Analyses of Peanut Kernels With Relation to U. S. Standards for Farmers' Stock Peanuts

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The present grading standards for farmers' stock peanuts are based on physical factors deemed important in marketing peanuts as edible kernels. These factors are the percentage of kernels obtained on shelling and certain qualitative factors of damage, varietal admixture, and immature seeds. With the recent increase in production to provide a source of oil to meet domestic and lend-lease requirements large quantities of peanuts have been and will be processed for oil and meal. In marketing the crop for processing some knowledge of the yields of oil and meal and certain characteristics of both the oil and meal are considered essential. For this reason, a large number of samples of peanuts of the several market grades of Spanish, Runner and Virginia types from the 1942 crop were obtained by the Office of Distribution, War Food Administration, and the kernels were chemically analyzed by the Southern Regional Research Laboratory.

The U. S. No. 1, 2 and 3 grades of farmers' stock White Spanish and Runner peanuts consist of unshelled peanuts which are mature, dry, and practically free from damage. The percentage of sound kernels, of tolerance for other varieties, and of damaged kernels for the specified grades are given in Table 1.

TABLE 1

Requirements for U. S. Standard Grades of Unshelled White Spanish and Runner Peanuts [1]
(Percentage based on total weight of sample)

Grade	Tolerance for other varieties	Minimum sound kernels		Tolerance for damaged kernels
		White Spanish	Runner	
	Pct.	*Pct.*	*Pct.*	*Pct.*
U. S. No. 1	1	70	65	2
		71	66	3
U. S. No. 2	1	65	60	2
		66	61	3
		67	62	4
		68	63	5
U. S. No. 3	1	60	55	2
		61	56	3
		62	57	4
		63	58	5
		64	59	6

[1] U. S. Standards for Farmers' Stock White Spanish Peanuts (Reissued June 15, 1942) and U. S. Standards for Farmers' Stock Runner Peanuts (Reissued July 27, 1942), Agricultural Marketing Administration, Office of Distribution, War Food Administration, U. S. Department of Agriculture.

The standards for farmers' stock of the Virginia type of peanuts give consideration to the kernel size. Virginia type peanuts are much less important than the other varieties in the oil seed market because their use is confined largely to the edible nuts trade.

The grade card, showing the values for the factors by which the grades were determined was furnished the Laboratory with each sample of kernels analyzed.

[1] This is one of four Regional Research Laboratories operated by the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

An example of the grade card follows:

Sample No. R-20-Texas

Karnes City, Texas — Place

October 29, 1942 — Date

From Warehouse No. 1 — Grower's Name

*Seriously Damaged Loose shelled kernels	0
Loose Shelled Kernels Included in T.O.K.C.	3
Sound Small Shrivelled	1
Other Varieties	0
Sound Mature Meats	70
Damage Not Serious	0
Total Oil Kernel Content	74

* Serious Damage 1.5

Type White Spanish Grade U. S. No. 1

* Serious Damage means decayed, moldy, rancid, and sprouts over ⅛" long.

The most important factors determining the grade of peanuts are the percentage yield of sound mature kernels and the percentage of damaged kernels, both of which are determined on the basis of peanuts obtained after shelling. Other factors of quality which constitute part of the grading are the percentages of loose kernels, small shriveled kernels, foreign material, kernels of other varieties and shells.

"Total oil kernel content" was a term used by the marketing agencies of the Department of Agriculture in the inspection of the 1942 crop, and was intended to indicate the relative value of the lots for crushing. In addition to the sound mature kernels, it included sound loose kernels, sound small shriveled kernels, kernels which were not seriously damaged, and kernels of other varieties. In other words, the term was defined so as to include all kernels in the lot excepting the seriously damaged kernels.

The samples obtained represented the production in eleven states from Texas to Virginia, inclusive. The location of the points of origin of the samples is shown in Figure 1. White Spanish peanuts are grown commercially in large quantities in two distinctly different production areas, namely, (1) Texas and (2) Alabama-Georgia. The production of the Runner type is largely localized in the Alabama and Georgia areas, and that of the Virginia type in Virginia and North Carolina.

TABLE 2

Analysis of Spanish Peanuts From the 1942 Crop in Texas

Grade	Peanuts in sample		Weight per 100 kernels	Analysis of kernels			Iodine No. of oil (Wijs)	Free fatty acid in oil
	Sound mature kernels	Total oil kernel content		Oil (Dry basis)	Nitrogen (Dry basis)	Nitrogen (Dry and oil-free basis)		
	Pct.	*Pct.*	*g.*	*Pct.*	*Pct.*	*Pct.*		*Pct.*
U. S. No. 1 (20 samples)								
Highest Value	74.0	78.5	36.4	54.7	5.50	10.81	98.2	1.30
Lowest Value	70.0	73.0	29.9	47.9	4.12	9.09	93.4	0.10
Range	4.0	5.5	6.5	6.8	1.38	1.72	4.8	1.20
Average	71.7	75.5	33.4	51.4	5.04	10.37	95.0	0.38
Standard deviation	±1.3	±1.7	±1.8	±1.5	±0.31	±0.40	±1.4	±0.33
U. S. No. 2 (22 samples)								
Highest Value	71.0	78.5	37.8	56.2	5.44	10.99	99.4	1.52
Lowest Value	65.0	69.0	30.4	49.1	3.76	8.58	93.0	0.11
Range	6.0	9.5	7.4	7.1	1.68	2.41	6.4	1.41
Average	67.1	74.0	32.8	51.4	5.05	10.37	95.6	0.44
Standard deviation	±1.4	±1.9	±2.0	±1.7	±0.37	±0.54	±1.9	±0.36
U. S. No. 3 (14 samples)								
Highest Value	66.0	77.0	37.8	52.5	5.32	10.68	99.2	3.00
Lowest Value	60.5	68.0	30.4	49.1	4.88	9.98	92.7	0.14
Range	6.5	9.0	7.4	3.4	0.44	0.70	6.5	2.86
Average	62.7	72.3	33.7	50.9	5.11	10.40	96.1	0.72
Standard deviation	±1.4	±2.6	±2.1	±0.9	±0.13	±0.22	±1.9	±0.73

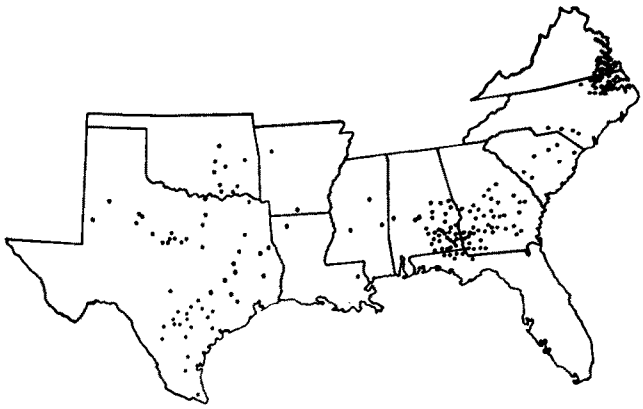

FIG. 1. Location of the points of origin of market samples of peanuts of the 1942 crop.

