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Ascertaining the Shelf-life of Ground Melon Seed (*Cococynthis citrullus*)

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ABSTRACT: *The shelf life of ground melon seed stored at room temperature was investigated. Melon seed at moisture content of 5.2% were ground and stored in an airtight plastic container. Physicochemical analysis such as free fatty acid, acid value, peroxide value, iodine value and moisture content were carried out on the ground melon seed oil for a period of 18 days at 2 day intervals. Also the sensory analysis of soup prepared from ground melon seed at each storage period was studied. The physicochemical properties results were significantly ($p<0.05$) different and showed that the free fatty acid content increased from 3.95% to 9.31%, acid value decreased from 1.88% to 1.12%, peroxide value increased from 12.30% to 16.40%, iodine value decreased from 57.70% to 26.70% and moisture content decreased from 5.2% to 1.6%. The sensory properties value showed no significant ($p<0.05$) difference between the 0 and 10th day of storage. There were virtually slight decrease in the sensory attributes, but all values were still with the acceptable limit (greater than 3 points) of the scale. Also there was no observable effect of changes in physicochemical properties on the sensory. It was concluded that, the shelf-life of ground melon seed used for soup was valid throughout the 18 day storage and ground melon seed used for other purposes such as edible oil might have a shelf-life of 2 days.*

KEYWORDS: Ground melon seed, shelf-life, room temperature, physicochemical properties and sensory properties.

INTRODUCTION

Melon (*Cococynthis citrullus*) belongs to the family Cucurbitaceae and is a variety of melon seeds grown in India, Africa and parts of Asia especially the tropical and temperate region. It is commonly known as "egusi" and is an important component of most Nigeria diets. Melon seeds contain about 53% oil, 28% protein and some other important mineral nutrients (Oyolu, 1977; Achinewhu *et al.*, 1996). Research studies have also shown that these seeds contained about 50% oil (Olaofe *et al.*, 1994), 42-50% oil (Fokou *et al.*,2004), 44-53% oil (Achu *et al.*, 2005). A valuable vegetable oil is extracted from the seeds while ground seed is used to prepare various delicacies including cake and soup.

Bankole *et al.*, (2005) reported that one major problem that besets melon seeds is that it deteriorates quickly in storage due to fungal infection which decreases the nutritive value, increase in the peroxide value and the production of mycotoxin. The moisture content plays a vital role in the

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maintenance of seed quality in store. Harrington (1972) observed that a 1% decrease in moisture doubles the life of seeds. To reduce quality loss in stored products many researchers have sorted for several techniques, and evaluating their effectiveness through physico-chemical properties, sensory analysis and microbiological examination (Bankole, 1993; Bankole *et al.*, 2003, 2004a, 2004b, 2005; Akusuand and Kiin-Kabari, 2013, 2016). However, there is lack of information about the shelf-life of ground "egusi" seed flour used in soup preparation and oil extraction. The actual period when deteriorative changes become biochemically unacceptable have not been elucidated. Thus, this study aimed to ascertain the shelf-life of ground melon seed.

MATERIALS AND METHODS

Dehulled melon seed and other ingredients were purchased from Ekeonunwa, a local market in Owerri Imo State, Nigeria.

Preparation of melon seed flour

Shelled melon seeds were cleaned, sorted, and sundried for 48 hours, and milled in an attrition mill. The milled seeds were packaged in an airtight transparent polyethylene container for storage studies for 0, 2, 4, 6, 8, 10, 12, 14, 16 and 18 days.

Storage studies (physicochemical properties)

Moisture content

Moisture Content was determined by the method of Lee *et al.* (2007) and Ezeagu *et al.* (2011) as described by AOAC (1990). Five (5) grams of each flour samples were weighed into moisture Cans. The Cans and its sample content were dried in an oven at 105°C for 3 hours in the first instance. The Cans were removed, cooled in a desiccator and reweighed. The weights were recorded. The drying, cooling and weighing were continued repeatedly until a constant weight was obtained by the difference. The weight of the moisture loss was determined and expressed in percentage. The procedure was repeated for samples.It was calculated as shown below:

$$\% \text{ moisture content} = \frac{W_3 - W_1}{W_2 - W_1} \times 100 \qquad 2.1$$

Where,
W1 = weight of empty moisture can
W2 = weight of can before drying
W3 = weight of can + sample after drying to a constant weight

