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Effect of Growing Seasons, Locations and Planting Dates on Total Amino Acid Composition of Two Valencia Peanut Varieties Grown in New Mexico[1]

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ABSTRACT

Two Valencia peanut (*Arachis hypogaea* L.) cultivars, New Mexico Valencia A and New Mexico Valencia C, were grown at Arch and Los Lunas, N.M. All peanuts were grown under either sprinkler or furrow irrigation. Samples were obtained following harvest, hydrolyzed and analyzed in Raleigh, N. C. for amino acid content. With samples from Arch, no variety by planting date effects were noted for amino acid composition. With samples from Los Lunas, however, significant variety by planting date effects were noted for glutamic acid, glycine, methionine, isoleucine, and leucine. Planting date effects were found only for glycine at the Los Lunas location and phenylalanine at both locations. Significant variety differences were found for methionine, tyrosine, phenylalanine, and lysine at the Arch location and for glycine, methionine, phenylalanine, and lysine at the Los Lunas location. A significant year effect, although small, was noted for about half of the amino acids (aspartic acid, serine, glutamic acid, proline, glycine, tyrosine, phenylalanine, arginine, and the sum of all amino acids) studied at the Arch location. Data at Los Lunas were observed only during the second year. The amino acid content agrees closely with that previously reported for other types of peanuts except for a 100% higher level of cystine found in this study.

Key Words: *Arachis hypogaea* L., amino acid composition, Valencia, location effect, planting date effect.

New Mexico produces over 90 percent of the Valencia peanuts (*Arachis hypogaea* subsp. *fastigiata* var. *fastigiata*) grown in the United States. Valencia peanuts, raw or roasted, are sold primarily in the shells. Roasted Valencia peanuts have excellent flavor.

Genotypes and environments (planting locations, irrigation levels, disease infection, and maturation) are reported to cause variation in amino acid composition of peanuts (1, 2, 6, 7, 8, 9). A previous report (9) showed the location and year variation in amino acids in the Spanish, Virginia, and Runner market types grown in the three major peanut production areas. The present study was undertaken to quantitate the influence of growing seasons, locations, and planting dates upon the amino acid composition of two Valencia peanut varieties grown under irrigation in New Mexico in 1978 and 1979.

Materials and Methods

Two newly released Valencia peanut varieties, New Mexico Valencia A (3) and New Mexico Valencia C (4), were grown at locations in Arch (Roosevelt County) and Los Lunas (Valencia County), N.M., which are about 350 km apart. The approximate elevation of Los Lunas is 1,476 m whereas that of Arach is 1,223 m. Because of its higher altitude and slightly wider latitude, Los Lunas has a shorter frost-free period, lower average temperatures and greater fluctuations of day and night temperatures than Arch. The soil type for the peanut field in Los Lunas is Vinton Loamy Fine Sand with a pH of 7.9. The Arch peanut field has Clovis Fine Sandy Loam soil with a pH of 8.1.

There were five planting dates (April 28 to May 25 at weekly intervals) at the Arch location and 6 planting dates (April 24 to May 29) at the Los Lunas location. All peanuts were grown under either sprinkler or furrow irrigation. Samples were collected in both 1978 and 1979 at the Arch location and only in 1979 at the Los Lunas location.

Peanut samples were obtained after harvest and shipped to North Carolina for storage at 18 C prior to sample preparation and analysis. Total edible kernels (25 g) were ground in a coffee mill and 100 mg was hydrolyzed (5,6) and analyzed on a Durrum D-500 amino acid analyzer for total individual amino acid content: aspartic acid (ASP), threonine (THR), serine (SER), glutamic acid (GLU), proline (PRO), Glycine (GLY), alanine (ALA), cystine (CYS), valine (VAL), methionine (MET), isoleucine (ILE), leucine (LEU), tyrosine (TYR), phenylalanine (PHE), histidine (HIS), lysine (LYS), ammonia (NH_4), and arginine (ARG). Individual amino acids from single determinations are reported as g/100g of edible peanuts. All amino acids plus NH_4 were added to obtain the values listed under SUM (Tables 1 and 2). The total weight of hydrolyzed amino acids represented by SUM is approximately 15 percent greater than that of the protein from which they are derived, since one molecule of water is added for each peptide bond hydrolyzed. Therefore, multiplying SUM by 0.85 will result in a reasonable estimate of the protein content of the peanut samples.

The experiment at Arch was analyzed as a three-factor factorial with planting dates, varieties, and years as factors. The Los Lunas experiment did not have the year factor and was analyzed as a two-factor factorial.