Since no moisture determinations were made at the time of grading of farmers' or warehouse stocks, no adjustment can be made to put the grading data on a uniform moisture content basis.

The determinations made in duplicate on the kernels of the market grades of peanuts by the 1941 methods of the American Oil Chemists' Society were: (1) grams per 100 kernels, (2) moisture, (3) oil, (4) nitrogen, (5) iodine number of the oil (Wijs), and (6) free fatty acid content of the oil. The weight in grams of 100 kernels, which gives a relative measure of the kernel size, was determined on the laboratory air-dry kernel sample containing about 5.25 percent moisture. The oil and nitrogen contents of the kernels are reported on the moisture-free basis. The values may be converted to any other desired moisture basis by multiplying by the dry matter value corresponding to the desired moisture content. The protein contents may be obtained by multiplying the nitrogen values by the conversion factor. In addition, the nitrogen values were calculated to the moisture- and oil-free basis. These values may be converted to any desired peanut meal basis by multiplying by the difference between 100 percent and the combined percentages of moisture and oil of the desired meal basis and dividing by 100. The iodine number and free fatty acid were determined on the solvent-extracted oil.

The summary data, including the highest and lowest values, range, average values, and standard deviation for the factors determined are given in Tables 2 to 7, for the various grades and types of peanuts. Because of the differences in environmental conditions of the two main production areas of the Spanish type, the data for this type are summarized separately for (1) 56 samples from Texas and (2) 76 samples from Alabama and Georgia in Tables 2 and 3, respectively. The data for all 172 samples of market grade Spanish type peanuts including 40

TABLE 3

Analysis of Spanish Peanuts From the 1942 Crop in Alabama and Georgia

Grade	Peanuts in sample		Weight per 100 kernels	Analysis of kernels			Iodine No. of oil (Wijs)	Free fatty acid in oil
	Sound mature kernels	Total oil kernel content		Oil (Dry basis)	Nitrogen (Dry basis)	Nitrogen (Dry and oil-free basis)		
	Pct.	*Pct.*	*g.*	*Pct.*	*Pct.*	*Pct.*		*Pct.*
U. S. No. 1 (30 samples)								
Highest Value	77.3	79.5	54.0	53.2	5.43	10.86	97.1	2.54
Lowest Value	70.0	72.0	29.2	45.8	4.52	9.34	93.2	0.07
Range	7.3	7.5	24.8	7.4	0.91	1.52	3.9	2.47
Average	72.0	76.0	32.9	50.2	4.99	10.02	95.2	0.37
Standard deviation	±1.9	±1.8	±4.4	±1.6	±0.21	±0.30	±1.0	±0.50
U. S. No. 2 (30 samples)								
Highest Value	70.0	77.5	53.1	53.4	5.34	10.52	97.3	1.58
Lowest Value	65.0	70.0	28.7	46.7	4.26	8.80	91.5	0.10
Range	5.0	7.5	24.4	6.7	1.08	1.72	5.8	1.48
Average	67.5	73.7	32.9	49.9	4.98	9.95	95.3	0.41
Standard deviation	±1.7	±1.8	±5.1	±1.7	±0.26	±0.37	±1.3	±0.37
U. S. No. 3 (16 samples)								
Highest Value	68.0	78.8	37.4	53.4	5.40	10.71	98.8	1.28
Lowest Value	60.3	66.8	26.4	47.0	3.98	8.01	93.8	0.14
Range	7.7	12.0	11.0	6.4	1.42	2.70	5.0	1.14
Average	63.9	72.0	31.4	49.4	4.95	9.77	95.3	0.48
Standard deviation	±2.0	±3.4	±2.8	±1.6	±0.40	±0.65	±1.2	±0.29

TABLE 4

Analysis of All Graded Samples of Spanish Peanuts Obtained From the 1942 Crop

Grade	Peanuts in sample		Weight per 100 kernels	Analysis of kernels			Iodine No. of oil (Wijs)	Free fatty acid in oil
	Sound mature kernels	Total oil kernel content		Oil (Dry basis)	Nitrogen (Dry basis)	Nitrogen (Dry and oil-free basis)		
	Pct.	*Pct.*	*g.*	*Pct.*	*Pct.*	*Pct.*		*Pct.*
U. S. No. 1 (62 samples)								
Highest Value	77.3	80.5	54.0	54.7	5.50	10.86	98.5	2.54
Lowest Value	70.0	72.0	28.6	45.8	4.06	8.74	93.2	0.07
Range	7.3	8.5	25.4	8.9	1.44	2.12	5.3	2.47
Average	71.8	75.7	33.1	50.8	4.95	10.06	95.4	0.34
Standard deviation	±1.8	±1.9	±3.4	±1.7	±0.31	±0.47	±1.3	±0.40
U. S. No. 2 (68 samples)								
Highest Value	71.0	78.5	53.1	56.2	5.44	10.99	99.4	1.58
Lowest Value	65.0	69.0	28.7	46.7	3.40	7.62	91.5	0.08
Range	6.0	9.5	24.4	9.5	2.04	3.37	7.9	1.50
Average	67.4	73.4	32.7	50.9	4.92	10.01	95.7	0.39
Standard deviation	±1.5	±2.0	±3.7	±2.0	±0.37	±0.57	±1.5	±0.34
U. S. No. 3 (42 samples)								
Highest Value	68.0	78.8	37.8	53.8	5.40	10.71	99.2	3.00
Lowest Value	60.0	63.0	26.4	47.0	3.98	8.01	92.7	0.10
Range	8.0	15.8	11.4	6.8	1.42	2.70	6.5	2.90
Average	63.2	71.3	32.4	50.5	4.91	9.92	96.0	0.51
Standard deviation	±1.8	±3.5	±2.6	±1.6	±0.36	±0.60	±1.5	±0.50

samples from other states are summarized in Table 4. Of the grading factors, only the percentage of sound mature kernels and the percentage of total oil kernel content are summarized. The summary data are graphically presented in Figures 2 and 3 for the Spanish and Runner types.

