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Comparative Studies on the Physicochemical and Sensory Properties of Watermelon (*Citrullus lanatus*) and Melon (*Citrullus vulgaris*) Seed Flours Used in "EGUSI" Soup Preparation

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Abstract

A comparative study on the physicochemical and sensory properties of watermelon (*Citrullus lanatus*) and melon (*Citrullus vulgaris*) seed flours in food preparation were investigated. A composite flour containing equal parts of watermelon seed flour and melon seed flour were prepared. Egusi soups were prepared from the melon seed flour; watermelon seed flour and a combination of the two flours in equal proportions. Sensory properties of the three soups were evaluated. The results of the investigation showed that the equal proportions of watermelon/melon seed flours had higher crude protein of 27.73% and crude fat of 47.85% than the water melon seed and melon seed flours. There was no significant difference (P>0.05) in water absorption, foam capacity, viscosity and least gelation properties of the melon seed flour compared to the 50:50 flour sample. The sensory properties showed no significant difference (P>0.05) in appearance, taste, thickness and overall acceptability of egusi soup from melon seed flour and 50:50 flour sample. Therefore watermelon seed flour can be used to replace 50% melon seed flour in the preparation of egusi soup

Keywords: melon seeds, watermelon seed, egusi soup, comparative studies

1. Introduction

Melon (*Citrullus vulgaris*) is a member of the cucurbitaceous family and is the biological ancestor of water melon (*Citrullus lanatus*). It is a large plant family which includes many economic species such as melon, various gourds, pumpkins and cucumbers (Oyeleke et al., 2012). Melon (*Citrullus vulgaris*) is grown widely in the tropics and its seeds popularly known as "egusi" in Nigeria is consumed in various forms such as egusi soup, melon ball snacks and ogiri fermented melon seed (King & Onuora, 1983; Achinewhu, 1987).

Melon seeds have nutritive and caloric values which make them necessary in diets. Ojieh et al. (2008) reported that melon seeds (egusi) contain 3.7% ash, 45.7% ether extract, 23% crude protein, 12% crude fibre and 10% total carbohydrate. Similar proximate composition had been reported by Kiin-Kabari and Akusu (2014) on watermelon seed flour using different processing methods. The oils from melon seed and watermelon had been characterized by other researchers Oresanya et al. (2000), Ebuehi and Avwobobe (2006) and they observed that melon seed oil contained more of unsaturated fatty acids than watermelon seed oils.

The consumption of watermelon fruit in Nigeria had increased tremendously in recent years due to the increased awareness on the health benefits. The watermelon juice contains important carotenoids such as β-carotene, carotene and Lycopene which are important in neutralizing free radicals in the body (Oseni & Okoye, 2013; Penuel et al., 2013). In Nigeria, the utilization of watermelon fruits is limited to the direct consumption of the fresh fruits. The fruits contain seeds which are un-utilized fruit by-products. The seeds are discarded and not eaten but are consumed in other parts of the world either roasted and served as snacks or milled into flour for incorporation into wheat flour and baked into bread (El-Adway & Taha, 2011). Watermelon seeds are high in proteins and fats and can find applications as a protein source in various food formulations and preparation (El-Adway & Taha, 2011). Shadrach and Oyebiodun (1999) reported that the ultimate success of utilizing plant proteins as ingredients largely depends upon the beneficial qualities they impact to foods which also depend largely on their nutritional and functional properties.

Melon seeds (egusi) is used traditionally as the basis for a number of soup preparation especially the popular "egusi" soup in Nigeria, were the melon seed act as a thickener in the soup.

Water absorption, viscosity and the least gelation concentration are all important functional properties in egusi – like soup preparation (Kiin-Kabari & Akusu, 2014). One of the major sensory attributes of the egusi soup is the thickening properties of the soup, whether it is prepared from melon seeds flour or water melon seed flour.

However, melon (egusi) seeds are becoming very expensive in Nigeria whereas water melon seeds are discarded after the consumption of the water melon fresh fruits.

Improvement in the utilization of both melon seeds and water melon seeds can be achieved if we understand their proximate and functional behaviour of the seed flour in food preparation.

