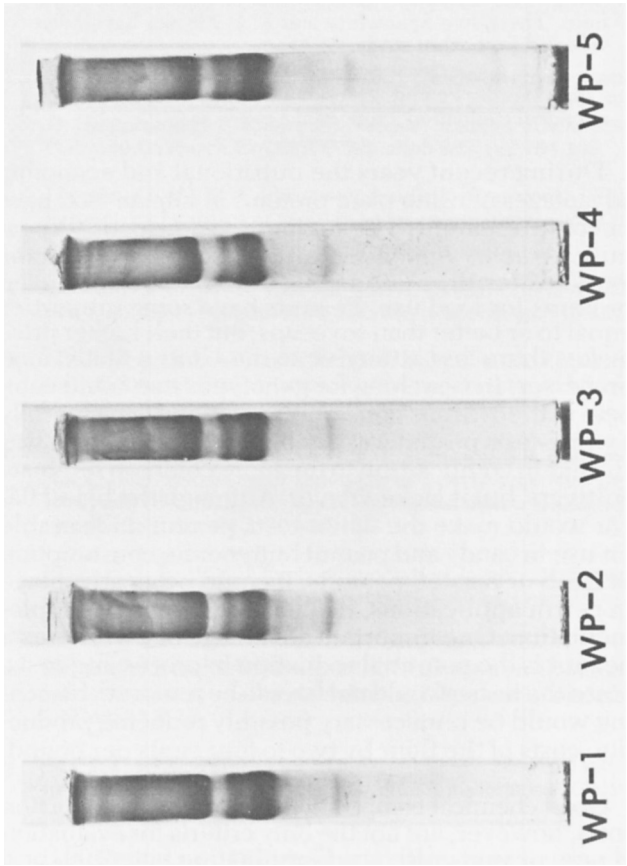

Fig. 2. Gel-electrophoretic patterns of proteins from five white-testa peanut genotypes.

flatus-causing oligosaccharides associated with legumes (8). The low concentration of these materials in peanut flours compared to soy flours could make peanuts more desirable for food use (2). Thus genotypes WP-2, WP-3, and WP-4 would be more acceptable than WP-1 and WP-5.

The five genotypes vary in maturity, growth habit and other production characteristics. WP-1 and WP-5 gave poor yields initially, possibly because the seed were of low germinability. In 1975, WP-2, WP-3, and WP-4 yielded 98%, 100% and 97%, respectively, of the farmerstock production of the red-testa Spanish cultivar in field comparisons. The 1977 production was similar for the latter three genotypes but was lower than that in 1975.

The essential amino acid patterns of WP-2, WP-3, and WP-4 are similar except for their methionine and cystine contents. The methionine content of WP-4 is approximately 43% less than that of either WP-2 or WP-3. Since methionine, a sulfur-containing amino acid, is one of the more limiting amino acids in pea-

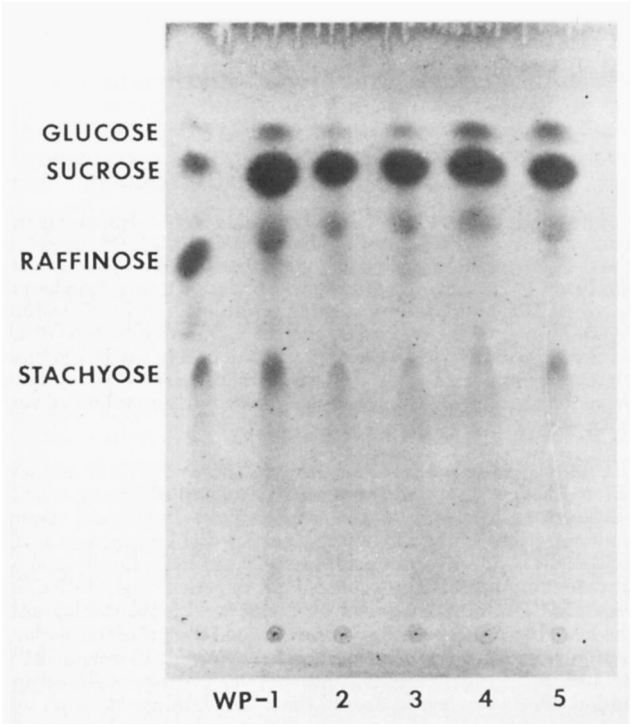

Fig. 3. Thin-layer chromatographic separation of sugars in five white-testa peanut genotypes.

nut flour, higher concentrations of it, as in WP-2 and WP-3, are preferred. Cystine, another sulfur containing amino acid, can exert a sparing effect on the methionine requirement (7). The total sulfur-containing amino acids, therefore, can be considered in evaluating the essential amino acid pattern of a protein. The total sulfur-containing amino acids contents of WP-2, WP-3, and WP-4 are 2.5, 2.7, and 1.9 g/16g N, respectively. Again, the higher concentrations of these amino acids, as in WP-2 and WP-3, would be preferred.

Among these five genotypes, therefore, WP-2 and WP-3 appear to be most suitable for further evaluation. Sufficient seeds were planted at the Coastal Plain Station to provide at least 90.8 kg (200 lb) of shelled peanuts from each of these genotypes. These peanuts have been de-oiled on a pilot plant scale and the flours are being evaluated in greater detail. Plans include taste-panel evaluation of various food products prepared with the flours. Results will be reported later.

Table 2. Production Performance and Statistics for Three White-testa Peanut Genotypes Grown at Coastal Plain Station, Tifton, Ga. in CY 1975 and CY 1977[1]

	WP 2		WP 3		WP 4	
Crop Year	1975	1977	1975	1977	1975	1977
Yield:						
Mean	11.1	7.4	11.3	7.4	10.9	7.1
S.E.M.	.71	.22	5.35[2/]	.53	.61	.45
% Check	98	87	100	84	97	84
(Check)	Tamnut	Tamnut	Tamnut	Starr	Tamnut	Tamnut
Std. dev.	1.7	0.5	13.1[2/]	1.3	1.5	1.1

1/ Six replications annually.

2/ Value inflated by aberrant data for one entry-replicate.

Table 3. Essential Amino Acids of Flours from Three White-testa Peanut Genotypes. g/16g N

	WP-2	WP-3	WP-4
Isoleucine	1.9	1.6	2.1
Leucine	5.6	5.7	6.3
Lysine	2.9	2.6	2.9
Methionine*	1.3	1.4	0.8
Cystine/2	1.2	1.3	1.1
Phenylalanine	4.4	4.5	4.7
Tyrosine	3.6	4.0	3.6
Threonine	2.1	2.0	2.2
Valine	2.6	2.3	2.8
Arginine	11.0	11.7	12.3
Histidine	1.9	1.9	2.0

* Determined as MeSCN, variance = ±0.1%.

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