Qualities of Watermelon Seed Oil Extracted at Different Moisture Content

Adejumo, B. A, Olorunsogo S. T. and Njoku, C.B.
Department of Agricultural Bioresources Engineering,
Federal University of Technology, Minna, Nigeria

ABSTRACT
Quality attributes of watermelon seed oil at four moisture content was investigated. Oil was extracted using solvent extraction method at 4.31% (control), 10% (A), 20% (B) and 30% (C) moisture content (wb). Result shows that the acid values (Mg/KOH/g), iodine values (g/100), peroxide values (M/Mol/Kg), saponification values (Mg/KOH/g) and free fatty acid values (Mg/KOH/g) ranged between 5.61-10.10, 122.60-135.66, 2-16, 196.35-325.38 and 11.22-20.20 respectively. The increase in moisture content does not have significant effects ($p \leq 0.05$) on the refractive index, viscosity and specific gravity of watermelon seed oil while saponification value, acid value, free fatty acid and peroxide value increased significantly with increase in moisture content. The oil yield and iodine content decreased with increase in moisture content. It is concluded that water melon seed oil will be suitable for lubrication and soap making.

Keywords*: watermelon seed, moisture content, free fatty acid, peroxide value, refractive index and saponification value.*

1.0 INTRODUCTION
Watermelon is a drought tolerant crop which belongs to the *cucurbitaceae* family of flowering plants. It is generally considered to be of the *citrullus* species and has been referred to as *citrullus vulgaris* [1].. Watermelon is originally found in southern Africa and reaches maximum inherited diversity there, with sweet, bland and bitter forms [2]. One of the characteristics of watermelon fruit is it supplies of food and water both at a time unlike other kind of fruits. Its juicy pulp is very tasty and acts as the best substitute of natural drinks and food in dry conditions. The watermelon fruit varies in shape and colour. The fruits are derived from an inferior ovary, and this is a general characteristic of the *cucurbitaceae*. The fruit, loosely considered a type of melon (although not in the genus c*ucumis*) has a smooth exterior rind (green, yellow and sometimes white) and a juicy, sweet interior flesh (usually deep red to pink, but sometimes orange, yellow and even green if not ripe). The fruit contains many obovate, smooth compressed seeds thickened at the margin, which is usually black or yellowish white in colour and sometimes reddish spread in the pulp.

Watermelon fruit is rich in vitamin A and C with small amounts of vitamin B_1, B_2, B_6, folate, and niacin. It is very rich in potassium and also contains other minerals like iron, calcium, magnesium and phosphorous in traces but free of fats and cholesterol. Its seed averagely consist of 31.9% protein, 4.4% carbohydrates, 57.1% fat, 8.2% fiber, 6.2% ash, 130 mg calcium, 456 mg phosphorus, and 7.5mg iron. It also contains the necessary amino acids such as Leucine, Isoleucine, Tryptophan and Valine [3].
Watermelon seeds contain oil which is known as *Ootanga* and *Kalahari* oil in West Africa. In Africa, it is valued highly for its nutritive oil content. Conventionally, the seeds are removed from the rind and then allowed to dry outside in the sun to significantly reduce its moisture content. Once dried, the seeds are then pressed to extract the useful oil. The seeds are extracted either by manual maceration and washing of decayed fruits in a basket or scooping out pulp from fruit. However, there are special machines which pick up the fruits and crush them into pieces [3]. This seed is of great importance in diets because of its nutritional content and diverse medicinal uses. Watermelon seed oil is light, penetrating and rich in essential fatty acids. It is used in cooking, baking, curing diseases like urinary problems and cosmetics making. The stable shelf life of watermelon seed oil makes it a suitable emollient. Watermelon seed oil contains high amounts of unsaturated fatty acids with linoleic and oleic acids as the major acids [4].
Vegetable oils are essential in meeting global nutritional demands and are utilized for many food and industrial purposes [5]. Despite the broad range of sources for vegetable oils, the world consumption is dominated by soya bean, rapeseed, and sunflower oils with 31.6, 30.5, 15.5, and 8.6 million tons consumed per year, respectively [6]. These conventional sources of vegetable oil no longer meet the ever increasing demands of domestic and industrial sectors [5]. From this view point, non-conventional oil seeds are of much concern to cope with this challenge. More recently, research activities have focused on examining and characterizing new sources of edible oils. It has been reported that seeds of some species of *cucurbitaceae* can be the edible oil sources to meet the increasing demands for vegetable oil [7].
The watermelon seed, despite its high nutritional content and medicinal value still remain under-utilized in Nigeria. Over the years, due to the high rate of

