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Original Article

Physicochemical and Phytochemical Analysis of *Vitellaria paradoxa* Nut in Selected Districts in Kebbi State, Nigeria

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Abstract

Selected shea nut fat extracts were subjected to physicochemical and qualitative phytochemical analysis and showed the following results; Saponification values mgKOH/g; 141.65 ± 0.40^{c} 166.1 ± 0.80^{ab}, 169.79 ± 1.29^{a}, Iodine values I_2/100g; 51.17 ± 0.18^{c}, 53.54 ± 0.39^{a}, 51.78 ± 0.26^{b}, Acid values mgKOH/g; 15.52 ± 1.62^{a}, 14.26 ± 0.33^{b}, 7.52 ± 0.33^{a}, Free fatty acids mg/g; 5.04 ± 0.05^{b}, 4.20 ± 0.04^{bc}, 7.52 ± 0.33^{a}, and Specific gravities; 0.94 ± 0.02^{a}, 0.96 ± 0.03^{a}, 0.93 ± 0.01^{a} both for Illo, Kwanga and Kwere samples respectively. Phytochemical qualitatively determined includes; cardiac glycosides, flavonoids, saponins, steroids and terpenoids for Illo, Kwanga and Kwere samples respectively. The results showed various probable uses of the fats extracts including domestic and industrial.

1. Introduction

The shea nut fat is produced from shea nuts derived from the shea nut tree, called *Vitellaria paradoxa*. This tree is an indigenous tree species to many countries in Sub-Saharan Africa and in these countries the shea tree and its many uses have been known for over centuries [1]. It constitutes an important source of fat in food and cosmetics [2]. Its fatty matter has been used for years in Africa for different purposes, ranging from food and soap processing, health care and other medicinal uses [3]. It is also used to treat horses internally and externally for girth galls and other sores [4]. In some African countries such as Benin, shea butter is used for cooking oil, as a waterproofing wax, for hairdressing, for candle-making, and also as an ingredient in medicinal ointments. It is also used by traditional Africans to increase the durability of wood, dried calabash gourds, and leather tuning straps. Shea butter is used as a base for medicinal ointments. Some of the isolated chemical constituents are reported to have anti-inflammatory, emollient and humectant properties [5]. In fact the seed kernels produce high oil content which is nutritious with unsaturated fatty acids such as oleic and linoleic fatty acids and fat soluble vitamins [6]. In this work, physicochemical analysis and preliminary phytochemical screening of selected Shea nut fat was explored.

2. Materials and methods

2.1 Methods

2.1.1 Sample collection and identification

Some selected samples of shea nut seeds (*Vitellaria paradoxa*) were collected from Illo, Kwanga and Kwere towns of Kebbi State, Nigeria. The leaves and stems of *Vitellaria paradoxa* were authenticated by Dr. Dhramemdra Singh of the Botany Unit of Biological department, Kebbi State University of Science and Technology Aliero in comparison with voucher specimen No. 320 kept at Herbarium.

2.2 *Sample treatment*

The nuts dried under the sun for a day and later dried in the oven for about three hours at 50°C to ensure that water and moisture were removed. The seeds were immediately ground using mortar and pestle into a paste. The paste was stored in a labeled airtight container for oil extraction. All the chemicals and reagents used were of analytical grade unless otherwise stated. Distilled water was used in the preparation of solutions and dilution unless otherwise stated.

2.3 Extraction of fat

Extraction of fat from the powdered nuts is carried out using Soxhlet extraction apparatus. A 70g of the powdered nuts sample was put into a porous thimble and placed in a Soxhlet extraction apparatus, using 150 cm^3 of n-hexane (with boiling point of 40-60^{0}C) as extracting solvent for 6hrs repeatedly until required quantity was obtained. The fat was obtained after excess solvent was removed using water bath. The fat was then stored in a freezer for subsequent physico-chemical analysis.

2.4 Physico-chemical analysis

The chemical analysis of the fats was carried out using the methods reported [7-9]. The physico-chemical analyses were carried out in triplicate.

2.5 Phytochemical screening

The phytochemical screening was performed on the fat extracts using standard procedures [10-13].

Flavonoids

Two millitres of dilute sodium hydroxide was added to 2ml of the extract. The appearance of a yellow colour indicates the presence of flavonoids.

Saponins

One millitre of distilled water was added to 1ml of the extract and shaken vigorously. A stable persistent froth indicated the presence of saponins.

Tannins

A portion of the extract was dissolved in water, after which solution was clarified by filtration. 10% ferric chloride solution was then added to the resulting filtrate. The appearance of bluish black colour indicated the presence of tannins.

Anthraquinones

Half gramme of the extract was shaken with 10ml of benzene and filtered 10% of ammonia solution was added to filtrate and the mixture was shaken. The formation of pink, red or violet colour on the ammonical phase indicated the presence of anthraquinones.

Cardiac glycosides

Half gram of the extract was dissolved in 2ml glacial acetic acid containing 1 drop of ferric chloride solution. This was under layered with 2ml of concentrated sulphuric acid. A brown of deoxy sugar characteristics of cardiac glycosides.

Phlobatannins

A few drops of 1%HCL was added to1ml of extract and boiled. A red precipitation indicates the presence of phlobatannins.

Terpenoids (Salkowski test)

Five millilitres of each extract was mixed in 2ml of chloroform and concentrated H_2SO_4 (3ml) was carefully added to form a layer. A reddish brown coloration of the inter face was formed to show positive results for the presence of terpenoids.

Cardenolides

Two millilitres of benzene was added to 1ml of the sample extract. The formation of a turbid brown colour is an indication of the presence of cardenolides.

