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A survey questionnaire of cashew nuts processing methods in Enugu state

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Abstract: Technical investigation on the method and constraints on cashew nuts processing in Enugu state of Nigeria was carried out and a survey made involving the use of questionnaire and personal interview during the field trips. The aim was to technically investigate the difficulties encounter in cashew nuts processing in Enugu State and suggest the means of improving on the difficulties. The manual and mechanical methods of processing cashew nuts were investigated. From the result of the survey, it was found that majority of cashew nuts processors visited processed the nuts by manual means and only few were processing mechanically. The results showed that most of the machines from the mechanical processors visited were not functional. The results of the survey showed that averages of 7588.4 kg of cashew nuts are harvested in a season and only 1422.43 kg of cashew nuts were processed. Therefore, majority of the cashew nuts harvested were either sold or stored for a short period. Most of the cashew nuts stored by the producers deteriorate because of lack of storage experience. The averages quantity of cashew nuts processed in a season by manual means was 657.05 kg, cashew nuts breakages recovered was 13.19 kg and that of mechanical method was 705.65 kg and the breakages recovered was 105.75 kg. The analysis of variance (ANOVA) for the effectiveness of shelling between the mechanical and manual method was calculated using the variances from the t-test and it was shown that the calculated F is greater than the tabular F at 5% and 1% probability level. The hypothesis was rejected because the two shelling methods were not equal. This showed that the efficiency and precision of the machines used were very low compared the manual way of processing, therefore, cashew nuts processors should liaise with Government to provide support in terms of provision of credit facilities for the purchase of modern cashew nut processing equipment for improved processing of the products.

Keywords: technical, investigation, method, constraints, cashew nuts, processing

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1 Introduction

The cashew tree, native to Brazil, was introduced to Mozambique and then India in the sixteenth century by the Portuguese, as a means of controlling coastal erosion. It

was spread within these countries with the aid of elephants that ate the bright cashew fruit along with the attached nut. The nut was too hard to digest and was later expelled with the droppings. It was not until the nineteenth century that plantations were developed and the tree then spread to a number of other countries in Africa, Asia and Latin America (Azam-Ali and Judge, 2001).

The cashew fruit is unusual in comparison with other tree nuts since the nut is outside the fruit. The cashew apple is an edible false fruit, attached to the externally born nut

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by a stem. In its raw state, the shell of the nut is leathery, not brittle. It contains the thick vesicant oil, Cashew nut shell liquid (CNSL), within a sponge-like interior. A thin testa skin surrounds the kernel and keeps it separated from the inside of the shell. The primary products of cashew nuts are the kernels which have value as confectionery nuts. CNSL is an important industrial raw material for resin manufacture and the shells can be burned to provide heat for the decorticating operation (Enwelu et al., 2013).

Cashew processing, using manual techniques, was started in India in the first half of the twentieth century. It was exported from there to the wealthy western markets, particularly the United States. In the 1960s, some of the producing countries in East Africa began to process nuts domestically rather than sending them to India for processing. This allowed them to benefit from the sale of both processed nuts and the extracted CNSL (Enwelu et al., 2013).

The harvesting and processing of cashew is very labour intensive. After producing clusters of flowers, cashews produce the edible apple and also a nut encased in a heavy shell, which is the true cashew fruit. The cashew tree flowers for two or three months and fruit mature about two months after the bloom. When fully ripe, it falls to the ground. Harvesting generally involves collecting the nuts, as shown in figure 1, once they have dropped to the ground after maturing. Workers scour the area and detach the nut from the fruit. If fruit are picked from the trees, the cashew apple will be ripe, but the kernel will still be immature (Wikipedia, 2015).



Figure 1 Matured harvested cashew nut

Apples to be used for processing into products such as jam or juices should be picked from the tree before they fall naturally. On falling to the ground, apples may become damaged. Once damaged, the apples may ferment and deteriorate quite rapidly. The riper the apple, the sweeter the taste (Hanlon, 2000).

