

PHYSIOCHEMICAL PROPERTIES AND ORGANOLEPTIC QUALITY OF *M. OLEIFERA* SEED OIL

ABSTRACT

The studies were undertaken in order to determine the physico-chemical properties and sensory attribute of oils extracted from the seeds of *Moringa oleifera*. The oils were extracted from the seeds and analyzed for moisture content, specific gravity, saponification value, refractive index, peroxide value, acid number, iodine value and sensory quality. The fresh oil was also characterized for its sensory attribute using three different foods. The seed oil had the following physical and chemical parameters. The ~~colour~~color? (yellow), moisture content (2.0%), specific gravity 1.0598 kg/dm³, refractive index (1.465 ± 0.04), acid values (0.67 mg/KOH/g), iodine value (110g/100g), peroxide value (7.0 meq/kg), saponification value (178.10 mg/KOHg), melting point (36.7), Flash point(0c) (162) and rancidity (14.0). Organoleptic scoring show that yam fried with *Moringa* seed oil had more taste, ~~colour~~color?, aroma than yam fried with vegetable oil while chicken and egg fried with vegetable oil had higher taste, colour^[1], aroma and overall acceptance scoring than chicken and egg fried with *Moringa* seed oil. The study showed that *Moringa* seed oil can be used as nutritional oil, industrial raw material and nutraceuticals.

Keywords: *Moringa oleifera* seed oil; physicochemical parameters; organoleptic assesment; oil extraction and characterization

INTRODUCTION

Fats and oil whether the source is of animal or vegetable in origin represent the highest source of energy per unit weight that man can consume. Apart from being a source of reserved energy, fats deposits insulate the body against loss of heat and protect the vital organs against mechanical injury. They are an important food source for man, and are also extensively used for nutritional, cosmetic and industrial purposes. They are used for supplying essential fatty acids such as linolenic and arachidonic acids. Fats and oils are also used for producing drug dispersants in therapeutics [1].

The high world demands for oils and fats to meet the multiplex human consumption and the multitudinous industrial needs are the reasons for the increase in the importance of oil seeds and make them play an important role in the national economy of the producing countries [2].

Nigeria has over 150 million people and estimated to be 170,123,740 as at July 2012 [12] which are particularly used to palm oil, ground nut oil and soya beans oil as edible oil [3]. To ensure the increase of oils and fats, it is necessary to continue not only with the development of new varieties with improved oil yields, but also to

search for new sources of oil [4]. In identifying new source of edible oil, there is a need to carry out the [13] physicochemical parameters of the oil so as to determine its edibility in terms of properties and composition.

Moringa oleifera Lam. (Moringaceae) is one of the 14 species of family Moringaceae, native to India, Africa, Arabia, Southeast Asia, South America, and the Pacific and Caribbean Islands [5]. Because *M. oleifera* has been naturalized in many tropic and sub-tropic regions worldwide, the plant is referred to by a number of names such as horseradish tree, drumstick tree, ben oil tree, miracle tree, Moringa plant and "Mother's Best Friend"

The Moringa plant has been consumed by humans throughout the century in diverse culinary ways [5]. Almost all parts of the plant are used culturally for its nutritional value, purported medicinal properties and for taste and flavor as a vegetable and seed. The leaves of *M. oleifera* can be eaten fresh, cooked, or stored as a dried powder for many months reportedly without any major loss of its nutritional value [6]. Epidemiological studies have indicated that *M. oleifera* leaves are a good source of nutrition and exhibit anti-tumor, anti-inflammatory, anti-ulcer, anti-atherosclerotic, anti-convulsant activities [7], and antianaemic effect [8]. Seeds of *M. oleifera* are also known as a great source of vitamins and minerals including calcium, copper, sulphur, vitamin A and B-vitamins [9]. In this study, attempt was made to evaluate the physiochemical properties and organoleptic quality of *M. oleifera* seed oil.

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MATERIAL AND METHOD

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Plant collection

Moringa oleifera seeds, were collected from Baddegi, Niger State Nigeria. Taxonomic identification of the plant was conducted by a Botanist in the Department of Biological Science, Federal University of Technology Minna, Niger State. The seeds were then dried to constant weight in an oven at 60°C for 24 h to remove moisture content and then ground using mechanical grinder, put in air tight container and stored in a desiccators for further analysis [10].

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Oil extraction

Oil from the *Moringa* seeds was extracted by continuous extraction in Soxhlet apparatus for 6 h using petroleum ether (40-60°C) as solvent according to the method described [11]. At the end of the extraction, the extraction solvent was evaporated in a rotary evaporator.

The extracted oil was assayed using standard methods.

