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Effects of Moisture Content in Groundnut Decortication

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Abstract: *Mechanical groundnut decortication in Nigeria has been associated with high percentage of bruised and split kernels inflicting contagious aflatoxin moulds that is injurious to human health and reduces the kernel's quality and value. The aim of this study was to determine the effects of moisture content on decorticating three groundnut inshell varieties (Samnut 10, 14 and 18) commonly cultivated in Nigeria in order to maximize their kernel quality. Moisture content of the pods was varied using the method of American Society of Agricultural Engineers (ASAE). The varieties were graded into three grades (I, II and III) and decorticated at 8, 10 and 20 % moisture levels using 12 mm screen aperture. Results obtained shows significant variations in clean, bruised and split kernels of the decorticated groundnuts for the three moisture regimes at 5 % confidence level. The maximum of clean kernels of 83.39 % recovered from Samnut 10 was observed in grade II groundnuts in-shell at 10 % moisture content, while the maximum clean kernels recoverd was 92.58 % obtained in grade III groundnuts in-shell at 10 % moisture content for Smnut 14. However, 77.80 % clean kernels was recovered from grade I groundnuts in-shell, 8 % moisture content when Samunt 18 was decorticated. This study has established specific moisture contents for decorticating a particular grade of groundnut with a view to minimizing kernel damage, hence optimizing clean kernel recovery.*

Keywords: *Controller, Differential Drive, Kinematics, Mobile Robots, Modelling*

INTRODUCTION

Groundnuts (*Arachis hypogaea*), also known as peanuts, earthnuts, *gobber* peas or monkey nuts, are the edible seeds of a legume plant that grow to maturity in the ground. It is a member of the genus *Arachis* in the family *Leguminosae*. Cultivated in nearly 100 countries, over 90% of which are developing countries, groundnut is a valuable cash crop for millions of households (CGIAR, 2004-2005). It is an important oilseed crop in the semi-arid tropics and generates employment on the farm during cultivation and in agroprocessing. The seed contain high quality edible oil, protein and carbohydrates (FAO, 1994). It is an essential product that enjoys good patronage in both the domestic and international market as a veritable source of edible oil, animal feed and consumed as snacks. Groundnuts thus plays a key role in the agriculture-dependent economies of West Africa where its marketing and trade served as the major sources income and foreign exchange (Rai *et al.*, 1993; Revoredo and Fletcher, 2002; Ntare *et al.*, 2008).

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, Waliyar (2005). This reduces the net profit of both the farmer and produce agent. The cost of exporting undecorticated groundnuts also increase because of the space needed to ship the produce, Waliyar (2005). 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. Decortication has been known for a long time before the advent of machines. Historically, decortication of groundnut in-shell in developing countries has been done at home by women as part of their meal preparation and source of income. The nature of their produce (small quantities) and lack of modern processing techniques reduce their bargaining power as individual sellers (Haruna *et al.*, 2006).

Manual processing operations of groundnut in Nigeria and most Sub-Saharan Africa, especially decortication, is time consuming, unsanitary and laborious involving use of primitive tools, Simonyan and Oke (2010). The capacity of this method is very low and rate of kernel damage and other impurities is very high. Adopting mechanical processing system provides a stronger and constant power which would in turn increase the productivity of the groundnut farmers. However, mechanical decortication of groundnut is relatively rough and can cause severe damage due to the splitting and cracking of the kernels. This is largely due to non-consideration of vital engineering properties of groundnuts seeds and kernels such as size and moisture contents that may aid the design of such processing machines (Fashina *et al.*, 2015 and Akanni *et al.*, (2005). The problems of establishing specific moisture contents for a particular grade of groundnut with a view to minimizing kernel damage has not been overcome, hence the need for additional work. This study, therefore, investigates the effects of moisture contents while decorticating groundnut in order to obtain maximum clean kernels that wound enhance maximum net return of the farmer.

