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Analysis Of Physiochemical And Phytochemical Properties Of Abakaliki-Indigenous Nigerian Melon (Isekele) Seed Flour

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ABSTRACT: The physiochemical and phytochemical properties of Abakaliki-indigenous Nigeria isekele melon seed flour was determind in this study. Foaming capacity, emulsion capacity, oil absorption, water absorption, and bulk density tests were conducted. The moisture, protein, fat, fibre, ash, carbohydrate, flavonoid, saponin, carotenoid and alkaloid contents of the flour were determined. The results indicate that the functional properties of the flour are: foaming capacity 0.07 %, emulsion capacity 70.50 %, oil absorption capacity 32.50 %, water absorption capacity 30.90 % and bulk density 1.29 g/ml. The proximate composition of the flour are: carbohydrate 56.25 %, protein 34.13 %, moisture 2.70 %, fat 26.00 %, crude fibre 5.55 % and ash 2.15 %. The flour has the following phytochemical composition: flavonoid 2.90 %, saponin 6.10 %, carotenoid 0.85 % and alkaloid 2.90 %. The analysis revealed that the flour could be used in soup making and infant food formulation. It could also be useful for prevention and cure of heart related diseases.

KEYWORDS - Physiochemical analysis, Phytochemical properties, Melon seed flour, Abakaliki-indigenous melon

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I. INTRODUCTION

Melon seed is used as a common component of daily meals in West Africa. It is edible, somehow bitter, nutty-flavoured, rich in fat and protein. The seed could be eaten whole or used as an oil seed. It has been reported to dominantly contain fatty acid [1-3]. The Abakaliki-indigenous melon (Isekele) belongs to the egusi melon (colocynthis citrullus) specie. The egusi melon resembles a common watermelon vine, but bears small hard fruits with a bitter pulp. It is grown in sandy, arid soil and is a good source of food [4] and income to many families. Its importance to humanity as a good source of food and nutrient has attracted research attention in the past.

Egwim *et al*. [5] studied the physicochemical properties and sensory characteristics of oil extracted from melon seeds grown at Minna, Niger State of Nigeria when used in frying foods. The results show that the fresh melon oil is yellow in colour, has 2.0 % moisture content, 1.059 kg/dm^3 specific gravity, 0.97 mgKOH/g acid value, 108 g/100g iodine value, 7.0 mmol O_2/kg peroxide value and 178.11 mgKOH/g saponification value. The colour, moisture content, specific gravity, acid value, iodine value, peroxide value and saponification value of stored melon seed oil are yellow, 1.2 %, 1.0598 kg/dm^3, 0.67 mgKOH/g, 110 g/100g, 7.90 mmol O_2/kg and 178.10 mgKOH/g respectively. The findings indicate that melon seed oil could be used as a cooking oil since plantain fried with melon seed oil has better taste, aroma and overall acceptance organoleptic scoring than plantain fried with groundnut oil.

Jacob *et al*. [6] investigated melon (Citrullus lanatus) seed flour to determine the mineral, nutritional and antinutritional compositions of the flour using the soxhlet extraction, AOAC, Kjeldhal, atomic emission spectrometry, atomic absorption spectrophotometry and vanado-molybdate methods. The results showed that the seed has a moisture content of 7.10 %, ash content of 2.70 %, crude protein of 30.63 %, crude lipid of 49.05 %, crude fibre of 6.00 %, carbohydrate of 4.52 %, dry matter of 92.90 %, organic matter of 97.30 % and energy value of 582.05 Kcal/100g. It has iron content of 144.70 mg/100g, manganese content of 22.73 mg/100g, zinc content of 21.05 mg/100g, magnesium content of 20.46 mg/100g, calcium content of 0.10 mg/100g, oxalate content of 26.40 mg/100g, tannin content of 39.40 mg/100g and hydrocyanic acids content of 1.56 mg/100g. findings indicated that the melon seed flour has high contents of protein and fat and could serve as dietary supplements.

