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Physicochemical And Organoleptic Properties Of Some Selected Foods Fried With Melon (Citrullus Lanatus) Seed Oil

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Abstract :*This study was undertaken to determine the physicochemical properties and sensory attribute of oil extracted from melon seeds, (Egusi) citrullus lanatus,when used in frying foods. Standard analytical procedures were used to evaluate the oil extracted from the seeds for moisture content, specific gravity, saponification value, refractive index, peroxide value, acid number, iodine value and sensory assessment of the fresh oil was done using three different foods. The physicochemical properties repeated after storage for two weeks. The colour, moisture content, specific gravity, acid values, iodine value, peroxide value and saponification value were yellow, 2.0%, 1.059kg/dm^3, 0.97mgKOH/g, 108g/100g, 7.0mmol O_2/kg and 178.11mgKOH/g for fresh melon seed oil and yellow, 1.2%, 1.0598 kg/dm^3, 0.67mgKOH/g, 110 g/100g, 7.90mmol O_2/kg and 178.10mgKOH/g for stored melon seed oil respectively. The organoleptic scoring of foods fried with melon seed oil compared to foods fried with groundnut oil shows thatplantain fried with melon seed oil had better taste, aroma and overall acceptance scoring than plantain fried with groundnut oil while yam and egg fried with groundnut oil had better taste, colour, aroma and overall acceptance scoring compared to those fried with melon seed oil. This study shows that melon seed oil can be used as cooking oil.*

I. Introduction

As oils are to plant so are fats to animals.They both (lipids)have a greasy feelanddo not mix with water. The most important characteristic is that they have a caloric content more than twice as high as the other food stuff (9kcalg^{-1}) (Kalanithis and Badri,1993). They can play the role of lubricants when ingredients are mixed together as well as a channel for heat transfer. They transport fat soluble vitamins, andgood source of essential fatty acids (Ziyada and Elhussien, 2008).

There are only a handful of oil and fat obtained from plants and animals that exist in high and sufficient amount such that they are been regarded as commercial.Most seeds of annual plants produce high amount of oil(Raziq*et al.*, 2012).Globally, the demand for oil and fatare high, this is because of their diversity in utilization both for human and industrial needs as a result making oil seeds very important inthe national economy of countries producing them (Corley *et al*., 2008).Improving on new oil seed varieties and more importantly finding novel sources of oil are very vital in enhancing the yields of oil(Ziyada and Elhussien, 2008).Since oils are used both for consumption as well as for industrial purposes, it is therefore necessary that physicochemical parameters of the oil are analyzedin other to determine its edibility in terms of metal composition, taste, colour and fatty acid composition.The major components of lipids are fatty acids and their physical, chemical, and physiological properties depend largely on its fatty acid composition. The quality and freshness of oil is determined by the fatty acid constituents, this is because long chain organic acids are not very volatile compounds (Justyna and Waldemar, 2011).

Melon (Egusi) *Colocynthiscitrullus L.*, a member of the Cucurbitaceae family is an important crop in Nigeria and most other African countries. It is called such names as: Shamu in Hausa; Ibara in yoruba and Ogiri-isi in Igbo (Bello, 2011). It is native to Africa where it has been in cultivation for many centuries. It has been referred to in some texts as *Citrullus vulgaris* (Ogbonna and Obi, 2007) and *Citrulluslanatus*(Ogbonna, 2013). Melon seeds are small, flat and oval containing a white cotyledon in a thin walled shell with a thick ring around the edges (Oriaku*et al.*, 2013). They are grown in Nigeria not for their pulp which is bitter, but for their seeds which are particularly rich in protein and fat, in addition to essential vitamins and minerals. The seed kernel (Egusi) has been used as the basis for a number of soups where it results in thickening, emulsifying, fat binding and flavoring. The oil content is the main temptation forpossible use as source of oil but it is also self-sustaining as it is widely grown in Nigeria.Due to increasing importance of oilseeds in the national economy ofNigeria, the high demand for new sources of oil and the availability of this plant in Nigeria, the scarcity of scientific studies of Melon (*Citrullus lanatus)* seed oil,the need to evaluate the physiochemical properties of *Citrulluslanatus*seed oil becomes relevant.

