Processing Costs and Derived Demand for Screened Versus Unscreened Farmer Stock Peanuts[1]

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ABSTRACT

Screening of farmer stock peanuts separates smaller, lower value pods from larger, higher value pods by mechanical separation. The returns to screening farmer stock peanuts depend on prescreened peanut quality. The purpose of this research was to examine the post-harvest processing costs and the resulting derived demand schedules between screened and unscreened lots. Screening increased value by $19.79/Mg in screened versus unscreened lots. Due to the removal of peanuts during the screening process, the farmer stock lot value and total value of 45 paired farmer stock lots comparing screened versus unscreened lots differed by only $2.45 (0.10%) and $109.98 (0.98%), respectively. Thus, the total purchase cost to shellers for screened lots is not significantly different from unscreened lots. Differences in shelled stock values on a per ton, per lot, and total basis were $38.86, $17.29, and $704.01, respectively, where processing cost differences were assumed to be zero. However, 16 shelled stock lots (20,287 kg) were rejected due to aflatoxin > 15 ppb in the unscreened peanuts compared to five rejected lots (5265 kg) in the screened peanuts. Estimates for blanching cost and product loss due to shrink and disappearance were applied to the unscreened and screened lots, respectively. For farmer stock lots in which at least one shelled stock lot was rejected, the added processing costs per Mg equate to $349.54 and $153.43 in the unscreened and screened lots, respectively. Deducting the added processing cost from the loan value ($677.73/Mg) resulted in net farmer stock values per Mg of $328.19 and $524.30 in the unscreened and screened lots, respectively. Thus, screening peanuts improved shelled stock peanut quality by reducing rejected lots and processing costs.

Key Words: *Arachis hypogaea* L., shelled stock peanuts, derived demand.

Mechanical screening of farmer stock (FS) peanuts prior to marketing increases the value of farmer stock (FS) peanut lots (Blankenship *et al.*, 1988; Lamb and Blankenship, 1999). Based on physical characteristics, screening divides peanut lots into overs (which consist of larger, higher value pods) and thrus [which consist of smaller, lower value pods and loose shelled kernels (LSK) and foreign material (FM)]. Comparing overs to unscreened lots in previous studies, sound mature kernels

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(SMK) and sound splits (SMKSS) increased 0.61% while LSK, FM, and other kernels (OK) were decreased by 4.31, 2.32, and 0.30%, respectively, contributing to the value increase of screened lots (Blankenship *et al.*, 1988; Blankenship and Woodall, 1998; Lamb and Blankenship, 1999, 2000). The average value of peanuts was increased by $29.15 per Mg (metric ton) in the overs. This translates directly into higher purchase cost to peanut shellers for overs. Henning *et al.* (1993) reported that mechanical screening reduced aflatoxin contamination by 35% in overs by concentrating aflatoxin in the thrus. This finding parallels results from Whitaker *et al.* (1998), who reported that aflatoxin in LSK accounted for 33.3% of total aflatoxin mass. Cumulatively, LSK, OK, and damaged kernels (DAM) accounted for 93.1% of total aflatoxin but only 18.4% of the total weight of unscreened FS lots (Whitaker *et al.*, 1998). Removal of LSK and small pods by screening should increase shelling efficiency and peanut quality. Lamb *et al.* (1993) concluded that the economic feasibility of shellers purchasing unscreened versus screened FS lots depended upon LSK in the FS lot and the percentage LSK that could be recovered into edible channels. However, in that study, the assumption was made that processing cost was the same for screened and unscreened lots and the need for further research on processing cost differences was noted.

The potential for aflatoxin in peanuts imposes considerable economic cost to the U.S. peanut industry. A 4 yr study (1993-1996) was conducted to estimate the net cost due to aflatoxin to the farmer, buying point, and sheller segments of the southeast peanut industry. The farmer segment net cost due to Segregation III lots (visible *Aspergillus flavus* Linx. found during FS grading) averaged $2,595,000 per year. Buying point losses from handling Segregation III lots average $532,585 annually. The yearly average net cost to the southeast sheller segment over the 4 yr period was $22,697,737 per year. In the 4 yr studied, Segregation III lots and aflatoxin cost the farmer, buying point, and sheller segments of the southeast U.S. peanut industry an average of $25,825,259 annually (Lamb and Sternitzke, 2001).