Tabiri *et al*. [7] conducted a study to analyse the proximate, minerals, phytochemicals, total phenols content and antioxidant activity of three varieties of watermelon seeds. The results showed that the watermelon seeds have moisture content, fat, protein, fibre, ash, carbohydrate and energy value in the range of 7.40 - 8.50 %, 26.50 - 27.83 %, 16.33 - 17.75 %, 39.09 - 43.28 %, 2.00 - 3.00%, 9.55 - 15.32 %, 354.05 - 369.11 kcal/100g respectively. The seed also contains saponins, tannins, triterpenoids glycosides and alkaloids. The findings suggest that the watermelon seed is a considerable source of nutrients in the diet.

Although researchers have studied the physiochemical and phytochemical properties of some melon species in the past, there is little literature on the physiochemical and phytochemical properties of Isekele seed flour, an Abakaliki-indigenous Nigerian melon. Therefore, the present study seeks to analyse the physiochemical and phytochemical properties of the isekele melon seed flour that is grown at Abakaliki in southeast Nigeria.

II. MATERIALS AND METHODS

The isekele melon seed samples were sourced from Ezzangbo town in Abakaliki of Ebonyi state, Nigeria. The seeds were de-husked, sieved and screened to achieve a dirt free sample, after which they were ground to flour, stored in sealed polyethylene bag, and put inside containers.

To determine the functional properties, 2 g of the sample was blended with 10 ml distilled water and whipped at 1600 rpm for 5 minutes. It was then poured into a measuring cylinder and the volume was recorded after 30 seconds. The foam capacity was calculated in line with Abbey and Ibeh [8] thus:

$$\%\ \text{whipability} = \frac{\text{volume after whipping} - \text{volume before whipping}}{\text{volume before whipping}}\ \text{x}\ 100$$

After whipping, the foam stability was recorded at 15, 30, 60 and 120 minutes to generate foam stability according to Ahmad and Chmidt [9].

$$\text{Foam stability} = \frac{\text{foam volume after time 't'}}{\text{initial foam volume}}\ \text{x}\ 100$$

The emulsification capacity was determined by blending 2 g of the flour sample with 25 ml distilled water at room temperature for 39 seconds at 1600 rpm. 25 ml vegetable oil was added slowly after complete dispersion and blended for another 30 seconds. The product was transferred into a centrifuge tube at 1600 rpm for 5 minutes. The emulsion capacity was expressed according to Padmashree *et al*. [10].

$$\text{Emulsion capacity} = \frac{\text{height of emulsified layer}}{\text{height of whole solution in the centrifuge tube}}\ \text{x}\ 100$$

To determine the water/oil absorption capacity, 5 g of the sample was put into a clean conical graduated centrifuge tube and mixed thoroughly with 10 ml distilled water/oil using a mixer for 30 seconds in line with the method described by Onwuka [11]. The sample was then allowed to stand for 30 minutes at room temperature after which it was centrifuged at 1600 rpm for 30 minutes. The water and oil absorption capacities were expressed in grams of water/oil absorbed per gram of the sample.

$$\text{Water absorption capacity} = \frac{\text{volume of water absorbed}}{\text{weight of sample}}\ \text{x}\ 100$$

$$\text{Oil absorption capacity} = \frac{\text{volume of oil absorbed}}{\text{weight of sample}}\ \text{x}\ 100$$

The bulk density was determined using the method described by Onwuka [11]. 5 g of the sample was filled in a 10 ml graduated cylinder and its bottom tapped on the laboratory bench until there was no reduction in volume of the sample. The volume was calculated thus:

$$\text{Bulk capacity (g/ml)} = \frac{\text{weigth of sample}}{\text{volume of sample}}$$

To determine the moisture content of the sample, the empty petri dish was cleansed and dried in an oven at 100 ℃ for 10 minutes and cooled in desiccators in line with AOAC [12]. The dried and cooled dish was weighed. 5 g of the prepared sample was weighed and dried in an oven with air circulation at 105 ℃ for 3 hours, cooled in desiccators and then weighed. The percentage amount of moisture was calculated using the formula.

$$\text{Moisture}\ (\%) = \frac{\text{M} - \text{N}}{\text{M} - \text{T}}\ \text{x}\ 100$$

Where T = weight (g) of petri dish, M = weight (g) of petri dish + sample before drying, N = weight (g) of petri dish + sample after drying.