II. Materials And Methods

2.1 Materials

2.1.1 Seed collection

Melon (*Citrulluslanatus*) seeds, were obtained from Bossomarket in BossoLocal Government Area, Minna Niger State, Nigeria.

2.2 Methodology

2.2.1 Plant processing and oil extraction

The seeds were separated manually from the fruits, screened to removethe bad ones and sun dried for 30minutes at ambient temperature for easy removal of the shells from the seeds, after which the seeds were further fried for 3 minutes to reduce the moisture content before grinding with mechanical grinder to increase the surface area for oilextraction. The grinded seed flour were mixed with clean water to extract the possible oil in the melon. The extracted oil was heated at low temperature.

2.2.2 Determination of chemical properties

2.2.2.1 Iodine value

The method specified by the British Pharmacopoeia (TBP) (2007) was used.0.20gram of the oil was dissolved in 15ml carbontetrachloride in 100ml glass stopper flask. 25ml of Wiji's solution was added; the flaskstopper and allowed to stand for 2hour in the dark at 25^0C. 20ml of 10% potassium iodide(KI)solution was added and the mixture titrated with 0.2N Sodium thiosulphate ($Na_2S_2O_3$)using starch indicator. A blank determination was carried out and the iodine value calculatedusing the formula:

Iodine value = 12.69N (V1 –V2) / W

Where N = Normality of thiosulphate, V1 = Volume (ml) of thiosulphate solution used in test

V2 = Volume (in ml) of thiosulphate solution used in blank, W = Weight of sample

2.2.2.2 Determination of Saponification Value:

The method specified by TBP, (2007) was used. 2.0 gram of sample was weighed in a conical flask;25ml of alcoholic KOH was added to it and was refluxed for one hour. It was boiled gently until the sample was completely saponified. The flask and condenser was cooled and then washed with about 10ml of hot neutral ethyl alcohol. 1ml of phenolphthalein was added and then titrated with standard HCl solution.

Calculations:

$$\text{Saponification value}=\frac{56.1(\mathrm{B}-\mathrm{S})\mathrm{N}}{\mathrm{W}}$$

Where,

B= volume in ml of standard HCl required for the blank.

S= volume in ml of standard HCl required for the sample.

N= normality of standard solution.

W= weight in gram of the oil taken.

2.2.2.3 Determination of Unsaponification value:

The method specified by TBP (2007). 5.0 gram of oil was weighed into a flask; 50ml of KOH solution was added and then boiled gently under reflux condenser for 2hrs. The condenser was washed with 10ml of ethyl alcohol and the mixture was cooled, transferred to a separating funnel. The transfer was completed by washing the flask first with ethyl ether and then with cold water. Altogether 50ml of water was added followed by an addition of 50ml of hexane. It was shaken vigorously for 2mins and then allowed to settle. The lower layer containing the soap solution was transferred to another separating funnel and the ether extraction was repeated for five more times. If any emulsion is formed small amount of ethyl alcohol was added. All the ether extract was collected in a separating funnel. This was washed three times with 25ml portions of alcohol shaking it vigorously and drawing off alcohol water layer after each washing. It was then washed with 20ml portions of water until the washed water no longer turns pink on addition of few drops of phenolphthalein indicator. The ether layer was evaporated to dryness, cooled and weighed. After weighing, residue was taken in 50 ml of warm neutral ethyl alcohol containing few drops of phenolphthalein indicator and titrated with standard KOH solution.

Calculations:

$$\text{Unsaponifiable matter, percent by weight} = \frac{100\ (A-B)}{W}$$

Where,

W= weight in grams of the oil taken for the test. A= weight in grams of the residue.

B= weight in grams of the fatty acid and equal to 0.282VN

V= volume in ml of standard KOH solution used. N= normality of standard KOH solution

2.2.2.4 Peroxide Value:

1g of oil sample was weighted into a 200mlconical flask, then 25ml of 2:1 v/v glacial acetic acid: chloroform solvent was added. 1ml ofsaturated potassium iodide was then added and mixture left in the dark for 1 minute. 30ml of water was added and the mixture titrated with 0.02N thiosulphate solution using 5mlstarch as indicator. A blank determination was similarly carried out. PV was calculated fromthe equation:

Peroxide value (PV) = [100(V1 –V2) meg/Kg] / W

W = weight of sample, V1 = Volume (ml) of thiosulphate used in test

V2 = Volume (ml) of thiosulphate used in blank, N = Normality of thiosulphate ($Na_2S_2O_3$).

