Effect of Shelling Methods on the Shelling Efficiency, Product Quality, Functional and Sensory Properties of Melon (*Egusi*) Seeds Sold in Aba, Abia State, Nigeria

Akusu O.M. and Chibor B.S.

Abstract—Local Aba made melon shelling machine type I (sample B) and improved Aba made melon shelling machine type 2 (sample C) were used to shell melon seeds and compared with hand shelling method (sample A). The shelling efficiency, quality of shelled melon seeds, functional properties of the seed flours and sensory properties of egusi soups prepared from the melon seeds were determined. The results revealed that sample A gave the highest shelling efficiency of 92.25%, followed by sample C (90.42%) and the least was sample B (80.85%). For the quality of shelled melon seeds, sample A gave the highest score of 95.88%, following by sample C (94.46%) while sample B gave the least score of 79.84%. There was no significant difference (P > 0.05) in the proximate composition of the melon seeds obtained from the three shelling methods (samples A, B and C). There were no significant difference (P > 0.05) in all the selected functional properties between samples A and C while sample B had significantly lower values in all the functional properties that were studied. The mean scores for overall acceptability of egusi soup prepared from the shelled melon seeds were; samples A (7.95), sample B (6.02) and sample C (7.72). Functional and sensory properties of the melon seeds shelled by the improved Aba made melon shelling machine type 2 compared favourably with the hand shelled melon seeds. Hence, it can be recommended for commercial operations to meet the demands of industrial and commercial markets.

Index Terms—Melon seeds, shelling efficiency, egusi soup, functional and sensory properties.

I. INTRODUCTION

Melon (*Citrullus vulgaris*) commonly known as “*egusi*” is extensively cultivated and consumed in Nigeria and West Africa especially use in the preparation of soups as a thickener [1]. *Egusi* seed is rich in protein, polyunsaturated fatty acids (PUFA), vitamins and minerals [2]. It has a high water and oil holding capacity and forms thick and stable emulsion and could find a place in the food industry as it could find a place in the food industry as it

obtained by the traditional or manual hand shelling method. This traditional hand shelling method is tedious and time consuming; thus, limiting the availability of shelled melon seeds in the market and its commercial production. The traditional method of shelling also causes bruises and serious injury to the human fingers coupled with low output. Adekunle et al. [4], reported that the inability to effectively shell melon seed in order to meet the required capacity necessary for industrial utilization has been a hindrance to its use for large scale production and product diversification.

Mechanised shelling method which involves advanced automated shelling machine that has an efficient shelling performance, less time consuming has become imperative for small and medium scale *egusi* farmers. In Nigeria, substantial research has been carried out on the design and fabrication of mechanised melon shelling machines [5-9]. Despite all these efforts at producing a good melon shelling machine over the years, most of these machines were found to have low shelling efficiency, high percentage of seed breakages. Okokon et al. [9], reported that the test conducted on most of the locally designed and fabricated melon shelling machines showed that their shelling efficiencies rate were below 30%. Noted setback been; wasting of the cotyledon through breakage, unhygienic outlook of the shelled melon seed, swelling ability, rancidity and souring of soups prepared from such melon seeds. Sobowale et al. [3], reported that seed moisture content and the speed of the shelling machine are the main factors that affect the quality of the shelled melon seed, shelling efficiency was shown to increase with increase in moisture content of unshelled melon seed and a decrease in shelling speed. An optimum moisture content of 18.32% and a shelling speed of 1500 rpm was recommended to be appropriate [10]. There have been several complaints among Nigerian women about the use of machined shelled *egusi* in food preparation. These complaints include, poor hygienic outlook of the melan seeds, high percentage of broken kernels, low swelling ability and rancidity/souring of soups compared to *egusi* soups prepared from hand shelled melon seeds. Majority of current melon shelling is done with hand shelling. Whereas to the best of the authors' knowledge, there is only one type of melon shelling machine, fabricated in Aba, Abia State, Nigeria that is used commercially. This machine seems to be an improvement on all the other locally fabricated shelling machine in Nigeria.

Thus, this study aimed to evaluate the shelling efficiency, melon quality, proximate, functional and sensory

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properties of local (Type 1) and improved (Type 2) Aba fabricated melon shelling machines and compared them with the hand shelled melon seeds.

II. MATERIALS AND METHODS

A. Materials
Unshelled melon seeds were purchased from new market in Aba, Abia State and transported to Food Chemistry Laboratory in the Department of Food Science and Technology, Rivers State University, Port Harcourt, Nigeria. Chemicals used for the analysis were of analytical grade and were obtained from the same Department.