The ash content was determined in line with AOAC [12]. The crucible was washed and dried in a muffle furnace at 550 ℃ for 10 minutes, and cooled in desiccators for 10 minutes. 2 g of the sample was weighed with lid and charred on a hot plate until the smokes disappear. The charred sample was put in the muffle furnace at 550 ℃ and burned to ashes for 3 hours. The ashes were weighed after cooling for 1 hour. The amount of ashes was calculated by using the formula.

$$\text{Ash}\ (\%) = \frac{\text{M} - \text{T}}{\text{N} - \text{T}}\ \text{x}\ 100$$

Where T = weight (g) of crucible, N = weight (g) of crucible + sample before burning to ashes, M = weight (g) of crucible + sample after burning to ashes.

The crude protein content was determined according to AOAC [12]. 1 g of the sample was weighed in a clean testator flask. 6 ml of concentrated sulphuric acid was added and left to stand for 24 hours. After 24 hours, 3.5 ml of H_2O_2 (30 %) was added step by step. When the violent reactions stopped it was shaken and left in the rack. 3 g of accelerated reagent (a mixture of copper sulphate pent hydrate and anhydrous potassium sulphate)

was added and left for 15 minutes. The mixture was digested in a digest, stored at 37 ℃ for 4 hours. After digestion, it was cooled in a hood on the rack and 25 ml of distilled water was added to dissolve the precipitate, 25 ml of 40 % NaOH was added to the digested sample and placed in the distiller. 25 ml of saturated solution of boric acid (H_3BO_3), 25 ml of distilled water and 3 drops of methyl red was added in the 250 ml conical flask and placed in the distiller. After distillation, about 150 – 200 ml distillate was collected and titrated with 0.1 M HCl. The amount of protein was calculated using the formula.

$$\text{Protein (\%)} = \frac{\text{titre value x 0.0014 x 6.25}}{\text{weight of sample}} \text{ x 100}$$

To determine the crude content, a cleaned flask and the boiling chips were dried in the drying oven at 100 ℃ for 1 hour, cooled in the desiccators for 3 minutes and weighed in line with AOAC [12]. 2 g of sample was weighed in a thimble containing fat free cotton. The thimble was placed in the thimble holders. 50 ml of petroleum ether (boiling range of 60 – 90 ℃) was poured into the flask and the thimble immersed in the petroleum ether and heated at 80 ℃ in the fat determination apparatus for 1 hour. The thimble was hanged and heated at the same temperature for 2 hours and then the solvent was recovered for 15 minutes. The heater was switched off and the flask dried in the drying oven at 90 ℃ for 30 minutes, cooled in the desiccator for 15 minutes and then weighed together with the extract. The amount of extracted fat was calculated by using the formula.

$$\text{Weight of fat (Wf)} = \frac{\text{Wi} - \text{Wii}}{\text{T}} \text{ x 100}$$

Where T = weight (g) of sample, Wi = weight (g) of extraction flask after extraction, Wii = weight (g) of extraction flask before extraction.

The crude fibre content was determined using the method of AOAC [12]. 0.5 g of the sample was transferred into a 600 ml beaker and 200 ml of 1.25 % sulphuric acid was added and boiled for 30 minutes. Recording took place by placing a watch glass over the mouth of the beaker. After 30 minutes heating by gently keeping the level constant with distilled water, 20 ml of 25 % KOH was added and again boiled gently for 30 minutes, then the solution was filtered through sintered glass crucible. Subsequently, washing was done with hot distilled water, 1 % NaOH solution and finally with acetone. It was later filtered and dried in electric oven at 130 ℃ for 2 hours. Furthermore, it was transferred to a muffle furnace and burnt to ashes for 30 minutes at 550 ℃. Finally, it was cooled and weighed again. The crude fibre content was determined by using the formula.

$$\text{Crude fibre content (\%)} = \frac{\text{M} - \text{N}}{\text{T}} \text{ x 100}$$

Where M = weight (g) of crucible after drying, N = weight (g) of crucible after burning to ashes, T = weight (g) of sample.