The functional properties are important in determining the organoleptic properties of "egusi" and "egusi-like" soup preparation. Combining melon seeds and watermelon seeds in "egusi-like" soup preparation may be of interest in reducing the costs of "egusi" soup preparation.

This study was aimed at evaluating the potential food uses of water melon seeds by comparing its proximate, functional and sensory properties with that of melon (egusi) seed in soup preparation as well as evaluating the functional impact on the organoleptic/ acceptability of "egusi-like" soup prepared from a 50:50 melon: Water melon seed flour blends.

2. Materials and Methods

2.1 Materials

Watermelon fruits (*Citrullus lanatus*) were purchased from a local market in Port Harcourt and transported to the Department of Food, Science and Technology laboratory for processing. All chemicals used were of the analytical grades, products of BDH chemical Ltd pool, England.

2.2 Methods

2.2.1 Preparation of Watermelon Seed Flour

Watermelon seeds were removed from the pod, washed, pre-boiled for 5 min and sun-dried at 34 °C for 3 days. The sun-dried seeds were dehaulled and milled into flour as shown in Figure 1a.

2.2.2 Preparation of Melon Seed Flour

Five (5) kg of melon seed was shelled, sorted, cleaned and oven dried (50 °C, 24 h) in a hot – air fan circulating oven (model QUB,305010G, Gallenkamp, U.K), ground to pass through a 0.25 mm British standard sieve (Model B5410, Endecoths Lt, London, UK), as shown in Figure 1b.

Both watermelon seed flour and melon seed flour were divided separately into fifteen lots for each; stored in air tight containers in a refrigerator. A 50:50 ratio was used based on the preliminary study on various blends of melon/watermelon seed flour that was most acceptable.

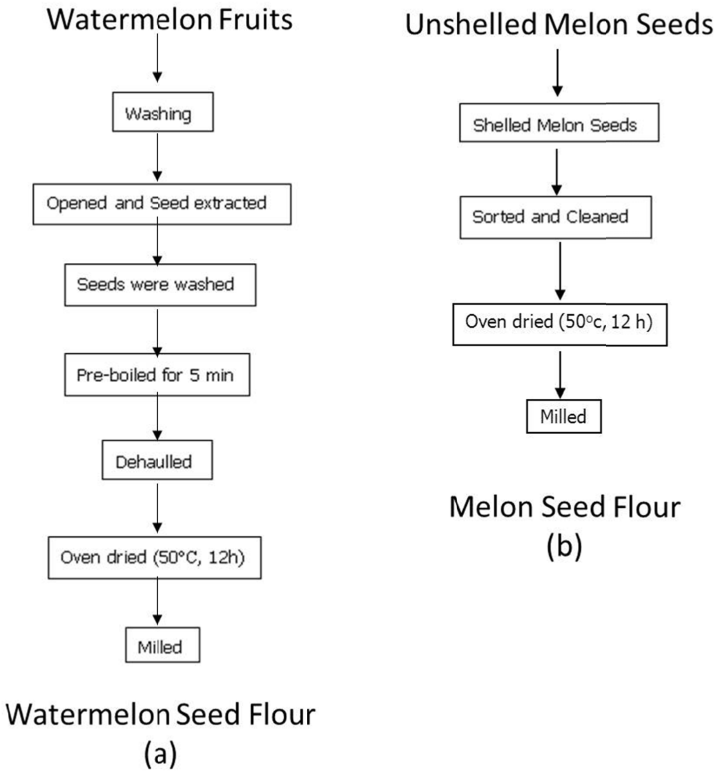

Figure 1. Flow chart for production of (a) Watermelon seed flour (b) Melon seed flour

2.2.3 Proximate Analysis of Watermelon/Melon Seed Flours

Moisture content (method 14.004), total ash (method 14.006), crude fiber (method 7.070), either extract (method 7.062) and crude protein (method 2.057) were determined according to AOAC (2006) procedures. The conversion factor N × 6.25 was used for conversion of nitrogen to crude protein. Carbohydrate content was determined using the method of clegg Anthrone reported by Osborne and Voogt (1978).