It is apparent that the factor given greatest consideration in grading both Spanish and Runner peanuts is the percentage of sound mature kernels. However, the proportion of damaged kernels and the nature of the damage are also important factors. The importance of damage is indicated by the difference between the percentage of total oil kernels and sound mature kernels, which difference tends to increase in No. 2 grade as compared with No. 1.

The average kernel size of Spanish and Runner types, as measured in grams per 100 kernels, does not appear to be associated with the grade which is largely based on the yield of kernels on shelling, except possibly in the case of grades 1 and 2 of the Runner type. The wide range in the kernel size of Spanish peanuts grown in Georgia may be due to the inclusion in the samples analyzed of a few samples of Improved Spanish variety.

The oil content on the moisture-free basis appears to be influenced by type and environmental conditions under which the crop is grown. The Spanish peanuts grown in Texas averaged 51.3 percent oil on the moisture-free basis as compared to 49.9 percent for those grown in Alabama and Georgia. Peanuts of the Virginia type showed a similar difference in oil content between the Georgia and the Virginia-Carolina areas of production. The oil content does not appear to be associated with the grade, averaging about the same for all three grades of each type. Though there is a statistical tendency for the oil content of the kernel to decrease 0.07 percent in absolute value for each increase of 1.0 percent in absolute value of total oil kernel content, there is no practical significance to the relation. The correlation coefficient was negative and barely highly significant for the Runner and not significant for the Spanish samples. The standard deviation for the percentages of oil varied from ±0.9 to ±2.0 for the various groups of these types analyzed. There was no correlation between the oil content and the kernel size measured in grams per 100 kernels since approximately a zero correlation coefficient was obtained for the data statistically examined. The average oil contents of all samples of Spanish and Runner types analyzed were 50.8 and 50.3 percent on the moisture-free basis, and the average weights per 100 kernels were 32.8 and 41.0 g., respectively.

On the basis of average values, there appears to be no association between the nitrogen content of the Spanish and Runner peanut kernels and the market

TABLE 5

Analysis of All Graded Samples of Runner Peanuts Obtained From the 1942 Crop

Grade	Peanuts in sample		Weight per 100 kernels	Analysis of kernels			Iodine No. of oil (Wijs)	Free fatty acid in oil
	Sound mature kernels	Total oil kernel content		Oil (Dry basis)	Nitrogen (Dry basis)	Nitrogen (Dry and oil-free basis)		
	Pct.	*Pct.*	*g.*	*Pct.*	*Pct.*	*Pct.*		*Pct.*
U. S. No. 1 (69 samples)								
Highest Value	71.5	74.0	49.4	53.0	5.26	10.41	99.2	2.68
Lowest Value	65.0	66.8	31.9	45.4	4.42	8.69	86.1	0.10
Range	6.5	7.2	17.5	7.6	0.84	1.72	13.1	2.58
Average	67.3	70.6	42.0	50.1	4.85	9.73	91.7	0.47
Standard deviation	±1.4	±1.5	±3.3	±1.6	±0.16	±0.35	±2.4	±0.42
U. S. No. 2 (34 samples)								
Highest Value	69.0	72.0	46.0	54.1	5.14	10.59	102.0	2.38
Lowest Value	60.0	62.5	28.0	47.0	4.56	8.88	88.2	0.14
Range	9.0	9.5	18.0	7.1	0.58	1.71	13.8	2.24
Average	62.8	67.5	36.9	50.5	4.82	9.74	91.5	0.64
Standard deviation	±1.8	±2.4	±4.2	±1.7	±0.16	±0.37	±2.3	±0.52
U. S. No. 3 (20 samples)								
Highest Value	62.0	67.0	46.8	52.5	5.08	10.39	96.1	2.68
Lowest Value	56.0	61.3	31.9	49.0	4.12	8.43	89.4	0.10
Range	6.0	5.7	14.9	3.5	0.96	1.96	6.7	2.58
Average	59.0	64.3	39.6	50.6	4.81	9.74	91.4	1.28
Standard deviation	±1.8	±1.8	±4.7	±1.0	±0.20	±0.40	±1.9	±0.88