MATERIALS AND METHODS

Three groundnut varieties were identified and selected based on variations in their characteristics and wide adoption in Nigeria: Samnuts 10, 14 and 18. They were graded and sorted into three grades according to their geometric dimensions. Each grade was subjected to three moisture regimes; 8, 10 and 20%. Samples were decorticated with a modified groundnut decorticator using 12 mm screen aperture. The products of the decortication were separated into clean, bruised and split kernels. Physical analyses of these measured outputs were done to determine the best moisture regime that yields the highest percentages of whole clean kernels. Samples of the three selected groundnuts varieties were dried in an oven (Heraeus/Hanau) at 60°C for 12 h to a constant weight and their respective moisture contents were determined using Equation (1) as suggested by Baumler *et al*. (2006).

$$Mc\ (\%) = \frac{\text{Wsbd} - \text{Wsad}}{\text{Wsad}} \times 100 \qquad (1)$$

where,
Mc=$Moisture\ Content$,%
$Wsbd$=$Weight\ of\ Sample\ before\ drying$, g
$Wsad$=$Weight\ of\ Sample\ after\ drying$, g

The weight of the groundnut was determined using an electronic weighing balance (2000 kg capacity with 0.01 accuracy) as suggested by Milani *et al.* (2007); Mohsenin (1986) and Dakogal (1999). Moisture content of the pods was varied using the method of ASAE (1983 and 2003) as reported by Aviara *et al*. (2005). The groundnut pods were oven-dried to bring the moisture down to the required level at temperatures between 80 °C to 130 °C for 8 to 24 hours by ASAE standard (S.352.3, 1994). The pods were then sealed in marked polyethylene bags and stored in that condition for another 24 h to obtain stable and uniform moisture content of the pods. The experiment was replicated three times for each sample and the average values of the moisture contents obtained were determined. The weights of the decorticated kernels were determined by a digital scale. These values were converted into percentages for ease of comparison in order to draw conclusions. Samples of the output were separated manually into four categories: clean (undamaged) kernels, bruised kernels, split/broken kernels and undecorticated pods as shown in Fig. 1.

Fig. 1. Classification of the product of decortication

RESULTS AND DISCUSSION

Results obtained showed that the average clean kernel recovery for all grades was significantly higher at lower moisture levels (8 %) than the efficiency of decorticated groundnut with moisture level at 10 % and 20 % respectively (Fig. 2 and Fig. 3). This agrees with finding of Simonyan and Oni (2001) and Paulsen *et al*. (1980).

