International Journal of Biochemistry Research & Review
4(6): 568-573, 2014

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Comparative Study of the Physicochemical Properties of Vegetable Oil from *Irvigna gabonesis* and *Citrullus colocynthis* Dried Seeds Samples

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Author's contribution

This work was carried out by the author IOI. Who designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. The author IOI read and approved the final manuscript.

Original Research Article

Received 5th July 2013
Accepted 23rd May 2014
Published 30th July 2014

ABSTRACT

Aim: Extraction and analysis of the physicochemical properties of vegetable oil from *Irvigna gabonesis* and *Citrullus colocynthis* were carried out to predict possible applications.
Study Design: It was designed to extract oil from the seeds and investigate the properties to indicate their performance and potentials in industrial applications.
Place and Duration of the Study: Department of Biochemistry, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria, between October and December, 2012.
Methodology: Fresh seeds were collected, dried and ground to smaller particle size. Soxhlet apparatus method was used in extraction with petroleum ether (40-60ºC) while standard official methods were employed in the analysis.
Results: The result revealed that both were oil seeds yielding *Irvigna gabonesis* 36.43±2.60% and *Citrullus colocynthis* 28.03±1.20% oil. Physicochemical properties of the oil showed that the total fatty matter in both samples were very high at about 98%. The refractive index was 1.46 and 1.43 for *Citrullus colocynthis* and *Irvigna gabonesis* respectively. The acid values of 2.02 and 20.2mgKOH/g were respectively low and high in *Citrullus colocynthis* and *Irvigna gabonesis.* The free fatty acid content of 6.97% in

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Irvigna gabonesis was higher than 2.15% in *Citrullus colocynthis*. Consequently, the peroxide value of 1.20meq/g was also higher in *Irvigna gabonesis* than the low amount of 0.45meq/g in *Colocynthus*. The iodine value of 7.90±1.00 Wij's was low in *Irvigna gabonesis* compared to 114.30±1.06 Wij's in *Citrullus colocynthis.* The saponification values of 208.10 and 202.90mgKOH/g were high.

Conclusion: *Irvigna gabonesis* oil had high acid value, free fatty acids and peroxide value compared to *Citrullus colocynthis.* The low iodine number of the *Irvigna gabonesis* oil indicates high degree of saturation while the high level of iodine value in *Citrullus colocynthis* was indicative of high unsaturation. The saponification values showed presence of saponifiable lipids. The oils can be useful in nutrition and manufacturing industry.

Keywords: Irvigna gabonesis; Citrullus colocynthis; vegetable oil; acid value; peroxide value; iodine value; saponification.

1. INTRODUCTION

Information on the nutrient composition of locally available foods is very scanty and where available, these data are related to only the most popular food materials [1]. The food use of local food materials calls for more investigative data on the nature of their compositions and properties. Some of the local seeds have been neglected and not been given the necessary attention in the diets of the world people, which might be as a result of ignorance of their nutritive value and other possible health benefits.

In the Igbo speaking South-Eastern Nigeria, soup is in the center of the people's food. Condiments are plant seeds that are added to enrich and enhance flavour of soup while thickeners are substances added to "thicken" and add bulk or body to soup which helps to stimulate appetite and aid swallowing [2]. These seeds serve both as condiment and thickeners and form an important part of the West and Central African diet, providing carbohydrate, oil and protein [3]. Examples of such seeds are *Citrullus colocynthis* (melon) and *Irvingia gabonnesis* (bush mango).

Citrullus colocynthis (English: melon; Igbo: egusi) is a seed crop that belongs to the gourd family Ucurbtaceae [4]. It is a seed crop and the commonest soup condiment enjoyed in the south-east region of Nigeria. The melon plant has smooth spherical fruits of the size of cucumber sometimes or as big as a small ball. The fruit contains soft spongy pulp, with numerous ovale-shaped, compressed, white or brown seeds [5]. *Irvigna gabonesis* (English – bush mango; Igbo - ọgbọnọ) has the ability to form gels at lower concentration than many oil seed flours and this is why they are applied in food industry that require a thickening agent [6].

The industrial application of any material can be achieved through biochemical analysis which has proven very useful because it analyzes the components and their properties, which determines the specific or spectrum of functions of the material. Vegetable oils have been used among others, for nutrition, production of paints, varnishes and biodiesel production [7,8].

The aim of this study was to extract and analyze the oils from these seeds and determine their physicochemical properties while comparing them with each other to establish other useful applications beyond their use in nutrition.