Acid value

The acid value was determined by titration method as described by WHO (2015). Two (2) grams of the oil was weighed into a 250mL conical flask. 50mL of neutralized ethyl alcohol was added to the oil sample. The mixture was then heated in a water bath. The solution was titrated against 0.1M KOH using phenolphthalein as indicator. The acid value was calculated using the following formular;

$$\text{Acid value} = \frac{A \times M \times 56.1}{W} \qquad 2.2$$

Where,
A= Amount (mL) of 0.1M KOH consumed by sample.
M= Molarity of KOH

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W= Weight (g) of oil sample

Free fatty acid

Free fatty acid value was determined as described by DaTech (2016). The percentage free fatty acid of the oil samples was obtained from the acid values of the oil sample as follows;

Free fatty acid (% oleic) = $\frac{Acidvalue}{2}$ 2.3

Peroxide value

Peroxide value was determined according to ISO 3960 (2007). 2.5g of the oil sample was dissolved in a mixture consisting of glacial acetic acid : Chloroform (30mL, 3:2 v/v), then freshly prepared saturated potassium iodide solution (1mL) was added. Distilled water (30mL) was added then titrated slowly with a sodium thiosulphate solution (0.1N) in the presence of starch solution (1%) as an indicator. Each sample was analyzed in duplicate and peroxide value is expressed as milliequivalent of O_2 kg^{-1} oil, i.e;

Peroxide value (meq/kg) $=(S-B) \times W \times N$ 2.4

Where,

S= Volume of sodium thiosulphate consumed by the oil sample

B= Volume of sodium thiosulphate used for blank.

N= Normality of the sodium thiosulphate (meq/kg).

W= Weight of the sample (g)

Iodine value

Iodine value was determined according to ISO 3961 (2009). 0.2g of oil sample was dissolved in chloroform (20mL) and then Hanus iodine (I_2 + Br/ACOH) solution (25mL) was added and left in the dark for 30mins. A potassium iodide solution (10mL, 15%) was added followed by freshly distilled water (100mL) and the excess iodine was titrated with sodium thiosulphate (0.1N) until the yellow colour of solution had almost disappeared. Titration was continued after adding a few drops of starch as an indicator until the blue colour had entirely disappeared. A blank was conducted where the total halogen content of the Hanus solution (25mL) was determined by a sodium thiosulphate solution without the addition of oil. Each sample was analyzed in duplicate and iodine value is expressed as grams of I_2 absorbed by 100g oil, i.e;

Iodine value (g /100g)=$\frac{(B-V)\times N\times 126.9 \times 100}{W}$ 2.5

Where,

B= Quantity of sodium thiosulphate used for blank.

V= Quantity of sodium thiosulphate for sample.

N= Normality of the sodium thiosulphate (meq/kg).

126.9= Molecular weight of iodide.

W= Weight of the sample (g)

Preparation Egusi Soups

The method of Akusu & Kiin-Kabari (2013) was used in the preparation of the soups. Two hundred (200g) of 'egusi' seed flour that has been packaged for 0, 2, 4, 6, 8, 10, 12, 14, 16 and 18 days were removed at intervals and used in the preparation of 'egusi' soup. After all the ingredients had

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been added, the pot was allowed to boil for 30 min to make the soups. The soup is allowed to cool, after 30 min, sensory evaluation was conducted on both soups.

Sensory Analysis

A panel of thirty consumers comprising of staff and students of the Department of Food Science and Technology, Federal University of Technology Owerri, Nigeria were used to evaluate the sensory properties of 'egusi' (melon) soup prepared from the seed flours that were stored at ambient condition for 0, 2, 4, 6, 8, 10, 12, 14, 16 and 18 days. The panelists were selected based on their familiarity with sensory qualities of 'egusi' soup. A five - point hedonic scale was used to evaluate appearance, taste, aroma and overall acceptability of the soup, where 1 and 5 represents dislike extremely and like extremely, respectively according to Meilgaard *et al.* (1991) method. Samples that obtained approximately 80% of the scores in the like (>3 points) hedonic region for appearance, taste, aroma and overall acceptability were considered acceptable. Water was provided to rinse the mouth between evaluations.

Statistical Analysis

The data obtained was subjected to Analysis of Variance (ANOVA). Where there is significant difference the means were separated by Fisher's Least Significance Difference (FLSD) at $p < 0.05$.