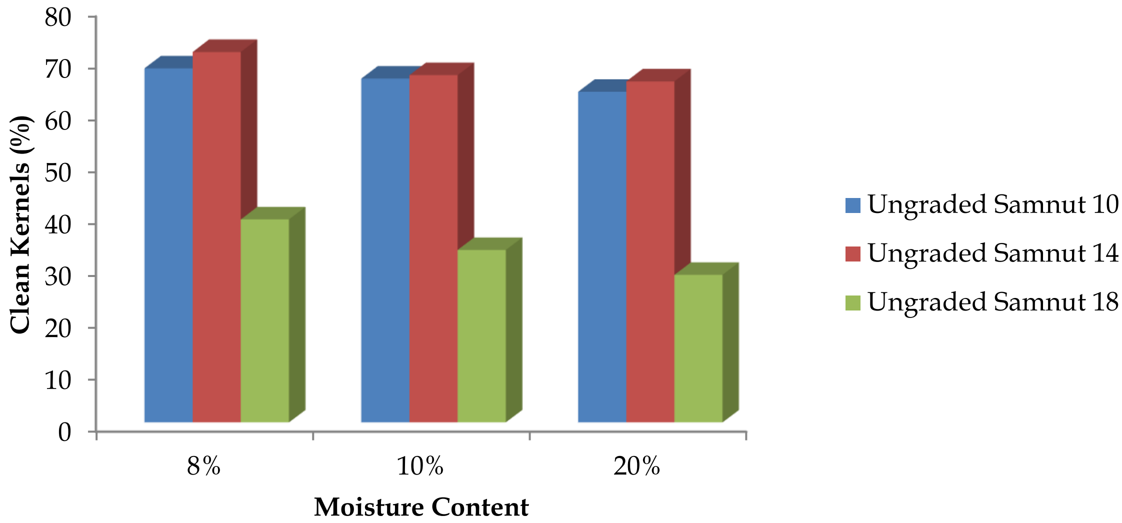

Fig. 2 Effects of Moisture Content on Clean Kernels from Ungraded Samples

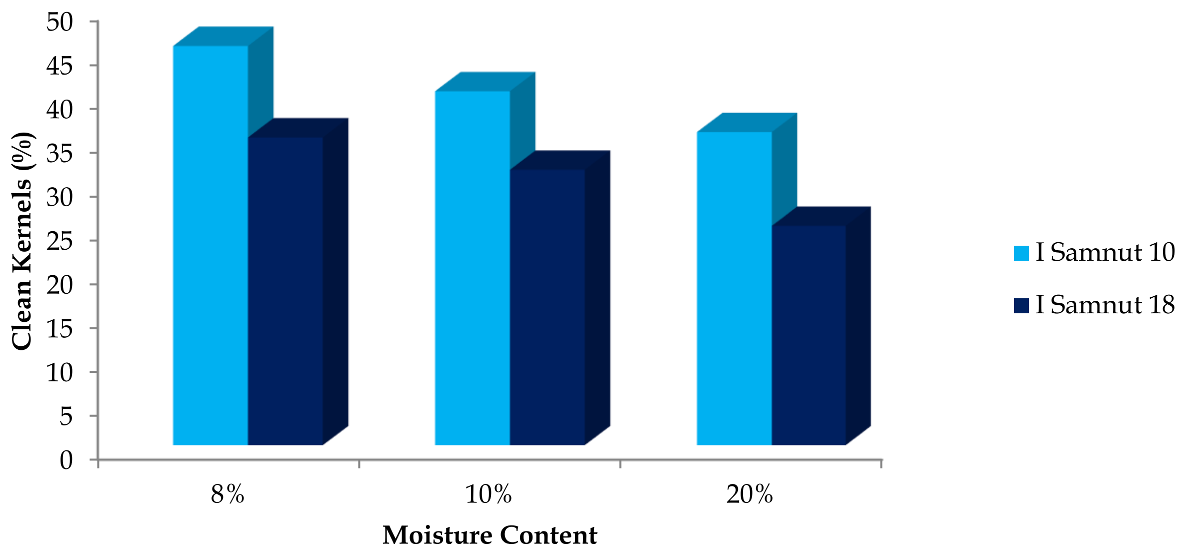

Fig. 3 Effects of Moisture Content on Clean Kernels from Grade I Samples

The results obtained also showed that more kernels are bruised at higher levels of moisture content for all the grades (Fig. 4 - 6). Kernels decorticated at 20 % moisture level were observed to have the highest bruised kernel. This result also agrees with the results found by Omran *et al.* (2005), Atiku *et al.* (2004) and Simonyan and Oni (2001) who noted in separate researches that pod damage decrease with decrease in moisture content.

