EFFECTS OF SCREEN APERTURE ON GROUNDNUT DECORTICATION

Saleh A[1]* and Akande, F.B.[2]

[1]Department of Agricultural and Bio-Resources Engineering, Ahmadu Bello University, Zaria, Nigeria
[2]Department of Agricultural Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria

***Corresponding Author**: salehaminu@gmail.com +234803 577 4780
fakande@lautech.edu.ng

ABSTRACT
The high rate of bruised and split kernels realized from most groundnut decorticators necessitated the need to develop a decorticator with optimum clean kernels recovery. The objective of this study was to determine the effects of screen aperture on decorticating three selected groundnut varieties commonly cultivated in Nigeria. The varieties were Samnut 10, 14 and 18. A modified groundnut decorticator was used as part of the study. A removable oblong-shaped screen replaced the fixed net-like iron bars in the modified decorticator. 50kg each of the selected groundnuts in-shell were graded into three grades (I, II and III) while screen apertures of 8, 10 and 12 mm were used for decorticating the groundnuts at 8 % (d.b) moisture level using three replications in a complete randomized design. The results were evaluated using ANOVA at P<0.05 while the significant difference were evaluated using NDMRT. The analysis of variance test showed that the variations in clean, bruised and split kernels of the decorticated groundnuts in-shell were significant at 5 % level of significance. Results obtained showed progressive increase of clean kernels recovered. It revealed that both Samnut 10 and 18 recorded the highest percentages of clean kernels of 79.62 and 77.80 %, respectively at 8 % moisture content and 12 mm screen aperture. However, when screen apertures were varied from 8 – 12 mm for grade III, the rate of clean kernels recovery decreased progressively from 94.68 % using 8 mm aperture to 31.61 % with 12 mm aperture. It was also evident from the results obtained that the smaller the difference between the screen aperture and the major diameter of the groundnut pods the better the quality of higher percentage of clean kernels obtained.

KEY WORDS: Damaged Kernels, Decortication, Clean Kernels, Screen Aperture

1. INTRODUCTION
Groundnut (*Arachis hypogaea* L.) is one of the world's principal oil seed crops that is rich in protein and has a high energy value. Groundnut is also an important food crop in many areas of semi-arid tropics (FAO, 1994). Improvements in groundnut production and processing for a qualitative output are also crucial because of its potential to regain and increase export earnings. Growth in agriculture has generally been linked to development in other sectors which invariably contributes to poverty alleviation (Khan, 1990). Like most developing countries, majority of the rural dwellers in Nigeria depends on agriculture. It thus plays a key role in the agriculture-dependent economies of West Africa where its marketing and trade served as the major sources of employment, income and foreign exchange (Rai *et al.*, 1993; Revoredo and Fletcher, 2002; Ntare *et al.*, 2008). Therefore, groundnut sector provided the basis for the agro-industrial development

and contributed significantly to the commercialization and integration of the national rural sectors (Ntare *et al*., 2007).

However, groundnuts exported into Europe during the years of bumper harvests in Nigeria and other Sub-Saharan African countries (SSA) was done majorly in-shell because of high incidence of aflatoxin contamination on decorticated kernels. Aflatoxin is associated with bruises and breakages of kernels, thus reducing the net profit of both the farmer and produce agent. The cost of export also increases because of the space needed to ship the produce. Decorticated kernels from most indigenous equipment result in having bruises, cracks and breakages that reduce their quality. Kernel quality as a method of measuring marketability is very essential in successful agricultural production as poor quality produce is characterized by gradual decline in value and vigour (Hartmann *et al.,* 1990). A good quality kernel has high economic value, better germination and free from disease and insect attack.

The screen is a major component of the decorticator. It allows the decorticated kernels to pass to the collection chamber. It is usually fixed under the decorticating drum. The clearance between the drum and screen could be adjusted to accommodate different decorticating conditions. Decorticating screen could either be in form of wire mesh or oblong depending on the designer's choice (Singh, 1993). Because of the unique importance of the screen in kernel separation with the husks, the dimensions of pods and kernels are considered important limiting factors in passing the kernel and the hull between the screen holes and in determination of clearance between the decorticating drum and the separating screen, (Helmy, 2001). Similarly, Sudajan *et al*. (2005) also emphasized the importance of the physical properties of agricultural materials in the determination of screen sizes. Heiderbeigi *et al.* (2009) and Olajide and Ade-Omowaye (1999) reported further that dimensions are very important parameters in groundnut decortication as this will help in selecting appropriate screen sizes for each groundnut variety. The dimensional characteristics of groundnut pods and kernels are, therefore, very important in selecting appropriate screen aperture for mechanical decortication of the groundnut in-shell.

The greatest potential for providing clean decorticated kernels is by means of establishing suitable screen apertures for each grade of groundnut in-shell in order to improve the kernels quality by reducing bruises and breakages that could meet the standards of the importing countries and in turn, serves as leverage for creating jobs for the teaming unemployed youth population, hence the focus of this study.