RESULTS AND DISCUSSIONS

Physicochemical properties

The results obtained from the storage studies of ground melon seed oil samples for each storage period are shown in Table 1.

Moisture content of the storage samples showed significant ($p<0.05$) difference among samples GMSO0, GMSO2, GMSO4. However, samples GMSO4 to GMSO18 were not significantly different ($p>0.05$). There was observable gradual decline in moisture content of the sample as the storage duration progresses. GMSO0 and GMSO18 have the highest and lowest moisture content respectively. The moisture content of 5.2% before storage was within the recommended storage moisture content ranges (7% to 10%) of oilseeds (Gwarysiak-Witulska *et al.*, 2009; Canadian Grain Commission, 1994), however, the storage moisture content of sample (GMSO0) under study is more acceptable. Decrease in moisture content of samples might be as a result of biochemical changes of the oil content. Moisture initiates hydrolytic reaction of oil that yields free fatty acid and glycerol products.

Free fatty acid content of the oil samples were significantly ($p<0.05$) different throughout the storage period except for samples GMSO6 and GMSO8. There was gradual decrease in the free fatty acid composition with the samples GMSO0 and GMSO18 having the lowest and highest values respectively. Free fatty acid value obtained for GMSO0 is within free fatty acid content reported by Edidiong and Ubong (2013) for melon seeds. GMSO0 and GMSO2 free fatty acids value were below 5.00% oleic (max.) value recommended for non-rancid oil (Savage *et al.*, 1997; Rethinam, 2003), especially unrefined (Virgin) oil. Rancid oils are said to have off-flavour or off-odour and develop as the free fatty acid content increases. Free fatty acid is a product of hydrolytic

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reaction or autoxidation of oil and serves as quality criteria. High free fatty acid content of the samples after the 2nd day shows that the samples might not be suitable for edible purposes. Also the gradual increase in free fatty acid contents could be as a result of hydrolytic reaction. Evidently, decrease in moisture content showed that hydrolytic reaction might be responsible for the increase in free fatty acid contents.

The acid values as shown in Table 1. for the various samples were significantly ($p<0.05$) different except for samples GMSO0, GMSO2, GMSO4 and GMSO6; GMSO8 and GMSO10; GMSO12 and GMSO14 which showed no significant ($p>0.05$) differences. The acid values obtained throughout the storage period are within the recommended limit specified by FAO (1999). Acid value is an important index of physicochemical property of oil which is used to indicate the quality, age, edibility and suitability of oil for used in industries (Akubugwo *et al.*, 2008, Balami *et al.*, 2004). According to Demian (1990), an acid value measures the extent to which the glycerides in the oil have been decomposed by lipase action and other physical factors such as light and heat.
Peroxide values obtained for various sample (except GMSO8 and GMSO10) were significantly ($p<0.05$) different. The peroxide values obtained were above the standard values of 10meqO_2/kg oil specified by SON (2000) and NIS (1992), but below values reported by Edidiong and Ubong (2013) for melon seeds. It has been reported that rancid flavor becomes noticeable when the peroxide value lies between 20 and 40meqO_2/kg oil (Egan *et al.*, 1981; Ojeh, 1981; Ajayi *et al.*, 2006). Peroxide value is used as a measure of the extent to which rancidity have occurred during storage and also as an indication of the quality and stability of fats and oils (Ekwu and Nwagu, 2004). High peroxide values are associated with higher rate of rancidity, however, low peroxide values of oils indicate that the oil do not contain much of trace elements (especially copper) and moisture which normally accelerates autooxidation (Odoemelam, 2005; Anyasor *et al.*, 2009; Adebisi and Olagunju, 2011).

Iodine value of the samples showed no significant ($p>0.05$) difference among samples GMSO0, GMSO2, GMSO4; GMSO8, GMSO10, GMSO12; GMSO14, GMSO16. GMSO0 and GMSO18 have the highest and lowest value respectively. The peroxide values increases alongside the storage periods. The values were below those reported by Edidiong and Ubong (2013), and Abiodun and Adeleke (2010) for melon seeds. Iodine value is used to quantify the amount of double bond (unsaturation) present in oils which shows the oil susceptibility to oxidation. The higher the iodine value, the more unsaturated fatty acid bonds in an oil or fat (Ziyadal and Elhussien, 2008). Oils with iodine value less than 100gI_2/100g of oil are non-drying oils. Non-drying oils are not suitable for ink and paint production due to their non-drying characteristics but may be useful in the manufacture of soaps (Kochhar, 1998) and can be regarded as liquid oil. However, a good drying oil should have iodine value of 130 and above.