B. Production of Hand Shelled Melon Seeds
The traditional hand melon shelling method was used. Six kilograms (6kg) of unshelled melon seeds were sorted and sprinkled with water, air dried for 10min and shelled manually. The shelled melon seeds containing the shells were dried for 2h, then winnowed and sorted into shells, shelled whole seeds, unshelled seeds and broken seeds. The weight of the fractions were determined for calculation of shelling efficiency within 20min of shelling. The shelled unbroken seeds were oven dried at 50°C for 12h using the air oven (model QUB 305010G, Gallenkamp, UK).

C. Production of Machine Shelled Melon Seeds
Twenty-five kilograms (25kg) of unshelled melon seeds were sorted and sprinkled with water, air dried for 10min and divided into two equal parts. One part was shelled using the local Aba made (Type 1) and the second part with improved Aba made (Type 2) melon shelling machines. The shelling was done within 20min, the shelled mixture was then dried for 2h, winnowed and sorted into shells, unshelled seeds and broken seeds. Their weight were determined.
and used for the calculation of shelling efficiency. The unbroken seeds were oven dried at 50°C for 12h in a hot-air fan oven (model QUB, 305010G, Gallenkamp, UK) and ground using a laboratory mill (Numex pep grinding mill, India).

Plate 4: Local Aba Melon Shelling Machine

Plate 5: Improved Aba Melon Shelling Machine

Plate 6: Unshelled Melon Seeds

Plate 7: Mixture After Shelling By Machine

Plate 8: Local Aba Shelled Melon Seeds

Plate 9: Improved Aba Machine Shelled Melon Seeds
D. Determination of Shelling Efficiency and Melon Seed Quality

The shelling efficiency of both manual and machine shelled melon seeds were determined by calculating the ratio of completely shelled melon seed to the total weight of unshelled melon seeds fed into the machine hopper or manually hand shelled. Total pieces produced or expected outputs were used for the calculation and included unshelled melon, melon shells, broken melon and unbroken wholesome melon seeds. The weight of unshelled melon seed input, shells produced, unbroken shelled melon seeds, unshelled melon seeds after shelling and broken shelled melon seeds were equally determined and used for the calculation. The shelling efficiency, effectiveness, productivity and quality of shelled melon seeds were then calculated with the use of the following equation;

\[
\text{Melon Seeds Shelling Efficiency} = \frac{\text{Weight of shelled melon seed mixtures} - \text{unshelled melon seeds}}{\text{Total weight of melon seeds shelled (input)}}
\]

where;

\[
\text{Shelled Melon Seed Quality} = \frac{\text{Weight of shelled whole (unbroken) melon seeds}}{\text{Total weight of melon seeds shelled (input)}}
\]

E. Chemical Properties

Moisture, total ash, crude fibre, either extract and crude protein were determined according to AOAC [11] standard procedures. The factor N x 6.25 was used for conversion of nitrogen to crude protein. Carbohydrate content was calculated by difference.

F. Functional Properties

Selected functional properties such as water and oil absorption capacity, viscosity, swelling power and foam capacity were determined on the melon seed flour. Water and oil absorption capacities were determined according to the method of Benchart [12], viscosity was determined according to the method of Fleming et al. [13], foam capacity was determined according to the method of Onwuka [14] and swelling power was determined according to the method of Takashi and Sieb [15].
The results of the study revealed that there were no significant differences in the proximate compositions of the melon seeds shelled by the three shelling methods as shown in Table 3. This result is similar to that reported by Abbah et al. [2] for proximate properties of melon seed samples. This is an indication that proximate properties of melon seeds is not effected by any form of shelling method. Moisture, ash and crude fibre values of melon seeds obtained from the three shelling methods observed in this study is in agreement with those reported by Ajilola et al. [19] while crude protein values are low compare to that recorded by Abbah et al. [2] for melon seeds shelled by the three methods of melon shelling observed in this study is in agreement with those reported by Abbah et al. [2]. This could be associated to the drying or processing method adopted by Bankole and Joda [20]. This could be associated to the drying or processing method adopted by Bankole and Joda [20].

III. RESULTS AND DISCUSSION

A. Shelling Efficiency

The result of the study revealed that there were no significant differences in the proximate compositions of the melon seeds shelled by the three shelling methods observed in this study is in agreement with those reported by Abbah et al. [2]. This could be associated to the drying or processing method adopted by Bankole and Joda [20]. This could be associated to the drying or processing method adopted by Bankole and Joda [20].

B. Proximate Composition

The data obtained were subjected to Analysis of Variance (ANOVA) using Statistical Package for Social Science (SPSS) version 20.0 software 2011. All the analyses were conducted in triplicate and means separated using Duncan multiple range test.
The prepared soup samples were not affected by the melon seeds obtained from different shelling methods. This study has revealed that melon seeds shelled using the improved Aba made melon shelling machine have the ability to reduce bruises and serious injuries to human fingers caused by hand peeling, increase the output of melon seeds in the market, as well as having the ability to compare favourably with hand peeled melon seeds in soup making which meets the sensory needs of the Nigerian homemaker.