Derived demand is based on price-quantity relations which exist at intermediate points within a market system. Product demand between market segments are separated by marketing margins which by definition are a collection of services such as assembly, processing, transportation, and retailing. Marketing margins are generally assumed to be constant for a particular commodity. Derived demand was used to address inefficiencies in peanut grade price differentials and the subsequent impact on resulting price signals. Final shelled stock peanut value was not accurately reflected in the FS peanut value resulting in the overpayment of lower grade FS peanuts and underpayment of higher grade FS peanuts (Lamb and Miller, 1992). Thus, market incentives could discourage the delivery of higher grade, higher quality FS peanuts while providing false incentives for delivery of lower grade, lower quality FS peanuts.

Marketing margin cost also can be different for a commodity if excessive waste, loss, or spoilage occurs. This concept was used to compare the economic returns to further processing aflatoxin-contaminated lots. It was feasible to further process and market peanuts with aflatoxin levels of 99 ppb in the runner medium outturn category. However, due to excessive losses during remilling and blanching, it was not feasible to further process and market lots with higher aflatoxin levels indicating that incoming quality can impact marketing margins (Henning *et al.*, 1993; Lamb *et al.*, 1993). Thus, improvements in commodity quality due to technology advances should reduce marketing cost and lower the marketing margins, improve processing efficiency, and increase derived demand for the incoming commodity. The objectives of this study were to (a) compare the economic efficiency of processing screened versus unscreened FS peanuts and (b) determine if different derived demand exists for screened versus unscreened FS peanuts.

Materials and Methods

Ninety runner-type farmer stock lots were utilized in the study. Peanuts were delivered to the buying point as paired lots from similar production and harvest practices. One of the lots was then screened over a standard vibratory farmer stock cleaner with a 0.953-cm separation width to separate LSK, FM, and small pods (thrus) from larger pods (overs). The other FS lot remained unscreened. Farmer stock grade data and weights for the unscreened and overs lots were obtained using standard Federal-State Inspection Serv. grading procedures (USDA, 1999). The farmer stock price per Mg for each lot was calculated based on the respective grade factors and the national average support price ($677.73 per Mg). In a previous study, Lamb and Blankenship (1999) analyzed the average difference in loan value per Mg associated with purchasing overs instead of unscreened lots. However, to address the economic efficiency and estimate derived demand schedules for unscreened versus screened FS peanuts based on incoming aflatoxin, the difference in FS value must be on a total purchase cost basis instead of a per Mg basis. Thus, the difference in the FS loan value of unscreened and overs is defined as:

$$FS_{diff} = \sum_{i=1}^{n}(FS_{oi} - FS_{ui}) \qquad \text{[Eq. 1]}$$

where:

FS_{diff} is the difference in loan value between overs and unscreened lots,

FS_{oi} is the loan value per lot of overs based upon grade,

FS_{ui} is the loan value per lot of unscreened based upon grade, and

n represents the number of lots.

Samples (22.7 kg) were gathered from the unscreened and overs lots and shelled to obtain commercial shelling outturn and values using commercial screen sizes and kernel values in Table 1. After shelling, samples were electronically color sorted using a Satake Scanmaster EMS (RM 200S, Houston, TX) using standard industry settings. Electronic color sorting segregated the shelled stock (SS) lots into accepts and rejects to reflect the commercial marketings of shelled stock peanuts for both unscreened and overs lots resulting from the paired lots delivered to the buying points. The SS value difference between unscreened and overs lots can be obtained from:

$$SS_{diff} = \sum_{i=1}^{n} \{(O_{joi} - O_{jui})*P_j\} \qquad \text{[Eq. 2]}$$

where:

SS_{diff} is the difference in gross shelled stock value between overs and unscreened lots,

O is the shelling outturn in pounds per farmer stock lot,

P is the price per pound for each shelled category,

Table 1. Commercial shelling outturn screen sizes and price of shelled stock peanuts.