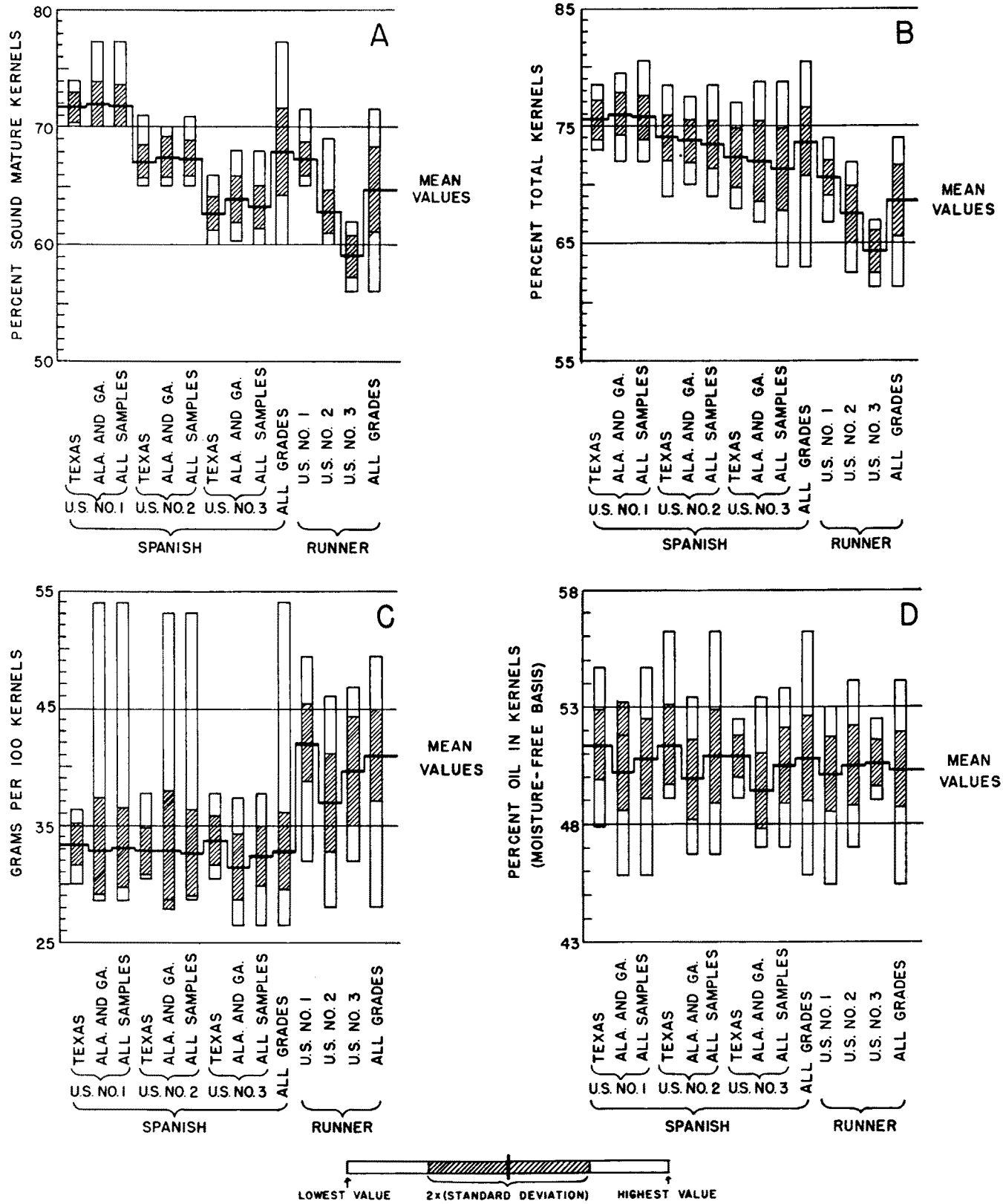

FIG. 2. Range, mean and standard deviation for (A) percent sound mature kernels, (B) percent total kernels, (C) grams per 100 kernels and (D) percent oil on moisture-free basis for market grades of Spanish and Runner peanuts from the 1942 crop. (See tables for number of samples of each grade and type.)

TABLE 6

Analysis of All Graded Samples of Virginia Peanuts Obtained From the 1942 Crop

Grade	Peanuts in sample		Weight per 100 kernels	Analysis of kernels			Iodine No. of oil (Wijs)	Free fatty acid in oil
	Sound mature kernels	Total oil kernel content		Oil (Dry basis)	Nitrogen (Dry basis)	Nitrogen (Dry and oil-free basis)		
	Pct.	*Pct.*	*g.*	*Pct.*	*Pct.*	*Pct.*		*Pct.*
U. S. No. 1, 2, 3 (13 samples)[1]								
Highest Value	68.0	69.5	83.4	53.0	5.03	10.44	93.2	1.88
Lowest Value	58.0	59.5	61.0	48.9	4.50	9.04	86.5	0.10
Range	10.0	10.0	22.4	4.1	0.53	1.40	6.7	1.78
Average	63.9	65.6	70.4	51.3	4.84	9.95	89.6	0.71
Standard deviation	±2.8	±3.1	±5.4	±1.3	±0.16	±0.48	±2.2	±0.58
U. S. No. 3A (49 samples)[2]								
Highest Value	71.0	73.0	85.0	50.8	5.20	10.06	98.3	0.69
Lowest Value	65.0	67.0	55.2	44.4	4.36	8.24	91.3	0.07
Range	6.0	6.0	29.8	6.4	0.84	1.82	7.0	0.62
Average	67.1	69.9	68.5	47.7	4.86	9.30	94.3	0.21
Standard deviation	±1.7	±1.5	±7.2	±1.4	±0.19	±0.41	±1.3	±0.11
U. S. No. 3B, 3C (22 samples)[2]								
Highest Value	69.0	70.5	77.5	52.3	5.08	9.84	96.7	1.15
Lowest Value	57.0	62.0	56.4	44.6	2.94	6.16	92.6	0.10
Range	12.0	8.5	21.1	7.7	2.14	3.68	4.1	1.05
Average	62.7	66.1	67.9	48.3	4.55	8.79	94.5	0.28
Standard deviation	±2.9	±2.2	±5.4	±2.0	±0.45	±0.72	±0.9	±0.24

[1] Ten samples, Georgia grown; two, Virginia grown; and one, North Carolina grown.
[2] Virginia-North Carolina grown.

grade. However, there seem to be some differences attributed to variety and environment of production, which is more apparent from nitrogen values calculated on the moisture- and oil-free basis. The average nitrogen content on this basis of the Texas-grown Spanish peanuts was 10.38 percent as compared to 9.94 percent for those grown in Alabama and Georgia. The average values might be reversed for another crop year should the climatic conditions be reversed. The Runner peanuts averaged somewhat lower in nitrogen than did the Spanish. The average total nitrogen values on a moisture-free basis for all of the samples of market grade Spanish type is slightly lower than the average for the Texas and Alabama-Georgia groupings. This indicates that peanuts grown on the edge of, or outside, the regions of considerable production tend to be low in total nitrogen.

The iodine number of the oil does not appear to be associated with the market grade of the peanuts. The average for all samples of Spanish was 95.7 with a standard deviation of ±1.4, and for all samples of Runner was 91.6 with a standard deviation of ±2.3.

Even though some consideration is given to damage in establishing the grade, the data on the samples do not indicate that the damage considered permissible for grades No. 1, 2, and 3 is reflected in the percentage of free fatty acid in the oil of Spanish and Runner peanuts. The average values were below 1.0 percent except for U. S. Grade No. 3 of the Runner type. It seems that apparent damage must be very serious to develop a high free fatty acid content in the oil in the kernel.