Table 1: Mean value for the physicochemical properties of ground melon seed oil (GMSO) samples
Mean in the sample column with the sample superscripts are not significantly different at $P> 0.05$ and those with different superscripts are significantly different at $P < 0.05$. MC- Moisture Content; FFA- Free Fatty Acid; AV- Acid Value; PV- Peroxide Value; IV- Iodine Value.
Sensory properties

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The results of the sensory evaluation carried out on soup prepared from the ground melon seed at each storage period were shown in Table 2. There was no significant (p>0.05) difference in sensory parameters up to the 10th day of storage. However after the 10th day, there was significant decrease in sensory attributes of appearance, taste, aroma and overall acceptability. Expectedly, the properties values agreed with earlier reports that off-flavour becomes noticeable at peroxide value between 20 and 40meq/kg. Despite the decrease in values of the sensory properties of the stored ground melon seed, they were still within the acceptable region (>3 points) of the hedonic scale.

Sample	Appearance	Taste	Aroma	Overall Acceptability
GMS0	5.00^{a}	5.00^{a}	5.00^{a}	5.00^{a}
GMS2	5.00^{a}	5.00^{a}	5.00^{a}	5.00^{a}
GMS4	5.00^{a}	4.97^{a}	5.00^{a}	4.94^{a}
GMS6	4.97^{a}	4.97^{a}	5.00^{a}	4.97^{a}
GMS8	4.90^{a}	4.87^{a}	4.80^{a}	4.87^{a}
GMS10	4.90^{ab}	4.67^{ab}	4.67^{ab}	4.73^{ab}
GMS12	4.50^{c}	4.17^{c}	4.27^{c}	4.33^{c}
GMS14	4.27^{d}	4.00^{cd}	3.77^{d}	3.83^{d}
GMS16	3.87^{e}	3.73^{e}	3.73^{de}	3.73^{d}
GMS18	3.67^{e}	3.63^{e}	3.40^{f}	3.53^{e}
LSD	**0.21**	**0.20**	**0.21**	**0.17**

Sample	MC	FFA	AV	PV	IV
GMSO0	5.2^{a}	3.59^{j}	1.88^{a}	12.30^{j}	57.70^{a}
GMSO2	4.4^{ab}	4.61^{i}	1.84^{a}	12.70^{i}	57.20^{a}
GMSO4	2.5^{c}	6.11^{h}	1.80^{a}	13.00^{h}	56.20^{ab}
GMSO6	2.3^{c}	6.58^{fg}	1.82^{ab}	13.50^{fg}	49.50^{c}
GMSO8	2.5^{c}	6.87^{f}	1.66^{c}	14.10^{g}	38.10^{d}
GMSO10	2.1^{c}	7.24^{e}	1.57^{cd}	14.30^{e}	38.10^{d}
GMSO12	2.0^{c}	7.71^{d}	1.43^{e}	14.80^{d}	36.55^{de}
GMSO14	1.9^{c}	8.08^{c}	1.42^{ef}	15.50^{c}	32.50^{f}
GMSO16	1.9^{c}	8.84^{b}	1.28^{g}	15.80^{b}	31.00^{fg}
GMSO18	1.6^{c}	9.31^{a}	1.12^{h}	16.40^{a}	26.70^{h}
LSD	**0.94**	**0.33**	**0.09**	**0.26**	**3.47**

Mean in the sample column with the sample superscripts are not significantly different at P> 0.05 and those with different superscripts are significantly different at P < 0.05.

CONCLUSION

The results obtained from physicochemical properties showed that ground melon seed would be biochemically unacceptable after the second day of storage. Also, the sensory properties showed

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slight significant differences after the 10th day of storage, but still within the acceptable region. Therefore, the shelf-life of ground melon seed could be concluded based on their utility. The shelf-life of ground melon seed used for soup was valid throughout the 18 day storage. Ground melon seed used for other purposes such as edible oil has a shelf-life of 2 days.

REFERENCES

A. O. A. C. (1990). Official Method of Analysis.15th edition, *Association of Official Analytical chemists*, Washington D. C. Pp 858-869.

Abiodun, M.A.; Adeleke, R.O. (2010). Comparative studies on nutrition composition of melon seed flour varieties. *Pakistan Journal of Nutrition*. 9(9): 905-908.