The nut is encased in a rock hard shell that is virtually impossible to penetrate after harvest. In order to extract the nut, the whole shell is soaked in water, softened by steaming and carefully air-dried to the final moisture content (9 percent). Each nut is hand massaged and cracked via a manual process that entails putting the nut against one sharp blade and bringing another blade, which is on a foot powered lever, through the outer shell. The blade on the foot lever is raised by an enthusiastic stomp allowing the outer shell to separate from the nut. The nut inside is carefully picked out of the outer shell using a nut pick (Vaidehi and Babu, 2000).

The cashew kernels are highly nutritive. They are rich source of carbohydrates, proteins, unsaturated fats, minerals like calcium, phosphorus, Iron and vitamins. Why this kidney shaped nut called Natural Vitamin Pills? Its high nutritional value work as great health boosters and a good source of monounsaturated fats and proteins. Cashew nuts are great source of iron so this is important pregnant women produce more blood in order to nourish the fetus. Its anti-bacterial components fight against infection (Vaidehi and Babu, 2000).

Technical requirements for storage are dependent on weather conditions. As cashew nuts are usually produced in climates with a long dry season, simple buildings with concrete floors and walls and roofs of corrugated metal, should provide adequate storage (Hammed and Adedeji, 2008).

The cashew nut kernel is constituted of three different portions namely the shell, the kernel and the adhering testa. The primary product of cashew nuts is the kernel, which is the edible portion of the nut and is consumed in three ways: directly by the consumer, as roasted and salted nuts, in confectionery and bakery products, for example, finely

chopped kernels are used in the production of sweets, ice creams, cakes and chocolates, both at home and industrially and as paste to spread on bread (Ogunbameru, 2011).

Traditionally, extraction of the kernel from the shell of the cashew nut has been a manual operation. The nut is roasted which makes the shell brittle and loosens the kernel from the inside of the shell. By soaking the nuts in water, the moisture content of the kernel is raised, reducing the risk of it being scorched during roasting and making it more flexible so it is less likely to crack. The CNSL is released when the nuts are roasted. Its value makes collection in sufficient quantities economically advantageous. However, for very small-scale processors, this stage is unlikely to take place due to the high cost of the special roasting equipment required for the CNSL collection (see the section on 'hot oil' roasting). If the nuts are being manually shelled, gloves need to be used or alternatively, the nuts should be tumbled in sawdust or ashes to absorb the liquid coating which has a harmful affect on the skin (Hammed et al., 2008).

The shell can be cracked either manually, using a hammer, or mechanically. Manually operated blade openers are relatively expensive, however the more successful mechanical methods depend on the nuts having passed through the 'hot oil' CNSL extraction operation. Care must be taken not to break or split the kernel at this or subsequent stages as whole kernels are more valuable than broken ones. Once the kernel is removed from the shell, it is dried, the testa is peeled off and the kernel is graded (Heuzé et al., 2017).

The kidney shaped edible Nuts are called kernels and are obtained from the fruit or the raw nut after removal of the outer leathery covering which surrounds it, using different processing methods – dried well, steaming, shelled, peeled, graded, roasted, quality inspection, quality control and packing. Cashew processing actually includes the various steps and the processing methodology used varies from region to region (Heuzé et al., 2017).

Since the 1960s, various mechanized pieces of equipment have been developed and are available in several

countries but none in Nigeria. The processes that have been mechanized are roasting, CNSL extraction and shelling. For the most part, the cleaning of raw materials and sizing and kernel grading have remained labour intensive manual operations. Therefore, processing of cashew nut in Nigeria has been a manual operation. This study is to suggest a way of eliminating tedious or traditional way of processing cashew nuts in Nigeria.

The objectives of this research are to study ways of processing cashew nuts, investigate the difficulties encounter in cashew nuts processing and to suggest the means of improving on the difficulties in Enugu State

2 Material and methods

This study was conducted in Enugu State of Nigeria. Enugu State, which is located in South Eastern Nigeria, comprises of 17 local governments that are grouped into three senatorial districts. The main people visited were the cashew nuts processors and places that grow cashew in abundant within the zones. The Study was carried out from February to August, 2018 within the places mentioned below.

