



**PHYSICO CHEMICAL AND FATTY ACIDS COMPOSITION OF OILS FROM  
SOME LEGUME SEEDS**

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**ABSTRACT**

The Physicochemical properties and fatty acids composition of oils from calabash, bottle gourd, lump-in-neck gourd, *Citrullus lunatus* and *Citrullus colocynthis* kernels have been investigated. The studies showed that calabash kernel has the highest amount of protein (35.9%). The ranges of the physicochemical properties are: acid value (4.59-5.92 mgKOH/g oil), peroxide value (5.63-6.63mgKOH/kg), refractive index (1.46-1.52), iodine value (40.2 - 153mg/100g), specific gravity (0.90-0.94) free fatty acid (ffa) (2.30-2.96mgKOH/g) and saponification value (159-225mgKOH/g). The increasing order of concentration of fatty acids is linoleic acid (20.20-65.80%) > oleic (16.6-58.2% > palmitic (0.02 – 12.9%) > stearic acid (0.10 – 9.58%). The samples contained small quantities of palmitoleic, capric and linolenic acids.

**Keywords: Physico-chemical, Fatty acids, Oils, Legume**

**INTRODUCTION**

The legume seeds are sources of human food that provide much-needed essential protein and oils for growth, repairs, etc. They play important roles in the acceptability of monotonous diets and balanced in many parts of the world [1]. Plant sources are the major providers of protein and oil intake in many developing countries [2-5]. These samples are

underutilized because they are not widely consumed and their industrial processing is highly limited or non- existence except with some rural farmers using local processing methods. This is because their nutritional potentials have not been analyzed and tapped and only received little attention of food scientists. Some of the nutritional values of these underutilized seeds such as

calabash, lump-in-neck gourd and bottle gourd, *Citrullus lunatus* and *Citrullus colocynthis* are reported in the present report.

Calabash seed is mainly cultivated in semiarid regions and usually grown in a shrub with its fruit hanging or grown on a flat bed. Matured calabash seeds may be harvested 90 – 120 days after planting. In Africa, the calabash seeds are widely cultivated and traditionally and majorly used as containers and storage vessels by rural dwellers.

The bottle gourd is a vigorous, annual and running or climbing vine with large leaves. It grows fast and may begin to flower only 2 months after planting. The thick stem is longitudinally furrowed. The foliage is covered with soft smooth margins. It originated from Africa and later distributed widely in Columbia through the sea ways and then travelled to India and China. It thrives well mostly in sea water.

*Citrullus colocynthis* is a member of the cucurbitaceae family. It is smooth, hand-shelled when ripe and grows in many sizes and shapes but usually elongated oval shape. It is widely cultivated in the tropical areas of West Africa and Africa continent.

*Citrullus lunatus* is a fruit which belongs to the cucurbitaceae family. The plant is cultivated on a large scale in West and central Africa. It is easy to grow and its seed

is a popular food. The seed is handled like water melon or pumpkin. The planting method depends on site and situation. It is sown majorly during the raining season and will remain viable for at least 8 years when stored dry at temperature below 18°C.

Lump-in-neck bottle gourd (*Lagenaria siceraria*) belongs to a large family called cucurbitaceae. Many cucurbitaceae species are eaten in several forms as seed, leaves, fruits and sometimes the flowers could be eaten by the rural farmers. They are widely grown in Africa and other parts of the world. The specie used for the present study has a rough surface with ridge, the kernel is about 50% of the whole seed and the kernel contains about 50% of oil. They are very thick and hard to dehull.

The aim of this work is to determine the physico-chemical and fatty acids composition of oil from the samples.

## MATERIALS AND METHODS

The dried seeds were obtained from a market in Ado-Ekiti, Ekiti State of Nigeria. The seeds were screened to remove stones and bad ones. The remaining good ones were mixed thoroughly and dry-milled using a blender. The milled samples were then defatted using petroleum ether of analytical grade (British Drug House, London) boiling point range 40-60°C as described [6]. The proximate compositions of the flours were determined using method

[6] while the physicochemical properties of the oils such as acid value, peroxide, iodine, saponification value were determined using the methods described [7] while specific gravity was determined by conventional displacement method and refractive index was determined using Abbe's refractometer.

The fatty acids were determined using a method described [8]. The fatty esters were analyzed using a PYE Unicam 304 gas chromatography fitted with a flame ionization detector and PYE Unicam computing integrator. Helium was used as carrier gas. The column initial temperature was 150°C rising at 5°C min<sup>-1</sup> to a final temperature of 220°C. The injection port and detector temperatures were maintained at 220°C and 250°C respectively. The peaks were identified by comparison with peaks of standard fatty acid methyl esters.

