Research Article

Raw Cashew Nut Quality Evaluation in Selected Growing Communities in Nigeria

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Abstract

Assessment of raw cashew nut is an important activity in evaluating quality of the produce in both local and international markets, and it's based on a number of parameters: defectivity, moisture content, nut count and kernel out-turn ratio (KOR). However, most cashew farmers lack the required technical skill to determine quality of their raw nut. Raw cashew nuts were sourced from the North Central, Southeastern and South Western, Nigeria. Raw nut from Nsukka had least number of nuts (142) per kilogram of raw nut, Adogo recorded highest of 220 nuts per kilogram and the 12% moisture in similarity to raw nut from Lafia and Doma. Likewise, the percent of foreign materials was highest 12 and 10% in Lafia and Doma respectively and similarly were the rates of defectiveness (26.8% and 25.2%) of the raw cashew nut in the two locations. Ochaja and Ogbomoso recorded the least defective rate of the raw nut, 19.7% and 19.8% respectively, shelling percent range from 28% (Ogbomoso, Luwani) to 31% in Ochaja community. Ochaja and Ogbomoso recorded KOR of 52lbs, followed by 49lbs in Idi-Ayunre, 48lbs (Luwani, Nsukka) and the least KOR 42lbs found in Adogo and Lafia respectively.

Keywords: Quality; Defective Rate; Kernel Out-Turn Ratio; Moisture; Raw Cashew Nut

Introduction

Cashew farming and production operations are an income generating business to small holder farmers' households in Nigeria; although the apples are allowed to waste in many farming communities, but the raw nut is an economically important produce and article of trade from cashew trees. The raw nuts when harvested add value to farmer's income and command premium in both local and international market especially when the quality of the nuts meets the required specifications from buyers. Market prices of raw cashew nuts are very dynamic with fruiting season and harvesting time, however in West Africa, the price of raw cashew nut (RCN) fall sharply with losses in the value of the produce in international market [1].

The out-turn test is an important analysis used by processors and have become accepted worldwide in evaluating the quality of the raw nut. ACi (2010) defined out-turn as the number of usable kernels after de-shelling the nuts. The RCN found across different growing ecologies in Nigeria are of different biotypes, nut sizes, nut weight and give different outputs and out-turn. The quality specification of the RCN which is based on nut count and size, yield and defectiveness is largely dependent on their source, soil type and postharvest handling techniques. The quality parameter of the raw nut also varies with cashew fruiting time and season (early fruiters, middle, peak season, and late fruiters) within the same or similar ecologies and cashew plantations in Nigeria. The adequate knowledge on measurement of quality parameters of RCN and packaging requirements are important factors for the growers, license buying agents (LBAs) and exporters to achieve expected returns on their investments. However, the services of quality assurance personnel or company can be engaged for the purpose.

Major negotiating factor facing farmers is the quality of the raw nut vis-à-vis it's defectivity, moisture content, nut count and kernel out-turn ratio (KOR). Information about quality of harvested produce is another important factor in securing a purchase contract between farmers and buyer's value. There is a gap in the Nigerian cashew value chain as farmers lack technical know-how and reliable information on quality of raw cashew nut from their plantations. The knowledge deficient in quality assurance of RCN was one of the factors that necessitate this quality survey. Adeigbe., *et al*. (2015) [2] reiterated that revenues of cashew farmers are majorly from the production cycle and that farmers lack the skills and techniques for proper postharvest handlings and value addition.

The objective of this survey was to evaluate raw cashew nut from **selected** cashew communities across Nigeria and provide template for farmers and potential buyers (local and foreigners) on the quality of raw nut obtainable across cashew ecologies.

Materials and Methods
Sample location

A survey of raw cashew nut for quality evaluation was conducted in five cashew growing states spread across the North Central, Southwest and South East regions of Nigeria. Raw cashew nuts were sampled directly from farmers' store with sample size depending on quantity of raw nut in storage, sampling not less than ten percent of each eighty-kilogram sized jute bags of the number of bags in storage, at six random sampling points per bag. Raw nuts were collected from Idi-Ayunre, Ogbomoso (Oyo State), Ochaja and Adogo (Kogi State), Joga Orile and Luwani (Ogun State), Lafia and Doma (Nasarawa State), Umu-Alumona and Nsukka (Enugu State). A five-sample of 5 kg each, composite RCN were randomly obtained from farmers' storage in the selected localities and states.