production of watermelon and lack of awareness of the benefits its seed, the seed has suffered negligence which results in wastage. Due to the increasing awareness of the use of watermelon seed oil; there is need to know the appropriate sets of parameters necessary for the optimum extraction of the oil. The aim of this study is to extract oil from watermelon seed at different moisture contents, with the view to determine the effect of moisture content on the yield and quality of oil extracted from watermelon seed.

2.0 MATERIALS AND METHODS

The watermelon seed was obtained from *kure* market, Minna Nigeria and cleaned. The initial percentage moisture content of the seeds was determined (4.31%) using standard methods and calculated amount of water was added to vary the percentage moisture content to 10%, 20% and 30% for samples A, B, and C [8]. The oil was extracted using the solvent extraction method with the aid of a soxhlet apparatus and the oil yield for each samples calculated [9]. The characteristics of the evaluated oil include: acid values (Mg/KOH/g), iodine values (g/100), peroxide values (M/Mol/Kg), saponification values (Mg/KOH/g), free fatty acid value (Mg/KOH/g), specific gravity, and viscosity (Kg/m^3) using the prescribed methods [10].

3.0 RESULTS AND DISCUSSION

The results of the effect of moisture content on oil yield, physical properties and chemical properties are presented in Tables 1, 2 and 3 respectively.

Table 1: The Effect of Moisture Content on Percentage Oil Yield of Watermelon seed

Parameter	Control	Sample A	Sample B	Sample C
Weight of sample before extraction	10	10	10	10
Weight of sample after extraction	7.19	7.46	7.99	8.44
Weight of oil	2.81	2.54	2.01	1.56
Oil yield (%)	46.71	43.96	38.71	34.11

Where control sample = seed with 4.31% moisture content, sample A = seed with 10% moisture content, sample B = seed with 20% moisture content, and sample C = seed with 30% moisture content. The weights of the samples are in milligrams.

Table 2: Physical properties of watermelon seed oil

Properties	Control	Sample A	Sample B	Sample C	*Standard for edible oil
Viscosity 40^O (mm/s)	1.78	1.28	1.22	1.21	60
Specific gravity	0.99	0.98	1.01	1.01	1.16
Refractive index	1.45	1.45	1.45	1.45	1.460±0.05

Table 3: Chemical Properties of Watermelon seed Oil

Properties	Control	Sample A	Sample B	Sample C	*Standard for edible oil
Saponification value (Mg/kOH)	196.35	308.55	316.35	325.38	181.4±2.60
Iodine value (g/100g)	135.60	122.60	126.32	131.00	80-106
Acid value (Mg/KOH/g)	5.61	6.17	7.86	10.10	4
Peroxide value (M/Mol/kg)	2	4	12	16	10
Free fatty acid (Mg/KOH/g)	11.22	12.34	15.71	20.20	5.61-7.28

3.1 EFFECTS OF MOISTURE CONTENT ON THE PHYSICAL PROPERTIES OF WATERMELON SEED OIL

The percentage oil yield was compared to with previous findings [11] for melon seed oil and chemical properties were compared to F.A.O/W.H.O international standard for edible oil [12] [13]. The result of the percentage oil yield of watermelon seed at various moisture contents is as presented in Table 1. The result shows that the control sample had an oil yield of 46.71 %, sample A 43.96%, sample B 38.71% and sample C 34.11%. The oil yield of all the samples ranged between 22.10-53.50 % which is similar to that reported for melon seeds [11]. The result shows that the oil yield of watermelon seed decreases with increase in moisture content, this is similar to that reported for other oil bearing seeds [4] [7].

