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Quality evaluation and antimicrobial activities of adzuki bean seed oil (*Vigina angularis)*

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Abstract
The crude oil extracted from Adzuki bean oil (*Vigna Angularis)*, purchased from Owo in Oba market in Owo local government area of Ondo state Nigeria. The extraction of the oil from the seed was carried out by soxhlet method using hexane as the extractant. The physicochemical properties of the oil were determined using gas chromatography (GC) and other standard methods. The antimicrobial activities were carried out using five species of bacterial. The results of the investigation is as follows: specific gravity (0.8142±0.11), refractive index at 250®C (1.462±O0.10), moisture content (0.850±0.12), PH (4.52±0.01), flash point (121®C±0.50), smoke point (110.®C±0.12), fire point (125®C±0.20), color (22.00 unit), others were free fatty acid (0.58%±0.02), acid value (1.18±0.01), peroxide value (12.05±0.05)meg/0.2/KOH, iodine value (105.00±0.03wij) and saponification value (195.05±0.05 mg/KOH). Gas chromatography analysis gave the following: fatty acid profiles, myristic (1.05%) %, palmitic (22.05%), stearic (56.60%), (oleic 78.60%), (linoleic 18.5%), (linolenic 16.58%) and behenic acids of (0.51%). The antimicrobial activities revealed the activities of the following organisms as against popular commercial antibiotics Escherichia Coli (15.00±0.04), Proteus (1.00±0.00), Klebsiella (3.00±0.03), Salmonella (7.00±0.01), and Bacillus Substill (5.00±0.02). The study shows that the vegetable seed oil is a good source of edible oil and for food formulation as well as drying oil in pharmaceutical, paint, soap and perfume industries because of its higher level of unsaturation in the fatty acid content.

Keywords: antimicrobial activities, physicochemical properties, adzuki bean, fatty acid profile, bacteria

Introduction

A lot of vegetable oils, of varying quality are available on the Nigeria markets, oil recovered from vegetable, seed or nuts by solvent extraction or mechanical pressing are termed "crude vegetable oil" and they contain various classes of lipids. They consist primarily of neutral lipids which include tri-di—and mono acylglycerols free fatty acids and polar lipids such as phospholipids. They also contain a minor amount of unsaponifiable matters that includes phytosterols, tocophenols and hydrocarbons such as squalene (Amos, Tautua, *et al*; 2013) [7]. Vegetable oil is essential in meeting global nutritional demand and it is realized for many foods and other industrial purposes, despite the broad range of sources for vegetable oil, the world consumption is dominated by soya beans, palm, rape seed and sunflower (Jide, *et al*., 2023). Adzuki bean has been cultivated and it is in used for thousands of years in south Asia countries such as China, Japan and Korea, where it is a popular ingredient for deserts, snacks and confessionary items.

In west countries, it has been little more than a curiosity until recently (Listari, 2014). Adzuki bean (*Vigna Angularis*) is grown in more than 30 countries of the world which is an important legume crop. Starch, digestible proteins, mineral elements, and vitamins are abundantly present in Adzuki beans (Srishti and Ekta, 2019). Adzuki beans are available in many varieties around the world depending on grain size and color, harvest time, climate and region where it is being cultivated. In Asia countries, varieties of food can be prepared by millions of people using adzuki beans such as cake, rice jelli, milk and ice cream (Listari, 2014).

The aim of this study is to determine the physic-chemical properties, fatty acids profile as well as microbiological activities of crude oil extracted from Adzuki beans seed oil. (*Vigna Angularis)*.