The carbohydrate content was determined using the technique adopted by Cordenunsi and Lajolo [13] by estimation using the arithmetic difference method. The carbohydrate was calculated and expressed as the nitrogen free extract as shown.

$$\text{Carbohydrate (\%)} = 100 - \text{a} + \text{b} + \text{c} + \text{d} + \text{e}$$

Where a = % protein content, b = % fat content, c = % ash content, d = % crude fibre content, e = moisture content.

The flavonoid content was determined according to the method proposed by Harborne [14]. 5 g of the sample was boiled in 50 ml of 2 M HCl solution for 30 minutes under reflux. It was allowed to cool and then filtered through Whatman number 1 filter paper. A measured volume of ethyl acetate was added. The flavonoid precipitate was recovered by filtration using weighed filter paper. The resulting weight difference gives the weight of flavonoid in the sample.

To determine the saponin content, 5 g of the powdered sample was mixed with 50 ml of the 20 % ethanol and both extracts were pooled together in line with the double solvent extraction gravimetric method proposed by Harborne [14]. The combined extract was reduced at about 40 ml at 90 ℃ and transferred to a separating funnel where 40 ml of diethyl ether was added after shaking vigorously.

For the determination of carotenoids content, measured weight of the sample was homogenized in methanol using a laboratory blender. The homogenate was filtered to obtain the initial crude extract, 20 ml of ether was added to the filtrate to take up the carotenoid, and it was mixed well and then treated with 20 ml of distilled water in a separating funnel. The ether layer was recovered and evaporated to dryness at low temperature (35 ℃ – 50 ℃) in a vacuum desiccator. The carotenoid was taken up. The dry extract was then saponified with 20 ml of ethanoic potassium hydroxide in a dark cupboard. The next day, the carotenoid was taken up in 20 ml of ether and was washed with two portions of 20 ml distilled water. The carotenoid extract was dried in a desiccator and was treated in a light petroleum and was allowed to stand overnight in a freezer at 10 ℃. The next day, the precipitate steroid was removed by centrifugation and the carotenoid extract was evaporated to dryness in a weighed evaporation dish, cooled in a desiccator and then weighed. The weight of carotenoid was determined and express as a percentage of the sample weight.

The alkaloid content was determined by the alkaline gravimetric method described by Harborne [14]. A measured weight 5 g of the sample was dispersed in 10 % acetic acid solution in ethanol to form a ratio of 1:10.

The mixture was allowed to stand for 4 hours at 28 ℃. It was later filtered via Whitman number 1 grade of filter paper. The filtrate was concentrated to one quarter of its original volume by evaporation and treated with drop wise addition of concentrated aqueous NH_4OH until the alkaloid precipitate was received in a weighed filter paper, washed with 1 % ammonia solution and dried in an oven at 80 ℃. Alkaloid content was calculated and expressed as a percentage of the weight of the sample.

III. RESULTS AND DISCUSSION

The results of the functional properties, proximate composition and phytochemical composition of the isekele melon seed flour are presented in Tables 1, 2 and 3. Table 1 shows that the foaming capacity is 0.07 %. The low foaming capacity could be because of the inadequate electrostatic repulsions, less solubility and excessive protein-protein interactions [15]. The foaming capacity value is lower from the value submitted by Arawande and Borokini [16], who proposed that melon seed flour has a foaming capacity of 23.5 %. The difference in result could be due to the uniqueness of the Abakaliki-indigenous isekele melon seed.