2.1 Design of the study

The study was designed on the basis of investigative survey Research Approach (ISRA). The investigative survey research approach for obtaining the data for this research entails the schedule of visits to places of interest but relevant to this research. The task to be accomplished during such visit included the following

- i. Physical visit to places where cashew nuts were processing in abundant.
- ii. Administration and completion of questionnaire on how they process cashew nuts.
- iii Interviews with relevant and competent processors or people involved.

The data sought for in each place visited were based on observation, opinions from cashew nuts processor experts and information from questionnaires.

2.2 Description of the questionnaire

The questionnaire designed for this study was in two different parts. They include the bio data of the person

interviewed or filled the questionnaire and the processes on how to process cashew nut after harvest. The main targets of this questionnaire were the cashew nuts processors and places that grow cashew in abundant. The places visited in Enugu State of Nigeria include Udi, Oghe, Oji river, Nkanu, Agwu and most places in Enugu North Senatorial Zone like Igbo etiti, Uzo Uwani, Igbo eze south, Igbo eze North and Udeno. The questionnaire seeks information on the steps involved in processing cashew nuts, machines for cleaning, roasting, shelling, peeling, separating and the quantity to be process in a day and season.

2.3 Cashew nuts processors visited and procedure for data collection

In carrying out this investigative survey, a total of 10 different cashew nuts processors were visited in every area. During the visit, questionnaires were administered to collect appropriate data. Data collected was based on major area covered. Also, personal interviews were conducted to get some vital information necessary for this study. The direct processors, Cashew tree growers, farm managers and cashew nuts dealers were in the best position to give the required information by virtue of their Position and

experience. Averagely, twenty questionnaires were administered from each place visited.

2.4 Machines used in the area visited

Most of cashew processor in the state shell cashew nut by manual means but several machines were designed to remove shells from cashew nuts. These include centrifugal shellers, foot operated lever shellers, Oltremare shellers, Cashco system shellers. The machine used in Enugu state by some of them that process by mechanical means was centrifugal shellers except one place at Amalla in Udeno local government that uses Oltremare sheller. The objective of shelling is to produce clean, whole kernels free of cracks. Therefore, the best machine within period the study was conducted was foot operated lever shellers, which produces 15 kg of kernel per hour and up to 96% clean, free of cracks and whole kernel after shelling.

3 Results and discussion

The investigative survey was carried out in major cashew nut processors in Enugu State of Nigeria. The average data obtained from the questionnaires issued and oral interview to the cashew nut processors are shown in the Tables 1-6.

Table 1 Quantity of cashew trees and nuts harvested in the study areas

S/N	Places	Qty of Cashew Trees	Cashew nuts Harvested Daily (kg)	Cashew nuts Harvested Seasonal (kg)	Qty of Cashew nuts Processed (kg)
1	Igbo Etit	1020	5.3	5358	280.4
2	Uzo Uwani	1211	19.4	7500	1850.0
3	Igbo Eze south	1731	39.8	8706	2005.9
4	Igbo Eze North	1645	37.7	8684	2008.7
5	Udeno	1520	41.7	8490	1856.5
6	Udi	1503	37.8	7760	1852.3
7	Oghe	1524	40.5	8972	2025.8
8	Oji River	1603	25.3	8684	1930.7
9	Nkanu	324	3.5	6320	193.6
10	Agwu	410	5.2	5410	220.4
Total		12491	256.2	75884	14224.3
Average		1249.1	25.62	7588.4	1422.43

Table 2 Mechanical methods of cashew nuts shelling

S/N	Places	Number of Shelling Machines	Number of Functional Machines	Number of Non Functional Machines	Qty of shelled cashew nuts Daily (kg)	Qty of shelled cashew nuts Seasonal (kg)
1	Igbo Etit	-	-	-	-	-
2	Uzo Uwani	1	1	-	12	783.4
3	Igbo Eze south	6	3	3	30	1063.3
4	Igbo Eze North	5	4	1	25	1032.2
5	Udeno	5	3	2	30	986.3
6	Udi	4	4	-	27	976.7