Materials and methods

The seeds (*Vigna Angularis)* used for this work were obtained from market at Owo, in Owo local government area of Ondo state Nigeria. They were prepared for use by decoating, sun drying and milling. The soxhlet extractor was used for the solvent extraction of the oil. The solvent used was hexane and it was recovered by simple distillation. The residual oil was collected and it was used for the analytical work. The extracted oil was stored in a dark brown bottle glass so as to prevent oxidation before it is being used. The PH, moisture content, specific gravity, flash, smoke and fire point were determined according to (Aladekoyi and Jide, 2019) [4]. Refractive index of the oil sample was measured by the angle through which beam of light is bent when passing through a film of method fat or oil. This was determined by Abbey refractometer, couple with thermometer calibrated specimen and light sources. The color was determined using lovibond tintometer and inche cell. The color which is in unit was then calculated based on this formula (5 R x Y-B) where R is the red pigment, Y is the yellow pigment while B is the blue pigment (Jide, *et al*., 2018). The chemical properties of the oil sample includes,

free fatty acids, acids value, saponification value, peroxide value, iodine value and fatty acids composition were determined according to (AOAC, 2005) [5]. The antimicrobial activities of the oil sample were determined using the Agar well techniques (Pelcza and Black, 1993) [16]. The assay antibacterial activity was carried out *with Klebsiella, pheumona, Bacillus Substill, proteus, salmonella typii* and *E.coli.*

Table 1: Results of physical characteristic of (*Vigna Angularis) seed oil.*

Parametears	Results
Specific gravity	0.8142±0.11
Refractive index (25®C)	1.4620±0.10
Moisture content (%)	0.50±0.12
PH	4.52±0.01
Flash point (®C)	121±0.50
Smoke point (®C)	110±0.12
Fire point (®C)	125±0.20
Color (unit)	22.001/light yellow
Oil content (%)	45.05±0.25

Mean ± standard deviation of triplicate determination

Table 2: Results of chemical composition of oil extracted from (*Vigna Angularis)* Adzuki beans seed oil.

Parametears	results
Free fatty acids (%)	0.58±0.02
Acids value (%)	1.18±0.01
Peroxide value (Meg o.2/KOH)	12.05±0.05
Iodine value (wij)	105.00±0.03
Saponification value (Mg/KOH/)	195.05±0.05

Mean ± standard deviation of triplicate determination

Table 3: The fatty acid composition of oil extracted from (*Vigna Angularis)* Adzuki beans bean flour

Fatty Acids Methyl Ester	Fatty Acids	Carbon Number	(%)
Methyl myristate	myristic	14.0	1.05
Methyl palmitate	palmistic	16.0	22.05
Methyl steriate	stearic	18.0	56.60
Methyl oleate	oleic	18.1	78.60
Methyl linolate	linoleic	18.2	18.50
Methyl linolenate	linolenic	18.3	16.58
Methyl behenate	behenic	22.0	0.51

Table 4: Antimicrobial activities of oil extracted from (*Vigna Angularis)* Adzuki beans flour

Test Organisms	Zone Of Inhibition (Cm)	Control
Escherichia coli	15±o.40	25
Proteus	1.00±0.00	15
Klebsilella pheumonia	3.00±0.03	18
Salmonella	7±0.01	14
Bacillus substils	5±0.02	16

Gentamycin antibiotic was used as control. Table 1 shows the physical properties of the crude seed oil from (*Vigna Angularis),* the color of the oil is yellow and odorless, liquid at room temperature. The color was also determined using lovibond tintometer to be 22.00 lovibond units. This was calculated based on the expression (5 R+Y-B), where the R is the red pigment, Y yellow pigment and B blue pigment. The oil content is of great importance in the determination of the products for processing the percentage oil yield oil of 45.05% indicates that Adzuki bean is suitable for industrial production of vegetable oil. The result was very close to a result reported for shear of 49.85±0.25 by (Abitogun *et al*, 2011) [3].