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Physicochemical Characterization

Standard procedures of American Oil Chemists Society were used for indices values [11]. The procedures were also applied for acid value, iodine value, peroxide value and saponification value. Refractive index, color [14], melting point and specific gravity were determined using the recommended methods. (B+S) Bellingham + Stanley Refractometer (England) and tintometer were used to determine refractive index and color [15], respectively. The saponifiable matter in the oil was determined using standard methods [1], while the ester value was obtained by subtracting the

acid value from the saponification value. Each of the analysis were performed in triplicate.

Organoleptic evaluation

The *M. oleifera* seed oil was use to fry 3 different foodfoods (yam, egg and chicken). The foods were evaluated for organoleptic properties (in comparison with the same kind of food fried with vegetable oil) according to the method as described by Stone [12]. Their organoleptic evaluations were evaluations were carried out by 8 judges. All the judges forming the panel were conversant with the factor governing the quality of the sample. The fried food was evaluated organoleptically for color, taste, aroma [16] and overall acceptability. The taste panelists were asked to rate the samples for color [17], taste, aroma and overall acceptability on 1-7 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.

Statistical Analysis

Values were analyzed using statistical package for social science (SPSS) version 16

and presented as means $\pm$ SE of the mean. [18]

RESULTS

Physicochemical parameters

The results of the physicochemical parameters of *M. oleifera* seed oil are presented in table 1: the seed oil had the following physical and chemical parameters. The colour (yellow), moisture content (2.0 %), specific gravity 1.0598 kg/dm³), refractive index (1.465 $\pm$ 0.04), acid values (0.67 mg/KOH/g), iodine value (110 g/100 g), peroxide value (7.0meq/kg), saponification value (178.10 mg/KOHg), melting point (36.7), flash point(0c) (162) and rancidity (14.0)

Table 1: physicochemical Characteristics of *Moringa oleifera* seed oil.

Physicochemical Properties	<i>Moringa oleifera</i> seed oil
Specific gravity at 200C	1.0598 $\pm$ 0.12
Refractive index at 290C	1.465 $\pm$ 0.04
Acid value (mg/KOH/g)	0.67 $\pm$ 1.93
Iodine value mg/100g	110.89 $\pm$ 4.13
Peroxide value (meq/kg)	7.00 $\pm$ 0.12

Saponification value (mg-KOH/g)	178.10 ± 2.35
Free fatty acid (as oleic acid ^[9])	0.99 ± 0.02
Melting point ^[10]	36.7 ± 3.04
Flash point(0c) ^[11]	162 ± 7.32
Rancidity ^[12]	14.0 ± 1.09
Colour ^[13]	Yellow

114 Data are Mean ± SEM of triplicate determination

115 ORGNAOLEPTIC SCORING

116 The results of the organoleptic scoring of foods fried with *Moringa* seed oil in
 117 comparison with foods fried with vegetable oil are shown in table 2. Yam fried with
 118 *Moringa* seed oil had more taste, colour^[14], aroma and overall acceptance than
 119 plantain fried with vegetable oil while egg and chicken fried with vegetable oil had
 120 higher taste, colour^[15] aroma and overall acceptance scoring than egg and chicken
 121 fried with *Moringa* seed oil (Table 2).

122 **Table 2. Organoleptic assessment of *Moringa* seeds**

Sensory attribute	Yam		Egg		chicken	
	M.S.O	V.O	M.S.O	V.O	M.S.O	V.O
Taste	6.12±0.64	5.87±0.99	5.50±0.53	5.87±1.12	5.25±1.03	5.50±0.92
Colour	5.7±1.03,	5.12±1.35	5.50±0.92	5.62±1.30	5.25±1.28	5.37±0.51
Aroma	5.75±1.03	5.00±0.53	5.50±1.30	5.87±1.12	5.00±1.06	5.12±1.12
Overall Acceptance	6.12±0.83	5.69±0.74	5.50±.75	5.87±0.64	5.00±1.06	5.3±0.51

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 124 Data are Mean±SEM (N= 8)

125 M.S.O = *Moringa* seed oil

126 V.O= Vegetable oil

127 DISCUSSION

128 The oil extracted from *Moringa* seed is yellow in colour. The colour of the oil is
 129 used preliminarily in judging the quality and in determining the degree of
 130 bleaching of the oil. The darker the colour^[16], the poorer the quality. Therefore the
 131 yellow colour shows that the quality of the oil is good and confirms to
 132 Encyclopedia of Chemical Technology [13].

