Change in Grade of Farmers' Stock Peanuts Stored in the Southwest

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ABSTRACT

The effects of storage time on the extent and cause of grade reductions of farmers' stock Spanish peanuts harvested in the Southwest are discussed in this paper. This study was based on 184 randomly selected lots of farmers' stock peanuts sampled from 31 buying points throughout the Southwest area. Results of this research indicate that there was a significant decrease in the grade (sound mature kernels plus sound splits) with storage time and that this decrease occurred within the first 5 days of storage. The grade decreased from an initial average value of 71.3 to 70.3 after the 5-day storage period. There was a continuing decrease in grade with increased storage time; however, the change after the first 5 days of storage was not found to be significant. Decrease in grade results in an annual loss of approximately 2.26 million dollars in the Southwest peanut producing area.

The principal cause for this reduction was determined to be the shift of the weight ratio of hulls and kernels during storage while only a small part of the grade loss was due to kernel shrinkage. The method of drying and grading had a significant influence on the decrease in grade. Mechanically dried peanuts lost 1.8 percentage points in grade during a 90-day storage preiod compared to only 0.3 percentage points for field-dried peanuts.

Since the price of farmers' stock peanuts is determined by a uniform commercial grading system, it is important that the initial grade be maintained up to the time of final utilization. Any decrease in grade of a particular lot of peanuts is the responsibility of the seller, regardless of the operation which may have caused this loss. This decrease in grade represents a monetary loss of approximately $3.23 to $4.63 per ton of farmers' stock peanuts for each one point drop in grade.

Concern has been expressed by the peanut industry regarding grade reductions during extended storage periods. Normally, the total dollar value of peanuts after warehousing is less than the value when received for storage. This monetary loss can be attributed to several factors, one of which is the change of grade. In order to determine the extent of monetary losses associated with grade reductions during storage, research was conducted in the three major peanut producing areas of the United States. Results of this research in the Virginia-North Carolina and the Southeast areas have been reported (1) (2). The extent and cause of grade reductions of farmers' stock Spanish peanuts stored in the Southwest are discussed in this report. These results were obtained through cooperative research with the Agricultural Research Service, United States Department of Agriculture.

Materials and Methods

Samples of farmers' stock peanuts used in these studies were collected over a three-month period during the 1972 harvest season. This period extended from August to November in order to cover the major producing areas of the Southwest. A total of 184 randomly selected lots of farmers' stock peanuts was sampled from 31 buying points throughout the Southwest area. One sample was taken from each lot with each sample weighing approximately 4,000 grams. Of this total, 117 lots were sampled in Texas and 67 in Oklahoma. This ratio was selected so

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that the percent of samples collected in each state was approximately proportional to the percent of production. Lots sampled in Texas were proportioned in a similar manner, with 47 lots being sampled in the South Texas producing area and 70 in the North Texas area.

All samples used for this study were randomly selected from lots of farmers' stock peanuts at the time of grading. Each 4,000-gram sample was divided into a representative subsamples and weighed prior to being stored for periods of 5, 28, 60 and 90 days. Since the major objective of this study was the effect of storage time on grade, all peanuts were stored at a single location in College Station, Texas. All subsamples were placed in storage at this location within 2 days of the time they were collected. These subsamples were stored in cotton bags in a room located within a steel building. This building was unheated in order to simulate warehouse storage structures.

At the end of the specific storage period, samples were re-weighed and graded. The standard grading procedure established by the Consumer and Marketing Service — USDA was followed with the exception of damage analysis (3). No attempt was made in this research to determine damage; therefore, the initial grades obtained at the time of collection were adjusted to reflect the damage kernels and splits for comparative purposes. Also, moisture measurements were determined from the oven method instead of the standard moisture meter since a study was conducted on the change in the moisture contet of pods, kernels and hulls. Samples weighing approximately 70 grams were dried in a forced-air oven at 205° C for 48 hours.

