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Physicochemical Properties and Organoleptic Quality of *M. oleifera* Seed Oil

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Authors' contributions

This work was carried out in collaboration between all authors. Authors ANT, BL and IFO designed the study, wrote the protocol and carried out all laboratories work and performed the statistical analysis. Author ENG managed the analyses of the study. Author BL wrote the first draft of the manuscript. Authors MIU and AYG managed the literature searches and edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The study 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 color (yellow), moisture content (2.0%), specific gravity 1.0598 kg/dm$^{3)}$, 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

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more taste, color, aroma than yam fried with vegetable oil while chicken and egg fried with vegetable oil had higher taste, color, 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.

1. 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 which particularly use 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 need to determine the 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 physicochemical properties and organoleptic quality of *M. oleifera* seed oil.

2. MATERIALS AND METHODS

2.1 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 60ºC 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].

2.2 Oil Extraction

Oil from the Moringa seeds was extracted by continuous extraction in Soxhlet apparatus for 6 h using petroleum ether (40-60ºC) 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.

2.3 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, 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, respectively. The saponifiable matter in the oil was determined using standard methods [11], while the ester value was obtained by subtracting the acid value from the saponification value. Each of the analysis was performed in triplicate.

2.4 Organoleptic Evaluation

The *M. oleifera* seed oil was use to fry 3 different foods (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 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 and overall acceptability. The taste panelists were asked to rate the samples for color, 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.

2.5 Statistical Analysis

Values were analyzed by one way analysis of variance (ANOVA) using statistical package for social science (SPSS) version 16 and presented as means±SE of the mean.

3. RESULTS

3.1 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 color (yellow), moisture content (2.0 %), specific gravity 1.0598 kg/dm$^{3)}$, refractive index (1.465±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	*Moringa oleifera* seed oil
Specific gravity at 200C	1.0598±0.12
Refractive index at 290C	1.465±0.04
Acid value (mg/KOH/g)	0.67±1.93
Iodine value mg/100g	110.89±4.13
Peroxide value (mEq/kg)	7.00±0.12
Saponification value (mg-KOH/g)	178.10±2.35
Free fatty acid (as oleic acid)	0.99±0.02
Melting point	36.7±3.04
Flash point (0c)	162±7.32
Rancidity	14.0±1.09
Color	Yellow

Data are mean±SEM of triplicate determination

3.2 Orgnaoleptic Scoring

The results of the organoleptic scoring of foods fried with *Moringa* seed oil in comparison with foods fried with vegetable oil are shown in Table 2. Yam fried with *Moringa* seed oil had more taste, color, aroma and overall acceptance than plantain fried with vegetable oil while egg and chicken fried with vegetable oil had higher taste, color aroma and overall acceptance scoring than egg and chicken fried with *Moringa* seed oil (Table 2).

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
Color	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

Data are Mean±SEM (N= 8); M.S.O = Moringa seed oil; V.O= Vegetable oil

4. DISCUSSION

The oil extracted from Moringa seed is yellow in color. The color of the oil is used preliminarily in judging the quality and in determining the degree of bleaching of the oil. The darker the color, the poorer the quality. Therefore the yellow color shows that the quality of the oil is good and confirms to Encyclopedia of Chemical Technology [13].

The moisture content of the oil was 2.0%; low moisture content of this seed oil is an indication of low perishability of the oil and this responsible for it relatively long shelf life [14]. In addition, the low moisture content shows the presence of a lesser amount of dirt and impurities in the oil [15]. Thus low moisture content observed in this study is an indication that the dirt and impurities in *Moringa* seed oil are very low. However this value is lower than the moisture contents (10.9%) of melon seed oil [13].

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

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

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

The peroxide value reflects the degree of oil oxidative rancidity [22]. The peroxide values of fresh and stored *Moringa seed* oils were obtained to be 7.0. The peroxide values obtained for oil in this study is lower compared to the value (20.0 mEq/kg) reported for melon seed oil [15]. Oxidative rancidity is the addition of oxygen across the double bonds in unsaturated fatty acids in the presence of enzyme or certain chemical compounds [23]. The odour and flavor associated with rancidity are due to liberation of short chain carboxylic acids. High peroxide values are associated with higher rate of rancidity. The low peroxide values of *Moringa* seed oils obtained in this study is an indication that they are less liable to oxidative rancidity at room temperature [24]. These oils are fresh because the content of peroxide lower than 10 mEq O_2/kg and oil grow rancid when the content peroxide lies between 22 and 40.0 mEq O_2/kg [25].

The specific gravity of *Moringa* seed oil obtained in this study (1.0598 kg/dm^3) is higher than the value (0.956 kg/dm^3) for *Blighia sapida* oil [16]. However the refractive index (which reflects the purity the oil) obtained in this study (1.465) is similar to the reported value (1.462) for *Blighia sapida* oil [16]. The results indicate that the *Moringa* seed oils are of high purity.

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

5. CONCLUSIONS

The study showed that *M. oleifera* may be considered as Nigeria's potential asset in the seed oil for industrial application. The oil has a considerable high quality and can be used as

nutritional oil, industrial raw material and source of nutraceuticals.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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