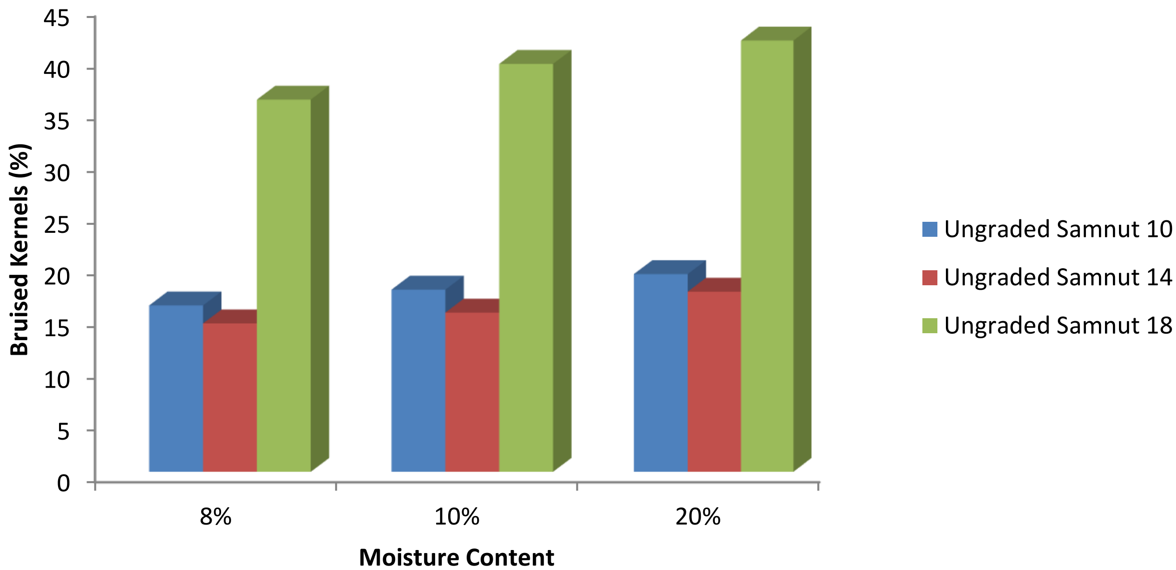

Fig. 4 Effects of Moisture Content on Bruised Kernels from Ungraded Samples

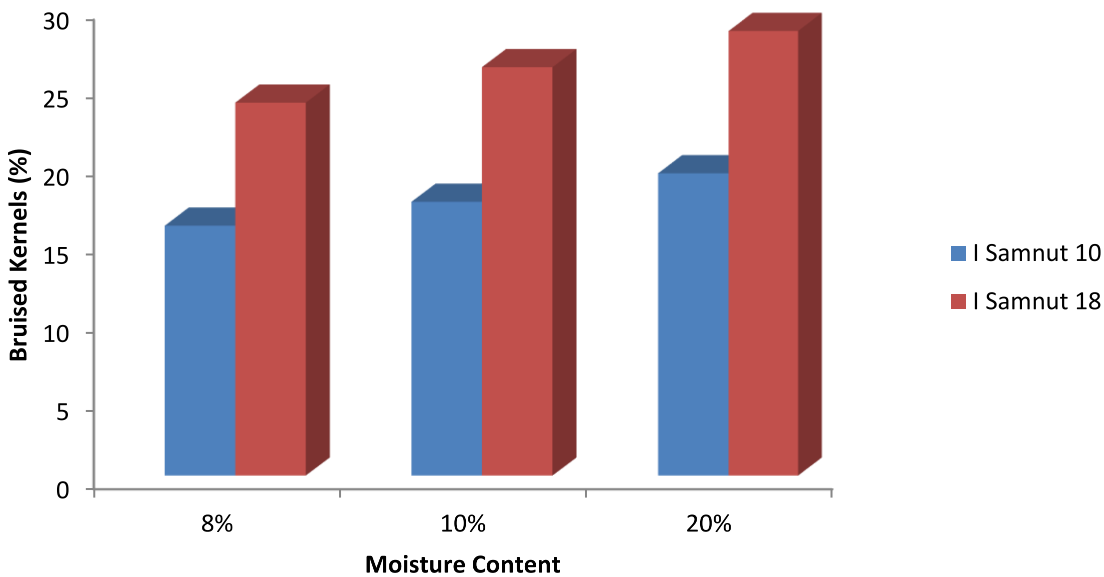

Fig. 5 Effects of Moisture Content on Bruised Kernels from Grade I Samples

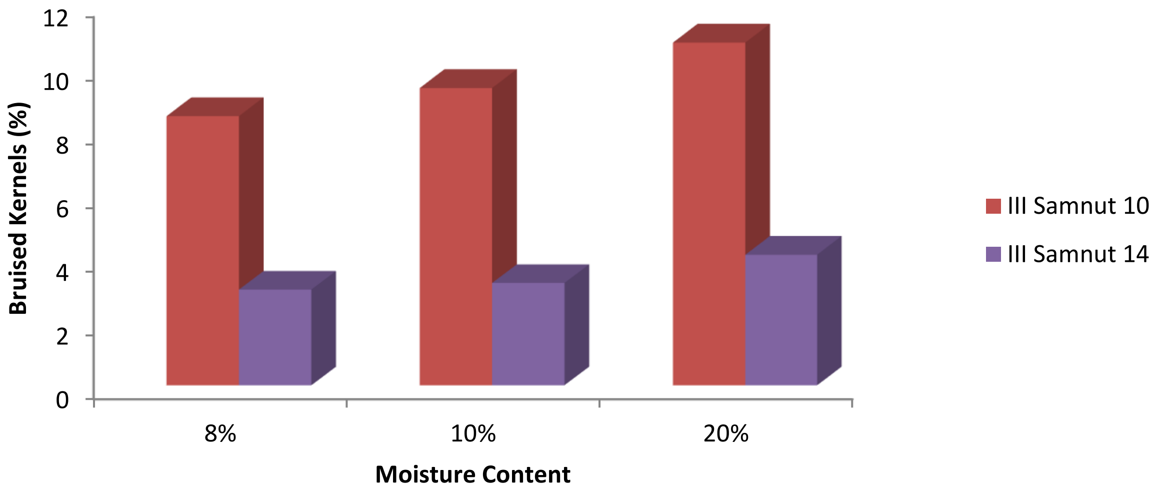

Fig. 6 Effects of Moisture Content on Bruised Kernels from Grade III Sample

Saiedirad *et al*. (2008) also discovered similar trends in kernel bruise as observed in this study (Fig. 7). This was because as the groundnuts pod diameter become progressively larger than the sieve apertures with increase in moisture content, the greater the possibility of obtaining a relatively higher percentage of bruised and split kernels. This is in agreement with the findings of Konak *et al*. (2002) who reported higher cracks and bruises in