Results and Discussion

This paper is concerned with the total amino acids produced through hydrolysis of the peanut proteins, which are related to the nutritional value of peanuts, The free amino acids, which are related to roasted peanut flavor, were not measured. Table 1 presents the amino acid composition, NH_4, and SUM for Valencia peanuts grown at Arch, New Mexico in 1978 and 1979. Significantly ($p<0.05$) higher means were detected for ASP, SER, GLU, PRO, GLY, TYR, PHE, ARG, AND SUM in 1978 and in 1979. The year means are shown at the bottom of the table. The small differences probably do not represent a significant variation in the nutritional quality and/or in nutritional labeling of Valencia peanut products. Valencia A had significantly ($p<0.05$) higher means than Valencia C for MET, THR, PHE, and LYS. The time of planting at the Arch location significantly ($p<0.05$) affected only PHE, which was highest at the earliest planting date of April 28. There was no significant ($p<0.05$) variety by planting date interaction at this location. Seven of the amino acids (THR, ALA, CYS, VAL, ILE, LEU, and HIS) and NH_4 were not affected by any of the factors measured at the Arch location.

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Table 1. Mean squares from the analysis of variance, coefficient of variability, and means of amino acids to two Valencia peanut varieties at Arch, New Mexico, 1978-1979.

Source	df	ASP	THR	SER	GLU	PRO	GLY	ALA	CYS	VAL	MET	ILE	LEU	TYR	PHE	HIS	LYS	NH_4	ARG	SUM
Analysis of Variance with Mean Squares[x]																				
Variety (V)	1	0.097	0.002	0.007	0.379	0.010	0.004	0.001	0.000	0.003	0.002†	0.005	0.018	0.017†	0.026†	0.003	0.004*	0.006	0.080	5.00
Year (Y)	1	0.126*	0.002	0.017*	0.463*	0.024*	0.028*	0.014	0.004	0.006	0.000	0.003	0.023	0.014*	0.014*	0.003	0.002	0.000	0.258*	8.14*
Date (D)	4	0.009	0.000	0.001	0.035	0.001	0.002	0.003	0.000	0.001	0.001	0.001	0.004	0.003	0.011*	0.002	0.001	0.001	0.023	0.66
V x D	4	0.024	0.001	0.003	0.088	0.003	0.003	0.006	0.000	0.004	0.000	0.002	0.008	0.001	0.001	0.001	0.001	0.001	0.050	1.40
Error	9	0.023	0.001	0.002	0.078	0.003	0.004	0.016	0.001	0.004	0.000	0.002	0.007	0.001	0.003	0.001	0.001	0.003	0.024	1.33
C. V. (%)		5.7	5.3	4.3	5.6	5.5	5.2	14.7	7.9	6.2	6.4	5.6	5.6	3.4	5.3	5.0	3.9	18.8	5.7	5.1
Variety (A or C) by Planting Date Means[y]																				
April 28	A	2.62	0.59	1.02	4.96	0.98	1.20	0.77	0.38	0.99	0.20	0.78	1.46	0.98	1.13	0.66	0.82	0.30	2.64	22.5
	C	2.76	0.62	1.07	5.21	1.02	1.27	0.89	0.40	1.06	0.20	0.84	1.55	0.94	1.09^{a}	0.64	0.84	0.28	2.90	23.6
May 4	A	2.79	0.62	1.08	5.28	1.04	1.29	0.86	0.40	1.07	0.22	0.84	1.56	0.98	1.06_{b}	0.64	0.84	0.27	2.94	23.8
	C	2.55	0.58	.99	4.79	0.95	1.21	0.92	0.41	1.00	0.19	0.77	1.42	0.90	0.96^{b}	0.60	0.78	0.26	2.64	21.9
May 11	A	2.67	0.60	1.04	5.04	1.00	1.20	0.88	0.42	1.03	0.22	0.79	1.47	0.93	1.00_{b}	0.61	0.80	0.36	2.77	22.8
	C	2.47	0.58	1.00	4.65	0.92	1.17	0.83	0.43	0.98	0.18	0.76	1.39	0.88	0.92^{b}	0.60	0.78	0.28	2.51	21.3
May 18	A	2.70	0.61	1.06	5.10	1.00	1.23	0.86	0.42	1.02	0.21	0.81	1.51	0.97	1.05_{b}	0.65	0.82	0.36	2.76	23.1
	C	2.52	0.58	1.02	4.74	0.94	1.21	0.93	0.40	0.98	0.19	0.76	1.42	0.90	0.96^{b}	0.62	0.78	0.26	2.58	21.8
May 25	A	2.74	0.62	1.07	5.14	1.02	1.24	0.86	0.40	1.02	0.19	0.81	1.52	0.92	1.04_{b}	0.63	0.82	0.29	2.74	23.0
	C	2.57	0.60	1.04	4.82	0.96	1.20	0.84	0.42	0.99	0.16	0.76	1.43	0.87	0.98^{b}	0.63	0.80	0.27	2.50	21.8
Variety Means																				
Valencia A		2.72	0.61	1.06	5.14	1.01	1.24	0.85	0.40	1.03	0.21	0.81	1.51	0.96	1.07	0.64	0.82	0.30	2.77	23.2
Valencia C		2.58	0.59	1.03	4.86	0.97	1.21	0.87	0.41	1.01	0.18	0.78	1.45	0.90	0.99	0.62	0.79	0.27	2.65	22.2
Year and Grand Means																				
1978 Mean		2.73	0.61	1.07	5.15	1.03	1.26	0.89	0.42	1.04	0.20	0.81	1.51	0.96	1.05	0.64	0.82	0.28	2.82	23.3
1979 Mean		2.57	0.59	1.02	4.85	0.96	1.19	0.84	0.39	1.00	0.19	0.78	1.45	0.90	1.00	0.62	0.80	0.29	2.60	22.0
Grand Mean		2.65	0.60	1.05	5.00	0.99	1.22	0.86	0.40	1.02	0.19	0.80	1.48	0.93	1.02	0.63	0.81	0.28	2.71	22.6