2. MATERIALS AND METHOD

The original groundnut decorticator (Figure 1a) was designed to operate both manually and mechanically. Its major components were the shelling unit, main shaft, concave sieve, hopper and the fan. The screen is a net-like arranged iron rod bars. The gap in between the bars allows for only the shelled mix material to pass through. The hopper is rectangular tray-like having a wider opening to receive more materials and deliver into the shelling unit causing a lot of wastage due to spillage. Modifications done on this decorticator include: replacing the fixed net-like arranged iron bars screen with a removable oblong-shape screen slots; decorticating unit that consists of six decorticating bars made of flat plates with tapered studs replacing the decorticator shaft that has spikes made of rod bars along its functional length; and an trapezoidal frustum hopper as against rectangular tray-like hopper.

2.1 *General Description of the Modified Groundnut Decorticator*

The modified groundnut decorticator used for the study consists of the hopper, frame, decorticating drum, drum housing, main shaft, blower, pulleys, belt, bearings and a 5 kW electric motor (Figure 1b). The detailed description of the modified parts of the decorticator is given below:

Frame - The frame of the decorticator was constructed from angle iron of 50 x 50 x 5 mm. It supports the other components and also serves as the prime mover seat. It has a total length of 1.16 m and a maximum height of 850 mm. The decortication and blower chambers are joined to the frame by arc welding while the main shaft, blower shaft, decorticating drum cover and blower cover are bolted together for easy packaging and transportation.

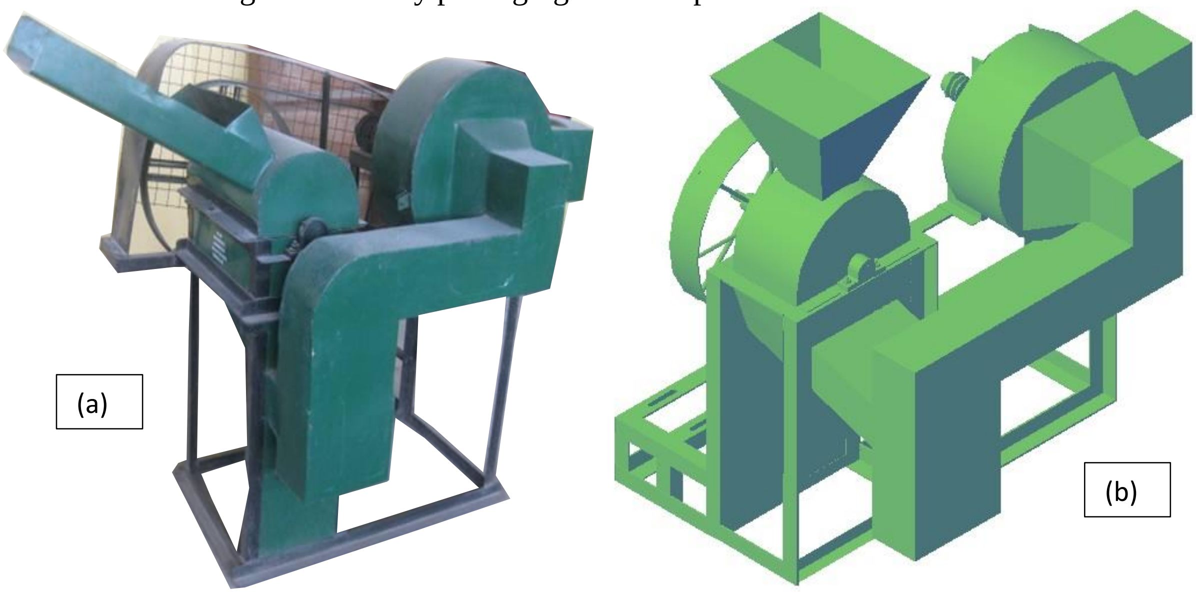

Figure 1: Pictorial view of the (a) original and (b) modified groundnut decorticators

Hopper - The feed hopper is that part of the decorticator through which groundnut in-shell are fed into the decorticator. It has a vertical height of 380 mm. The bottom width is 140 mm to allow easy down flow of pods into the drum. It is a trapezoidal frustum, with a square top of 410 mm having both ends opened to allow free flow of pods. The upper part of the hopper was covered half-way by a sheet of metal to prevent splitting the pods due to impact force of the decorticating drum. The material for the hopper is galvanised steel plate chosen because of its ability to be forged with ease.

Decortication Drum Housing - The decortication drum has two main components: the upper part is a half drum made of galvanised metal sheet folded such that it serves as guide for the groundnut in-shell being processed and as a protective cover for operator; the lower part of the housing serve as collector of the shelled mix. It also houses the screen and decorticating shaft arrangement. It has a length of 400 mm and a diameter of 410 mm.

Decortication Drum - The decortication drum rotates and thus does the decortication process by rubbing action. It is referred to as the decortication unit. It is cylindrical in shape and has a diameter of 370 mm. The decortication unit consist of 6 flat shelling bars fitted at equal distance with tapered pegs of 10 mm length and 13 mm diameter spirally arranged with which it rubs the materials against the screen while it rotates. The bars are made from cast iron in order to minimise contamination due to corrosion. Each bar is 210 mm long and 50 mm wide with 16 pegs on 2 rows. The drum is mounted on the main shaft via two 25 mm diameter support bearings.

Screen **-** The screen was a slot/capsule-like perforated metal with apertures allowing only the shelled mix material to pass through as recommended by Singh (1993) and Sudjad *et al.* (2005). It was fastened to the housing with bolt and nuts instead. The oblong-shaped screen aperture has a diameter range between 8 – 12 mm. For this design, the concave clearance determined was 20 mm based on the impressive results of some pre-decortication tests and the physical sizes of the groundnut pods measured.