chick pea seeds when moisture content increases. It was also found that kernels became more sensitive to cracking at higher moisture contents causing the rate of bruising and splitting to increase. Altuntaş and Yildiz (2007) conducted a similar study on the effects of the moisture content on some physical and mechanical properties of faba bean grains (*Vicia faba* L.) and reported that as the moisture content increases, grains cracking increases. Similarly, Liu *et al*. (2009) and Paulsen (1980), Hoki and Tomita (1987) reported a decrease in rate of seed breakages for soybean with decrease in the moisture content, which is not at variance from the findings of this study.

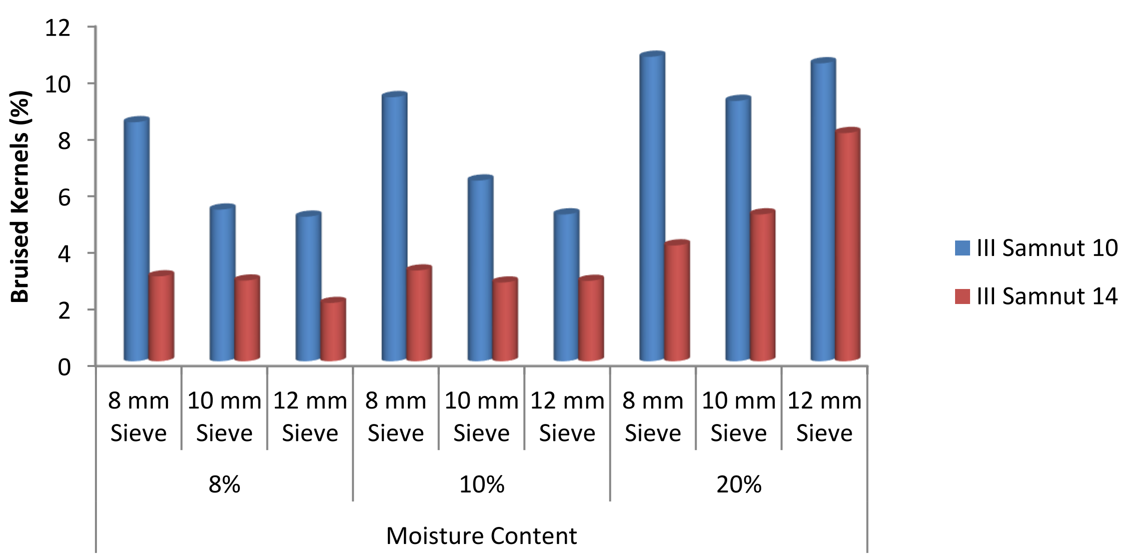

Fig. 7 Effect of Moisture on Mean Percentages of Bruised Kernels from Grade III Samples

