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EFFECTS OF PROCESSING ON FUNCTIONAL PROPERTIES OF SOME MELON (EGUSI): *LAGENERIA SICERARIA* AND *CITRULLUS VULGARIS* SEED FLOURS

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Abstract

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Functional properties are the intrinsic physico-chemical characteristics which may affect the behaviour of food system during processing and storage. Dried seeds of Lageneriasiceraria (African wine kettle) and Citrullus vulgaris were processed into boiled, roasted, germinated and fermented flour samples. Standard methods were used to determine the functional properties of the processed samples in order to determine the effects of these processing techniques on water absorption capacity (WAC) and oil absorption capacity (OAC), bulk density (BD) and foaming capacity (FC).WAC and OAC of raw Lageneria siceraria flour are 2.451±0.164 (g/g) and 6.417±0.369 (g/g) respectively. These values are higher than the WAC and OAC determined for raw Citrullus vulgaris. However, these values are generally reduced with processing for the two seed flour samples, except for the higher WAC value of germinated Citrullus vulgaris, OAC values of roasted and germinated Citrullus vulgaris as well as the higher WAC of fermented Lageneriasiceraria seed flours. Fermentation increased the FC of Lageneriasiceraria , while roasting, boiling and germination reduced the FC of Lageneriasiceraria. However, the foaming stability (FS) of the raw samples of the two seeds are higher than FS of the processed seed flour samples after 2 hours.

1.0 Introduction

*Lagenaria siceraria*are gourd is grown in most parts of Nigeria. Gourd seeds (Cucurbitaceae) are versatile and include hundreds of species of vine bearing coiled climbing tendrils and some of the most unusual fruits in the world. Some *Lagenariasiceraria* gourds are grown in Yoruba land mostly for utility purposes [1, 2]. In West Africa, a region where soups are integral to life, egusi melon (*Citrulluslanatus*) seeds are a major soup ingredient and a common component of daily meals. Coarsely ground up, they thicken stews and contribute to widely enjoyed steam dumplings. Some are soaked, fermented, boiled and wrapped in leaves to form a favourite food seasoning. Egusi melon-seed meal is compacted into patties that served as a meat substitute. Despite being a significant foodstuff even by global standard, egusi melon is hardly known to nutritionists outside a few West African Nations. Little nutritional detail on egusi melon oil is readily available to an international readership. Research studies have shown that these seeds contained about 50% oil [3], 42-57% oil [4] and 44-53% oil [5] for seeds cultivated in different bioclimatic regions of Cameroon.

Functional properties are the intrinsic physico-chemical characteristics which may affect the behaviour of food system during processing and storage e.g. protein solubility, gelation, foamability and emulsion properties[6].The processing method of melon seeds before consumption include boiling, frying and roasting [7]. Ogundele and Oshodi [2] reported that the three varieties of *Lageneriasiceraria* seed flours reported on, have appreciable functional properties that are suitable for innovative application in the food industry. However, not much have been reported on the effect of processing on the functional properties of *Lageneriasiceraria*seeds (African wine kettle) and *Citrullus vulgaris*. This study is therefore to determine the effect of some processing techniques on some functional properties of some melon (egusi) seed flours: *Lageneriasiceraria* (African wine kettle) and *Citrullus vulgaris*.

2.0 MATERIALS AND METHODS

2.1 Samples and sample preparation

Seeds of *Lagenaria Siceraria* (African wine kettle), were purchased from Ilora market in Oyo. *Citrullus vulgaris* were purchased from Akure market in

OndoState. The seeds were identified at Forestry Research Institute of Nigeria (FRIN), Ibadan, Oyo State, Nigeria. The seeds were dehusked and further sun dried. The sample were put in polyethylene bags and then in air tight plastic containers and labeled appropriately.

Samples of the seeds were processes into raw dried form, boiled form, fermented form, germinated form and roasted form.

2.1.1 Processing of the seeds into Raw Dried Flour (RDF)

Dehusked melon seeds were dried and ground to a very fine flour, packed in a polythene bag and kept in a cool dry place prior to analysis.