Outturn	Screen size	Shelled stock price
	cm	$/kg
Jumbos	Ride 0.833 × 1.905 slotted screen	$1.39
Mediums	Ride 0.714 × 1.905 slotted screen	$1.37
No. 1s	Ride 0.635 × 1.905 slotted screen	$1.32
U.S. splits	Ride 0.675 round screen	$1.35
Oil stock	Fall through 0.675 round screen + damage + LSK not recovered into edible	$0.33

j represents shelled stock outturn categories,
o represents overs,
u represents unscreened, and
n represents the number of lots.

In previous research, the assumption was made that the marketing margin for shelling and marketing overs and unscreened SS lots was the same. Data were gathered in this study to focus on both the sign and magnitude of marketing cost differences between overs and unscreened lots as follows:

[Eq. 3]

where:

T_{diff} is difference in value a sheller could expect from purchasing and shelling overs lots as compared to unscreened lots, and

C represents marketing margin differences associated with shelling and marketing overs versus unscreened lots.

Results and Discussion

Significant differences (P = 0.05) were found in LSK, FM, and FS value/Mg between the unscreened and overs lots while SMKSS, OK, and DAM were not significantly different (P = 0.05) (Table 2). The FS value/Mg was $19.79/Mg higher in the overs lots. However, the FS value per lot was not significantly different (P = 0.05) in the overs lots because of the peanut weight removed during the screening process (Table 2). The implication is that while the per Mg purchase cost for overs lots is significantly higher, the resulting cost per FS lot was not significantly different (P = 0.05) at $2.45 per FS lot. Thus, the total peanut cost of purchasing overs versus unscreened FS lots was only $109.98 different (Table 2). This result extends previous findings which focused only on the difference in loan value per Mg of unscreened versus overs lots instead of the differences on a lot or total basis.

Table 3 provides the mean SS outturn weights and values for the unscreened and overs lots. The accepts and rejects from the electronic color sorting are provided separately. It is important to note that the assumption is made in Table 3 that C = 0 from Equation 3 to provide a comparison for unscreened versus overs lots based on aflatoxin contamination in SS and the associated cost of removal. The only significant difference found in the SS outturn weights was for the oil stock category in the unscreened rejects which was significantly different from the oil stock rejects in the overs (P = 0.05) (Table 3). Significant differences resulted for the SS value per Mg in the unscreened versus overs accepts. The SS value differences were not significant on a SS lot basis (Table 3). The total value of the unscreened rejects was significantly higher (P = 0.05) than the total value of the rejects in the overs, which is consistent with previous findings indicating the removal of lower quality peanuts during the screening process. The results in Table 3 indicate that, even though peanut weight purchased is reduced by screening, the SS outturn weight, value per lot, and total SS value are not significantly different (P = 0.05).

Table 2. Mean farmer stock grade factors and value per ton in unscreened and overs lots (n = 90).

Outturn	Unscreened[a]	Overs
SMKSS (%)	75.53 a	76.27 a
LSK (%)	2.98 a	0.80 b
OK (%)	2.60 a	2.36 a
DAM (%)	0.91 a	0.87 a
FM (%)	4.27 a	1.36 b
Net lot weight (kg)	8270 a	7895 b
Value ($/Mg)	$703.62 a	$723.41 a
Value ($/FS lot)	$2467.40 a	$2469.85 a
Total value of FS peanut	$111,033	$111,143

[a]Means followed by the same letter within rows are not significantly different at P = 0.05 based on Duncan's new multiple range test.

Aflatoxin in parts per billion (ppb) was measured in each of the SS outturn categories resulting from the unscreened and overs lots. Lots with 15 ppb or less are considered as "negative" aflatoxin content and are certified as meeting edible quality (Peanut Administrative Committee, 1999). Lots with aflatoxin greater than 15 ppb must be remilled and/or blanched until edible quality standards are met. If the 15-ppb limit is not met, then the lot is removed from edible channels and crushed for oil. In the unscreened lots a total of 16 shelled stock lots were rejected because of aflatoxin greater than 15 ppb while five of the overs lots were rejected. The total weight of the peanuts in the rejected lots was 20,287 and 5265 kg in the unscreened and

Table 3. Mean shelled stock outturn per lot (kg) and shelled stock value per Mg, lot, and total in unscreened and overs lots (n = 90), assuming no deductions for aflatoxin contaminated SS lots.