The samples of the Virginia peanuts obtained were not as representative of the grades as were those of the other types. The kernels of the Virginia type are larger and are usually lower in oil and protein than are those of Spanish and Runner types. The effect of climate on the unsaturation of the oil is reflected in the iodine numbers found. The average value for the U. S. No. 1, 2, and 3 group of Virginia samples, graded on the basis of Farmers' Stock Runner standards and grown in Georgia (Table 6), was 89.6 as compared to 94.3 for the U. S. No. 3A group and 94.5 for U. S. No. 3B and 3C groups. The 3A, 3B, and 3C groups were grown in North Carolina and Virginia, where because of more northern latitudes lower temperatures prevail during the growing season. This climatic effect on iodine number was also observed with the Runner type. The iodine numbers for the few samples of Runner peanuts grown in Virginia and North Carolina were 99.2, 97.8, 97.0,

TABLE 7

Summary of Analyses of All Graded Samples of Spanish, Runner, and Virginia Peanuts Obtained From the 1942 Crop

Type	Peanuts in sample		Weight per 100 kernels	Analysis of kernels			Iodine No. of oil (Wijs)	Free fatty acid in oil
	Sound mature kernels	Total oil kernel content		Oil (Dry basis)	Nitrogen (Dry basis)	Nitrogen (Dry and oil-free basis)		
	Pct.	*Pct.*	*g.*	*Pct.*	*Pct.*	*Pct.*		*Pct.*
Spanish Peanuts (172 samples)								
Highest Value	77.3	80.5	54.0	56.2	5.50	10.99	99.4	3.00
Lowest Value	60.0	63.0	26.4	45.8	3.40	7.62	91.5	0.07
Range	17.3	17.5	27.6	10.4	2.10	3.37	7.9	2.93
Average	67.9	73.7	32.8	50.8	4.93	10.01	95.7	0.40
Standard deviation	±3.7	±2.9	±3.3	±1.8	±0.34	±0.54	±1.4	±0.41
Runner Peanuts (123 samples)								
Highest Value	71.5	74.0	49.4	54.1	5.26	10.59	102.0	2.68
Lowest Value	56.0	61.3	28.0	45.4	4.12	8.43	86.1	0.10
Range	15.5	12.7	21.4	8.7	1.14	2.16	15.9	2.58
Average	64.7	68.7	41.0	50.3	4.84	9.74	91.6	0.65
Standard deviation	±3.6	±3.0	±3.9	±1.6	±0.16	±0.36	±2.3	±0.62
Virginia Peanuts (84 samples)								
Highest Value	71.0	73.0	85.0	53.0	5.20	10.44	98.3	1.88
Lowest Value	57.0	59.5	55.2	44.4	2.94	6.16	86.5	0.07
Range	14.0	13.5	29.8	8.6	2.26	4.28	11.8	1.81
Average	65.5	68.2	68.6	48.4	4.77	9.27	93.6	0.30
Standard deviation	±3.0	±2.8	±6.5	±2.0	±0.31	±0.63	±2.2	±0.32

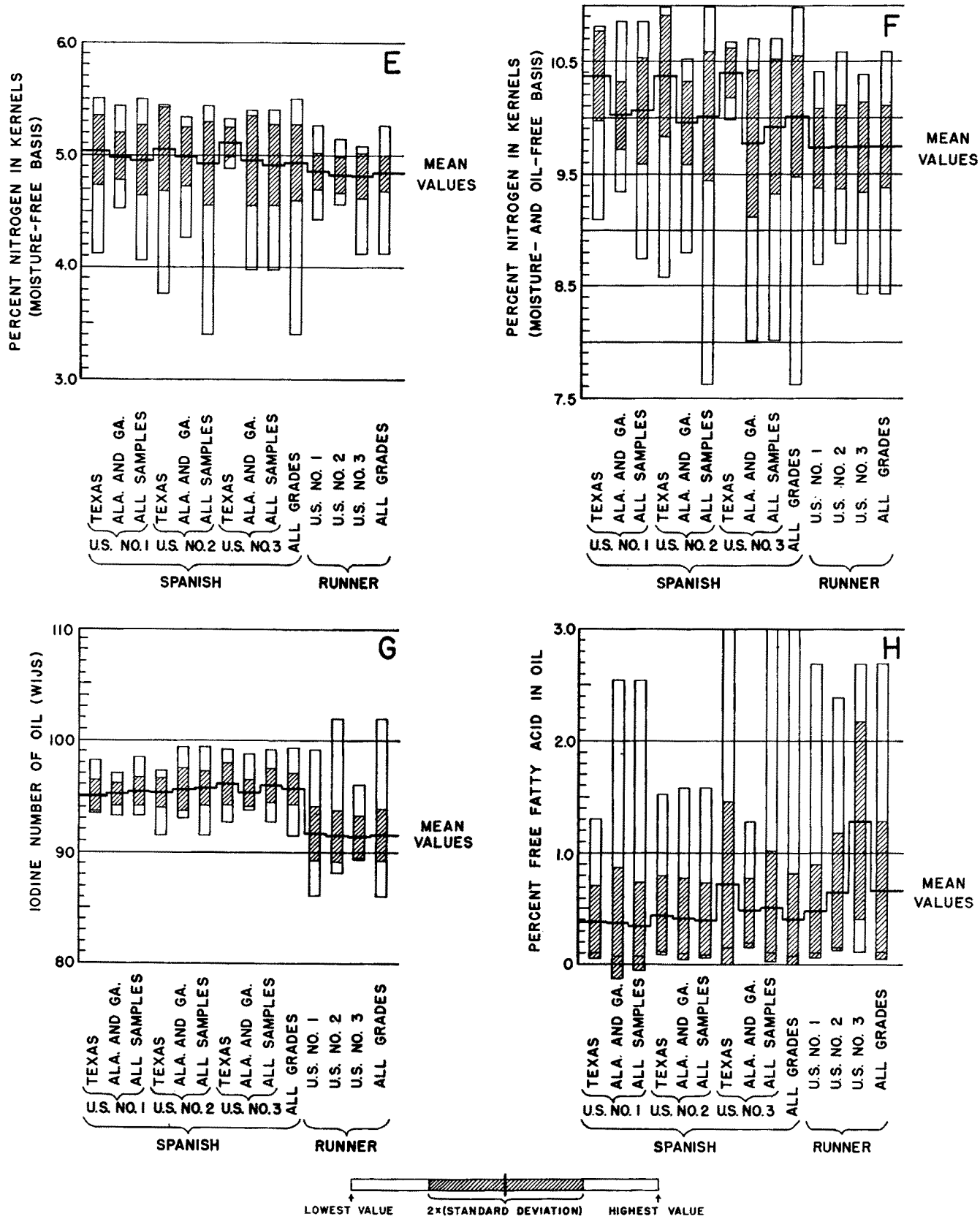

FIG. 3. Range, mean and standard deviation for (E) percent nitrogen on moisture-free basis, (F) percent nitrogen on moisture- and oil-free basis, (G) iodine number (Wijs) of oil and (H) percent free fatty acid in oil for market grades of Spanish and Runner peanuts from the 1942 crop. (See tables for number of samples of each grade and type.)