2.1.2 Processing of the seeds into the Boiled Seed Flour (BSF)

The raw dehusked seeds were boiled with water for 30 minutes. Boiled seeds were put in perforated trays and left to drain off all excess water content and slightly dried in an air oven.The boiled, dried seed were milled into flour samples, packed in a polythene bags and kept in a cool dry place [8].

2.1.3 Processing of the seeds into the Fermented Seed Flour (FSF)

The seeds were put into a container of water and left to ferment naturally for 3 days. After the end of the 3 days, the fermented seeds were dried in an oven at 50 ˚C to avoid being burnt off, milled using a grinder to a fine flour, packaged in polyethylene bags and stored in a cool dry place prior to further analysis [8].

2.1.4 Processing of the seeds into the Germinated Seed Flour (GSF)

The seeds were put into a container of water and left to sprout for the period of 6-7 days. The sprouted seeds were removed and dried in air to remove all water content and was then milled with a grinder to a powdery form. The powdery form was then packaged into a polyethylene bag and kept in a cool dry place for further analysis [8].

2.1.5 Processing of the seeds into Roasted Seed Flour (RSF)

The dehusked and dried seeds were roasted in a hot cast iron pan at a temperature of 75-85 ˚C. Roasting was done to obtain light cream to brown colour. Roasted seeds were milled to a powdery form, packaged in a polyethylene bag and kept in a cool dry place for further analysis [8].

2.2 Determination of Functional Properties

2.2.1 Determination of Water Absorption Capacity (WAC)

The WAC of the flour samples were determined by using the procedure described by Sathe*et al* [9]. 10ml of water was added to 0.5 g of each sample in a beaker, the suspension was then stirred for 5 minutes. The suspension was centrifuged at 3,500 rpm for 30 minutes. The volume of the supernatant obtained was measured in a 10 ml measuring cylinder. The water absorbed by the seed flour was calculated as the difference between the initial water used and the volume of the supernatant obtained after centrifuging. The result was expressed as a percentage of water absorbed by 1 g of the flour.

$$\text{WAC(g/g)} = \frac{\text{weight of water absorbed}}{\text{weight of sample}} \quad \text{(1a)}$$

or

$$\text{WAC(\%)} = \frac{\text{weight of water absorbed} \times 100}{\text{weight of sample}} \quad \text{(1b)}$$

2.2.2 Determination of Oil Absorption Capacity (OAC)

Vegetable oil (Executive Chef Vegetable oil) obtained from JOF local Family Farm Owo, with density of 0.92 g/ml was used was used instead of distilled water as described under section 2.2.1 above for WAC. 1.0 g flour in 10 ml were mixed using stirrer for 5 minutes. The mixture was then centrifuged at 3,500 rpm for 30 minutes. The amount of oil separated as supernatant was measured. The difference in volume between the initial oil used and the supernatant was taken as the oil absorbed by the samples. The result was expressed as g/g % of oil absorbed [9].

$$\text{OAC(g/g)} = \frac{\text{weight of oil absorbed}}{\text{weight of flour used}} \quad \text{(2a)}$$

or

$$\text{OAC(\%)} = \frac{\text{weight of oil absorbed} \times 100}{\text{weight of flour used}} \quad \text{(2b)}$$

2.2.3 Determination of Bulk Density (BD)

The procedure of Narayana and NarasingaRao [10] was slightly modified and used all the processed samples. A specified quality of the samples of each of the differently processed seed flour was put into already weighed 5ml measuring cylinder (W1). It was gently tapped to eliminate air spaces between the flour in the measuring cylinder and the volume was noted to be the volume of the sample used. The new mass of the sample and measuring cylinder recorded as (W2). Both the volume and mass of the flour sample were determined. The bulk density was computed as:

$$BD(g/cm^3) = \frac{W1-W2}{Volume\ of\ sample} \quad (3)$$

For each sample the process was repeated at least three times using different sample volume. The measuring cylinder was washed and dried after each determination and flour was not allowed to adhere to cylinder walls [10].