3.2 SOME PHYSICAL PROPERTIES OF WATERMELON SEED OIL EXTRACTED AT VARIOUS MOISTURE CONTENTS.

i. Viscosity

The viscosity (mm/s) of watermelon seed oil determined at 40^0C for Control sample, Sample A, B and C are 1.78, 1.28, 1.22 and 1.21 respectively. These values are similar to the values reported for black and white watermelon seed oil [14]. Based on oil fluidity, Control sample with the lowest moisture content has the highest viscosity, therefore the higher the moisture content, the lower the viscosity. This property makes watermelon seed oil suitable for lubrication.

ii. Specific gravity

The specific gravity of the watermelon seed oil for control sample, sample A, B and C are 0.99, 0.98, 1.01 and 1.01 respectively, which is not significantly different from the international standard recommended

values for edible oil [11]. Specific gravity, which is the density of substance, was not significantly affected by increase in moisture content.

ii. Refractive Index

There were no significant differences in the refractive index of watermelon seed oil extracted from all the samples at the different moisture content and that reported for melon seed oil [11]. The results show therefore that moisture content has no significant effect on the refractive index of watermelon seed oil.

3.3 SOME CHEMICAL PROPERTIES OF WATERMELON SEED OIL EXTRACTED AT VARIOUS MOISTURE CONTENTS.

i. Saponification value

The saponification values (mg/KOH/g) of watermelon seed oil determined for control sample, samples A, B and C were 196.35, 308.55, 316.35, and 325.38 respectively. The values are higher than the 181.40 mg/KOH/g value previously reported for watermelon seed oil [15]. This variation maybe due to variety of the watermelon seeds, environmental factors or extraction method used. The saponification value gives information about the fatty acid present in the oil and the solubility of the soap derived from it in water. High saponification value contains low portion of fatty acid, which is higher than the value recommended for edible oil. This is an indication that watermelon seed oil will be suitable for soap making.

ii. Iodine Value

The iodine value (g/100g) determined for control sample, samples A, B and C were 135.60, 122.60, 126.32 and 131 respectively. The values are higher than that previously reported for water melon seeds [14]. The iodine value increased in a uniform manner between 10-30 % moisture content. The iodine value of oil is a measure of the unsaturated acid present; this also indicates its non-drying qualities. Therefore, the test measures the amount of iodine consumed by the acid. The greater the iodine value, the greater the unsaturation and hence the greater the liquidity. The lower value indicates lower degree of unsaturation. The sample C with the highest moisture content has the lowest iodine value, which indicates that iodine content decreases with increase in moisture content.

iii. Acid Value

The acid value (mg/KOH/g) of watermelon seed oil determined for control sample, samples A, B and C were 5.61, 6.17, 7.86, 10.10 respectively, which is higher than the standard value of 4.0 mg/KOH/g recommended by F.A.O/W.H.O for edible oil previously reported [12]. The acid value increased with increase in moisture content. Therefore, the higher the moisture content, the higher the acid value.

vi. Peroxide Value

The peroxide value (meq/kg) of watermelon seed oil determined for control sample, Sample A, B and C were 2, 4, 12 and 16 respectively. The results obtained are within the range previously reported [14]. The peroxide value increased significantly with increase in moisture content. Peroxide value is a measure of its oxygen content, which is used to monitor the rancidity through the evaluation of the quantity of peroxide generated in the product. The lower perioxide value of watermelon seed oil means it will not easily go rancid which is related to its longer shelf life and stability; this is in conformity with that reported for watermelon seed oil has a shelf life of up to 5 years [16].

v. Free Fatty Acid

The free fatty acid (mg/KOH/g) of watermelon seed oil determined for control sample, samples A, B and C were 11.22, 12.34, 15.71 and 20.20 respectively. The free fatty acid value measures the extent to which glycerides in the oil have been decomposed by lipase action. Rancidity is usually accompanied by free fatty acid formation; the determination is usually used as general indication for the condition and the edibility of the oil. The free fatty acid increased significantly with increase in moisture content. The free fatty acid of all the samples were all significantly higher than the recommended range of 5.6 – 7.28 by FAO/WHO [17].

4.0 CONCLUSION

It can therefore be concluded that the percentage oil yield decreased with increase in moisture content, while saponification value, acid value, free fatty acid and peroxide value increased with increase in moisture content. Watermelon seed oil will therefore be suitable for lubrication and soap making.

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