## RESULTS AND DISCUSSION

The results of the proximate composition of the varieties of melon are presented in **Table 1**. The value of crude protein was high in calabash kernel (35.9g/100g). When compared with other varieties of melon studied. The quantity of the crude protein is highly comparable with those of protein rich foods such as soybeans (*Glycine max*), cowpea (*Vigna unguiculata*) and pigeon peas (*Cajanus cajan*) [9, 10]. Among the samples considered, *Citrullus lunatus* has

the lowest value of 24.9g/100g. The values of crude protein in these varieties of melon studied are comparable with widely known sources of protein. Therefore, they can be used as alternative sources of protein in diets provided their amino acids contents are in the appropriate mixture especially in developing countries where a high proportion of the population depends mostly on starchy foods and cereals.

**Table 1** also shows that the *Citrullus lunatus* and *Citrullus colocynthis* have high fat content (54.1 and 52.0g/100g) compared to other varieties of melon studied. Calabash melon has the lowest value of 43.2g/100g). The values of fat content in calabash, bottleneck, lump-in-neck gourd melon are comparable with those of groundnut (47.5g/100g) [11] and fluted pumpkin seed (47.0g/100g) [12] but higher than those of soybeans (19.1g/100g) [13] and varieties of African yam bean flour (7.61-10.20g/100g) [14]. It has been observed that the total fat contents of the legumes vary with type and variety [15].

These values reported are in close agreement with those values reported by previous workers such as 44.6 - 46.9g/100g for gourd seed [16], 50.6g/100g [17] and 50.5g/100g [18]. The results also show that oil seeds have very low quantity of moisture. The low moisture contents make them not susceptible to microbial attack.

This will enable them to have high self life. Calabash kernel has the least value of moisture content (4.75g/100g) when compared with other varieties studied. The moisture content of calabash kernel is higher than that of gourd kernel but comparable with those of fluted pumpkin kernel [19]. The value of ash for calabash kernel (4.26g/100g) is similar to that of some Nigerian grains [20]. The results of the ash reported presently compared favourably with these of legumes like cowpea, bambara, lima beans [13, 21] this suggests that the samples may contain essential minerals for body development.

**Table 2** presents the results of the physicochemical analyses of the samples. The saponification values of the samples are fairly high but lump in neck seed has the highest value of 225mgKOH/g. The saponification value obtained for calabash kernel oil is 159mgKOH/g. The values presently reported for the samples are lower than those values reported [7] for quinoa oil (192.0mgKOH/g), for butter fat (220-241mgKOH/g) and coconut oil (200-250 mgKOH/g) [22]. But the value for lump-in-neck oil (225mgKOH/g) is within the range reported for coconut oil (200-250mgKOH/g) [22]. This indicates that the oil samples contain a lot of unsaturated fatty acids. The values for the refractive index ranged between 1.46 and 1.51, bottle gourd

seed oil has the highest value while *Citrullus lunatus* has the lowest value (**Table 2**). Among the samples studied, calabash seed has the same value with that of lump-in-neck seed. The value of the refractive index of *Citrullus lunatus* falls within the range of (1.475-1.485) [22] for linseed oil, soybean oil and cod liver oil.

The peroxide value is high in lump-in-neck oil (6.62 equiv O<sub>2</sub>/kg) while *Citrullus lunatus* has the lowest value of 5.63 Equiv O<sub>2</sub>/kg). This indicates that the oils would not easily go rancid when properly stored. The range of values presently reported (4.63-6.62 Equiv. O<sub>2</sub>/kg) is comparatively higher than that of quinoa oil (2.44%) (7).

The acid and the free fatty acid (FFA) values are presented in **Table 2**. The acid value ranges between 4.59 and 5.92mgKOH/g oil while that of free fatty acid ranges between 2.3 – 2.96%. The calabash kernel oil has the highest acid value and free fatty acid value among the samples studied. These values obtained presently for the samples were higher than these of water melon kernel oil (2.82mgKOH/g oil, 1.41%), pumpkin oil (2.88mgKOH/g oil, 1.44%) and paprika seed oil (2.94mgKOH/g oil, 1.48%). This indicates that they would not easily go rancid when preserved in absence of oxygen and other contaminant.

The iodine value ranges between 40.2 and 153mg/100g oil. *Citrullus colocynthis* has the highest value while calabash seed oil has the lowest value. The Iodine value is related to a proximate amount of the unsaturated fatty acids present [7]. The high level of iodine value indicates a high level of unsaturated fatty acids [23]. The present value reported for calabash seed oil is lower than that of quinoa oil (54.0mg/100g) [7]. This shows that the amount of unsaturated fatty acid in Calabash seed oil is likely higher than that of quinoa oil. The present results show that the amount of unsaturated fatty acids in *Citrullus colocynthis* is highest among the samples. The Iodine value of lump-in-neck oil is highly comparable with that of *Adenopus breviflorus* oil (100.6mg/100g) [24].