Quality evaluation parameters
The collected raw cashew nut (RCN) was thoroughly mixed and remixed to obtain another composite sample based on source and were subjected to quality evaluation parameters. The quality assessment of RCN was based on nut count, moisture content, shelling percentage, defective rate, and the kernel out-turn ratio (KOR).

Sample preparation
The samples of RCN were re-mixed to obtain a 1kg composite sample from the bulk randomly collected from source; the cut test was carried out independently based on source of RCN. The numbers of cashew nut in 1kg sample were counted and expressed in nuts per kilogram. The moisture content of RCN was determined using the digital moisture meter model Vadodara-390 012 (Gujarat) India following standard procedure for moisture determination of raw cashew nut. Each composite 1kg RCN was cut into two equal halves using a specialized tool (scissor/cutter), the kernel with test a were carefully scooped outer using the scooper. The kernels were observed and separated under good illumination according to grading standards; Good kernels, Spotted kernels, Bad kernels, Premature kernels and Humidified kernels, in reference to the quality chart of raw cashew nut developed by African Cashew Alliance (ACA) and Competitive Cashew Initiative (ComCashew). Kernel grades were weighed separately; Percent defective rate, Kernel outturn ratio (KOR) in lbs and Percent shelling were calculated according to these formulae $\frac{P3 + P5}{P1} \times 100$

Percent defective rate: Defective rate (%) =

Where

P1 = Weight of raw cashew nut sample=1000 grams

P3= Weight of kernel with shell (Accepted/Rejected 50%)

P5= Weight of kernel with shell (Rejected 100%)

$P2 + \left(\frac{P4}{2}\right)^{\square} \times \left(\frac{80}{454}\right)^{\square}$ atio (KOR): Kernel Outturn Ratio (KOR) =

Where

P2 = Weight of kernel with shell (Accepted at 100%)

P4 = Weight of kernel with shell (Accepted/Rejected at 50%)

$\frac{\text{Weight of kernel + testa at 100\% accepted}}{\text{Weight of kernel+shell at 100\% accepted}} \times 100$

Percent shelling: Shelling (%) =

Statistical analysis
Quality parameters were determined in triplicates, values were subjected to analysis of variance (ANOVA) using SAS statistical package and mean values were separated using Duncan multiple range test (DMRT) at P≤ 0.05. Some quality parameters were also subjected to graphical illustrations for comparison.

Results
Primary actors in the cashew value chain are the farmers, of which other stakeholders are not of less importance as activities differentiate the importance players in the value chain management. There are several factors relating to trade of raw cashew nut in both local and international markets with exception of farm gate

linkages; however major determining factor is the quality of the RCN. Preferences are given to raw nut of certain localities or origin in Nigeria with claim of high and good quality produce and other areas were treated as of less value, supplements, and command poor price in the trade of the commodity. Cashew growers especially lack the knowledge to evaluate quality of the raw nut, only the nut count is achievable to them, among parameters that can be assessed to ascertain quality of the RCN. They suffered deficient skills and technical know-how to determine the quality of their raw nut to the tune of kernel out-turn ratio. This study surveyed raw nut from varied and heterogeneous cashew growing ecologies in Nigeria, Kogi and Nasarawa states despite have been in the same cashew growing ecology, the selected localities had varied quality even within the states and wide differences occurred in the quality of the RCN.

Table 1 shows a good nut weight, nut count and moisture of 7.14g, 140, 10% respectively in raw nut obtained from Ochaja community. Highest nut count and least nut weight of 258 and 3.87g were recorded in Lafia, Nasarawa state. The rate of impurities in the raw nuts was also the highest with 26.8% defective rate and higher than the rate recorded in Kogi state. Adogo community recorded a similar KOR of 42 lbs with Lafia and nut count of 230, while Ochaja recorded KOR of 52 lbs which was the highest in North Central. The percent shelling was similar in raw nut obtained from most cashew communities in North Central (Table 1). Nut count could be used to evaluate raw cashew nut but does not adequately give details of quality of the kernel.