133 The moisture content of the oil was 2.0%; low moisture content of this seed oil is
 134 an indication of low perishability of the oil and this responsible for it relatively
 135 long shelf life [14]. In addition, the low moisture content shows the presence of a
 136 lesser amount of dirt and impurities in the oil. (Edidiong, 2013). Thus low moisture
 137 content observed in this study is an indication that the dirt and impurities in
 138 *Moringa* seed oil are very low. However this value is lower than the moisture
 139 contents (10.9) of melon seed oil [13].

140 Acid value gives an idea of the free fatty acid composition due to enzymatic
141 activities. The acid value obtained for *Moringa* seed oil in this study (0.67
142 mg/KOH/g^[117]) is very low as compared to the acid value (7.09 mgKOH/g) reported
143 for melon seed oil [15], 1.68 mgKOH/g for almond seed oil [16] and 2.37 mgKOH/g
144 for coconut oil [17]. This implies that *Moringa* seed oils contain low level of free
145 fatty acid.

146 Oil with iodine value in the range of 100-150^[118] have higher affinity for oxygen
147 when expose to atmosphere and cannot be classify as drying oil, thus the result
148 obtained in this study (110g/100g) compare with iodine value obtained for water
149 melon (114.94 g/100g—) by [15]. The oil can form thicken, sticky but cannot
150 develop into hard dry film. However this property makes them suitable for the
151 production of soap [18]. These findings indicate that *Moringa* seed oil can be used
152 as a raw material for the production of soap

153 The value of saponification reflects the molecular weight of oil [19]. In this study
154 saponification value obtained for *Moringa* seed oil was found to be high (178.10
155 mg/KOHg) and is comparable with the saponification value reported for palm
156 kernel (190-206 mg/KOHg) and oil obtained from groundnut (188-196 mg/KOHg)
157 [20]. High saponification value implies greater proportion of fatty acids of low
158 molecular weight. Thus the high saponification value of *Moringa* seed oil indicates
159 that the oil contained higher proportion of low molecular weight fatty acids. High
160 saponification is an additional property that makes it suitable as a raw material for
161 soap and lather industry [21].

162 The peroxide value reflects the degree of oil oxidative rancidity [22]. The peroxide
163 values of fresh and stored *Moringa* seed oils were obtained to be 7.0^[119]. The
164 peroxide values obtained for oil in this study is lower compared to the value (20.0
165 meq/kg^[120]) reported for melon seed oil [15]. Oxidative rancidity is the addition of
166 oxygen across the double bonds in unsaturated fatty acids in the presence of
167 enzyme or certain chemical compounds [23]. The odour and flavor associated
168 with rancidity are due to liberation of short chain carboxylic acids. High peroxide
169 values are associated with higher rate of rancidity. The low peroxide values of
170 *Moringa* seed oils obtained in this study is an indication that they are less liable to
171 oxidative rancidity at room temperature [24]. These oils are fresh because the
172 content of peroxide lower than 10 meqO₂^[121]/kg and oil grow rancid when the
173 content peroxide lies between 22 and 40.0 meqO₂^[122]/kg [25].

174 The specific gravity of *Moringa* seed oil obtained in this study (1.0598 kg/dm³) is
175 higher than the value (0.956 kg/dm³) for *Blighia sapida* oil [16]. However the
176 refractive index (which reflects the purity the oil) obtained in this study (1.465) is
177 similar to the reported value (1.462) for *Blighia sapida* oil [16]. The results indicate
178 that the *moringa-Moringa* seed oils are of high purity.

179 The panelist's assessment indicated that yam fried with *Moringa* seed oil have
180 higher acceptability for colour, taste and flavor than the yam fried with commercial
181 vegetable oil. However chicken and egg fried with commercial vegetable oil have
182 more acceptable taste, colour and aroma than those fried with *Moringa* seed oil.
183 This finding is an indication that the sensory attribute of oil depends^[123] on the
184 kinds of food in which the oil is used to prepare and thus *Moringa* seed oil is
185 suitable for frying yam.

CONCLUSIONS

The study showed that *M. oleifera* may be considered as Nigeria's potential asset in the seed oil for industrial application. The oil ~~of the plant found in this area~~ has a considerable high quality ~~and~~ can be used as nutritional oil, industrial raw material and ~~source of~~ nutraceuticals.