The result of flash, fire and smoke point were determined to be 121®C±0.05, 125®C-0.5±0.20 and 110®C±0.12 respectively. The results were lower than 298®C, 350®C and 147®C reported for cashew nut oil respectively by (Abitogun and Borokini, 2009) [1]. This might be because of the high content of steric acids. The refractive index (RI) related to molecular weight, fatty acids chain lengths, degree of unsaturated and conjugation (Gun Stone 2002) [10]. The refractive index of thee oil is 1.4620±0.10. These values fall within the range of edible oils (Ilesanmi *et al*, 1990) [11]. The specific gravity and moisture contents were 0.8142±0.11 and 0.850±0.12 respectively. This specific gravity is lower than 0.87 reported for luffa cylindrical oil (Abitogun and Olumayede, 2008) [2]. While the presence of moisture was as a result of traditional methods of preparation. The PH value of 4.52±0.01 implies that the oil has an acidic characteristic.

Table 2 shows the chemical composition of crude oil extracted from adzuki bean seed oil (*Vigna Angularis).* Free fatty acids and acidic values are used to indicate the level of edibility and identify suitability for making paint in industry (Amos-Tautau, *et al* 2013) [7]. The value obtained from free fatty acid and acidic value is 0.58±0.02 and 1.18±0.01 respectively. The allowable limit for free fatty acid for edible oil is 1.0-3.0% (Paul and Mittal, 1997) [15]. The lower the free fatty acid, the better the oil consumption processing. It shows that Adzuki bean oil is good for consumption after processing. Peroxide value of oil is the ability to absorb the definite amount of iodine (Moris and Jacob, 1999) [13]. The peroxide value was 12.05±0.05 Meg02/KOH. The low level of the value indicates that the oil would not be affected by oxidative rancidity; also it contains low level of unsaturated hydrocarbons. Iodine value is a measure of degree of unsaturated oil. The greater the iodine value, the more the unsaturation and higher the susceptibility to oxidation. The result shows that Adzuki bean oil had the value of 105.00±0.03 wij. The oil is more unsaturated fatty acids than saturated. Saponification value is used in checking oil adulteration. The value of 195.05±0.05mg (KOH) obtained from the samples indicate that the oil sample is of high molecular weight fatty acid triglyceride hence, it is used in soap and shampoo application in cosmetic industries. The value is higher than 145mgKOH/mg oil reported for cashew nut oil (Abitogun and Borokini, 2009) [1].

Table 3 presents the fatty acids composition of Adzuki bean oil. The fatty acids detected were myristic acids 1.05%, palmitic 22.05%, stearic 56.60%, oleic 78.60%, linoleic 18.5%, linolenic 16.58% and behenic acids of 0.51% respectively. The fatty acid composition is the relative proportion of different fatty acids in the mixture of triglyceride which is a characteristic of vegetable oil. The physiological effects of vegetable oil are also base on their fatty acids (Bamidele and Adebayo, 2013) [7]. Most of the experiments that palmitic acid, myristic acid and lauric increase plasma cholesterol than those with shorter or longer chain (Bornanome and Gynndu, 1988) [8]. While stearic consumption is associated with low level of total and low density of lipoprotein cholesterol than those found in similar intakes of palmitic acid. The cholesterol effect was equally similar to that of oleic acid (Cox *et al*., 1996) [9].

Table 4 shows the antimicrobial activities of Adzuki bean oil. The diameters of inhibition were measured in

centimeter. The results for each organism were as follow: Escherichia Coli (15.00±0.04), Proteus (1.00±0.00), Klebsiella (3.00±0.03), Salmonella (7.00±0.01), and Bacillus Substill (5.00±0.02) centimeter respectively. The highest activity was recorded in Escherichia coli while the lowest one was recorded in Proteus. The inhibitory activities of the oil are also as a result of bioactive component of the oil (Ashidi *et al*., 2005) [6]. The activity of the microorganism tested could be considered less active when compared with commercial antibiotic such as gentamycin.

Conclusion

The result of the study have shown that from the nutritional point of view, Adzuki beans oil (*Vigna Angularis)* appears to have a beneficial effect on health and can also be considered to be a good source of oil suitable for food formulation as well as pharmaceutical, paint, soap, and perfume industries due to its high level of unsaturation in the fatty acid contents compared to other seeds oil.

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