Analysis of variance tests were used to determine the significance of the data. Storage time was the treatment variable in each case, and Duncan's multiple range test was used to determine significance within treatments.

Results

All values reported in these results include damaged kernels and splits since no attempt was made to study damage. Initial grade data at 0-day storage were corrected to include damage so that a direct comparison could be made with data obtained after the various storage periods. Therefore, the grade values reported in this research should not be used as absolute values since the actual grades would be slightly lower.

GRADE REDUCTION

The effects of the various storage periods on the milling quality and grade of farmers' stock Spanish peanuts harvested in the Southwest are given in Table 1. Results indicate that there was a significant decrease in the grade with storage time for peanuts harvested throughout the Southwest production area. This loss in grade occurred within the first 5 days of storage and represented an annual loss of approximately $2.26 million in the Southwest. The grade decreased from an initial average value of 71.3 to 70.3 after the 5-day storage period. There was a continuing decrease in grade with increased storage periods. After a storage period of 90 days the grade was found to have decreased to 70.0 However, the change in grade after the first 5 days of storage was not found to be significant.

The same effects of storage on grade were observed with peanuts harvested in Texas as those harvested throughout the Southwest. All of the significant loss in grade occurred within the initial 5-day storage period with a non-significant decrease thereafter. The grade after 5 days of storage decreased to 70.5 from an initial level of 71.5. After 90 days of storage, peanuts harvested in Texas decreased only slightly to an average value of 70.2.

Table 1. Effect of several storage periods on the milling quality and grade of Southwest farmers' stock peanuts graded over a 15/64 screen.

Storage Period, Days	Kernel Moisture Content, Percent	Kernels Riding 15/64 Screen, Percent	Splits, Percent	Other Kernels, Percent	Grade
Southwest Area					
0	7.7	65.6	5.7	4.5	71.3
5	6.3*	64.7	5.6	4.6	70.3*
28	6.3*	64.3*	5.9	4.7	70.2*
60	6.3*	64.5*	5.7	4.9	70.2*
90	6.5*	64.3*	5.7	4.8	70.0*
Oklahoma					
0	---	65.9	4.8	4.1	70.7
5	6.1	64.8	5.2	4.4	70.0
28	6.3	64.4	5.5	4.4	69.9
60	6.4	65.0	5.1	4.4	70.1
90	6.6	64.6	5.0	4.7	69.6
Texas					
0	7.7	65.4	6.1	4.7	71.5
5	6.4*	64.6	5.9	4.7	70.5*
28	6.3*	64.2	6.1	4.9	70.3*
60	6.2*	64.2	6.1	5.2	70.3*
90	6.5*	64.1	6.1	5.0	70.2*

* Value is significantly different at the 5% level when compared to the 0-day storage values.

Peanuts harvested in Oklahoma had no significant change in grade during the complete 90-day storage period. Even though there was a decrease in grade points from 70.7 to 69.6, this was not statistically significant due to the number of samples and the normal variation of these samples.

The most probable explanation for the reduction in grade during the early stages of this research centered around kernel shrinkage. It appeared logical that some kernels which rode the screen during the initial grade would actually decrease in physical size during storage due to a normal loss in moisture. Since the same size screen is always used for grading, these kernels would then pass through the screen and be classified as other kernels. This would cause a reduction in grade because by definition the grade of a lot of farmers' stock peanuts is the sum of the percent of peanuts riding the screen and the percent of splits, assuming no damage. In order for kernel shrinkage to be responsible for grade reduction, then the decrease in the percent of peanuts riding the screen must equal the increase in the percent of other kernels if all other quality factors remain constant. Unfortunately, the results of this research do not appear to completely support this simple hypothesis.