REFERENCES

- 1 Ranften CO, Billy EH. Post-harvest Biotechnology of oil seeds. CRC press. 1993; pp. 161-170
- 2 Charley H. Food science, 2nd Ed. New York: John Wiley and Sons Publishers. 2002; pp. 91-95.
- 3 Ottong, JG. Population of Nigeria. Online Nigeria.com, www.onlinenigeria.com/Population/?blurb=137. Retrieved Jan 19, 2013.
- 4 Fadlalla E. Review of oil seeds production in the Sudan and its importance to the Sudan economy. Second Sudanese oilseed symposium. 2000; pp 7.
- 5 Iqbal S, Bhanger MI. Effect of season and production location on antioxidant activity of *Moringa oleifera* leaves grown in Pakistan. *J. of Food Comp. and Anal.* 2006; 19, 544-551.
- 6 Arabshahi-DS, Devi DV, Urooj A. Evaluation of antioxidant activity of some plant extracts and their heat, pH and storage stability. *Food Chemistry*. 2007;100, 1100-1105.
- 7 Dahiru D, Obnubiya JA, Umar HA. Phytochemical screening and antiulcerogenic effect of *Moringa*. *Afri J. Trad. CAM*, 2006; 3, 3, 70-75
- 8 Hisham MO, Mohamed ES, Elsiddig MB, Bashier O, Ali ME. Effect of Ethanolic Leaf Extract of *Moringa oleifera* on Aluminum-induced Anemia in White Albino Rats, *Jordan Journal of Biological Sciences*, 2012;5(4): 255 – 260
- 9 Lowell JF. The Miracle Tree. ACP – EU, Dakar. 2002; pp 137- 139.
- 10 Ekpa OD. Bioinorganic constituent and possible use of female fluorescence of oil palm W. *Afri. J. Bio and Appl. Chem*, 1995;40:13-18
- 11 A.O.A.C. Association of official analytical chemist. Method of analysis (ised). Pub .by association of official analytical chemist washinton D.C.1990.
- 12 Stone CV. Sensory Evaluation Prattices. Florida: Academic Press. 1985;pp 311.
- 13 Power WC. *Kirk-Othmer Encyclopedia of Chemistry Technology*, 3rd ed. New York: Wiley-Interscience Publishers. 2008; p. 41.
- 14 Kester DE, Kader AA. Almonds: In: *Encyclopedia of food science*, Food technology and nutrition, edited Academic Press Limited (London and San Dicgo, C.A). Edited by Macrae, R.; Robinson, R. K. and Sudler, M. J. 1993;1, pp. 124-726.
- 15 Edidiong AE, Ubong M. Chemical analysis of *Citrullus lanatus* seed oil obtained from Southern Nigeria. *Elixir Org. Chem.* 2013; 54 :12700-12703
- 16 Akpabio UD. Evaluation of proximate composition, mineral element and anti- nutrient in almond (*Terminalia catappa*) seeds *Advances in Applied Science Research*, 2012;3 (4):2247-2252.

- 230 | 17 Peter AO. Chemical properties of coconut oil. *West African Journal of*
 231 | *Biological and Applied Chemistry*, 1956;14: 120-130
- 232 | 18 Kinkela MI. Physicochemical Properties and Fatty Acid Composition of
 233 | Lipids Extracted from some Nigerian Fruits and Seeds. *Global Journal of*
 234 | *Pure and Applied Sciences*,2006;p23-29
- 235 | 19 Booth FEM, Wickens GE. Nontimber uses of selected and zone trees and
 236 | shrubs in Africa. FAO Conservation Guide, Rome, 1988; pp. 92–101.
- 237 | 20 Cocks LV, Van Reed C. Laboratory Handbook for Oil and Fat Analyst.
 238 | Academic Press, London. 1996 ;pp 113-117.
- 239 | 21 Nzikou JM, Mvoula-Tsieri M, Matos L, Matouba E, Ngakegni AC, Linder M,
 240 | Desobry SC. *Solanum Nigrum L. seeds* as an Alternative sources of edible
 241 | lipids and nutrition in Congo Brazzaville, *Journal Applied Science*. 2007;
 242 | 7:1107-1115.
- 243 | 22 Ekpa OD, Ekpa UJ. Comparison of the Characteristics Parameters and
 244 | Deterioration Properties of oils from the *Fenera and dura* Variety of the oil
 245 | palm, *Nigerian Journal of chemical research*.2006; 1:26-33
- 246 | 23 Oyenuga VA, Fetuga BL. “Some aspects of biochemical and nutritive value of
 247 | the water melon seeds (*Citrullus colocynthis*)” *J Sci Food Agric*, 1975; 26: 843–
 248 | 854.
- 249 | 24 Odoemelam SA. Proximate composition and selected physicochemical
 250 | properties of the seeds of African oil bean (*Pentaclethra marcophylla*). *Pak.*
 251 | *J. Nutr.*,2005; 4: 382-383.
- 252 | 25 Ojeh O.Effects of Refining in the Physical and Chemical Properties of Cashew
 253 | Kernel Oil. *Journal fats and oils Technology*, 1981; 16:513-517.

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