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Proximate and Mineral Composition of Sponge Gourd (*Luffa cylindrica*) Seed Grown in South-Western Nigeria

T. C. Ogunyemi[1*], C. M. Ekuma[1], J. E. Egwu[1] and D. M. Abbey[1]

[1]*Department of Chemistry, Federal Polytechnic of Oil and Gas, Bonny Island, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. Author TCO designed the study and wrote the first draft of the manuscript. Authors JEE and DMA performed the statistical analysis and wrote the protocol. Authors TCO and CME managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Luffa cylindrica is locally a source of food, medicinal substances and have other traditional application. This study investigated the proximate and mineral analysis of *L. cylindrica*. The result of the analysis showed that the seed contain principally protein (35.83%) and fat content (33.93%). The crude fiber, moisture and ash content are 4.58, 5.84 and 6.13% respectively, while 13.67% was found as the carbohydrate content which is determine by different methods. The mineral content showed that phosphorus is the most abundant mineral with 30.63 mg/100 g followed by Magnesium (28.93 mg/100 g). It also contains moderately high amount of other minerals such as Potassium (13.86 mg/100 g), Sodium (8.18 mg/100 g) while Chromium (0.25 mg/100 g) was found to be the lowest. The sample could be useful in preventing high blood pressure. Thus, the research suggests that *L. cylindrica* seed can serve as a potential source of vegetable protein and mineral in dietary formulation.

Keywords: Sponge seed; Luffa cylindrica; proximate analysis; mineral content.

**Corresponding author: E-mail: charlestolulope@gmail.com;*

1. INTRODUCTION

Luffa cylindrica also known as a vegetable sponge or sponge gourd is a sub-tropical plant belonging to the *Cucurbitaceae* family (Cucurbits) which is a significant source of food and substances of medical importance [1]. It is an annual climbing plant that grows climbing on other physical solid materials. The plant produces fruit containing fibrous vascular system with black seeds. Its fruit (a gourd) is green that has a large cylindrical shape and smooth as shown in Fig. 1.

1.1 Taxonomical Classification

Kingdom	*: Plantae*
Sub-kingdom	*: Tracheobionta*
Division	*: Magnoliophyta*
Class	*: Magnoliopsida*
Order	*: Violales*
Family	*: Cucurbitaceae*
Genus	*: Luffa*
Species	*: L. cylindrica*

It is used as edible vegetable and has a wide application in packing medium, shoes, mats, sound proof linings, bath sponges, utensil cleaning sponges, adsorbent for removal of heavy metal in waste water, and immobilization matrix for plant, algae, bacteria and yeast [2]. Pharmacological investigation on *L.cylindrica* showed its potential as immunostimulant [3,4] antibacterial [5], antiinflamatory agent, antitumour, antiviral effect and also induce uterine contraction to hasten child birth [6] as depicted in the diagram shown in Fig. 2.

(a) (b) (c) (d)

Fig. 1. Picture of *Luffa cylindrica* (a) flower (b) plant (c) Gourd (d) Seed

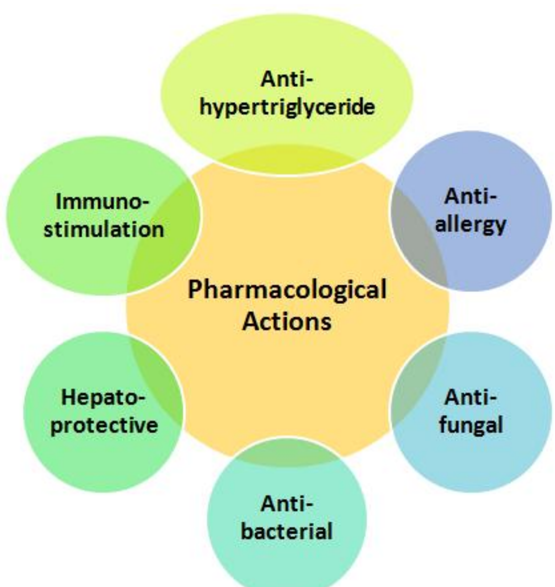

Fig. 2. Some pharmacological properties of *Luffa cylindrica* [6]

In Nigeria, *Luffa cylindrica* plant grows in the wild and abandoned building structures and fences walls in towns and villages [7]. Locally in Nigeria, it is called Asisa (Igbos), Ekian (Edos), Kaankan (Yoruba) and Baska (Hausa). The locals use loofah as traditional medicine in curing feverish conditions, malaria, jaundice, swelling and tumor and unknown external growths. The seeds, leaves and pods are all used for these purposes.