7	Oghe	6	5	1	32	1254.3
8	Oji River	4	2	2	16	960.3
9	Nkanu	-	-	-	-	-
10	Agwu	1	-	1	-	-
Total		32	22	10	172	7056.5
Average		3.2	2.2	1.0	17.2	705.65

Table 3 Manual method of cashew nuts shelling

S/N	Places	Qty of shelled cashew nuts Daily (kg)	Qty of shelled cashew nuts Seasonal (kg)
1	Igbo Etit	5.3	275
2	Uzo Uwani	6.4	521.4
3	Igbo Eze south	9.8	932.3
4	Igbo Eze North	12.7	973.6
5	Udenu	11.7	872.3
6	Udi	10.8	867.3
7	Oghe	8.5	768.4
8	Oji River	9.3	963.3
9	Nkanu	3.5	183.1
10	Agwu	5.2	213.8
Total		83.2	6570.5
Average		8.32	657.05

Table 4 Grades of shelled/peeled cashew nuts by mechanical method

S/N	Places	Qty of shelled cashew nuts Daily (kg)	Qty of shelled cashew nuts Seasonal (kg)	Qty of breakages	Qty of whole Nuts
1	Igbo Etit	-	-	-	-
2	Uzo Uwani	12	783.4	117.5	665.9
3	Igbo Eze south	30	1063.3	159.5	903.8
4	Igbo Eze North	25	1032.2	154.8	877.4
5	Udenu	30	986.3	147.9	828.4
6	Udi	27	976.7	146.4	830.3
7	Oghe	32	1254.3	188.1	1066.2
8	Oji River	16	960.3	143.3	817.0
9	Nkanu	-	-	-	-
10	Agwu	-	-	-	-
Total		172	7056.5	1057.5	5989
Average		17.2	705.65	105.75	598.9

Table 5 Grades of shelled/peeled cashew nuts by manual method

S/N	Places	Qty of shelled cashew nuts Daily (kg)	Qty of shelled cashew nuts Seasonal (kg)	Qty of breakages	Qty of whole Nuts
1	Igbo Etit	5.3	275	5.5	27.0
2	Uzo Uwani	6.4	521.4	10.4	511.0
3	Igbo Eze south	9.8	932.3	18.6	913.7
4	Igbo Eze North	12.7	973.6	19.5	954.1
5	Udenu	11.7	872.3	17.4	854.9
6	Udi	10.8	867.3	17.3	850.0
7	Oghe	8.5	768.4	15.5	752.9
8	Oji River	9.3	963.3	19.6	943.7
9	Nkanu	3.5	183.1	3.7	179.4
10	Agwu	5.2	213.8	4.3	209.5
Total		83.2	6570.5	131.80	6196.2
Average		8.32	657.05	13.18	619.62

Table 6 Analysis of variance (ANOVA) for the shelling cashew nut

Source of Variation	Degree of Freedom	Sum of Square	Mean Square	F-Calculated	F Table (5%)	F Table (1%)
Between Shelling Method	1	754.84	754.84	23.9518	4.75	9.33
Within Shelling Method(Error)	12	378.18	31.515			
Total	13	1133.02				

Note: 5% and 1% Probability Level.

The survey was carried out on the above ten areas of Enugu State of Nigeria that have high number of cashew trees. The data in Table 1 showed the quantity of cashew trees that grow in the sample areas, the quantity of cashew nuts harvested daily, quantity of cashew nuts harvested in a season and the quantity cashew nuts processed. The average cashew nuts harvested in a season was 7588.4 kg, while the average cashew nuts processed was 1422.43 kg. It means that over 81.3% of cashew nuts harvested in a season were nut processed. The average number of cashew trees in the area covered was 1249.1 that generate the average quantity of cashew nuts in a season.