TABLE 9

Analysis of Sample Grade or Unclassified Peanuts

Sample No.	Seriously damaged loose shelled kernels	Loose shelled kernels	Sound small shriveled	Other varieties	Sound mature kernels	Damage not serious	Total oil kernel content	Seriously damaged	Weight per 100 kernels	Oil (Dry basis) of kernels	Nitrogen (Dry basis) of kernels	Nitrogen (Dry and oil-free basis) of kernels	Iodine No. of oil (Wijs)	Free fatty acid in oil
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*g.*	*Pct.*	*Pct.*	*Pct.*		*Pct.*
Spanish														
1	0	12.0	4.0	0	46.5	0.5	63.0	2.0	34.2	51.4	4.97	10.23	97.5	0.38
2	1.0	10.0	2.0	0	56.0	0.5	68.5	0.5	29.4	52.0	5.20	10.83	94.7	0.57
3	0	17.5	3.0	0	50.0	0.5	71.0	2.0	31.0	49.9	5.42	10.82	95.3	0.60
4	0	37.5	1.5	0	29.0	1.5	69.5	0	29.3	53.7	3.84	8.29	99.6	0.25
5	2	11.0	2.0	0	57.0	3.0	73.0	1.0	33.8	49.3	5.56	10.97	92.8	0.68
6	0	8.0	2.0	0	59.0	0.5	69.5	0.5	29.9	51.0	5.16	10.53	94.8	0.42
7	0	18.0	2.0	0	49.5	0	69.5	0	35.1	53.2	4.77	10.19	97.0	0.20
8	0	7.0	4.5	0	61.5	1.5	74.5	3.0	31.3	51.5	5.26	10.85	92.6	0.40
9	0	3.0	2.5	0	59.5	2.0	67.0	2.0	31.0	49.4	5.10	10.08	94.4	0.40
10	....	2.5	1.0	0	72.0	1.0	76.5	1.0	34.8	51.1	5.12	10.47	93.6	0.15
11	0	3.0	2.5	0	63.5	1.25	70.25	1.25	36.2	50.6	5.00	10.12	98.4	0.23
12	0	0.5	4.0	0	56.0	0.5	61.0	0.5	45.2	49.0	4.91	9.63	99.4	0.23
13	0	1.0	6.5	0	43.0	1.0	51.5	4.5	27.3	50.3	4.90	9.86	98.4	1.64
14	0	1.0	10.0	0	56.0	1.0	68.0	....	29.2	50.6	5.24	10.61	97.0	0.90
15	2.0	0	6.25	0	58.5	1.5	66.25	2.0	31.1	50.6	4.64	9.39	96.8	0.33
16	....	3.5	4.0	0	48.5	5.5	61.5	....	33.4	51.7	5.15	10.66	95.0	2.25
17	0	0.5	4.0	0.5	54.0	17.0	72.0	2.0	30.4	48.5	5.36	10.41	94.9	1.41
18	0	0	1.0	0	58.5	14.5	74.0	1.0	36.2	50.3	5.09	10.24	93.5	0.46
19	0	0	1.5	2.0	66.0	2.0	71.5	1.5	32.6	47.9	5.34	10.25	92.6	0.14
20	4.0	0	8.0	0	24.0	1.5	33.5	32.0	....	47.8	5.00	9.58	97.5	4.09
21	2.0	5.0	0.5	0	63.0	1.5	70.0	6.5	34.2	50.8	5.32	10.81	93.5	2.54
22	1.5	4.0	0.5	0	63.0	0.5	68.0	5.0	34.6	51.7	5.13	10.62	93.7	0.51
23	3.0	0.5	1.0	0	59.0	....	60.5	3.0	36.4	50.9	5.36	10.92	93.1	0.86
Runner														
24	0	0	6.0	0	52.5	0	58.5	1.0	36.8	48.7	4.61	8.99	92.4	0.38
25	0	0.5	2.5	0	67.0	1.0	71.0	0	36.0	48.0	4.94	9.50	89.8	0.20
26	0.5	0	5.5	0	45.5	0	51.0	0.5	43.6	49.7	4.28	8.51	95.9	0.82
27	....	0.5	2.0	4.0	60.0	0.25	66.75	0.25	42.9	50.6	3.96	8.02	101.1	0.16
28	0.25	0.75	4.0	0	52.0	0	56.75	12.0	40.2	49.8	4.77	9.50	90.8	2.30
29	0	2.0	4.0	0	59.0	1.0	66.0	6.5	36.0	52.0	4.60	9.58	90.4	2.75
30	0	1.5	4.5	0	.....	56.0	.....	6.0	36.1	49.4	4.70	9.29	92.8	2.08
31	....	1.5	3.5	0	57.0	0.25	62.25	12.5	43.0	53.1	4.83	10.30	89.7	3.54
32	....	0.5	3.0	0	59.0	0.5	63.0	4.0	43.2	51.8	4.72	9.79	90.6	1.48
33	0	1.0	3.0	0	52.0	0	56.0	11.0	45.2	51.2	4.88	10.00	88.4	4.51
34	0	0	4.0	0	46.5	0	50.5	11.5	42.3	49.8	4.72	9.40	91.8	4.36
Virginia														
35	0	0	2.5	0	65.0	2.5	70.0	0.5	61.6	48.1	4.80	9.25	92.9	0.08
36	0	0	2.0	0	66.0	2.0	70.0	1.0	70.2	47.5	4.91	9.35	94.4	0.20
37	0	0	3.0	14.0	50.0	1.5	68.5	0.5	64.1	49.2	5.02	9.88	93.8	1.30
38	....	0	1.5	0	54.0	13.0	68.5	....	54.6	48.4	4.06	7.87	97.8	0.18
39	0	0	0.5	0	53.0	14.0	67.5	8.0	84.0	48.0	4.99	9.60	94.8	0.66
40	....	0	2.5	0	63.0	4.0	69.5	1.5	71.6	45.5	4.77	8.75	96.4	0.24
41	0	0	2.0	0	65.0	2.0	69.0	2.0	53.9	48.8	4.92	9.61	91.8	0.24
42	0	0	2.0	0	64.0	2.0	68.0	2.0	73.8	49.4	4.84	9.57	93.3	0.27
43	0	0	1.0	0	68.0	1.0	70.0	2.0	72.3	48.0	5.04	9.69	92.7	0.28
44	0	0	1.0	0	40.0	14.0	55.0	16.0	71.4	49.6	4.78	9.48	94.0	3.98

98.3, 102.0, and 101.1, while the grand average for this type was 91.6 (Table 7).

The summary for all graded samples of each of the three types analyzed, given in Table 7, characterizes these types relative to the percent of kernels, the kernel size, and the chemical factors which were determined.