2.2.4 Physicochemical Properties

Some functional properties were determined on the melon seed flour, watermelon seed flour and the 50:50 melon/watermelon seed flour samples. Water and oil absorption capacities were determined according to the method of Beuchart (1977). The least gelation concentration and viscosity were determined according to the methods of Coffman and Garcia (1977) and Fleming et al. (1975).

Table 1. Common recipe for “egusi” soup

Ingredients	**Weight/volume**
Ground watermelon or melon seed flour	200 gm
Palm oil	60 ml
Water	700 ml
Onion	20 gm
Maggi cube	3.5 gm
Pepper	1.5 gm
Salt	0.2 gm

Source: Authors computation.

2.2.5 Preparation of Egusi Soups

Palm oil was heated in a pot for 2 min then chopped onion was added and finally watermelon or melon seed and watermelon/melon seeds blend was added and stirred for 15 min. 700ml water was added, maggi, pepper and salt was added to taste. The soup was allowed to cooked for 25 min as shown in Figure 2.

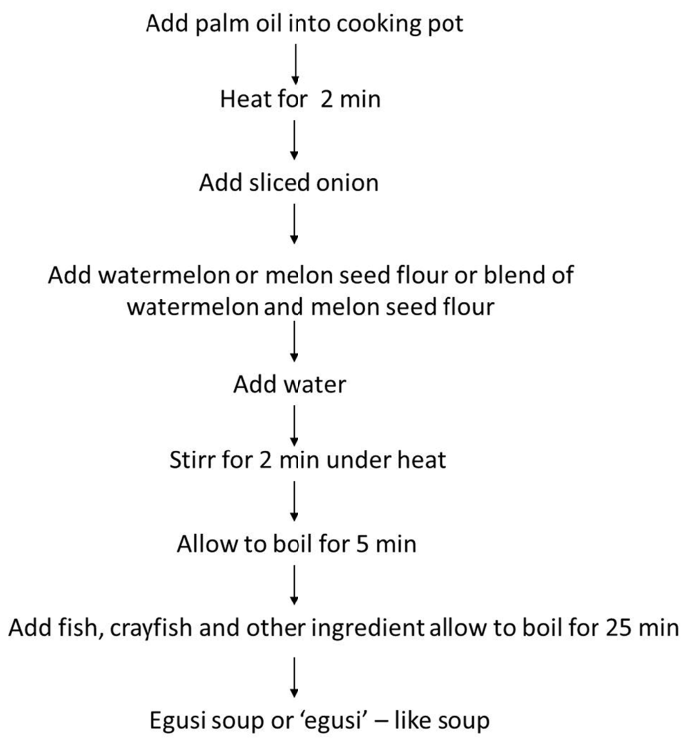

Figure 2. Flow chart for the preparation of traditional egusi soups

2.2.6 Sensory Evaluation

A panel of 20 people who are used to egusi soup were used for the sensory evaluation of the soup prepared with watermelon seed flour, melon seed flour and melon seed flour.

A 9-point hedonic scale with 9 = lie extremely, 5 = neither like nor dislike and 1 = dislike extremely was used for the evaluation of the prepared soups for colour, appearance, thickness, taste, aroma and overall acceptability. The panelists were served the "egusi" like soup and the egusi soup in the food and nutrition laboratory of the food science and technology department at room temperature (28 ± 2 °C).

Three soups were prepared: watermelon seed flour soup, melon seed flour soup (egusi soup) as control and a mixture of 50% water melon seed flour and 50% melon seed flour as shown in Table 1.

2.2.7 Statistical Analysis

The data obtained were subjected to analysis of variance (ANOVA) using Statistical Package for Social Science (SPSS) version 20.0 software 2011. All analysis was done in triplicate and means separated using Duncan Multiple Range Test.

3. Results and Discussion

Table 2 shows the proximate composition of watermelon seed flour, melon seed flour and a 50:50 watermelon: melon seed flour blend. The 50:50 blended samples had a higher crude protein of 27.73% and crude fat of 47.85%, watermelon seed flour crude protein of 25.33% and crude fat of 45.66%. Melon seed flour had crude fat of 42.89% and crude protein of 25.36%, respectively. There was no significant difference in the moisture content and crude fibre of the three flour samples. These values are within the range reported by Akobundu et al. (1982), Akubor (2005) and Oyeleke et al. (2012).