The emulsion capacity of the isekele melon seed flour was 70.50 %, which is higher than the value reported by Olaofe *et al*. [17] for calabash seed flour (a type of melon) with 23.20 % as the emulsion capacity. Geographical region difference and changes in climatic condition could be the cause of the variation of the results.

Table 1: Functional properties of isekele melon seed flour

Foaming capacity (%)	Emulsion capacity (%)	Oil absorption capacity (%)	Water absorption capacity (%)	Bulk density (g/ml)
0.07	70.50	32.50	30.90	1.29

The oil absorption capacity was 32.50 %, which is close to the value reported by Olorode *et al*. [18] who submitted a value of 39.05 % as the oil absorption capacity of melon seed flour. It implies that the seed flour could serve as a good aroma agent, flavour retainer and be used to improve mouth feels for food. The bulk density was 1.29 g/ml. It is higher than the value reported by Fagbemi *et al*. [19] who submitted a bulk density of 0.42 g/ml for fluted pumpkin. The difference could be due to the absolute difference among the species studied. The water absorption capacity is 30.90 %. The result shows that the flour could be useful in confectionery products where hydration to improve handling is desired [20].

Table 2 shows that the moisture content of the isekele melon was 2.70 %. Sanful *et al*. [21] pointed out that the higher the amount of moisture in a flour, the higher the rate of decay. It implies that the isekele melon seed that has a low moisture content might have a long shelf life, which is an advantage of product stability when wrapped and kept appropriately. The protein content was 34.13 %, which is within the range reported by Fokou *et al*. [22]. The high protein value indicates that it could be used as food.

Table 2: Proximate composition of isekele melon seed flour

Carbohydrate (%)	Protein (%)	Moisture (%)	Fat (%)	Crude Fibre (%)	Ash (%)
56.25	34.13	2.70	26.00	5.55	2.15

The crude fibre content was 5.55 %, which is higher than the values (1.66 – 2.16 %) submitted by Abiodun and Adeleke [23] for different varieties of melon seed flour, probably due to the variety and climate condition differences. The high crude fibre content implies that the seed flour contains indigestible materials, which can reduce constipation by increasing bowl movement. The fat content was 26.00 %, which is within the range reported by Tabiri *et al*. [7] who reported fat content value range of 26.50 - 27.83 % for melon seed flours. The result shows that the isekele seed flour is a good source of dietary oil. The ash content is 2.15 %, which is lower than the value (2.81 – 5.00 %) recorded by Fokou *et al*. [22]. The carbohydrate content was 56.25 %. Although it is not a perfect source of carbohydrate relative to cereals with a carbohydrate range of 72 – 90 % [24], it could serve as an alternative in a cereal scarce area.

Table 3 shows a flavonoid content of 2.90 %. It is higher than flavonoid content of 1.00 % for African eleme pulp reported by Ekoh [25]. It implies that the flour is a good source of flavonoid, which helps protect blood vessels from rupture or leakage. The saponin content was 6.10 %. The flour could be a good source of saponin for the treatment of hyper calcium in hum [26]. The alkaloid content was 2.90 %. Food with high content of alkaloid has a negative effect on humanity [27, 28]; it should be cooked very well to reduce the alkaloid content before consumption. The carotenoid content was 0.85 %. The result suggests that the Abakaliki-indigenous isekele melon seed could lower the risk of cardiovascular disease since it has some carotenoid content [29].

Table 3: Phytochemical composition of isekele melon seed flour

Flavonoid (%)	Saponin (%)	Carotenoid (%)	Alkaloids (%)
2.90	6.10	0.85	2.90

IV. CONCLUSION

The analysis of the physiochemical and phytochemical properties of Abakaliki-indigenous isekele melon seed flour indicates that the flour could be used in soup making and infant food formulation. The existence of phytochemicals in the flour indicates that the flour has disease defensive and healing attributes. The nutritional composition of the flour shows that the flour is a good source of energy, protein, fat and carbohydrate. It is suggested that research be conducted on the properties of other species of melon that are grown in Nigeria.

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