2.2.4 Determination of Foaming Capacity (FC) and Foaming stability (FS)

Determination of foaming capacity of the seed flour was carried out according to the method of Coffman and Garcia [11]. Two gramsof each sample was whipped with 100 ml distilled water in 250 ml measuring cylinder using GMBN homogenizer at 5,000 rpm. The volume of the mixture before and after whipping were noted and used to compute the foaming capacity, the foaming capacity was calculated as the percentage increase in volume due to whipping at zero time.

$$FC(\%) = \frac{(V2-V1)\ x\ 100}{V1} \quad (4)$$

Where:

V_1 = Initial foam volume

V_2= Final foam volume

The foaming stability was calculated as the percentage increase volume at the specific time interval over a period of 6 hours.

3.0 RESULTS AND DISCUSSION

Water Absorption Capacities (WAC) of *Lagenariasiceraria* (Table 1) ranged from 1.607 g/g (Roasted) - 2.661 g/g (Fermented) or (160.70-266.10) % and those of *Citrullus vulgaris* (Table 2) ranges from 1.085g/g(Roasted) - 1.855 g/g(Germinated) or (108.50-185.5) %. These values are closely related to that reported for WAC reported for some processed fluted pumpkin seeds ranging from 124 to175 % [12]. Hence, the high WAC of the processed and raw melon seeds makes them good soup thickener as stated by Ogundele and Oshodi, [2]. However, processing generally reduced the WAC of *Lageraniasiceraria* seed flours, except for the fermented *Lageraniasiceraria* seed flour that has a slightly higher WAC of 2.661±0.199 g/g compared with that of the RFS of 2.451±0.164 g/g. This higher value of WAC in FSF may be due to denaturation of the seed proteins [13]

Table 1: Effect of processing on some Functional Properties of *Lageraniasiceraria* Seed Flours.

	Samples				
Parameters	Raw (RDF)	Boiled (BSF)	Roasted (RSF)	Fermented (FSF)	Germinated (GSF)
Water Absorption Capacity (WAC) g/g	2.451±0.164	1.637±0.577	1.607±0.539	2.661±0.199	1.734±0.276
Oil Absorption Capacity (OAC) g/g	6.417±0.369	5.430±0.646	3.803±0.284	5.852±0.430	6.314±0.286
Bulk Density (BD)g/ml	0.502±0.241	0.459±0.144	0.509±0.019	0.521±0.057	0.482±0.006

The OAC of *Lagenaria siceraria* (Table 1) ranged from 3.803 g/g (Roasted) - 6.417 g/g (Raw) or (380.3 to 641.7) % and those of *Citrullus vulgaris* (Table 2) ranged from 4.622g/g (Boiled) to 5.393 g/g (Roasted) or (462.2 -539.3) %. These values are close to the values reported for processed Breadnut, cashewnut and fluted pumpkin seed flours of the defatted flours ranges between 336.36-414.26; 268.75-327.08; and 316.77 - 423.15 percent respectively [14]

Table 2: Effect of Processing on Some Functional Properties of *Citrullus vulgaris* Seed Flours.

Parameter	Samples				
	Raw	Boiled	Roasted	Fermented	Germinated
Water Absorption Capacity (WAC) g/g	1.509±0.167	1.367±0.472	1.085±0.940	1.490±0.306	1.855±0.210
Oil Absorption Capacity (OAC)g/g	4.627±0.379	4.622±0.226	5.393±0.745	4.630±0.392	5.332±0.468
Bulk Density (BD)g/ml	0.411±0.037	0.503±0.009	0.446±0.052	0.407±0.053	0.426±0.043

The Bulk Density of *Lagenariasiceraria*(Table 1) ranged from 0.459 g/g (Boiled) - 0.521 g/g (Fermented) and those of *Citrullus vulgaris* (Table 2) ranged from 0.407 g/g (Fermented) - 0.503 g/g (Boiled). The Bulk Density of full fat and defatted breadnut, cashewnut and fluted pumpkin seed flours ranges between 0.45-0.68 g/ml; 0.34-0.47 g/ml and 0.33-0.55 g/ml respectively while that of the defatted breadnut, cashewnut and fluted pumpkin seed flours ranges between 0.42-0.58 g/ml; 0.27-0.40 g/ml and 0.23-0.38 g/mL [14].