2.2 *Basic Design Calculations*

The area of the drum equals the ratio of its volume to its length

$$A_d = \frac{V_d}{L_d} \tag{1}$$

where:

A_d = Area of decorticating drum, mm^2
V_d = Volume of decorticating drum, mm^3
L_d = Length of the decorticating drum, mm

$$\therefore \; A_d = \frac{4.46 \times 10^{-2}}{0.4} = 1.1161 \times 10^{-1} m^2$$

But cross sectional area of the decorticating drum was given as:

$$A_{dcs} = \frac{\pi d^2}{4} \tag{2}$$

where:

A_{dcs} = Cross − Sectional area of the decorticating drum, mm^2
d = Diameter of the decorticating drum, mm

Thus,

$$d^2 = \frac{1.1161 \times 10^{-1} \times 4}{3.14} = 0.1422$$

$$\therefore \; d = 0.37m = 370\,mm$$

The weight of the groundnut was determined with the use of an electronic weighing balance with an accuracy of 0.001 g. After soaking the groundnut in-shell samples at 6 h intervals at a uniform temperature, the weight gained was monitored. The moisture gain was recorded and the moisture content in percentage was determined. The moisture content on wet basis was computed using equation 3 (Oluwole *et al.*, 2007):

$$M_{wb}(\%) = \frac{W_i - W_f}{W_i} \times 100 \qquad (3)$$

where:

$M_{wb} = \text{wet basis mositure content, \%}$
$W_i = \text{initial weight of the groundnut in} - \text{shell sample, g}$
$W_f = \text{final weight of the dry groundnut in} - \text{shell sample, g}$

The pods were then sealed in marked polyethylene bags and stored in that condition for another 24 h. This enables stable and uniform moisture content of the pods to be achieved in the bags. The polyethylene bags were transferred into a refrigerator and when needed for the experiments, the pods were allowed to equilibrate in ambient condition for 6 h. The experiment was replicated three times for each sample and the average values of the moisture contents obtained were determined.

2.3 *Sample Collection and preparation*

Three groundnuts varieties commonly cultivated in Nigeria were identified, selected and procured from the Institute for Agricultural Research (IAR), Zaria, Nigeria. They are: Samnut 10, Samnut 14 and Samnut 18. Their selection was based on variations of physical properties, especially size and wide adoption in most groundnut producing states of Nigeria. 50 kg of each of the three groundnut in-shell varieties were graded into three different grades (I, II and III) according to their geometric size with the aid of a grader. Each grade was then subjected to 8% and was decorticated with all the three screens (8, 10 and 12 mm) constructed. Studies conducted showed that the optimum moisture level for groundnut in- shell storage ranges between 6 – 9% (Franz *et. al.* 2000). Below this range, both kernel quality and seed germination will be adversely affected while the creation of *aflatoxin* is retarded. Similarly, decortication at moisture levels below 8% could cause high levels of loose-shelled kernels, (Baughman, 2007; Franz *et.al* 2000 and Sinha *et al*., 1997), hence the choice of 8 % moisture level of the groundnut in-shell for the study. The measured parameters studied were clean, bruised and split kernels and the process conditions (factors of interest) employed are grading, moisture content and screen apertures.

2.4 *Experimental Procedure*

To determine the geometric dimensions of the groundnut pods and kernels, one hundred pods and kernels were randomly selected from each variety. It was considered that this number would be adequate to give a sample mean that would be very close to the entire population mean. The sample dimensions were measured with precision digital Vernier callipers that measures to the nearest 0.01 mm sensitivity (Raider Professional Tools – RDDC 708).

Tests were conducted to evaluate the performance of the groundnut decorticator following the procedure outlined by Oluwole *et al*. (2004). To avoid bias and allow fairness to all the trials such that results obtained should not be by chance, the quantity of in-shell per decortications trial was pegged at 1000 g of the groundnuts in-shell. This was fed into the hopper by hand. The prime mover was put on to supply power and set the working components of the decorticator in motion. Pods were discharged into the decorticator and decorticated until the hopper was emptied. Preliminary tests showed that good results could be obtained with the concave clearance of 20 mm. Therefore, this clearance was maintained throughout the performance tests. The chosen clearance was in agreement with Omran *et al*. (2005) Oluwole *et al*. (2004) and Khan (1990) while optimizing the operating parameters for a model machine to thresh groundnut.

2.5 *Performance Evaluation*

Data collected form the decortication exercise was used to compute the performance of the decorticator in terms of clean, bruised and spilt kernels and rate of un-decorticated pods as given in equations 4 – 7 (Gitan *et al*., 2013; Bashiri *et al*., 2013):

$$P_{ck} = \frac{W_{ck}}{W_t} \times 100 \quad (4)$$

$$P_{bk} = \frac{W_{bk}}{W_t} \times 100 \quad (5)$$

$$P_{sk} = \frac{W_{sk}}{W_t} \times 100 \quad (6)$$

$$P_{up} = \frac{W_{up}}{W_t} \times 100 \quad (7)$$

where: P_{ck} = Percentage of whole(clean)kernels, %
P_{bk} = Percentage of bruise kernels, %
P_{sk} = Percentage of split kernels, %
P_{up} = Percentage of undecorticated pods, %
W_{ck} = weight of whole (clean)Kernels, g
W_{bk} = weight of bruised Kernels, g
W_{sk} = weight of split Kernels, g
W_{up} = weight of undecorticated pods, g
W_t = total weight of clean, bruised, split Kernels and undecoticated pods, g

2.6 *Statistical Analysis*

The data obtained on the percentages of clean kernels, bruised kernels, split kernels and un-decorticated pods during the decorticating processes were analyzed using the SPSS 16.0 and Microsoft Excel Statistical Package (2010). Analysis of variance (ANOVA) and New Duncan Multiple Range Test (NDMRT) were used to determine the effects of screen aperture on clean kernels recovery from each grade of the three groundnut varieties.