x*, + Analysis of variance component is significant at 5% and 1% level of probability, respectively.

y The comparison is made down a column for the planting date means. The dates which have different letters have significantly different means at the 5% level according to the Least Significant Difference (LSD) Test.

At the Los Lunas location (Table 2), significant ($p<0.05$) variety by planting date interactions were found for GLU, GLY, MET, ILE, and LEU. The two planting dates after May 15 resulted in higher levels of GLY, MET, and LEU for the Valencia C than of the Valencia A variety. GLU and ILE levels were lower for Valencia C than the Valencia A on the May 15 planting date. The Valencia A variety had significantly ($p<0.05$) lower PHE and LYS levels than Valencia C for all planting dates. The later planting dates (May 22 and May 29) had higher ($p<0.05$) levels of PHE than earlier planting dates. Over half of the amino acids (ASP, THR, SER, PRO, ALA, CYS, BAL,

Table 2. Mean squares from the analysis of variance, coefficient of variability, and means of amino acids in two Valencia peanut varieties at Los Lunas, New Mexico, 1979.

Source	df	ASP	THR	SER	GLU	PRO	GLY	ALA	CYS	VAL	MET	ILE	LEU	TYR	PHE	HIS	LYS	NH_4	ARG	SUM
Analysis of Variance with Mean Squares[x]																				
Variety (V)	1	0.018	0.003	0.004	0.089	0.001	0.174†	0.003	0.000	0.002	0.000*	0.000	0.039	0.005	0.101*	0.012	0.011*	0.000	0.158	2.14
Date (D)	5	0.052	0.002	0.006	0.166	0.012	0.030*	0.009	0.007	0.005	0.000	0.003	0.018	0.010	0.045*	0.008	0.004	0.002	0.084	3.40
V x D	5	0.100	0.003	0.016	0.434*	0.018	0.030*	0.009	0.004	0.013	0.002*	0.009*	0.035*	0.007	0.008	0.003	0.003	0.001	0.046	5.29
Error	12	0.041	0.001	0.005	0.130	0.009	0.008	0.007	0.006	0.005	0.000	0.002	0.009	0.007	0.012	0.003	0.002	0.002	0.036	2.27
C. V. (%)		6.7	5.4	6.1	6.5	8.4	6.5	8.9	18.7	6.0	4.8	5.2	5.6	7.7	9.0	7.5	5.0	13.4	6.1	5.8
Variety (A or C) by Planting Date Means[y]																				
April 24	A	2.74	0.61	1.07	5.14^{ab}	1.01	1.17^{a}	0.91	0.38	1.04	0.20^{ab}	0.83^{ab}	1.55^{a}	0.98	1.09_{a}	0.66	0.84	0.28	2.94	23.4
	C	3.04	0.67	1.19	5.72^{a}	1.13	1.40^{ab}	0.89	0.39	1.13	0.21^{abc}	0.95^{b}	1.70^{abc}	1.10	1.20	0.69	0.89	0.30	3.23	25.8
May 1	A	3.04	0.67	1.16	5.73^{a}	1.15	1.33^{a}	0.99	0.45	1.15	0.21^{abc}	0.90^{ab}	1.69^{ab}	1.08	1.14_{a}	0.67	0.88	0.30	3.07	25.6
	C	2.94	0.65	1.19	5.57^{ab}	1.09	1.33^{a}	0.86	0.38	1.09	0.21^{abc}	0.89^{ab}	1.64^{ab}	1.06	1.18	0.68	0.87	0.26	3.18	25.0
May 8	A	3.04	0.66	1.19	5.70^{b}	1.14	1.28^{a}	0.94	0.42	1.16	0.20^{ab}	0.91^{ab}	1.70^{abc}	1.08	1.16_{ab}	0.69	0.87	0.30	2.91	25.4
	C	3.16	0.68	1.23	5.92^{b}	1.20	1.37^{ab}	0.94	0.36	1.15	0.19^{a}	0.95^{b}	1.76^{abc}	1.13	1.25	0.72	0.91	0.28	2.17	26.4
May 15	A	3.15	0.69	1.29	5.93^{b}	1.18	1.39^{ab}	0.98	0.43	1.20	0.21^{abc}	0.94^{b}	1.75^{abc}	1.12	1.18	0.74	0.90	0.27	3.03	26.4