The average weight of raw cashew nuts was similar in Ogbomoso (6.32g), Joga Orile (6.75g) and Luwani (6.13g), but Idi-Ayunre recorded least of 5.61g of nut weight in Southwest, Nigeria. The nut count in cashew localities range from 148 in Joga Orile to 178 in Idi-Ayunre. However, the impurities in the raw nut and rate of defective nuts were highest in Joga Orile with 7% and 22.4% respectively. Defective rate (19.80%) was the least recorded in Ogbomosho and KOR of 52 lbs was highest the same community (Table 2). The shelling percent of the raw nuts also range from 28% (Ogbomoso, Luwani) and 30% (Idi-Ayunre, Joga Orile).

Table 3 shows there is similarity in the average weight of raw nut and KOR in the two communities selected in Enugu state. Nsukka recorded higher nut count, foreign matters and defective rate of

Quality Parameter	Kogi state		Nasarawa state	
	Adogo	Ochaja	Doma	Lafia
Nut count	230	140	175	258
Average nut weight (g)	4.34	7.14	5.71	3.87
Moisture content (%)	12	10	12	12
Shelling %	30	31	30	30
Foreign matters (%)	7	5	10	12
Defective rate (%)	23.5	19.7	25.2	26.8
Kernel Outturn Ratio (KOR)	42	52	46	42

Table 1: Quality of Raw Cashew Nut in Selected Community in North Central Nigeria.

Quality Parameter	Oyo state		Ogun state	
	Idi-Ayunre	Ogbomoso	Joga Orile	Luwani
Nut count	178	158	148	163
Average nut weight	5.61	6.32	6.75	6.13
Moisture content (%)	8	8	10	8
Shelling %	30	28	30	28
Foreign matters (%)	5	6	7	5
Defective rate (%)	21.46	19.80	22.4	20.7
Kernel Outturn Ratio (KOR)	49	52	46	48

Table 2: Quality of Raw Cashew Nut in Selected Community in Southwest Nigeria.

Quality Parameter	Enugu state	
	Umu-Alumona	Nsukka
Nut count	150	165
Average nut weight	6.66	6.06
Moisture content (%)	10	8
Shelling %	30	28
Foreign matters (%)	6	8
Defective rate (%)	22.4	23.5
Kernel Outturn Ratio (KOR)	48	48

Table 3: Quality of Raw Cashew Nut in Selected Community in Southeast Nigeria.

165, 8% and 23.5% respectively, while Umu-Alumona had lower number of nut/kg of the raw nuts.

The number of nuts in one kilogram of RCN was compared across the ten studied cashew localities in the North Central, South East and South West, Nigeria. Significant similarities and differences were recorded in the nut count obtained from different growing communities. The nut count was significantly highest (258) in Lafia than other cashew localities while the least significant nut count was in Ochaja (140). Significant similarities were recorded in the nut count of raw nut from Joga Orile (Ogun state) and Umu-Alumona (Enugu state). Nut count from other localities varied significantly among themselves and with other raw nut sources (Figure 1).
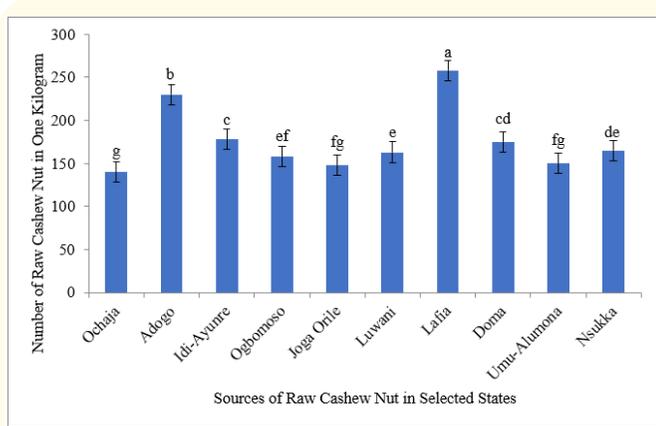

Figure 1: Number of nuts per kilogram of raw cashew nuts.