Achinewhu, S.C.; Banigo, E.B; Ugwu, J.C (1996). Proximate composition and functional properties of mechanically shelled and Heat treated melon seed (*Citrullus vulgaris schard*). *Niger Delta Biologia*, 1(2), 55-64.

Achu, M. B.; Fokou, E.; Tehicgang, C.; Fotso, M.; Tchouanguep, F. M. (2005).Nutritive Value of Some Cucurbitaceae Oil Seeds from Different Regions in Cameroon.*African Journal of Biotechnology*, 4 (10): 1329 – 1334.

Adebisi, G.A.; Olagunju, E.O. (2011) Nutritional potential of the seed of fluted pumpkin (*Telfairiaoccidentalis*), *Journal of New Trends in Science and Technology Application*, 1(1): 7-18.

Ajayi, I. A.; Oderinde, R. A.; Kajogbola, D.O.; Uponi, J. I. (2006) Oil Content and Fatty Acid Composition of Some Underutilized Legumes from Nigeria. *Food Chem.* 99: 115–120.

Akubugwo, I. E.; Chinyere, G. C.; Ugbogu, A. E. (2008).Comparative studies on oils from some common plant seeds in Nigeria.*Parkistan Journal of Nutrition.*7:570-573.

Akusu, M.O.; Kiin-Kabari, D.B. (2013). Effect of storage period on selected functional, chemical stability and sensory properties of bush mango (*Irvingiagabonensis*) seed flour. *African Journal of Food Science and Technology*, 4(6), 136-140.

Anyasor, G. N.; Ogunwenmo, K. O.; Oyelana, O. A.; Ajayi, D.; Dangana, J., (2009). Chemical Analyses of Groundnut (*Arachishypogaea*) Oil, *Pakistan Journal of Nutrition*, 8(2): 269-272.

Balami, Y. A.; Bolaji, P. T.; Hamza, F.; Bahagor, E. J.; Komolafe, G.; Onyeiwu S.C.; Hassan A. (2004). Practical Manual on Food Tech., Nutrition and Diatetic for schools and Industries.2nd edn.National Sci. and Tech. Forum.Kaduna Poly.Technic.Pp73-76.

Bankole, S.A (1993). Moisture content, mould invasion and seed germinability of stored melon. *Mycopathologia*. 122: 123-126.

Bankole, S.A.; Lawal, O.A; Adabanjo, A. (2004a). Storage practices and aflatoxin B1 contamination of 'egusi' melon seed in Nigeria. *Journal of Tropical Science*. 44: 150-153.

Bankole, S.A.; Adebanjo, A. (2003). Mycotoxin in food in West Africa: Current situation and possibilities of controlling it. *Afr. J. Biotech.* 2(9): 254-263.

Bankole, S.A.; Ogunsanwo, B.M. and Mabekoje, O.O. (2004b). Natural occurrence of moulds and aflatoxins in melon seeds in Nigeria. *Journal of Food and Chemical Toxicology*. 42: 1309-1324.

Bankole, S.A.; Osho, A.; Joda, A.O; Enikuomehin, A.O (2005). Effect of drying method on the quality and storability of 'egusi' melon seeds (*Colocynthiscitrullus L*.). *African Journal of Biotechnology*, 4(8), 799-803.

ISSN 2056-5798(Print), ISSN 2056-5801(online)

Canadian Grain Commission (1994).Official grain grading guide. Canadian Grain Commission, Winnipeg, Man. Canola Council of Canada. 1981. Canola storage. Canola Council of Canada, Winnipeg, Man. Canola Farming Fact Sheet 4, pp 2. Cass, J. 1991. Canola storage.Tips to help you through harvest.*Intermountain Canola Newsletter*, Fall 1991. Idaho Falls, Idaho, pp: 3-4.

Codex Alimentarius. (1999) Codex Alimentarius Standards for Fats and oils from Vegetable Sources. Section 2.Codex alimentarius Standards for Named Vegetrableoils.CodexAlimentarius-Stan 210.

DaTech, R. (2016). Acid Number to Free Fatty Acid Conversions. Make Biodiesel. Available from: http://www.make-biodiesel.org/Biodiesel-Chemistry/acid-number-to-ffa-conversion.html. Accessed: 11 November, 2016.

Demian, M.J. (1990).*Principles of Food Chemistry* (2nd Ed.). Van Nostrond Reinhold International Company Limited, London, England. pp: 37-38.