2. MATERIALS AND METHODS

The seed samples used were fresh indigenous seeds picked from farms in Okposi autonomous community in Ohaozara Local Government Area, Ebonyi State, Nigeria. They were dried in an oven at 60ºC for 48 hours and later milled with a blender to reduce the particle size and increase the surface area for the analyses.

2.1 Oil Extraction

Oil was extracted using petroleum ether (40-60ºC) in a soxhlet apparatus. The solvent was distilled off in a rotary evapourator [9].

2.2. Acid Value

The acid value was determined as the number of milligrams of potassium hydroxide required to neutralize 1g of the oil [9].

2.3 Peroxide Value

The peroxide value was determined by ”Active Oxygen Method” following procedures described in Hamilton et al., [10] as the amount of substance in a sample expressed in terms of milli equivalents of “active or peroxide oxygen” per kilogram of fat or oil which oxidizes potassium iodide.

2.4 Iodine Value

The iodine value was derived according to Wij’s method as a measure of unsaturation in fats and is the number of grams of halogen added to the double bonds of 100g fat and expressed as equivalent number of grams of iodine [11].

2.5 Saponification Value

The saponification value was determined by refluxing the oil with alcoholic potassium hydroxide [10] while the amount of unsaponifiable matter was determined as the total quantity of matter present in the oil, which after saponification by potassium hydroxide and extraction using diethyl ether, are not soluble in aqueous alkali and nonvolatile at 103ºC [12].

3. RESULTS AND DISCUSSION

3.1 Oil Yield

The result of the percentage oil yield (Fig. 1) revealed that both were oil seeds yielding *Irvigna gabonesis* 36.43±2.60% and *Citrullus colocynthis* 28.03±1.20% oil. The moisture content and total fatty matter of *Irvigna gabonesis* were 4.39±0.02% and 98.25±0.04% respectively. The oil content was lower in *Citrullus colocynthis 28.03*±1.20%. The moisture content and total fatty matter was similarly low 4.12±0.01% and high 98.40±0.20% respectively. The results indicate that the oil yield was higher in *Irvigna gabonesis* than in *Citrullus colocynthis.* The values were however higher than the oil yield of seeds used in soup thickening [13] and oil yields of *Raphia vinifera* mesocarp (seed pulp) oil [7] and vegetable oil from *Afzelia africana* both used in biodiesel production [8]. The oil composition

was however lower but comparable to 54.26% reported for Turkish sesame seeds and 48.00–50% reported for *Sesame indicum L.* [14] which are oil seeds that can provide a commercial quantity of oil for the industries. The oil content was also found to be lower than castor seed – 50%, cotton seed – 30%, linseed – 40% and palm kernel – 50% [15].

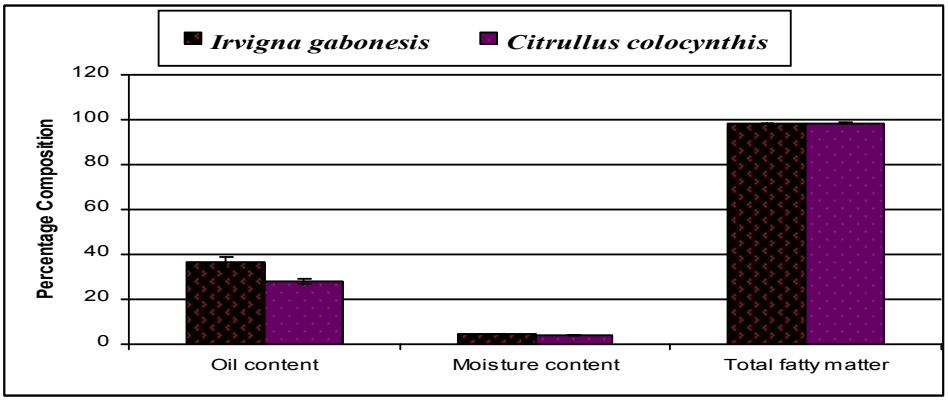

Fig. 1. Oil yield, moisture and total fatty matter of the seeds

Table 1. Physicochemical properties of vegetable oil from the seeds

Parameters	*Irvigna gabonesis*	*Citrullus colocynthis*
Refractive index @ 40ºC	1.43±0.00	1.46±0.00
Acid value (mgKOH/g)	20.10±0.51	2.02±0.01
Free fatty acid (%)	6.97±0.06	2.15 ± 0.01
Peroxide value (meq/g)	1.20±0.50	0.45±0.01
Sap. value (mgKOH/g)	202.90±3.00	208.10 ± 3.00
Iodine value (Wij's)	7.90±1.00	114.30±1.06