Outturn	Unscreened		Overs	
	Accepts	Rejects	Accepts	Rejects
	kg	No.	kg	No.
Jumbos	556	20	555	17
Mediums	1271	46	1315	40
No. 1s	292	15	266	11
U.S. splits	333	46	319	38
Oil stock		241		197
SS value/Mg	$865.87	$32.31	$908.93	$28.11
SS value/lot	$3,137.68	$121.23	$3,141.78	$99.74
Total SS value	$141,196	$5456	$141,380	$4488

Table 4. Number of lots with aflatoxin ppb>15, average ppb, and weight (kg) of rejected shelled stock lots in unscreened and overs.

	Unscreened lots			Overs lots		
Outturn	No.	Aflatoxin	Wt	No.	Aflatoxin	Wt
		ppb	kg		ppb	kg
Jumbos	3	35	3170	0		
Mediums	4	146	9595	2	105	3670
No. 1s	5	255	3371	3	151	1595
U.S. splits	4	29	4151	0		
Total	16	141	20,287	5	112	5265

overs lots, respectively (Table 4). Blanching costs were obtained from spot checks with blanchers at $0.03/kg and estimates for product loss and disappearance were obtained from previous studies and applied to the rejected lots (Lamb *et al.*, 1993). Peanut products removed during the blanching process were valued at oil stock prices. The blanching costs for the unscreened lots totaled $5398 versus $1929 blanching costs for the overs lots. Applying the added processing cost due to blanching of rejected lots to all FS lots resulted a in cost of $31.97 per Mg in the unscreened lots and $12.12 per Mg in the overs lots. This represents average losses per Mg based on total purchases of unscreened and screened Segregation I (visible *A. flavus* not found during FS grading) farmer stock lots.

FS lots with no resulting shelled stock lots that are rejected receive full grade basis value. However, to estimate derived demand, the losses should apply to the individual FS lot in which the rejected shelled stock lot(s) resulted. If one or more shelled stock lot is rejected, then added processing costs result and derived demand estimates at the FS level can be calculated by subtracting the added processing cost resulting at the shelled stock level from the value of the respective FS lot. The deductions in the unscreened lots in which one or more shelled stock lot was rejected averaged $349.54/Mg and ranged from $119.00/Mg to $457.39/Mg. Subtracting the losses from the respective FS value/Mg resulted in an average net FS value of $307.22/Mg (52% of FS value) with a range of $130.23/Mg (31% of FS value) to $527.78/Mg (82% of FS value) in the unscreened lots. The deductions in the overs lots in which one or more shelled stock lots was rejected averaged $153.43/Mg and ranged from $34.50/Mg to $311.92/Mg. Subtracting the losses from the respective FS value/Mg resulted in an average net FS value of $532.24/Mg (81% of FS value) with a range of $394.16/Mg (57% of FS value) to $679.83/Mg (96% of FS value) in the overs lots.

Summary and Conclusions

Previous research on the impact of screening FS peanuts did not address the cost differences associated with shelling and marketing screened versus unscreened peanuts. The results of this research indicate that screening and marketing overs lots compared to unscreened lots reduced the number and poundage of shelled stock lots rejected due to aflatoxin content greater than 15 ppb. The technical efficiency in terms of total volume shelled versus accepted shelled stock lots was greater in overs lots compared to unscreened lots. Since a shellers total purchase cost for overs and unscreened FS peanuts is the same, the economic efficiency of shelling and marketing overs lots was greater for overs lots. However, if a grading system was in place that reflected the net final value in purchase cost through derived demand schedules, there would be no gain in overall economic efficiency; yet, the technical shelling efficiency would remain the same.

A need for further research exists because it is not feasible to determine the actual derived demand of individual FS lots based on aflatoxin in each shelled stock outturn category. For each FS lot, peanuts were shelled and separated into five shelled stock outturn categories, color sorted, and aflatoxin analyses were conducted. A more direct and cost effective method for estimating derived demand curves for FS peanuts needs to be developed.

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