Table 2. Proximate composition of watermelon and melon seed flour

Parameters (%)	**Watermelon seed flour**	**Melon seed flour**	**Watermelon flour and melon seed flour (50:50 blend)**
Moisture	9.59^{a}	9.30^{a}	9.47^{a}
Ash	3.36^{ab}	3.33^{b}	3.71^{a}
Crude fat	45.66^{b}	42.89^{c}	47.85^{a}
Crude protein	25.33^{b}	25.36^{b}	27.73^{a}
Crude fibre	4.20^{a}	3.83^{a}	4.30^{a}
Carbohydrate	11.86^{b}	15.31^{a}	6.54^{c}

abc= means bearing the same superscript within the same row do not differ significantly (P>0.05).

The selected functional properties of watermelon seed flour, melon seed flour and the 50:50 blended sample are shown in Table 3. There was no significant difference (P>0.05) in water absorption capacity, foam capacity, viscosity and least gelation concentration between melon seed flour and the 50:50 blended sample; however, watermelon seed flour gave lower values for these functional properties. Ige et al. (1984) reported that proteins are linked to some functional properties such as foaming, water absorption, viscosity and gelation. Matti (1970) reported that the desirability of carrying out functional test is to predict how the plant proteins will affect the food system in which they are incorporated.

Table 3. Selected functional properties of watermelon seed flour and melon seed flour

Functional properties	Watermelon seed flour	Melon seed flour	50:50 blend of watermelon and melon flour
Water absorption (g/g)	0.96^{b}	1.47^{a}	1,39^{a}
Oil absorption (g/g)	1.13^{b}	1.45^{a}	1.10^{b}
Foam capacity (ml/s)	6.50^{c}	9.56^{a}	8.95^{a}
Viscosity (Pa.s)	0.87^{b}	1.42^{a}	1.40^{a}
Least gelation Concentration (%)	0.95^{b}	0.65^{a}	0.70^{a}

abc= means bearing the same superscript within the same row do not differ significantly (P>0.05) means of triplicate determinations.

The sensory properties of "egusi" soups prepared with watermelon seed flour, melon seed flour and the 50:50 blended sample is shown in Table 4. The result revealed that there was no significant difference (P>0.05) between melon seed flour soup and the 50:50 blended sample soup in terms of appearance, taste, flavour, thickness and overall acceptability. The viscosity of the melon seed flour is higher which may affect the thickness and functional properties such as foaming capacity, water absorption capacity and least gelation concentrations. This is similar to the observation made by Akusu and Kiin-Kabari (2013) on the relationship between viscosity and other functional properties of watermelon seed flour.

Table 4. Means sensory evaluation of watermelon seed flour soup, melon seed flour soup and 50:50 water melon seed flour: melon seed flour soup

Samples	Appearance	Colour	Taste	Flavour	Thickness	Overall acceptability
Melon seed flour soup (control)	5.2^{a}	5.1^{a}	4.6^{a}	4.3^{a}	5.5^{a}	5.7^{a}
Water melon seed flour soup	4.3^{b}	4.3^{b}	3.6^{b}	3.4^{b}	3.9^{b}	4.5^{b}
Watermelon/melon seed flour soup 50:50	5.3^{a}	4.5^{a}	4.4^{a}	4.4^{a}	5.2^{a}	5.5^{a}

abc = means with the same superscript within the same column do not differ significantly (p>0.05) values are the mean scores.

4. Conclusion

Equal proportions of melon/watermelon seed flours compared favourably well in viscosity, water absorption, foam capacity and least gelation concentration when compared to melon seed flour alone.

Similar patterns were observed in sensory properties of appearance, taste and overall acceptability of egusi soups. Thus the cost of egusi preparation can be reduced by substituting upto 50% of melon seed flour with watermelon seed flour which before now is un-utilized.

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