Steroids

Two millilitres of the sample was put in test tube, 6ml of chloroform was added. 4ml of concentrated H_2SO_4 was added by slide of the test tube. The upper layer turned red, whereas the sulphuric acid layer turned yellow with green fluorescence. This indicates the presence of steroids.

3. Results

Table 1: The physico-chemical properties of shea butter oil

Physico-chemical properties	Districts		
	Illo Sample	Kwanga Sample	Kwere Sample
Saponification Value mgKOH/g	141.65±0.40^{c}	166.1 ± 0.80^{ab}	169.79±1.29^{a}
Iodine value I_2/100g	51.17±0.18^{c}	53.54±0.39^{a}	51.78±0.26^{b}
Acid value mgKOH/g	15.52 ± 1.62^{a}	14.26 ±0.33^{b}	7.52±0.33^{bc}
Free fatty acid mg/g	5.04±0.05^{b}	4.20 ± 0.04^{bc}	7.52±0.33^{a}
Specific gravity	0.94 ± 0.02^{a}	0.96 ± 0.03^{a}	0.93±0.01^{a}

Values are in Mean±Standard deviation of triplicates.

The same subscript indicates that there is no significant difference while different subscript letters indicates that there is significant difference in the physico-chemical analysis of the shea nut fats.

Table 2: Phytochemicals

	Phytocontituents areas of sample collection					
	Illo		Kwanga		Kwere	
	LE	HE	LE	HE	LE	HE
Anthraquinones	-	-	-	-	-	-
Cardenolides	-	-	-	-	-	-
Cardiac glycosides	+	+	+	+	+	+
Flavonoids	+	+	+	-	+	+
Phlobatannins	-	-	-	-	-	-
Saponins	+	+	+	+	+	+
Steroids	+	+	+	+	+	+
Tannins	-	-	-	-	-	-
Terpenoids	+	+	+	+	+	+

LE = Local extract; HE= Hexane extract

4. Discussion

The physicochemical analysis (Table 1), determined for the soxhlet extracted indigenous Shea nut fat from three different selected areas of Kebbi State namely; Illo, Kwanga and Kwere. Saponification value for Illo fat 141 ± 0.4 mgKOH/g the value obtained which was lower than that of *Dennettia tripatala* fruit oil(Pepper fruit) 159.33±1-20 suitable for soap making [14] but higher than that of beeswax (93 mgKOH/g), which are commonly used in soap making [15].This indicates that the fats could be used in soap making. While saponification value for Kwanga fat sample was166.1±0.80 mgKOH/g, Kwere fat169.79±1.29 mgKOH/g which are lower than 213mgKOH/g for neem seed oil [16] and 253.2mgKOH/g in coconut oil [14] higher than that of *Dennettia tripatala* fruit oil (Pepper fruit) 159.33±1-20 [17] and African pear oil 143.76 mgKOH/g which could be good for soap making [18].. This indicates that the fat could also be used in soap making since it saponification value falls within the range of these oils. Higher saponification justifies the usage of fat or oil for soap production. Iodine value for Illo fat51.17±0.18, 53.54±0.39 for Kwanga fat and 51.78±0.26 for Kwere fat (All less than 100) were obtained, which shows that the fat belongs to the class of Non-drying oils, which are useful in the manufacture of soaps [19]. Acid value for Illo fat sample15.52 ± 1.62mgKOH/g and14.26±0.33mgKOH/g for Kwanga were obtained which were lower than that of olive oil 17 mgKOH/g [20] higher than the 10.49 3mgKOH/g reported [21] suitable for soap production while for Kwerefat , 7.52± 0.33mgKOH/g was obtained which is lower than 15.52±1.62mgKOH/g and14.26±0.33mgKOH/g obtained in Illo and Kwanga fat sample respectively; higher than that of Palm kernel seed oil 0.834±0.004mgKOH/g reported [22] suitable for soap production. Free fatty acid for Illo fat 5.04±0.05 which had almost the same value with that for rubber seed oil of 5.20 [23], but greater than that of Kwanga fat having 4.2±0.04 and lower than Kwere fat 7.52±0.33. The free fatty acids of the three fat5.04±0.05^{b} ,4.20 ± 0.04^{bc}, 7.52±0.33^{a} are higher than the values for bread-fruit oil 2.86 [24]. Even though high concentration of free fatty acids is undesirable in crude oils because it result in large loss of oil during refining and can cut off flavors and shorten the shelf life oils [25]. The specific gravity of the fat extracts ranges between 0.94±0.02 for Illo fat to 0.96±0.03 for Kwanga fat and 0.93±0.01 for Kwere fat. The values compare with 0.90 reported for Garlic *(Allium sativum L)* oil [26]. None of the fats had offensive odour. Preliminary phytochemical screening revealed the presence of flavonoids, saponins, cardiac glycosides, terpenoids and steroids in the N-hexane extract. While tannins, anthraquinones, phlobatannins and cardenolides were absent in both two extracts. Polyphenolic compounds such as flavonoids, tannins and phenolic acids commonly found in plants which have been reported to have multiple biological effect including analgesic property [27]. This is supported by another literature work [28]. Terpenoid which is qualitatively present and served as heart-friendly phytochemical constituent which helps to reduce diastolic blood pressure and lowers the sugar level in the blood [29]. Flavonoids, glycosides and cardiac glycosides found in the extracts are suggestive of their antioxidant property. Flavonoid glycosides are reported to be antioxidants and used as anti-inflammatory in the treatment of capillary fragility [30]. Their presence in the extracts is a probable indication of the potent antioxidant and membrane-stabilizing properties of the fats sample.

5. Conclusion

This study was undertaken to determine the physico-chemical and preliminary phytochemical properties of the fats obtained from shea nut kernels at selected towns of Kebbi State. The study showed various probable uses of the fats extracts including domestic and industrial applications.

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