The results further showed increase in splitting of the kernels when moisture content increases. This reduces kernel's quality and packaging/marketability (Fig. 8 – Fig. 10).

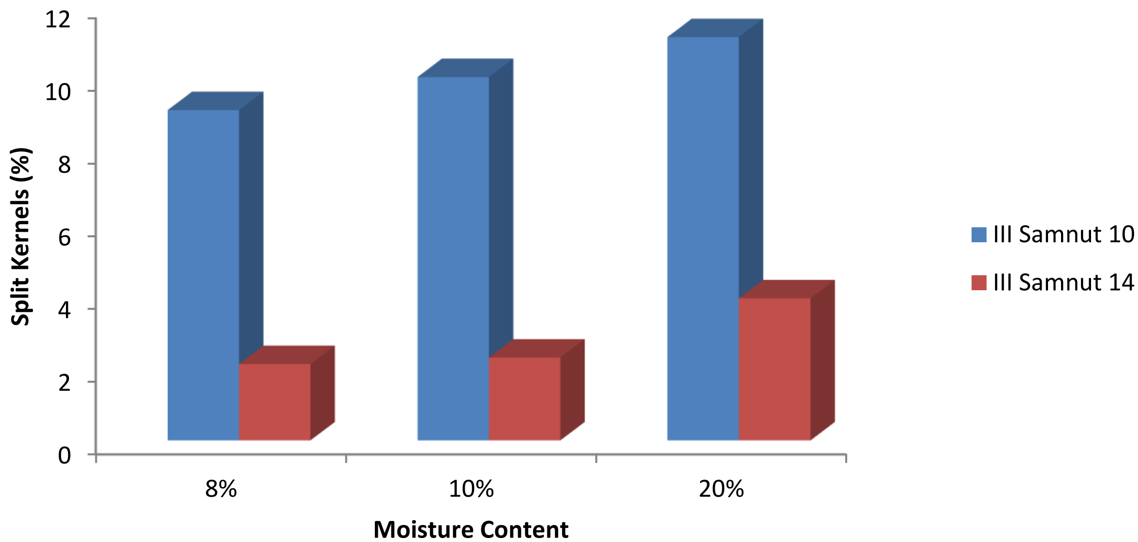

Fig. 8 Effects of Moisture on Mean Percentages of Split Kernels from Grade III Samples