3. RESULTS AND DISCUSSIONS

Samples of the selected groundnuts in-shell were decorticated with the modified groundnuts decorticator. Analyses of the results obtained for decorticating the three varieties of groundnut in-shell were determined by weight. These values were converted into output percentages for ease of comparison in order to draw conclusions. The result of the grading before decortication also show that while Samnut 10 had the three grades (I, II and III), Samnut 14 had grades II and III, Samnut 18 had I and II grades.

The result of the statistical test on effect of screen aperture on clean, bruised and split kernels using Samnuts 10, 14 and 18 varieties as presented on Table 1. The analysis of variance test shows that the variations in clean, bruised and split kernels of the decorticated groundnuts in-shell were significant at 5 % level of significance. This implies that process parameters employed significantly affect the efficiency of clean, bruised, split kernels at 5 % level. Interactions between process parameters were also significant at 5 % levels. It can therefore be concluded from the foregoing that the efficiency of the measured parameters differs significantly from one level to another on the three varieties.

Table 1: ANOVA showing the Effect of Screen Aperture on Clean, Bruised and Split Kernel using Samnuts 10, 14 and 18

Variety	Dependent Variable	Sum of Squares	Df	Mean Square	F	Sig.
Samnut 10	Clean Kernel	1624.777	2	812.389	2956.350	0.001*
	Bruised Kernel	267.781	2	133.891	1152.748	0.001*
	Split Kernel	4645.583	2	2322.791	15564.734	0.001*
Samnut 14	Clean Kernel	3266.062	2	1633.031	3224.258	0.001*
	Bruised Kernel	38.147	2	19.074	74.561	0.001*
	Split Kernel	328.431	2	164.215	548.052	0.001*
Samnut 18	Clean Kernel	21158.858	2	10579.429	25412.692	0.001*
	Bruised Kernel	3139.183	2	1569.592	4665.027	0.001*
	Split Kernel	8155.025	2	4077.513	7061.775	0.001*
Error	Clean Kernel	27.350	14	0.506		
	Bruised Kernel	13.814	14	0.256		
	Split Kernel	16.180	14	0.300		
Total	Clean Kernel	13159.430	20			
	Bruised Kernel	1657.584	20			
	Split Kernel	1776.647	20			

*significant at $p \leq 0.05$, #significant at $p \leq 0.10$

Table 2 shows the multiple comparisons between the different levels of screen aperture for the three groundnut varieties using the New Duncan Multiple Range Test (NDMRT). In comparing the clean kernels, bruised kernels and split kernels of the decorticated groundnut kernels along the various levels of grading, moisture and screen apertures. It was observed that screen aperture of 12 mm showed higher kernels recovery of 71.12 and 73.26 % for Samnuts 10 and 18 varieties, respectively. This shows that, keeping all known process parameters in the study constants, screen size 12 mm will be a better choice for cleaner kernels for Samnuts 10 and 18 varieties. However, 10 mm screen aperture with clean kernels recovery of 79.28 % would be more appropriate for Samnut 14 variety.

3.1 *Effects of Screen Aperture on Decorticating Grade I Samples*

Results obtained showed progressive increase of clean kernels recovery of decorticated grade I groundnut for Samnuts 10 and 18 varieties with increase in aperture size at 8 % moisture content. It revealed that 45.51% of clean kernels were recovered from Samnut 10 using 8 mm aperture. However, 60.36 and 79.62 % clean kernels were recovered when 10 and 12 mm apertures were used respectively. Similar tends was witnessed for Samnut 18 variety as observed by Atiku *et al.* (2004); Simonyan and Oni (2001). Clean kernels recovered from this variety were 35.11 % when

8 mm aperture was used. It rose to 57.68 and 77.80 % when 10 and 12 mm screen apertures were used respectively as shown in Figure 2.

Table 2: Mean Differentials Using New Duncan Multiple Range Test for Clean, Bruised and Split Kernels (Samnuts 10, 14 and 18)

Variety	Screen Aperture	Clean Kernel	Bruised Kernel	Split Kernel
	8 mm	62.53a	13.99a	22.70a
	10 mm	70.35b	11.76b	13.91b
Samnut 10	12 mm	71.12b	10.15c	6.65c
	8 mm	78.67	10.38	10.30
	10 mm	79.28	9.08	6.39
Samnut 14	12 mm	65.52	8.81	5.73
	8mm	33.71	31.54	34.75
	10mm	51.97	23.43	24.61
Samnut 18	12mm	73.26	16.30	10.29

Means with the same alphabet on same row are not significantly different from each other