2.2.2.5 Acid Value:

Acid Value of the oil sample was determined by dissolving 0.20g of oil in 2.5mlof 1:1 v/v ethanol: diethyl ether solvent and titrating with 0.1N sodium hydroxide while swirling using phenolphthalein as indicator (TBP, 2007).

Acid Value = [56.1 x N x V] / W

Where; N = Normality of NaOH used, V = Volume (ml) of NaOH used

W = Weight of sample used

Percentage free fatty acid (% FFA) (as oleic) was determined by multiplying the acid valuewith the factor 0.503. Thus % FFA = 0.503 x acid value.

2.2.2.6 DeterminationPhysical Properties:

2.2.3.1 Colour

Melon seed oil sample (10ml) melted at 35°C in water bath was placed in a cuvette and analyzed using a Lovi bond –Tintometer. The colours of red, yellow and blue units were adjusted until a perfect colour match was obtained. The unit value of the colour with the lowest unit was subtracted from the colours leaving two units which were then used to describe the colour of the sample (AOAC, 2009).

2.2.3.2 Determination of Refractive Index

Abbey refractometer was used in this determination. A drop of the sample was transferred into a glass slide of the refractometer. Water at 30°C was circulated round the glass slide to keep its temperature uniform. Through the eye piece of the refractometer, the dark portion viewed was adjusted to be in line with the intersection of the cross. At no parallax error, the pointer on the scale pointed to the refractive index. This was repeated and the mean value noted and recorded as the refractive index.

2.2.3.3 Determination of Specific Gravity

A clean 50 mlspecific gravity bottle was weighed (W0),and then filled to the brim with water and stopper was inserted.The water on the stopper andbottle were carefully wiped off and reweighed (W1). Sameprocess was repeated, but using oil samples instead ofwater and weighed again (W2). The specific gravity of theoil samples were calculated using the following formula.

Specific gravity of test sample $=\frac{W2-W0}{W1-W0}$

Where;

W0 = Weight of empty specific gravity bottle

W1 = Weight of water + specific gravity bottle

W2 = Weight of test sample + specific gravity bottle

2.2.4 Organoleptic evaluation of melon seed oil

The melon seed oil was used to fry some selected foods (plantain,yam and egg).The selected foods fried were evaluated for organolepticproperties (in comparison with the same kind of food fried with groundnut oil) accordingto the method described by Stone (2012). TheOrganoleptic evaluations werecarried out by 8 judges. The fried food was evaluatedorganoleptically for color, taste, aroma and overallacceptability. The taste panelists were asked to ratethe samples for color, taste, aroma and the overallacceptability on 7 point hedonic scale, Where, 7=like extremely; 6=like well; 5=like; 4=neither like nor dislike; 3=dislike; 2=dislike well;1=dislike extremely.

Table 1: Physical and chemical characteristics of freshly used and stored melon seed oil

Parameters	Freshlyused	Stored Oil (2 weeks)
Colour	Yellow	Yellow
Specific gravity 20^0C (kg/dm3)	1.0598	1.0598
Refractive index 20^0C	1.4650	1.4650

Table 2 : Chemical characteristics of freshly used and stored melon seed oil

Parameters	Freshlyused	Stored Oil (2 weeks)
Acid value (mgKOH/g)	0.97	0.67
Saponification value (mgKOH/g)	178.11	178.10
Iodine value (g/100g)	108	110
Peroxide value (mmol 0_2/kg)	7.0	7.90
Unsaponifiable matter (%)	1.02	1.80
Moisture content (%)	2.0	1.20
Rancidity	14.0	15.80