3.2 Physicochemical Properties

The physicochemical properties of the extracted oil (Table 1) revealed that the refractive index was 1.46 and 1.43 for *Citrullus colocynthis* and *Irvigna gabonesis* respectively. Refractive index of a fat is the ratio of speed of light at a defined wavelength to its speed in the fat itself. This value varies with wavelength and temperature, the degree and type of unsaturation, the type of substitutions of component fatty acids and with accompanying substances. Refractive index is widely used in quality control to check for the purity of materials and to follow hydrogenation and isomerization [12]. This value fell within acceptable range of 1.4677 to 1.4707 for virgin, refined and refined-pomace oils according to Codex Standards for fats and oils from vegetable sources [16]. The acid values were low in *Citrullus colocynthis* 2.02 and high in *Irvigna gabonesis* 20.10mgKOH/g respectively. These values however accounted for the presence of free fatty acids in the oil as an indicator of the presence and extent of hydrolysis by lipolytic enzymes and oxidation [17]. The low value in *Citrullus colocynthis* showed that the oil will be stable over a long period of time and protected against rancidity and peroxidation. This could be attributed to presence of natural antioxidants in the seeds such as vitamins C and A as well as other possible phytochemicals like flavonoids. These values are comparable to the values of 3.0, 12.2, 0.8, 2.1 and 2.5 reported for sunflower, cotton seed, groundnut, olive oil and coconut oils respectively used as edible and industrial oils [18]. The acid value of *Irvigna gabonesis* was higher than the

maximum level in refined, cold pressed and virgin oils for fats and oils from vegetable sources. However, the acid value from *Citrullus colocynthis* was higher than the maximum level for refined oil but lower than values for cold pressed and virgin oils [16]. These higher values can be lowered by bleaching or refining.

Correspondingly, the value of free fatty acids was higher in *Irvigna gabonesis* 6.97% than *Citrullus colocynthis* 2.15%. Consequently, the peroxide value of 1.20meq/g was higher in *Irvigna gabonesis* while *Citrullus colocynthis* had a lower peroxide value of 0.45meq/g. The peroxide values for both oils were lower than 10 – 15meq of active oxygen/kg oil. This is an improvement on the oxidative stability of the oil when exposed to air [7]. The saponification values were high that is, 208.10 and 202.90mgKOH/g respectively for *Citrullus colocynthis* and *Irvigna gabonesis* respectively. An increase in saponification value in oil increases the volatility of the oil. It enhances the quality of the oil because it shows the presence of lower molecular weight components in 1g of the oil which will yield more energy on combustion [8]. The saponification value is the number of milligrams of potassium hydroxide required to neutralize the fatty acids liberated on complete hydrolysis or saponification of 1g of the oil. It is inversely proportional to the molecular weight of the oil since 1g of oil or fat containing low molecular weight fatty acids will have more molecules than oil or fat containing higher molecular weight fatty acids [13].

The iodine values were 114.30 and 7.90 Wij's for *Citrullus colocynthis* and *Irvigna gabonesis* respectively. The iodine (Wij's) value of *Irvigna gabonesis* was lower than prescribed 75 – 94 Wijs for vegetable oils while the value for *Citrullus colocynthis* was higher (114.30±1.06 Wijs) than standard recommended value [16]. This result of iodine value indicates that *Irvigna gabonesis* was composed primarily of saturated fatty acids and this can be deduced from the nature and consistency of the oil at room temperature. Iodine number of oil is a measure of its unsaturation and is a useful criterion for purity and identification. The value for *Irvigna gabonesis* oils indicates that the oil is non-drying (fat) with iodine number lower than 100 while *Citrullus colocynthis* oil was semi-drying with iodine number between 100 and 130 [19]. Non-drying oils are not volatile at room temperature and does not pose any danger of inflammability.

4. CONCLUSION

The results showed that the seeds have extractable oil that is comparable to the yield of oil seeds. The total fatty matter in both samples were very high, an indication that they predominantly consisted of triacylglycerols. The physicochemical properties of the oil revealed possible industrial application as a raw material for biodiesel, paints, varnishes, margarine, edible oil and other products.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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