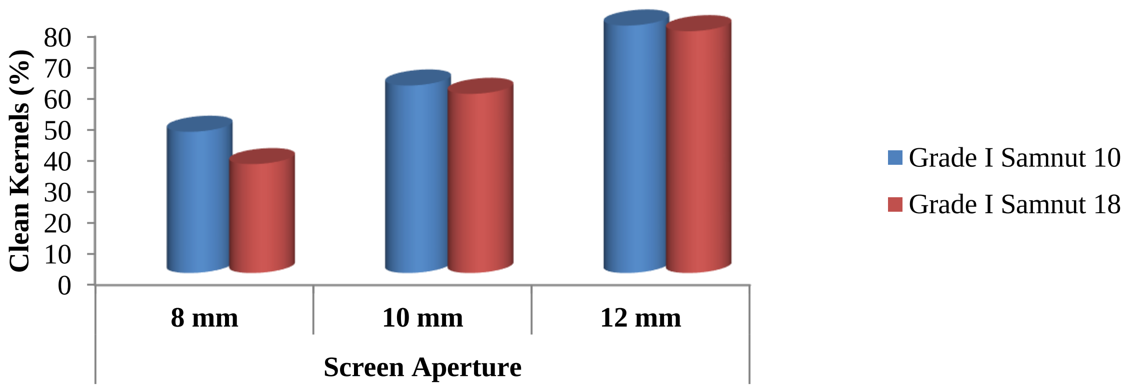

Figure 2: Mean Percentages of Clean Kernels from Grade I using 8, 10 and 12 mm Screen Apertures

Similarly, the least quantities of bruised and split kernels of 11.16 and 9.00 % were respectively observed from Samnut 10 variety at the same process conditions of 8 % moisture content and 12 mm screen aperture Figures 3 and 4. These results could be attributed to the fact that groundnuts pods are larger and could be prone to damage when small size apertures (8 mm) were used for the decortication as suggested by Sudajan *et al*. (2005). This revealed that screen aperture had significant effect on the quality of the groundnut kernels decorticated. It was also evident from the results obtained that the smaller the difference between the screen aperture and the groundnut in-shell major diameter the better the quality of higher percentage of clean kernels obtained.

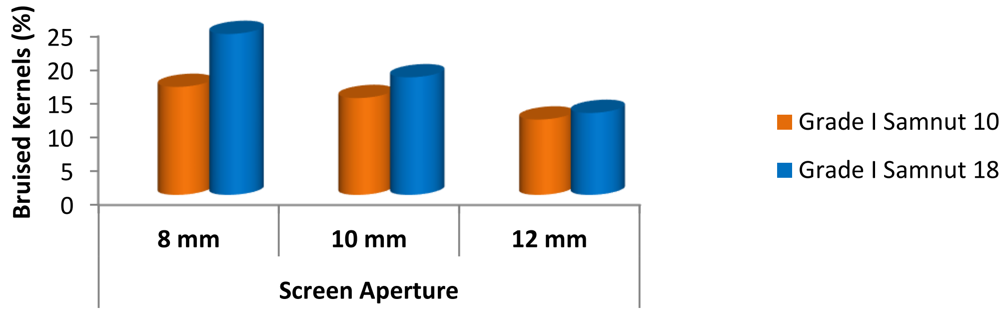

Figure 3: Mean Percentage of Bruised Kernels from Grade I using 8, 10 and 12 mm Screen Apertures

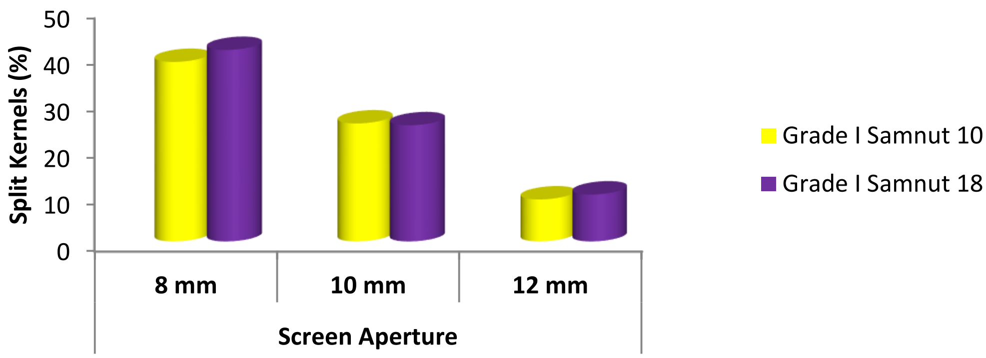

Figure 4: Mean Percentage of Split Kernels from Grade I using 8, 10 and 12 mm Screen Apertures

Studies conducted by Olajide and Igbeka, 2003; Sudjad *et al*., 2005; Davies, 2009; Liu *et al*., 2009 also emphasized the importance of pod and kernel sizes in designing process equipment. Similarly, it was observed in different studies (Ndjeunga *et al.*, 2010; Ezzatollah *et al.*, 2009) that relatively bigger geometric sizes would be crushed and/or bruised when the screen size is smaller. It was observed that the rate of clean kernels recovery was significantly different for all the three screen apertures used in decorticating grade I groundnut samples. This was supported in previous studies (Olajide and Igbeka, 2003; Sudjad *et al*., 2005) where the importance of the physical properties of agricultural materials in the determination of screen sizes was emphasized.