The Foaming capacity (FC) and FS after 2 hours of *Lagenariasiceraria*(Table 3) ranged from 2.00 (Roasted) to 10.00 ml(Raw)and ranges from 2.00 (Roasted) to 4.44 ml (Boiled) *Citrullus vulgaris* for FC and FS after after 2 hours respectively (Table 4). Processing affected the foaming properties of seed flours differently.

Table 3: Foaming Capacity/Stability for *Lageraniasiceraria*Seed Flours after 2 Hours.

	Foam capacity and stability (ml/ml) with time (min)				
Sample	0	30	60	90	120
Raw	12.00	10.00	10.00	10.00	10.00
Boiled	4.00	0.00	0.00	0.00	0.00
Roasted	10.00	10.00	6.00	4.00	2.00
Fermented	19.15	4.26	0.00	0.00	0.00
Germinated	6.00	0.00	0.00	0.00	0.00

Table 4: Foaming Capacity &stability for *Citrullus vulgaris* Seed Flours after 2 Hours.

	Foam capacity with time (min)				
Sample	0	30	60	90	120
Raw	23.40	4.26	4.26	4.26	4.26
Boiled	8.89	6.67	4.44	4.44	4.44
Roasted	4.00	2.00	2.00	2.00	2.00
Fermented	20.93	0.00	0.00	0.00	0.00
Germinated	12.00	6.00	6.00	4.00	4.00

In the case of defatted breadnut flours, Boiling, Fermentation and Toasting reduced foaming capacity of full fat and defatted seed by 67.24 %, 66.90 % and 51.72 %; 57.66 %, 50.36 % and 46.72 %, respectively while germination increased it by 37.93%, and 60.58% respectively [14].

4.0 CONCLUSION

In conclusion processed *Citrullus vulgaris* has higher foaming capacity and better foaming stability than processed *Lagerania siceraria*. The results obtained shows that water is readily absorbed in the boiled seed of *Lagerania siceraria* than than the boiled form of *Citrullus vulgaris* based on the Water Absorption Capacity.

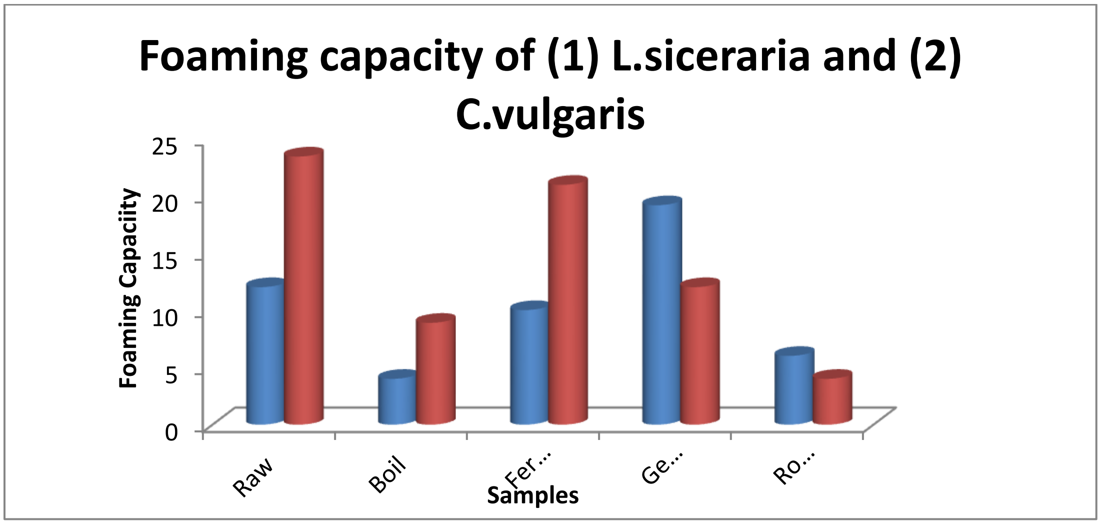

Fig. 1**:** Foaming capacity of (1) *Lageraniasiceraria*and (2) *Citrullus vulgaris* seedflours.

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