	C	2.64	0.63	1.08	4.57^{a}	0.93	1.36^{ab}	0.84	0.55	1.04	0.21^{abc}	0.77^{a}	1.55^{a}	1.01	1.26^{ab}	0.73	0.87	0.30	2.77	22.9
May 22	A	3.03	0.66	1.18	5.68^{ab}	1.15	1.31^{a}	1.01	0.40	1.13	0.20^{ab}	0.90^{ab}	1.67^{abc}	1.13	1.26_{c}	0.72	0.90	0.29	3.17	25.8
	C	3.33	0.74	1.31	5.73^{b}	1.23	1.71^{c}	1.06	0.36	1.26	0.24^{c}	0.94^{ab}	1.94^{c}	1.21	1.54	0.87	1.01	0.33	3.47	28.3
May 29	A	3.94	0.65	1.16	5.54^{ab}	1.11	1.28^{a}	0.89	0.41	1.09	0.20^{ab}	0.87^{ab}	1.61^{ab}	1.12	1.26_{bc}	0.71	0.87	0.35	3.09	25.1
	C	3.15	0.71	1.23	5.47^{ab}	1.13	1.61^{bc}	1.00	0.38	1.20	0.23^{bc}	0.89^{ab}	1.86^{bc}	1.17	1.45	0.75	0.97	0.32	3.35	26.9
Variety and Grand Means																				
Valencia A		2.99	0.66	1.18	5.62	1.13	1.29	0.95	0.41	1.13	0.20	0.89	1.66	1.09	1.18	0.70	0.89	0.30	3.03	25.3
Valencia C		3.04	0.68	1.20	5.50	1.12	1.46	0.93	0.40	1.15	0.21	0.90	1.74	1.11	1.31	0.74	0.92	0.30	3.20	25.9
Grand Mean		3.02	0.67	1.19	5.56	1.12	1.38	0.94	0.41	1.14	0.21	0.89	1.70	1.10	1.25	0.72	0.90	0.30	3.11	25.6

x *,† Analysis of variance component is significant at 5% and 1% level of probability, respectively.

y The comparison is made down a column for planting date means if the planting date by variety interaction is not significant. The comparison of planting date and variety combinations is made if the interaction is significant. Means followed by different letters are significantly different at the 5% level according to the least significant difference (LSD) test.

TYR, HIS, NH_4, ARG, and SUM) were not affected by any of the factors studied at the Los Lunas, New Mexico location.

The amino acid composition of the peanuts in this study were in close agreements with the minimum values published by Young (8) in the 1973 and 1974 uniform peanut performance tests, except for cystine. The coefficients of variability for both studies were also in close agreement. The lower amino acid values obtained in this study were generally about 75 percent of those published by Young (9) except for cystine, which was nearly 100 percent greater. Cystine complements methionine, an amino acid containing sulphur, which is essential for the nutritional requirements of man. Therefore, the higher cystine value is of nutritional interest. The proteins estimated in this study (ranging from 18.1 to 24.1 percent) are generally lower than the data shown by Young and Hammons (10), which ranged from 21 to 30 percent. Some previous data (4) has shown that oil content of the Valencia peanuts grown in New Mexico is about 43 to 46 percent. The lower quantities of protein and oil in the Valencia peanuts indicates that the carbohydrate and sugar fractions may be higher, but studies are needed to clarify this hypothesis. If true, this could account for the supposedly sweeter taste of the Valencia peanut. It could be very important in the development of the excellent roasted peanut flavor for which the Valencia peanuts are noted.

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