3.2 *Effects of Screen Aperture on Decorticating Grade II Samples*

All the three varieties had grade II samples. Clean kernels recovered from grade II sample also had similar trends with those of grade I for all the three groundnut varieties decorticated (Figure 5). The results obtained revealed that while Samnut 10 variety recorded its highest percentages of clean kernels of 83.39 % at 10 % moisture content and 12 mm screen aperture, Samnut 14 variety had a similar rate of 83.08 % at the same moisture level but at a relatively smaller screen aperture of 10 mm. For Samnut 18 variety, 76.61 % of clean kernels were recorded at 8 % moisture content using 12 mm screen aperture as shown in Figure 5.

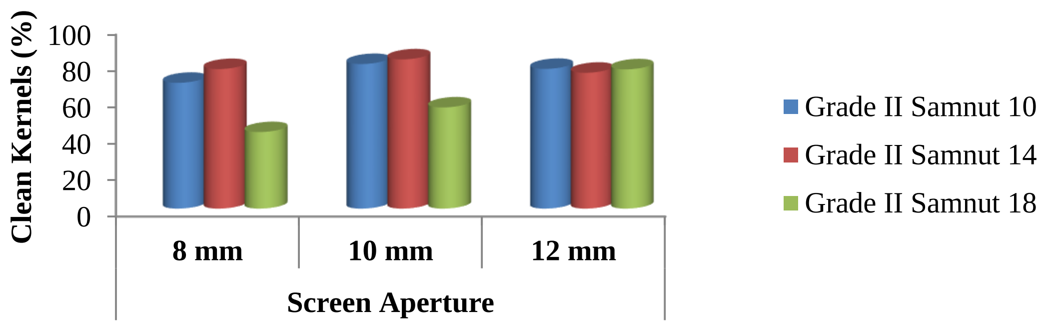

Figure 5: Mean Percentages of Clean Kernels from Grade II using 8, 10 and 12 mm Screen Apertures

Although visual inspection of the groundnut in-shell samples revealed that pods of the same grades had the same sizes, their kernel sizes might not be related to the external size of the nut as reported by Pinson *et al.* (1991) as such more kernels of Samnut 18 variety were crushed at all the moisture levels and screen apertures probably because their kernels were larger. The rate of un-decorticated pods would be higher if 12 mm screen was used to decorticate pods at lower moisture content of 8 %. This finding was in agreement with previous studies (Ezzatollah *et al.*, 2009; Ndjeunga *et al.*, 2010) that while smaller pods and kernel sizes tends to pass through moderate and bigger sieves, un-decorticated pods that are relatively bigger in sizes would be crushed and/or bruised when the screen size is smaller thereby causing serious damage to the kernels thus reducing quality and packaging/marketability. Previous studies (Olajide and Igbeka, 2003; Sudjad *et al*., 2005; Davies, 2009; Liu *et al*., 2009) also emphasized the importance of pod and kernel sizes in designing process equipment. At higher levels of moisture content, it was reasoned that the kernels lost their degree of internal voids, hence the kernel would be difficult to remove intact and was thus readily damaged by the decortication action as noted by Pinson *et al.* (1991).

The trend of obtaining clean kernels for grade II when Samnut 10, 14 and 18 varieties were decorticated was an increase kernel quality with increase in the size of the screen aperture (Figure 4) as suggested by Atiku *et al.* (2004); Simonyan and Oni (2001). The least quality of clean kernels was obtained when 8 mm screen aperture was used while higher quantities were recovered with 12 mm aperture for all the varieties at the three moisture regimes. These variations could possibly due to the difference in the physical properties of the groundnut varieties such as irregularity of kernels shapes, thickness of the shell, brittle nature of the shell and the uniformity and strength of the kernels as observed by Pinson *et al.* (1991). It was similarly observed that the percentages of clean kernels recorded while decorticating grade II samples of Samnut 10 and 14 varieties could be adjudged good because they falls within the acceptable range of 50 – 80 % recommended by Jambunathan (1991). However, he failed to ascertain the parameters attached to the groundnut in-shell before decortication.

Table 3 shows the multiple comparisons between the effects of various levels of screen apertures using the NDMRT on the rate of split kernels recovery. It was observed that the rate of split kernel recovery was significant for grades II samples when the three screen apertures were used to decorticate the three groundnut varieties. While Figure 6 shows that the highest amount of bruised kernels in grade II samples (28%) were obtained from Samnut 18 variety for all the screen apertures. Bruised kernels obtained from Samnut 10 and 14 varieties are relatively lower than what was obtained from Smnut 18 variety. There were also no significant differences between the bruised kernels obtained for Samnut 10 and 14 varieties. Similar situation was observed for split kernels as bruised kernels of Samnut 18 variety, but significant differences were observed between the split kernels of Samnut 10 and 14 varieties as shown in Figure 7. These variations could be attributed the differences in the irregularity of kernels shapes, thickness of the shell and the uniformity and strength of the kernels as observed by Pinson *et al.* (1991).