Average values for all samples of the three grades of the three types obtained from the 1942 crop are compared in Table 8 with the average values for 224 samples of genetic strains grown at Tifton, Georgia, in 1940 by the Georgia Coastal Plain Experiment Station. As the genetic strains were all grown under comparable conditions, the differences are attributed to genetic characteristics. The range, average, and

TABLE 8

Comparison of Average Analytical Values for Market Peanuts and Genetic Strains of Peanuts

Value	Peanuts in sample		Analysis of kernels				Iodine No. of Oil (Wijs)	
	Total oil kernel content		Oil (Dry basis)		Nitrogen (Dry basis)			
	A	B	A	B	A	B	A	B
	Pct.		*Pct.*		*Pct.*		*Pct.*	
Highest value	80.5	81.3	56.2	55.2	5.50	5.46	102.0	100.8
Lowest value	59.5	55.2	44.4	43.1	2.94	4.21	86.1	86.6
Range	21.0	26.1	11.8	12.1	2.56	1.25	15.9	14.2
Average	70.2	73.4	49.8	50.2	4.85	4.72	93.6	92.9
Stand. deviation	±3.9	±4.3	±2.0	±2.5	±0.29	±0.20	±2.6	±3.6

A—379 samples from 1942 commercial production of Spanish (172), Runner (123) and Virginia (84) types.

B—224 samples from 1940 experimental production at Tifton, Georgia, of a like number of genetic strains.

standard deviations for the values for all of the commercial samples of the three types approximate those found for the genetic types analyzed.

Peanuts which for qualitative reasons do not meet the requirements of U. S. No. 1, 2, and 3 grades are listed as "unclassified" and are marketed as "sample" grade. Analyses of 44 such samples are given in Table 9. It is apparent that the composition of the kernels is not correlated with high values for such grading factors as loose shelled kernels and sound small shriveled kernels, and low values for sound mature kernels. However, high percentages of seriously damaged kernels may result in a high free fatty acid content of the oil in the kernel, depending on the nature of the damage.

The analyses of samples selected for special characteristics are given in Table 10. Small shriveled kernels were found to have low oil content on the dry basis and low nitrogen content on the moisture- and oil-free basis. Seriously damaged, rancid, or decayed kernels had, as could be expected, very high free fatty acid contents in the extracted oils. The sound mature kernels group appeared to be normal in all respects. In sprouted kernels the oil content was low and the free fatty acid reasonably high. Two samples, composed entirely of peanuts having dark discoloration of more than 25 percent of the surface of the skins, appeared normal in composition.

Thirty samples of hulls of Spanish peanuts grown in Texas in 1942 were analyzed for total nitrogen.

TABLE 10

Analysis of Selected Samples of Peanut Kernels

Sample No.	Type of Peanut	Grams per 100 kernels	Oil (Dry basis)	Nitrogen (Dry basis)	Nitrogen (Dry and oil-free basis)	Iodine No. of oil (Wijs)	Free fatty acid in oil
			Pct.	*Pct.*	*Pct.*		*Pct.*
Small Shriveled Kernels							
1	Spanish	13.2	35.8	5.55	8.64	94.8	1.40
2	Spanish	12.8	36.5	5.56	8.76	94.7	0.88
3	Runner	17.8	36.4	5.02	7.89	92.1	0.30
4	Runner	18.2	37.9	5.03	8.10	91.7	0.46
5	Runner	17.2	36.8	4.94	7.82	90.2	0.54
6	Runner	16.7	36.8	4.98	7.88	91.0	0.54
Seriously Damaged (Rancid or Decayed) Kernels							
7	Spanish	29.2	50.1	5.62	11.26	93.2	34.82
8	Spanish	28.2	48.6	5.50	10.70	94.4	29.39
9	Runner	41.0	51.2	5.02	10.29	90.6	22.40
10	Runner	42.2	51.8	5.00	10.37	90.2	23.00
11	Runner	40.7	51.6	5.06	10.45	90.5	24.33
12	Runner	44.0	51.0	5.04	10.29	91.6	23.38
Sound Mature Kernels							
13	Spanish	31.4	48.6	5.15	10.02	95.5	0.54
14	Spanish	33.8	49.6	5.09	10.08	94.8	0.18
15	Runner	42.4	50.5	4.97	10.04	91.5	0.16
16	Runner	45.3	50.4	4.92	9.92	90.9	0.47
17	Runner	44.7	50.8	4.98	10.12	90.7	0.44
18	Runner	45.2	50.8	4.90	9.96	90.4	0.46
Sprouted Kernels							
19	Spanish	29.0	40.4	5.36	8.99	94.2	5.95
20	Spanish	32.0	46.8	5.31	9.98	94.4	3.44
Kernels With Over 25 Percent of Surface Showing Dark Discoloration							
21	Spanish	35.1	49.3	5.20	10.26	93.6	0.39
22	Spanish	34.8	48.1	5.32	10.25	93.4	1.26

The values, calculated on the moisture-free basis, varied from 0.79 to 1.35 percent and averaged 1.05 percent with a standard deviation of ± 0.13. This standard deviation represents about 5 lbs. of protein (Nx6.25) per ton for the average peanut containing 30 percent shells or about 1 percent of the total protein content of peanuts in the shell. Although wider ranges in nitrogen content of shells no doubt occur, it is believed that standard deviations will not be much larger; two-thirds of the values may be expected to fall within the range of one standard deviation above and one standard deviation below the mean.

Discussion

Since more than 95 percent of the economic value of the peanut, as marketed by the farmer, is in the kernel, it appears that the most immediate measure of the market value of market lots is the combined percentage of sound mature kernels and sound mature loose shelled kernels. However, when the peanuts are to be shelled and the kernels crushed for oil and meal, analysis of the kernels will give further evaluation for the economics of processing operations. The oil and meal yields may be estimated from the analytical data, and the free fatty acid value of the oil gives some indication of the refining loss.

The analyses reported indicate that all peanuts of a given commercial type of good to fair quality (meaning U. S. No. 1, U. S. No. 2, and U. S. No. 3 Farmers' Stock grades) which are grown under similar environmental conditions, may be expected to yield oil and nitrogen at practically the same rate in proportion to the *total* percentage of kernels after shelling; and the oil obtained from various lots of such peanuts may be expected to be of approximately the same quality from a refining standpoint. There appear to be slight differences in percentage of oil and nitrogen content which may be attributed to variety and growth environment. Reasonably small percentages of small shriveled kernels did not noticeably lower the yield of oil and nitrogen although it was established that samples composed entirely of small shriveled kernels contained only about three-fourths as much oil as did sound mature kernels. Damaged kernels in percentages tolerated for the U. S. No. 1, U. S. No. 2, or U. S. No. 3 grade had no very marked or consistent effect upon the concentration of free fatty acids in the oil. However, when entire samples of seriously damaged kernels were analyzed, the oil was found to have very high percentages of free fatty acids.