Table 3 : Sensory assessment of melon seed oil

Sensory	Plantain		Yam		Egg	
attributes	**M.S.O**	**G.O**	**M.S.O**	**G.O**	**M.S.O**	**G.O**
Taste	6.12 ± 0.02^b	5.87 ± 0.01^d	5.50 ± 0.29^a	5.80 ± 0.29^a	5.25 ± 0.05^b	5.50 ± 0.12^b
Colour	5.70 ± 0.09^a	5.12 ± 0.02^b	5.50 ± 0.22^a	5.62 ± 0.01^a	5.25 ± 0.03^b	5.37 ± 0.01^b
Aroma	5.75 ± 0.09^a	5.00 ± 0.02^a	5.50 ± 0.16^a	5.87 ± 0.01^a	5.00 ± 0.03^a	5.12 ± 0.01^a
Overall Acceptance	6.12 ± 002^b	5.69 ± 0.02^c	5.50 ± 0.03^a	5.87 ± 0.00^a	5.00 ± 0.02^a	5.3 ± 0.03^{ab}

Values aremean ± SEM (N=8), Values with different superscripts along the column, are significantly different at $p < 0.05$ (**M.S.O** =melon seed oil,**G.O**=ground nutoil)

III. ResultsAnddiscussion

The physical parameters of the freshly used and stored melon seed oil presented in Table 1, shows that freshly used and stored melon seed oil had the same specific gravity of 1.0598, melting point of 36.7 and refractive indexof 1.4650 indicating that the oil is not as thick as most drying oils with refractive index between 1.475 and 1.485 (Akinhanmi*et al*., 2008).However, the refractive index (reflects the purity an oil)1.465 of the oil in this study agreeswith the 1.462 reported for *Blighiasapida*oil (Akpabio,2012). This indicates that theMelon seed oils are of high purity.

The specific gravity of a substance is indicative of its comparative miscibility (TBP, 2007) with water and other oils. The specific gravity of the oils in this study indicates that it is denser than water (Aigbodion and Bakare, 2005). The specific gravity 1.0598 kg/dm^{3}obtained for the freshly used and stored melon seed oil in this study is higher than the 0.956kg/dm^{3}obtained for *Blighiasapida* oil (Akpabio, 2012) and (0.91 g/cm^3) for both ripe and unripe *ackee* seed oil (Emmanuel *et al.,* 2014).

The oil extracted from the melon seed is yellow in colour. The colour of the oil is used preliminarily in judging the quality and in determining the degree of bleaching of the oil. The darker the colour of the oil, the poorer the quality(Powe,1998). Therefore, the yellow colour of the melon seed oil in this study shows that the quality of the oil is good and confirms to Encyclopedia of Chemical Technology (Powe, 1998).

The chemicalcharacteristics of the freshly used and stored melon seed oil is presented in Table 2. The freshly used and stored melon seed oil also had similar saponification value of 178.11 and 178.10, iodine value of 108 and 110 and peroxide value of 7.0 and 7.90 respectively. Saponification value reflect the molecular weight of an oil (Booth and Wickens, 1988) and determines the quantity of potassium hydroxide (in mg) needed to neutralize the acids and saponify the esters contained in 1 g of the lipid (Asuquo *et al.,* 2010). In this study,the saponification value obtained for the freshly used and stored melon seed oil was found to be high(178.11 and 178.10 mg/KOHg) respectively. These value is lower than that reported for cotton seed oil, soybean, butter fat and coconut oil (Ogungbenle and Afolayan, 2015), rubber seed oil (Asuquo*et al.,* 2012), peanut oil which are in the range of 187 – 250 mg KOH/g. The higher the saponification value of oil, the higher the lauric acid content of that oil. The lauric acid content and saponification value of oil serve as important parameters in determining the suitability of oil in soap making. The saponification value obtained in this study projects the oil as good raw material for soap and lather industry (Nzikou *et al.,* 2007)and in the detection of adulteration in the oil.High saponification value also implies greater proportion of fatty acids of low molecular weight. Thus the high saponification value of the melon seed oil in this study indicates that the oil contained high proportion of low molecular weight fatty acids. These indicates that there was no appreciable difference in the physicochemical parameters of the freshly used and stored melon seed oil, thus could be stored after use for up to 2 weeks without deteriorating.