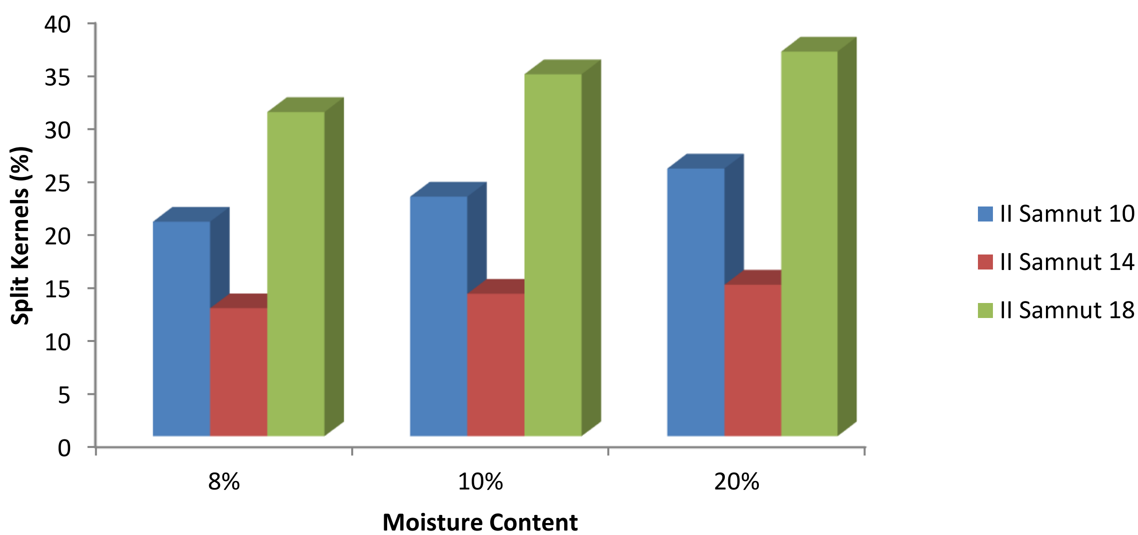

Fig. 9 Effects of Moisture Content on Split Kernels from Grade II Samples

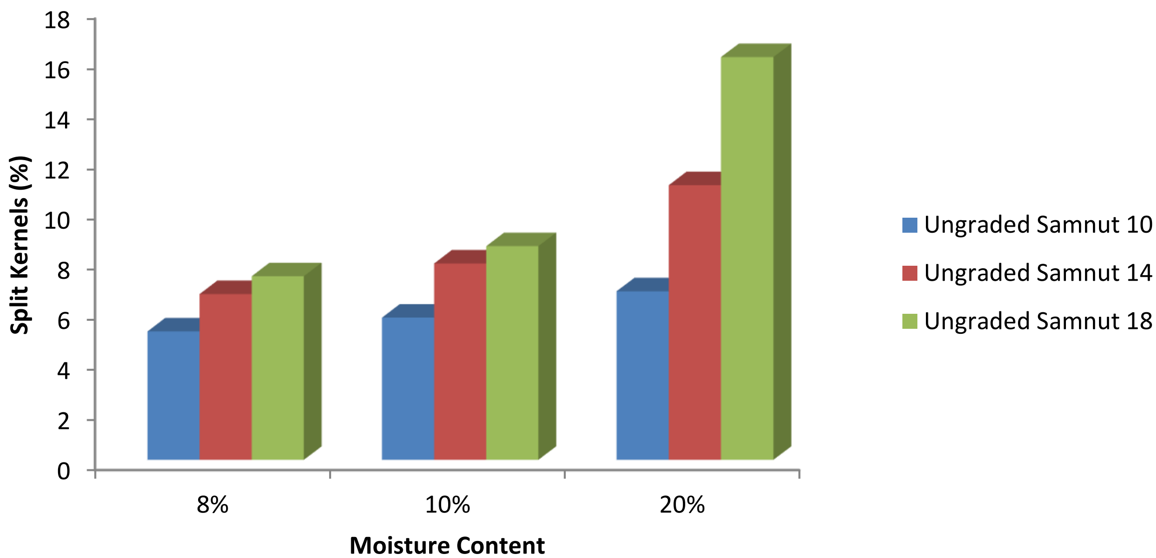

Fig. 10 Effects of Moisture Content on Split Kernels from Ungraded Samples

CONTRIBUTION TO KNOWLEDGE

This study has established specific moisture contents for decorticating a particular grade of groundnut with a view to minimizing kernel damage, hence maximizing kernel quality which in turn translates to more income by the groundnut farmer and processor.

CONCLUSION

The mean values of clean, bruised and split kernels recovered vary depending on the moisture content and the grade factor considered. Higher percentages of clean kernels recovery at relatively lower moisture levels were obtained while more kernels are bruised at higher levels of moisture content. The results obtained from the decortication of the three grades of the three groundnut varieties at varied moisture content regimes shows that there was possibility of improving their kernel's quality on the basis of their commercial values and usage. Establishing suitable moisture content regimes for groundnut decortication in order to improve the kernels quality and reducing bruises and breakages will ultimately increase farmer's income and will go a long way in sustaining groundnut production in Nigeria.

CONFLICT OF INTEREST

The authors declare no competing interest.

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