The percent of peanuts riding the 15/64 screen in the Southwest area decreased from 65.6 to 64.3 during the 90-day storage period. This resulted in a loss of 1.3 percentage points while the increase in other kernels was only 0.3 percentage points over the same period. This means that a 1.0 percentage point grade reduction cannot be accounted for under the shrinkage theory. The same results were observed with peanuts harvested in Texas. There was a grade reduction of 1.3 points during the 90-day storage period. Since the splits remained the same, this grade reduction resulted

from the 1.3 percentage point reduction in kernels riding the screen during the same storage period. However, the increase in other kernels was only 0.3 percentage points.

When the Texas data is arranged according to the location within the State, Table 2, the same conclusions to the shrinkage theory can be drawn. It should be noted that when these data are divided into the different locations, the significance of grade reduction changes. For example, a 1.2 grade reduction in peanuts harvested in South Texas during a 90-day period was not statistically significant while a 1.3 reduction for Texas, Table 1, was. It should be remembered that the same trends are followed in all cases and that additional samples of sufficient quantity could cause significance with the same observed change in grade.

Table 2. Comparison of grade factors of farmer's stock Spanish peanuts harvested in different climatic areas of Texas and stored for several time periods.

Storage Period, Days	Kernel Moisture Content, Percent	Kernels Riding 15/64 Screen, Percent	Splits, Percent	Other Kernels, Percent	Grade
South Texas					
0	7.8	62.0	9.2	6.2	71.2
5	6.4*	61.5	8.5	6.0	70.0
28	5.8*	60.7	9.0	6.1	69.7
60	5.9*	60.7	9.0	7.2	69.7
90	6.3*	60.9	9.1	6.3	70.0
North Texas					
0	7.6	67.7	4.0	3.7	71.7
5	6.4*	66.8	4.0	3.9	70.8
28	6.6*	66.6	4.2	4.0	70.8
60	6.4*	66.5	4.1	3.9	70.6
90	6.6*	66.3	4.0	4.0	70.3*

* Value is significantly different at the 5% level when compared to the 0-day storage value.

CAUSES OF GRADE REDUCTION

Data presented in Table 1 indicate that there was a significant decrease in kernel moisture content associated with grade reductions. If this moisture loss is not accompanied with a corresponding reduction in kernel size to account for the decrease in grade during storage, then some other phenomenon must be responsible.

A study was conducted to determine the effect of storage period on the moisture content of pods of farmers' stock Spanish peanuts. Results presented in Table 3 reveal that there was a corresponding decrease in pod moisture content whenever the grade went down. This pod moisture loss became significant after 5 days of storage for the Southwest area and Texas peanuts, as did the grade reduction. Since a loss of pod moisture dusing storage could cause a shift in the ratio of percent moisture content of the hulls compared to the percent moisture content of the kernels, a study was conducted to determine the effect of storage on the percent by weight of hulls and kernels in a grade sample. Data tabulated in Table 4 show that there was an increase in the percent by weight of hulls in a grade sample whenever there was a decrease in grade. For instance, the average hull content of peanuts harvested in the Southwest area prior to storage was 24.2 percent. This value increased to 25.1 percent during the first 5 days of storage. Additional storage time had little or no effect on this weight percentage. A similar result was obtained with peanuts harvested in Texas.

Table 3. Effect of storage period on the moisture content of pods in farmers' stock Spanish peanuts.

Storage Period Days	Southwest Area	Oklahoma	Texas
0	8.7	---	8.7
5	7.9*	7.7	8.1*
28	7.8*	7.7	7.8*
60	7.7*	7.8	7.6*
90	7.9*	8.0	7.9*

* Value is significantly different at the 5% level when compared to the 0-day storage value.

Table 4. Effect of storage period on the percentages of hulls and kernels in a sample of farmers' stock Spanish peanuts.