Table 3: New Duncan Multiple Range Test on the effects of screen aperture on split kernels for Ungraded, grades I and II groundnut in-shell

Grade	Screen Aperture (mm)	N	Subset		
			1	2	3
I	12	18	10.7817		
	10	18		27.7683	
	8	18			42.6000
	Sig.		1.000	1.000	1.000
II	12	27	6.1078		
	10	27		13.3830	
	8	27			23.2774
	Sig.		1.000	1.000	1.000

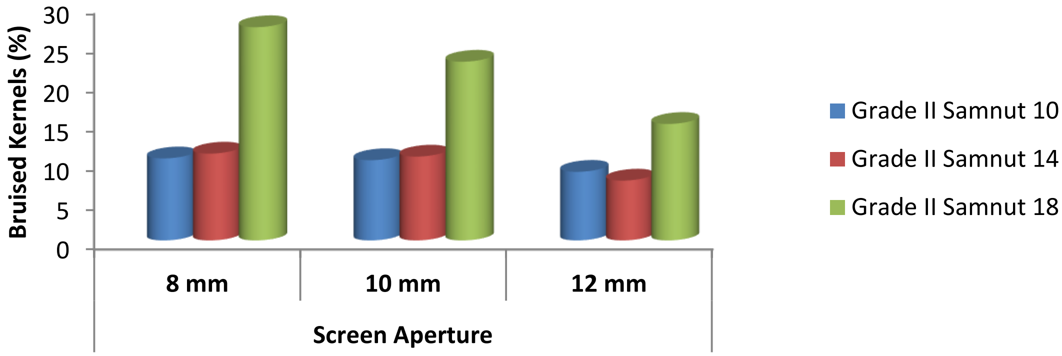

Figure 6: Mean Percentage of Bruised Kernels from Grade II using 8, 10 and 12 mm Screen Apertures

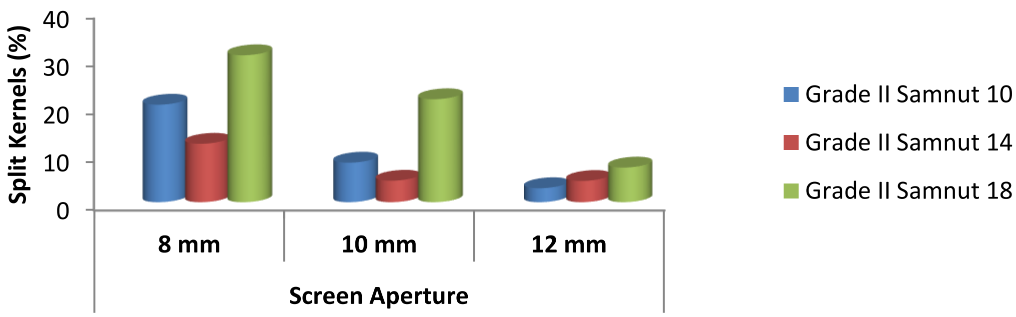

Figure 7: Mean Percentage of Split Kernels from Grade II using 8, 10 and 12 mm Screen Apertures

3.3 *Effects of Screen Aperture on Decorticating Grade III Samples*

Table 4 shows the NDMRT results on the effects of screen aperture on clean kernels recovery. It was observed that the rate of clean kernels recovery was significantly different when 12 mm aperture was used, but the difference was not significant between 8 and 10 mm apertures when decorticating grade III groundnut samples.

Table 4: Duncan Multiple Range Test on the effects of screen aperture on clean Kernels for Grade III groundnut in-shell

Groundnut in-shell Grade	Screen Aperture (mm)	N	Subset	
			1	2
III	12	18	53.1850	
	10	18		79.2556
	8	18		84.8756
	Sig.		1.000	.092

Results obtained from grade III samples of the two groundnut varieties show a reverse trend from what was obtained for grades I and II. Here, the rate of that clean kernels recovery of decorticated grade III groundnut for Samnuts 14 and 18 varieties decrease with increase in aperture size as shown in Figure 8. It was observed that at 8 % moisture content, 76.85% of clean kernels were recovered from Samnut 10 variety using 8 mm aperture. When the screen size was increased to 10 and 12 mm, clean kernels recovery decreased to 66.29 and 34.36 % clean kernels at same moisture level respectively. Similarly, when screen aperture was varied from 8 – 12 mm for grade III, the rate of clean kernels recovery decreased progressively from 94.68 % using 8 mm aperture to 31.61 % with 12 mm aperture (Figure 8). This may be due to the fact that some pods that would have passed through the screen un-decorticated with increase in size as stated by Oluwole *et al*. (2007).

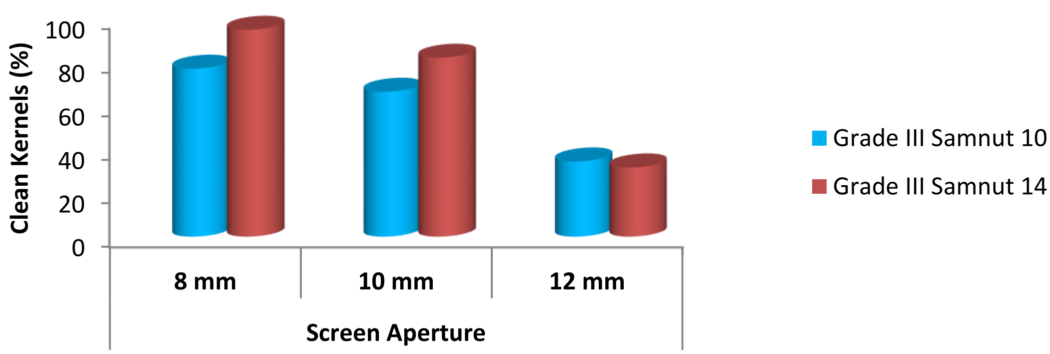

Figure 8: Mean Percentage of Clean Kernels from Grade III Using 8, 10 and 12 mm Screen Apertures