### C. Functional Properties

The result of the selected functional properties of melon seed flours shelled via three different shelling methods is presented in Table 4. Water absorption capacities (WAC) represent the ability of a product to associate with water under conditions where water is limited while oil absorption capacity (OAC) is an estimate of fat binding ability of proteins especially in melon seeds. Giami et al. [21] defined oil/fat absorption capacities as the difference in the flour weight before and after its oil absorption. Other researchers noted that oil/fat absorption capacities is an important functional property, since oil acts as flavor retainer and also increases soft texture to mouth feel of foods [22] and equally important because of their storage stability and particularly to determine the stage of rancidity development [23].

The study revealed that water and oil absorption capacities of the melon seed flours were within the ranges of 0.56-0.77g/ml and 0.93-1.52g/ml, respectively. The values for WAC reported here are low while OAC values are within the ranges of those reported by Akusu and Kiin-Kabari [16] for melon seed flour. Shelling methods and the season in which these research were carried out could be responsible for these variations in the water and oil absorption capacities of the reported melon seed fours. The study further revealed that there were no significant difference (P < 0.05) in water and oil absorption capacity, foam capacity, viscosity and swelling power between the hand peeled melon seeds (sample A) and sample C (improved Aba made melon shelling machine). Whereas, sample B (local Aba made melon shelling machine) had significantly (P > 0.05) lower values in all the selected functional properties that were studied. The result in this study could be the reason behind the high preference of hand peeled melon seeds over machine shelled melon seeds. Complaints has been arising by the Nigerian homemakers that machine shelled melon seeds are dirty in outlook, low in swelling ability and contain a lot of broken seeds which leads to rancidity and souring of egusi soups. Significantly (P < 0.05) low swelling power of 1.62g/cm recorded in sample B compare to other samples confirms the serials of complaints by homemakers with regards to the low swelling ability of machine shelled melon seeds. Peter-Ikechukwu et al. [24] also recorded 1.36g/ml swelling power of machine shelled melon seeds which is in agreement with that obtain in this study. The result of this investigation have revealed that the improved Aba made melon shelling machine have the ability to eliminate these complaints with regards to the negative effects of local machine shelled melon seeds use in cooking egusi soup.

### D. Sensory Properties

The mean sensory scores of egusi soups prepared with melon seeds obtained from different shelling methods is shown in Table 5. The report of the study revealed that there were no significant difference (P < 0.05) between samples A and C in all the sensory properties evaluated while sample B had significantly (P > 0.05) low score compared to the control sample. Although, the taste of the prepared soup samples were not affected by the melon shelling methods. This study has revealed that melon seeds shelled using the improved Aba made melon shelling machine have the ability to reduce bruises and serious injuries to human fingers caused by hand peeling, increase the output of melon seeds in the market, as well as having the ability to compare favourably with hand peeled melon seeds in soup making which meets the sensory needs of the Nigerian homemaker.
TABLE 5: MEAN SENSORY SCORES OF THE MELON SOUP

<table>
<thead>
<tr>
<th>Samples</th>
<th>Aroma</th>
<th>Taste</th>
<th>Appearance</th>
<th>Thickness</th>
<th>Overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7.70±0.001a</td>
<td>7.65±0.002b</td>
<td>7.45±0.000b</td>
<td>7.05±0.002b</td>
<td>7.95±0.001a</td>
</tr>
<tr>
<td>B</td>
<td>7.20±0.002b</td>
<td>7.56±0.002b</td>
<td>6.82±0.002b</td>
<td>5.20±0.002b</td>
<td>6.02±0.002b</td>
</tr>
<tr>
<td>C</td>
<td>7.50±0.002b</td>
<td>7.59±0.002b</td>
<td>7.40±0.002b</td>
<td>6.95±0.002b</td>
<td>7.72±0.002b</td>
</tr>
</tbody>
</table>

Mean values bearing different superscript in the same column differ significantly (P<0.05), ± standard deviation of triplicate determinations.

**Key:**
A = Manual hand shelled melon seeds, B = Local Aba made melon shelled seeds, C = Melon seeds obtained from the improved Aba made melon shelling machine.

**IV. CONCLUSION**

The three shelling methods adopted in this study revealed a significant effects on the shelling efficiency and the quality of the melon seeds while proximate properties of the three sampled melon seeds were not affected. Functional and sensory properties of the melon seeds shelled with the improved Aba made melon shelling machine (type 2) compared favourably with the hand peeled melon seeds. Hence, it is recommended for commercial operations in order to meet the demands of industrial and commercial markets.

**V. REFERENCES**


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