Storage Period, Days	Southwest Area		Oklahoma		Texas	
	Hull, %	Kernel, %	Hull, %	Kernel, %	Hull, %	Kernel, %
0	24.2	75.8	25.2	74.8	23.8	76.2
5	25.1*	74.9*	25.6	74.4	24.8*	75.2*
28	25.1*	74.9*	25.7	74.3	24.8*	75.2*
60	24.9*	75.1	25.5	74.5	24.5*	75.5
90	25.2*	74.8*	25.7	74.3	24.8*	75.2*

* Value is significantly different at the 5% level when compared to the 0-day storage value.

The very close correlation between the increase in weight of hulls comprising a grade sample and the decrease in grade with storage time leads to the conclusion that the shift of the weight ratio of hulls and kernels during storage is an important factor in grade reduction. This conclusion became more evident with a close examination of how the grade factors were determined. Since the grade is the sum of the percentages of sound mature kernels and sound splits, the total kernel weight in a grade sample is of primary importance. If it is assumed that the sample contains all sound mature kernels, then the grade is simply the percent of kernels in a 500-gram sample of pods (kernels plus hulls). As the ratio of kernel weight to hull weight changes in a grade sample, the percent of kernels changes since this is determined by dividing the kernel weight by a constant value of 500 grams. Therefore, if the percent by weight of hulls goes up during storage, then the

total weight of kernels upon which the grade is based must go down because the calculations are based on pod weight.

To illustrate the influence of hull percentage on grade, consider the initial grade analysis of a 500-gram sample of peanuts that originally contained 24 percent hulls. The lot of peanuts represented by this sample would be placed in storage with an official grade of 72. Now, assume that during the storage period there was a shift in the ratio of weights between the hulls and kernels, as shown in Table 4, so that the final grade sample would be composed of 25 percent hulls. Also assume that there was no change of sound split content or other kernel percent due to shrinkage during storage. This means that the highest theoretical grade after storage would be only 71 because there would actually be less total kernel weight with 25 percent hulls compared to 24 percent. Based on the official grade sample of 500 grams of pods, the total kernel weight before storage would be 380 grams compared to 375 grams after storage.

To determine the validity of the above discussion on grade reduction, reference is again made to the Southwest data in Table 1. As previously stated, only 0.3 percentage points of the total 1.3 grade change during the 90-day storage period can be attributed to kernel shrinkage. Referring to Table 4, the percent of kernels in the 500-gram grade sample was reduced by 1.0 percentage point during the same storage period due to the weight ratio shift between percent hulls and kernels. This caused a 1.0 loss in grade since the total kernel content which could ride the screen had been reduced by that amount. This 1.0 reduction plus the 0.3 caused by kernel shrinkage accounts for the total 1.3 loss in grade during the storage period. Similar results are obtained with the Texas and Oklahoma data.

INFLUENCE OF METHOD OF DRYING ON GRADE

It is a well-established fact that mechanically dried peanuts will continue to dry for several hours after the heat has been turned off. This is due to the fact that the overdried shells will continue to absorb moisture from the kernels until a point of equilibrium has been attained. During this transient state, there will be a change in the weight ratio of hulls to kernels due to the moisture transfer process. This will normally last for several hours. After this period, however, little change should be encountered.

To demonstrate the effects of moisture transfer after mechanical drying on the shift in weight ratio of hulls and kernels, and consequently on grade, research was conducted to determine the influence of method of drying on grade reduction. The drying records of 159 of the original 184 randomly selected samples were used in this study. These samples were subdivided according to the method of drying and grading and were classified as follows: (1) field dried, (2) mechanically dried —cooled before grading, and (3) mechanically ried—not cooled before grading. An arbitrary time period of 4 hours for cooling was selected in this classification. Therefore, any lot of peanuts which was graded within a 4-hour period after the heat was turned off was classified as not being cooled prior to grading.