Edidiong, A.; Eduok, U.M. (2013) Chemical analysis of *Citrulluslanatus seed* oil obtained from Nigeria. *Elixir International Journal* 54:12700-12703

Egan, H; Kirk, R.S.; Sawyer, R (1981).Pearson's chemical analysis of foods (8thed.) London, Churchill Living Stone.

Ekwu, F.C.; Nwagu, A. (2004).Effect of processing on the quality of cashew nut oils.*J. Sci Agric. Food Tech. Environ.*, 4: 105-110.

Ezeagu, I. E.; Metges, C. C.; Proll, J.; Petzke, K. J; Akinsoyinu, A. O. (2011). Chemical Composition and Nutritive Value of Some Wild-Gathered Tropical Plant Seeds. Available from: http://www.chemcomandnutrient. Accessed: 27 May, 2016.

Fatty Acid Composition of Some Underutilized Legumes from Nigeria.*Food Chem.* 99: 115–120.

Fokou, E.; Achu, M.B.; Tchouarguep, M.F. (2004) Preliminary nutritional evaluation of five species of egusi seeds in Cameroun.*Afr. J. Food Agric. Nutr. Dev.* 4:1-11.

Gawrysiak-Witulska, M.; Siger, A.; Nogala-Kalucka, M. (2009).Degradation of tocopherols during near-ambient rapeseed drying.*J. Food Lipid* 16:524-539.

ISO (2007).Animal and vegetable fats and oils- Determination of peroxide value.*ISO 3960: 2007*, 4thedn. Switzerland.

ISO (2009).Animal and vegetable fats and oils- Determination of iodine value.*ISO 3961: 2009*, 4thedn. Switzerland.

Kochhar, S.L. (1998). *Economic Botany in the Tropics*, Macmillan publishers Ltd., India. pp: 354-355.

Lee, H. C.; Htoon, A. K.; Paterson, J. L. (2007). Alkaline Extraction of Starch from Australian Lentil Cultivars: Matilda and Digger Optimised for Starch Yield and Starch and Protein Quality. *Food Chemistry*, 102: 551–559.

Meilgaard, M.; Civille, G.V.; Carr, B.T. (1991).Sensory Evaluation Techniques (2ndEdn.).CRC Press Inc., Boca Raton, Florida. pp: 135-235.

NIS (1992).*Standard for Edible Vegetable Oil*.Nigerian Industrial Standards. pp: 5-12.

Odoemelam, S. A. (2005). Proximate composition and selected physicochemical properties of the seeds of African oil bean (*Pentailethramarcrophlla). Pakistan Journal of Nutrition*, 4(6): 382-383.

Ojeh, O. (1981). Effects of Refining in the Physical and Chemical Properties of Cashew Kernel Oil.*Journal fats and oilsTechnology*,16:513-517.

ISSN 2056-5798(Print), ISSN 2056-5801(online)

Olaofe O., Adeyemi F.O. and Adediran G.O. (1994).Amino Acid and mineral Composition and Functional Properties of some Oil Seeds.*J. Agric. Food Chem.* 42: 878 – 881.

Oyolo, O. (1977). A qualitative and quantitative study of seed types in Egusi melon (*Cococynthiscitrullus L*). *Tropical Science, 19:*51-61

Rethinam, P. (2003). New Approaches to Coconut, Oils and Fats.*African Journal of Food, Agriculture, Nutrition andDevelopment*, 19 (2): 22-25.

Savage, G. P.; McNeil, D. L.; Dulta, P. C. (1997). Lipid Composition and oxidation stability of oils Hazelnuts (*Corylusavenllana*) grown in New Zealand. *Journal of American oilChemists society*, 74:755-759.

SON (2000).*Standards for Edible Refined Palm Oil and Its Processed Forms* Standard Organisation of Nigeria. pp: 2-5.

WHO (2015).Determination of Acid Value.The International Pharmacopoeia (5thEdn.), World Health Organization (WHO) Department of Essential Medicine and Health Products. Available from: http://apps.who.int/phint/en/p/docf/ Accessed: 11 November, 2016.

Ziyada A.K.; Elhussien S.A. (2008) Physical and chemical characteristics of *Citrulluslanatus Var. Colocynthoide*seed oil. *J. Phy. Sci.*, 19: 69-75

ISSN 2056-5798(Print), ISSN 2056-5801(online)