Kernels of Spanish peanuts grown in Texas in 1942 averaged significantly higher in both oil and protein (nitrogen x 6.25) than did those grown in Alabama and Georgia, which is in agreement with results previously reported on another year's crop of peanuts (1). Spanish and Runner peanuts grown in the Southeast had approximately the same average percentage of oil in the kernels. However, the Runner peanuts averaged appreciably lower than the Spanish in percentage of nitrogen in the moisture- and oil-free kernel (relative meal basis), and in iodine number of the oil. The Virginia peanuts averaged somewhat low in both percentage of oil and nitrogen when grown in the Virginia-Carolina area but approximated those of the Spanish type when grown under similar environmental conditions in Georgia. There seems to be a relatively greater variation in the total nitrogen content of the kernel than in the oil content.

The average values of oil, nitrogen, and iodine number for Spanish and Runner peanuts studied in this investigation agree fairly well with values reported by other investigators (2). Higgins, Holley, Pickett, and Wheeler reported average oil and nitrogen contents of kernels and iodine number of oil to be 48.6, 4.96, and 94.3, respectively, for Spanish

kernels, and 48.5, 4.91, and 93.1, respectively, for Runner kernels.

From a statistical consideration of the data obtained, it seems probable that two-thirds of all graded samples of Spanish and Runner peanut kernels will have oil contents between 48.9 and 52.3 percent and nitrogen contents between 4.64 and 5.14 percent on the moisture-free basis. Similarly, two-thirds of all graded samples of Virginia peanut kernels should have oil contents between 46.4 and 50.4 percent and nitrogen contents between 4.46 and 5.08 percent.

Acknowledgment

The authors wish to acknowledge the assistance of Walter A. Pons, Jr., Pauline B. Griffith, Robert Mod, Dorothy H. Petty, Florence B. Strohmeyer, Wilson A. Reeves, Alva Faust, and others of this Laboratory in making the chemical analyses; and acknowledgment is gratefully given to William Blossom, Jr., Glenn R. Hotchkiss, and R. T. Mumma, as well as to the numerous peanut inspection supervisors working under their direction, all of the Office of Distribution, War Food Administration, for collecting, grading, and transmitting peanut samples to the Laboratory.

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(1) G. S. Fraps; Texas Agr. Exp. Sta. Bull. 222, Dec. 1917.

(2) B. B. Higgins, K. T. Holley, T. H. Pickett, and C. D. Wheeler; Georgia Experiment Station Bull. 213, June 1941.

Report of the Oil Characteristics Committee

AS most of the common oils and fats have already received our attention and been proposed as "recommended standards" we find that from now on it is going to be a slow and difficult task to obtain sufficient data to add to our list more of other oils.

With some possible exceptions therefore most of our future work will be carried on in setting up the composition and characteristics of various oils as informative data, rather than as recommended standards.

Meantime this committee has under revision three of the standards that were proposed some time ago but returned to us because of objections to some of the values set up therein. They are on neatsfoot oil, lard and beef tallow.

Chinese vegetable tallow, Patua palm oil, Babassu palm kernel oil ,and Tall oil have been written up by the chairman, but as yet the report has not reached the stage of submission to the committee. I, therefore, regret that there is nothing definite for us to report as a committee at this time.

M. F. LAURO, *Chairman.*

Abstracts

Oils and Fats

Edited by
M. M. PISKUR and SARAH HICKS

THE COMPONENT ACIDS OF VARIOUS VEGETABLE FATS. T. P. Hilditch *et al. J. Soc. Chem. Industry 63,* 112-4 (1944).

THE FATTY ACIDS AND GLYCERIDES OF SOLID SEED FATS. XII. LOPHIRA ALATA KERNEL FAT (NIAM FAT). T. P. Hilditch and M. L. Meara. *J. Soc. Chem. Industry 63,* 114-5 (1944).

POSITION OF FATS AND OILS IN THE WAR AND POST-WAR. R. M. Walsh. *Soybean Dig. 4,* No. 8, 14 (1944).

THE BUTYROMETRIC DETERMINATION OF FAT IN BUTTER. A. Schloemer. *Deut. Molkerei-Ztg. 63,* 420-1 (1942). "Butyrometric" detns. gave results which were 1% and more lower than results with the Roese-Gottlieb method, and with a new method developed by S. S. recommends the construction of a new type of test bottle whereby the passage between the reaction chamber and the neck is made to slope more, and whereby the unit of the scale is narrowed to create zones in which fat values in different ranges can be read. Standardization is accomplished with butter and not with fat. (*Chem. Abs.*)

THE BUTYROMETRIC FAT DETERMINATION IN BUTTER. G. Roeder. *Molkerei-Ztg. 56,* 536-7 (1942). R. found that with increasing d. (1.50-1.60) of the H_2SO_4 used there is a decrease in the fat-value reading (81.3-80.2%). On account of the high % of fat in butter, fluctuations of readings are unavoidable; moreover the d. of butterfat fluctuates between 0.883 and 0.891. (*Chem. Abs.*)

AN IODINE NUMBER METHOD FOR TALL OIL. R. G. Rowe *et al. Ind. Eng. Chem., Anal. Ed. 16,* 371-4 (1944). The use of pyridine sulfate dibromide in conjunction with mercuric acetate catalyst as a Br addn. reagent is suggested for the I no. detn. of tall oil and similar highly unsatd. conjugated compds. Data are presented showing the effects of absorption time and excess reagent. Evidence is given that the undesired secondary reaction of substitution does not occur. I nos. of 8 different com. samples of crude tall oil ranged from 237-287. This method of I no. detn. has the possibility of general application.

STABILITY OF WIJS SOLUTION FOR IODINE NO. DETERMINATIONS. F. A. Norris and R. J. Buswell. *Ind. Eng. Chem., Anal. Ed. 16,* 417 (1944). Over a total period of 505 days, the Wijs soln. did not change sufficiently to cause a measurable difference in the I no. of the substrate. No measurable differences were found when the reagent was taken from bottles that had been previously opened. These facts indicate the validity of storing the soln. a year or more, if