The effect of method of drying and grading on the increase in percentage of hulls during a 90-day storage period is given in Table 5. These results show that the percent of hulls and kernels in a grade sample is definitely influenced by how the peanuts were dried and when they were initially graded. For example, peanuts which were field dried had a 0.2 percentage point loss in hull content during storage compared to a 0.8 and 1.3 increase for mechanically dried peanuts cooled and not cooled before grading, respectively. These data indicate that field-dried peanuts should have less grade loss during storage than mechanically dried peanuts because there would be very little change in the hull-to-kernel weight ratio during storage. Also, since the major portion of this ratio shift has already occurred before the initial grade of mechanically dried peanuts which were cooled prior to grading was determined, then this method should exhibit less grade reduction when compared to no cooling.

Table 5. Effect of method of drying and grading on increase in percentage of hulls of farmers' stock Spanish peanuts harvested in the Southwest during a 90-day period.

Method of Drying and Grading	Percent of Hulls in Grade Sample		Increase in Hull Percent
	Initial	90-Day	
All Methods	24.2	24.8	0.6
Field Dried	24.8	24.6	-0.2
Mechanically Dried:			
Cooled Before Grading	24.4	25.2	0.8
Not Cooled Before Grading	22.6	23.9	1.3

The influence of method of drying and grading on the decrease in grade of Spanish peanuts during a 90-day storage period is given in Table 6. The reduction in grade did follow closely to the increase in percent hulls. This was more evident for the peanuts harvested in Texas. Field-dried peanuts lost only 0.2 points in grade while mechanically dried peanuts lost 1.5 and 2.0 for peanuts which were cooled and not cooled prior to grading, respectively. The corresponding effects of method of drying and grading on percent of hulls for peanuts harvested in Texas are listed in Table 7 for comparative purposes. Field-dried peanuts had a slight loss in percent hull content after the 90-day storage period compared to a 1.4 percentage point increase for mechanically dried peanuts which were not cooled before grading.

Reviewing the sequence of events which allow the method of drying peanuts to influence the reduction in grade during storage, one additional relationship needs to be discussed. It has been demonstrated that the method of drying and grading peanuts does influence the change in grade during storage. This was influenced by the change

Table 6. Influence of method of drying and grading on decrease in grade of Spanish peanuts during a 90-day storage period.

Method of Drying and Grading	Decrease in Grade*, Percentage Points		
	Southwest Area	Oklahoma	Texas
All Methods	1.2	1.1	1.3
Field Dried	0.3	0.3	0.2
Mechanically Dried:			
Cooled Before Grading	1.7	1.9	1.5
Not Cooled Before Grading	1.9	0.8**	2.0

* Graded over 15/64-inch screen.

** Average of small number of samples compared to other data.

Table 7. Effect of method of drying and grading on increase in percentage of hulls in Texas farmers' stock Spaish peanuts during a 90-day storage period.

Method of Drying and Grading	Percent of Hulls in Grade Sample		Increase in Hull Percent
	Initial	90-Day	
All Methods	23.8	24.5	0.7
Field Dried	24.3	24.2	-0.1
Mechanically Dried:			
Cooled Before Grading	24.0	24.8	0.8
Not Cooled Before Grading	22.4	23.8	1.4

in the percent of hulls and kernels during the storage period. Now, if the change in the weight ratio of hulls to kernels was influenced by moisture being transferred, as previously discussed, then the effect of method of drying and grading on the kernel moisture content during storage should follow the same relationship as the grade. These results are tabulated in Table 8 for peanuts harvested in Texas. Note that field-dried peanuts did not have any change in kernel moisture content during storage while mechanically dried peanuts which were not cooled prior to grading had the highest. This is the same relationship as grade reduction during storage.

Table 8. Influence of method of drying and grading on decrease in kernel moisture content during a 90-day storage period for peanuts harvested in Texas.

Method of Drying and Grading	Kernel Moisture Content, Percent		Decrease in Kernel Moisture
	Initial	90-Day	
All Methods	7.7	6.5	1.2
Field Dried	6.3	6.3	0
Mechanically Dried:			
Cooled Before Grading	7.7	6.6	1.1
Not Cooled Before Grading	8.7	6.5	2.2

Literature Cited

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