Results shown in Figures 9 and 10 revealed that least bruised and split kernels were observed to have progressively decreased at the same process conditions of 8 % moisture content with increase in screen aperture from 8 – 12 mm for both Samnut 10 and 14 varieties. It was observed that Samnut 14 variety that had the least mean pod diameter (Table 4) could perform better at smaller screen apertures. This trend could be attributed to the fact that the pod sizes of this grade are smaller, the rate of un-decorticated pods increased as the screen aperture increase. This finding was also in agreement with previous observations (Sharma *et al*., 1995; Ezzatollah *et al.*, 2009; Ndjeunga *et al.*, 2010).

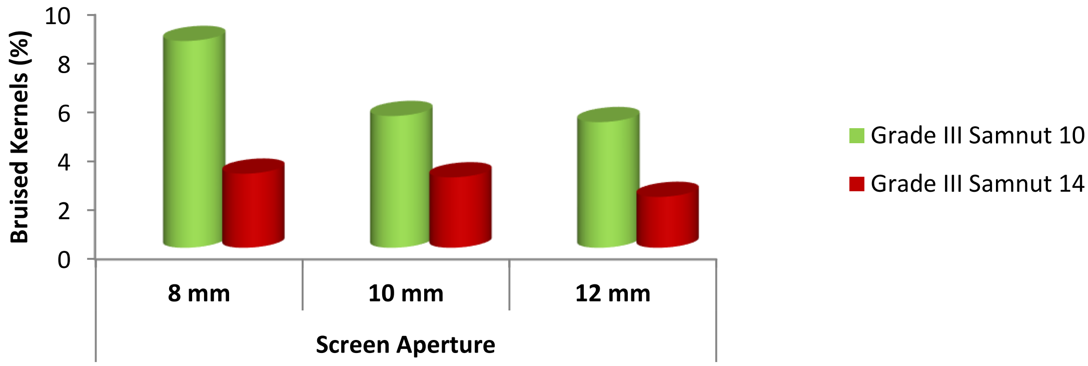

Figure 9: Mean Percentage of Bruised Kernels from Grade III using 8, 10 and 12 mm Screen Apertures

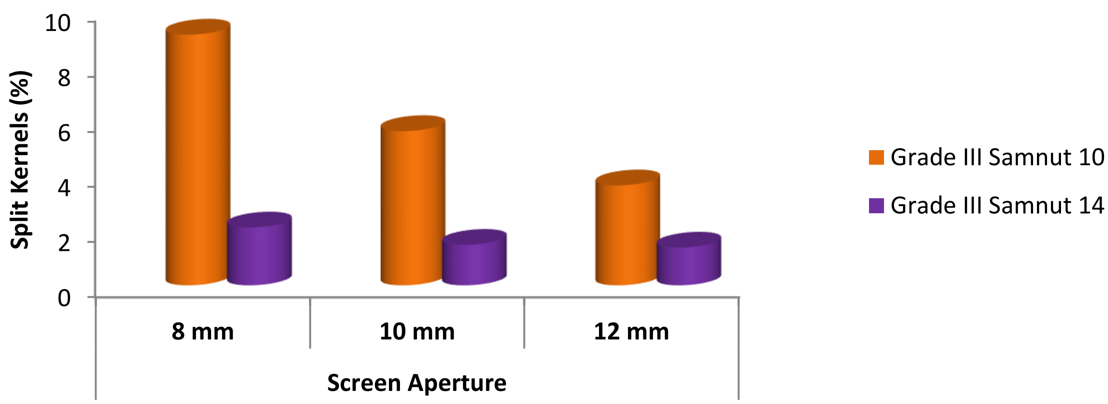

Figure 10: Mean Percentage of Split Kernels from Grade III using 8, 10 and 12 mm Screen Apertures

4. CONCLUSION

The groundnut in-shell grades (I, II and III) and screen apertures were varied at various levels and their effects on kernel's quality categorized as clean, bruised and split kernels were studied and investigated for the three varieties of groundnut in-shell namely; Samnuts 10, 14 and 18 respectively in this research shows that there was possibility of improving their kernel's quality on the basis of their commercial values and usage. The results obtained show that the highest percentage of clean kernels (94.68%) was obtained when 8 mm screen aperture was used at 8% moisture content for SAMNUT 14 groundnut variety. However, recommendations could be made regarding the independent variables that could be used to obtain best result from a specific grade of a particular variety:

i) The rate of bruised and split kernel decreases as the size of screen apertures increases, the possibility of obtaining higher proportions of un-decorticated pods increase when screen apertures becomes progressively larger than pod size, particularly for kernels that were relatively smaller in widths.

ii) The effects of screen aperture on the possibility of obtaining maximum percentage of clean kernels from each grade of the three groundnut varieties for efficient and profitable decorticating were also established.

iii) Finally, from the results obtained, it could be concluded that grading of the groundnut in-shell varieties had significantly improved the rate of clean kernel recovery.

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