**Table 3** presents the fatty acids composition (%) of the oil samples. The results revealed that the oils contained both saturated and unsaturated fatty acids. The present results show that the oils contain capric (C10:0), lauric (C12:0), myristic (C14:0), palmitic (C16:0) and stearic (C18:0). The monounsaturated acids include palmitoleic (C16:1), oleic (C18:0) while the polyunsaturated acids are linoleic (C18:2) and linolenic (C18:3). The present results show that oleic and linoleic acids are the most concentrated fatty acids. The present observation confirms the observation [25]

which stated that unsaturated fatty acids (oleic and linoleic) accounted for most of “egusi” seed oil. It has also been observed that linoleic and oleic acids are the major fatty acids in peanut, soybean, chickpea, garden pea, broad bean and lentil [26]. Many lipids from legumes contain substantial amounts of saturated fatty acids, especially palmitic acid [26, 27]. Lauric, myristic, palmitic, palmitoleic and stearic acids are more concentrated in the oils of calabash seed, bottle gourd, *Citrullus lunatus* and *Citrullus colocynthis* than soybean oil [22] and Africa yam bean [26] while it can be concluded oil seeds like those studied presently contained substantial amounts of unsaturated fatty acids. The oleic/linoleic (O/L) ratio of calabash oil (0.74) is the highest among the samples studied while *Citrullus colocynthis* has the lowest value (0.29). This helps in determining the detrimental effects of dietary fats. The higher the ratio the more nutritionally useful the oil [28]. Among the samples studied, calabash oil has high concentration of oleic acid (58.2%) while bottle gourd oil has the highest concentration of linoleic acid. It is worth nothing that (0.005%) arachidic acid was detected only in bottle gourd seed oil among the samples studied. The amount of linoleic acids (C18:2) in the samples were highly comparable with that of *Adenopus breviflorus* oil (60.73%) [29], with calabash

seed oil exclusive. The high percentage of polyunsaturated fatty acids in the samples may be an advantage over soybean and *Adenopus breviflorus* oils as these unsaturated fatty acids are essential constituents of human diet [30].

Table 1: Proximate Composition of the Varieties of Melon (g/100g)

	Calabash	Bottle gourd	Lump-in-neck bottle gourd	Citrullus lunatus	Citrullus colocynthis
Moisture	5.25	4.75	5.50	7.83	7.85
Ash	4.26	4.59	3.98	5.12	3.40
Crude protein	35.9	30.7	29.23	24.9	25.85
Crude fat	43.18	46.11	46.10	54.1	52.0
Crude fibre	2.55	1.96	6.60	4.28	4.20
Carbohydrate by difference	8.86	11.89	8.59	3.77	6.70

Table 2: Physicochemical Properties of the Varieties of Melon

	Calabash seed	Bottle gourd	Lump-in-neck	Citrullus linatus	Citrullus colocynthis
Specific Gravity	0.90	0.94	0.93	0.92	0.91
Refractive index	1.49	1.51	1.49	1.47	1.46
Colour	Yellow	White	Yellow	White	Yellow
Acid value (mg KOH/g)	5.92	5.21	4.59	4.77	4.75
Free fatty acid (%)	2.96	2.60	2.3	1.80	2.05
Iodine value (mg/100g)	4.02	98.7	100.32	150	153
Saponification value (mg/KOH/g)	159.0	221.0	225.1	197.0	197.0
Peroxide value (Equiv. O <sub>2</sub> /kg)	5.60	6.58	6.62	5.63	5.66

Table 3: Fatty Acid Composition of the Varieties of Melon

Fatty acid (%)	Calabash seed	Bottle gourd seed	Lump-in-neck bottle gourd seed	Citrullus linatus	Citrullus colocynthis
Lauric	9.12	0.11	0.510	0.035	-
Capric	-	-	0.0013	-	-
Myristic	5.36	0.16	0.164	0.0045	-
Palmitic	2.12	0.02	-	12.9	10.10
Palmitoleic	0.01	-	0.024	-	-
Stearic	2.54	0.10	-	7.78	9.58
Oleic	20.2	25.90	29.5	16.6	18.4
Linoleic	58.2	65.80	62.2	61.62	60.9
Linolenic	1.7	1.08	0.011	0.61	0.61
Arachidic	-	0.005	-	-	-
Mono unsaturated	58.2	26.13	29.556	16.6	18.4
Oleic/Linoleic ratio (O/L)	0.35	0.39	0.47	0.27	0.30

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**CONCLUSION**

It can be concluded that the presence of high concentration of saturated fatty acids indicates that these oil samples have potentials for future human food supplements and formulations.

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