Figure 2 showed that the highest KOR were recorded in Ochaja and Ogbomoso, which were significantly similar but differ significantly and significantly higher than KOR of raw nut from other localities. The KOR were significantly similar in Adogo (Kogi state) and Lafia (Nasarawa state) but were significantly lower than KOR of other cashew localities. However, significant similarities were also recorded in the KOR of raw nuts from Joga Orile, Luwani (Ogun state), Doma (Nasarawa state), Umu-Alumona and Nsukka (Enugu state). The values obtained from study locations were indicative of varied environmental factors, postharvest handling technique and storage facilities, thus affecting quality of the raw cashew nut.

The weight of raw cashew nut has a corresponding effect on the rate of defectious nut across the study locations. The least nut
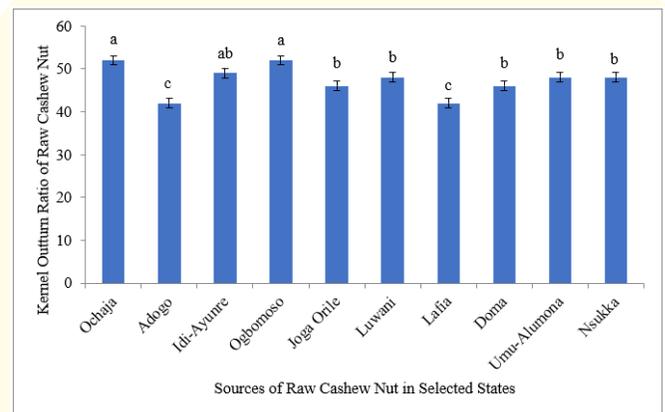

Figure 2: Values of kernel out-turn in cashew communities.

weight of 3.87g recorded in Lafia resulted into 26.8% defective rate, the highest in the study. Likewise, was the record of 23.5% defective rate from 4.34g of nut samples from Adogo. Raw cashew nut of similar weight 6.06g (Nsukka). 6.66g (Umu-Alumona) and 6.75g (Joga Orile) recorded 23.5, 22.4 and 22.4% defective rate respectively (Figure 3).
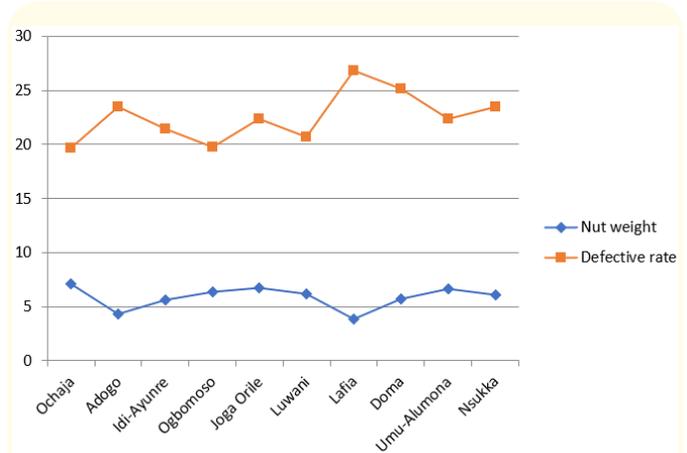

Figure 3: Values of kernel out-turn in cashew communities.

Discussion

The farm operation activities including post-production practices and handling to storage technique affect the quality of cashew nuts. Smallholder cashew farmers harvest apple to meet urgent cash needs, regardless of ripeness and nut maturity status, improp-

er drying and storage, not limited direct sunlight exposure, use of polythene instead of jute bags for packaging and storage of raw cashew nuts, which enhances the deterioration of stored kernels and hamper quality. Analysis of the yield quality showed that very good nuts influence the quality of the kernel yield obtained after processing (Anato., *et al.* 2017; Ogunsina, 2013; Gilleo., *et al.* 2011). The quality evaluation of raw cashew nut showed that the kernel outturn does not depend on the nut count, defective rate at selected sample localities. These two tests; nut count and out-turn, are then combined to determine the overall quality score.