Iodine value measures the degree of unsaturation in a fat or vegetable oil. It determines the stability of oils to oxidation, and allows the overall unsaturation of the fat to be determined qualitatively (Asuquo *et al.*, 2010). The iodine value of the freshly used and stored melon seed oil (108 and 110g/100g)in this study washigher than that obtained for ripe (2.07 mgI_2/g) and unripe (2.26 mgI_2/g)*ackee* seed oil (Emmanuel *et al.*, 2014),*Citrulus vulgaris* (38.5 mgI_2/g) and *Blighia sapida* oil (65.4 mgI_2/g) (Akintayo *et al*., 2002a) but lower than that of water melon seed (114.94g/100g) (Edidiong and Ubong, 2013). According to Essien*et al*., (2012), oil with iodine value in the range of 100-150 have higher affinity for oxygen when exposed to atmosphere and cannot be classified as drying oil.Thus, the oil in this study may be suitable as alky resins for paint formulation or used as varnishes.

Acid value can be used to check the level of oxidative deterioration of oil by enzymatic or chemical oxidation. It is a measure of the degree of unsaturation of oil and corresponds to the amount of potassium hydroxide required to neutralize free fatty acids (Asuquo*et al.,* 2010). The lower the acid value of oil, the fewer free fatty acids it contains which makes it less exposed to rancidity. The acid values obtained for the freshly used and stored melon seed oil in this study (0.97 and 0.67mg/KOH/g)are lower than those reported for oil of bean seeds (2.77 mg KOH/g and 2.74 mg KOH/g (Ekpa and Ekpe, 1995), *Plukenetia conophora* (11.5 mg KOH/g) (Akintayo and Bayer, 2000), *Blighia sapida* oil (14.2 mg KOH/g) (Akintayo*et al*., 2000b), almond seed oil (1.68mgKOH/g) (Akpabio, 2012),water melon seed oil (7.09mgKOH/g) (Edidong and Ubong, 2013), (39.49 and 66.09mgKOH/g) obtained for both ripe and unripe *ackee* seed oil (Emmanuel *et al.,* 2014).This implies that the melon seed oils in this study contain low level of free fatty acid and hence less prone to oxidative rancidity.

The peroxide values of the freshly used and stored melonseed oils were 7.0 and 7.9meq/kg. These values arehigher than the 1.00 and 2.05 mg reac. O_2g^{-1} obtained for ripe and unripe *ackee* seed oil but lower than the (14.4mg reac. O_2g^{-1}) obtained for rubber seed oil (Asuquo *et al*., 2012) and 20.0meq/kg for melon seed oil (Edidong and Ubong, 2013). Peroxide value indicates the deterioration of oils. Oils with higher peroxide values are more unsaturated than those with lower peroxide values. Highly unsaturated oils are known to absorb more oxygen and develop higher peroxide values, and oils with higher peroxide values are prone to rancidity (Nzikou *et al.,* 2007; Asuquo, 2008).The WHO/FAO stipulated a permitted maximum peroxide level of not more than 10 M equivalent of peroxide oxygen/Kg of the oils (Asuquo, 2008).Thus the low peroxide values of the melon seed oils in this study is an indication that they are less liable to oxidative rancidity at room temperature (Akubugwo*et al.,* 2008) and suitable for consumption since it has a peroxide value that is less than 10.

The moisture content of the freshly used and stored melon seed oil was 2.0 and I.20% respectively. These value is less thanthe (10.9%) reported for water melon seed oil (Powe, 1998). The low moisture content of this seed oil is an indication of low perishability of the oil and hence it's relatively long shelf life (Kester and Kader, 1993). Thus low moisture content observed in this study is an indication that the dirt and impurities in the melon seed oil is very low.

The results of the organoleptic scoring of foods fried with melon seed oil in comparison with foods fried with ground nut oil are presented in Table 3. The panelist's assessment of the food fried with the oils in this study indicate that plantain fried with melon seed oil had higher acceptability for taste and aroma than the plantain fried with commercial groundnut oil. However, yam and egg fried with commercial groundnutoil had abetter acceptability for taste, colour and aroma than those fried with the melon seed oil. This indicate that the sensory attribute of the oil depends on the kind of food the oil is used to prepare, thus melon seed oil is suitable for frying plantain.

IV. Conclusion

The findings in this study showsthatoil from the melon seed (*citrullus lanatus)*found in Bosso Local Government area is of considerable high quality and is suitable for cooking and could be shelved without deterioratingfor longer period.

Conflict of Interest

No Conflict of interest exist between the authors

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