The results obtained from the survey on the mechanical method of shelling cashew nuts were presented on Table 2. It showed the number of machines available in each area, the number that are functional and the number that are not functional. The results also showed the quantity of cashew nuts shelled daily and seasonal. The survey carried out showed that the areas covered had a total number of 32 machines, while 22 are functional and 10 were not functional. The functional machinery produced an average quantity of shelled cashew nuts of 17.2 kg on daily basis and 705.65 kg in a season. It was discovered from the interview and personal observation that the causes of machine breakdown were lack of Quality control and inspection, improper use of machine, lack of maintenance, improper feed rate and environmental effect.

The results of the survey on the manual method of shelling cashew nuts were shown on Table 3. The results also showed the quantity of cashew nuts that were shelled in a day and in season on the above areas covered. The average quantity of cashew nuts shelled daily was 8.32 kg and 657.05 kg were shelled in a season. The quantity shelled with machines was higher than the manual shelling.

The grades of shelled cashew nuts by mechanical means on the above chosen areas were presented in Table 4. The results showed the quantity of shelled cashew nuts in a day, quantity shelled in a season, quantity of cashew nuts breakages and quantity of whole kernel after shelling and peeling in each area. The average quantity of cashew nuts

breakages after shelling and peeling was 105.75 kg and average quantity of whole nuts was 598.9 kg by mechanical method.

The results obtained from the survey on the grades of shelled cashew nuts by manual method on the chosen areas were shown in Table 5. It showed the quantity of shelled cashew nuts in a day, quantity shelled in a season, quantity of cashew nuts breakages and quantity of whole kernel after shelling and peeling in each area. The average quantity of cashew nuts breakages after shelling and peeling was 13.19 kg and average quantity of whole nuts was 643.92 kg by manual means.

The analysis of variance (ANOVA) for the effectiveness of shelling between the mechanical and manual method was calculated using the variances from the t-test and it was shown in Table 6. The results show that the calculated F is greater than the tabular F at 5% and 1% probability level. The hypothesis was rejected because the two shelling methods were not equal.

4 Conclusion

The results obtained from the survey questionnaires and oral interview to the direct cashew nut processors showed that 80 percent of the cashew nuts harvested were not processed. Based on the survey and interview on the major areas in Enugu state that involved in cashew nuts production and processing, it was found that an average of 7588.4 kg of cashew nuts are harvested in a season and only 1422.43 kg of cashew nuts were processed. Therefore, majority of the cashew nuts harvested were either sold or stored for a short period. Most of the cashew nuts stored by the producers deteriorate because of lack of storage experience.

The average quantity of cashew nuts processed in a season by manual means was 657.05 kg and that of mechanical method was 705.65 kg. This means that the efficiency of the machines used were very low compared the manual way of processing. The average quantity of cashew kernels breakages recovered through manual way of processing was 13.19 kg while that of mechanical way was

105.75 kg in a season.

The survey and interview from the cashew nuts processors visited showed that majority of them processed the nuts by manual means and only few were processing mechanically. The results showed that most of the machines from the mechanical processors visited were not functional. The machines that are working cannot process much cashew nut but the few processed were of low grade and quality kernels which reduce the market value. The analysis of variance (ANOVA) showed that the results of the shelling were statistically difference, which means that high quantity of cashew were processed through mechanical method but of low grades.

It is recommended that shelling machine should be well checked of any foreign material inside the working mechanism to avoid malfunctioning and deformation of the sheller's face. The moisture content of cashew nut to be shelled should be reduced to 3% before shelling to avoid clogging that will lead to malfunctioning of the machine. The machines should be used according to the manual's guide and also maintain the feed rate to avoid overload. All the maintenance routine in the manual should be adhere to and shellers should be protected against environmental attack.

Cashew nut is lucrative, but government and other big private company should set up processing factories where cashew nuts can be processed into kernels and CNSL, which is greatly valued in the international market as a raw material for brake and clutch linings, paints, and vanishes.

The government should critically examine its policy thrust on cashew nut in the agricultural transformation

agenda with a view to improving cashew nut production and processing.

The government and non-governmental organizations should provide institutional support in terms of provision of credit facilities for the purchase of modern cashew nut processing equipment for improved processing of the products.

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