The findings in this study which recorded average nut count of 140 nut/kg in Ochaja and 148 nut/kg in Joga Orile was like the report on quality evaluation of raw cashew nut at Fatick region of Senegal which reported average nut count of 145 nut/kg (Dieng et. al., 2020). The nut count of most of the cashew localities in this study were below 240 nut/kg with exception of raw nut from Lafia, thus corroborate the international standard requirement of 150 and 240 nuts/kg (ICA, 2011), Ogunsina (2013) reported a finding similar to this record. However, the quality of the raw nut increases with decrease in the number of nuts per kilogram and nut count higher than 240 nuts/kg are not the preference.

The difference in the Kernel outturn ratio as shown by the significant variations showed they are widely varied in value of raw nut across the cashew growing communities. However, Kernel outturn ratio at Doma, Joga Orile, Luwani, Umu-Alumona, Nsukka communities showed relatively close Kernel outturn ratio values in these localities. The excellence and thoroughness of post-harvest handling affects the quality of raw cashew nut, which in turn affects the country's reputation for those products (Fitzpatrick, 2010). Product quality influences the demand for those products in international market, which in turn positively affects the price based on the quality of raw cashew nuts.

The fundamental consideration is that a quality cashew nut is due to the combination of large nut sizes (low nut count per kilo) and a high percentage of kernel inside the shell (high yield) (PADEC, 2014). These corroborate the findings in this study that quality measurement requires composite indicators, the most important of which are kernel outturn. Kernel outturn is an important factor in determining quality export in the cashew nut trade. Indeed, the cashew nut with a KOR ≥ 46 lbs allows sellers to attract the premium price and to produce good quality grains during

processing. According also to Dahiya, (2010). The kernel outturn of raw cashew nut varies from production with range of 40 to 56 lbs per 80 kg, for a better quality of kernel.

The defective rate of raw cashew nut in the selected localities in this study (19.70 to 26.8%) was higher than 7.0 to 13.0% reported by Dieng., *et al.* (2020), however ICA, (2014) reported percentage of defective nuts to be between 10% against 24% (ICA, 2014).

The percent shelling of the raw cashew nut in this study ranges from 28 to 30%, these however differ from the findings of Adeigbe., *et al.* (2015) which reported shelling percent of 32.46 (extra-large), 30.36 (madras) and 37.29 (small), as most of the raw nut obtained in this study belong to categories of large and medium sizes. Very small nuts are difficult to process and thus are considered lower quality, calculation was done to give an out-turn score that typically range from 48 lbs to 58 lbs (IRD, 2011). The KOR 48 lbs quality and above is the standard grade; buyers normally prefer 48 – 54 lbs quality. Less than 43 lbs quality is a poor grade and is usually rejected (Aci, 2010), and the higher the out-turn score the better (IRD, 2011).

Quality controls of raw cashew nuts are usually done by exporters, aggregators and processors. Producers do not have the specialized knowledge to do the kernel outturn ratio determination. However, counting of nuts per kilogram is done by some growers, while nut count is also used to assess quality, but it is limited. Many research studies have been carried out on raw cashew nut and kernel characterization of nuts (Adeigbe., *et al.* 2015; Ogunwolu., *et al.* 2016). According to Anato., *et al.* 2017, larger nuts are easier to process and are preferred by consumers. Indeed, the combination of large cashews with a high percentage of kernels generates the highest price. Fitzpatrick, (2010) reported that product quality influences the demand for the raw nuts in international world market, which, in turn, positively affects the price based on the quality of raw cashew nuts [3-5].

Conclusion

The finding in this study is important to cashew value chain development because cashew nut price is determined by its quality, which will enable the farmers to avoid underestimation of the price tag by buyer and thus improvement of agronomic practices, agricultural innovations of drying process, storage techniques and market opportunities. However, the reports are representative

samples of multi-dimensional cashew growing localities and ecologies of Nigeria. The cashew growers need to be coherence with not only the supply data of cashew nuts but the knowledge about the quality of their nuts. Buyers need to pay attention to both tests in order to ensure they are purchasing good-quality nuts. The bottom line is that a quality cashew nut is the combination of a large nut (low nut count/kg) and a high percentage of kernel inside of the shell, high outturn) (IRD, 2011).

Acknowledgement

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