The significance of seed legumes in the diets of animal and man in the developing countries is well documented [8,9]. They are rich in nutrients such as digestible proteins with good array of amino acids and minerals [10]. The percentage crude proteins of most legumes ranged from 20-50 mg/100 g dry weight [11,12] and have been judged as good sources of minerals [8]. Leguminous seed have been reported to be excellent sources of energy [13,14] in animal and human diets. This explains reasons why researches have been directed to harnessing the potential of the seed in animal and human diets. Since, it had been observed that the ecological factors, location, season, nature of soil and age of plants greatly influence the phytochemical composition of a plant. It is imperatively necessary to investigate the proximate and mineral analysis of *Luffa cylindrica* grown within a geopolitical zone in Nigeria.

2. MATERIALS AND METHODS

2.1 Sample Collection and Preparation

The *Luffa cylindrica* fruits were collected from a farmland in Ado-Ekiti. Ado-Ekiti is a city in Southwest Nigeria, the capital and headquarters of Ekiti State with Latitude and Longitude 7º37'23.84''N, and 5º13'15.13''E respectively. The gourds were broken and shaken to remove the seeds from the fibre mesh of the sponge manually. The seeds were removed from the fibrous interior and washed with water. The seeds were air-dried for four days and pulverized using an electronic blender. The powdered sample was stored at 5°C in air-tight container prior to further analysis.

2.2 Proximate Analysis

The proximate analyses (moisture, fibre, ash, crude fats, proteins and carbohydrates) of the sample were determined in percentage [15]. The moisture and ash were determined using weight difference method. Moisture was determined by drying sample at 105°C to constant weight. Ashing was performed at 550°C for 6 hrs in a muffle furnace. Fat content was determined via sohxlet extraction with petroleum ether and calculated by weight loss. Fibre content was estimated from the loss in weight of the crucible and its content on ignition. The nitrogen value was determined by micro kjeldahl method [16]. The nitrogen value was converted to protein content by multiplying a factor of 6.25. Carbohydrate contents were estimated by differences as stated in equation 1 below.

$$\%\text{Carbohydrate} = 100 - (\%\ \text{moisture} + \%\ \text{ash} + \%\ \text{fat} + \%\ \text{crude protein} + \%\text{crude fibre}) \qquad (1)$$

Furthermore, the energy value was calculated using the equation below [16]:

$$\text{Energy (kcal)} = [(\%\text{CHO} \times 4) + (\%\text{CP} \times 4) + (\%\text{CL} \times 9)] \qquad (2)$$

Where CHO, CP and CL stands for carbohydrate, crude protein and crude lipid respectively from the carbohydrates, crude protein and crude fat of the sample.

2.3 Mineral Analysis

Mineral contents were determined by the method described by [15]. The digested sample was sub-sampled into a glass container for Atomic Absorption Spectrophotometer and Flame Emission Spectrometer analysis. The following metals; Ca, Mg, Fe, Zn, Cu and Mn were analysed using Atomic absorption spectrophotometer (Shimadzu 6300 AAS Spectrophotometer) while flame emission spectrometer (FP6400 Na and K Air Flame photometer) was used for Na and K. Phosphorus was determined using Vanadomolybdo phosphoric Acid Colorimetric Method [17].

3. RESULTS AND DISCUSSION

The proximate composition of *L. cylindrica* is presented in Table 1. The macronutrient analysis of the seed revealed that protein had the highest content (35.83%) in the seed. The protein content reported in this research was higher compared to the previous report by [18] (22.90%) and *L. aegyptiace* seed 25.38% [3] but lower compared to report of 45.06% and 50.06% respectively [19,20]. The variation could be attributed to various ecological conditions affecting the growth of a plant. However the values were high when compared with those reported for *Acacia robusta* (12.52%), *Acacia erubescens* (21.8%) *and Bombax glabrum* seed

(10.23%) [20]. Proteins are essential component of diet needed for the survival of animals and human and the basic function in nutrition is to supply adequate amount of amino acids [21]. *Luffa cylindrica* could therefore be used as alternative source of protein in diet supplement especially in the areas where majority of populace live on starchy food and cereals which function basically in nutrition by supplying adequate amounts of required amino acids [21].

Table 1. Proximate analysis of *Luffa cylindrica*

Analysis	Composition (%)
Moisture Content	5.84
Ash Content	6.13
Fat Content	33.93
Fiber Content	4.58
Protein Content	35.83
Carbohydrate	13.67
Energy Value (Kcal)	503.37

The moisture content for the sample was very low 5.84% which is within the acceptable range for a good keeping period. Moisture content is a major quality factor in food stability and preservation. The moisture content recorded for the seed is lower than those reported for soybean (11.07%) and coconut seeds (14.3%) [22]. This value is also lower to the value obtained for *Luffa aegyptiace* seed 7.50% [23]. The relatively low moisture content is an indication that this flour will have high shelf life and less-susceptible to micobial attack when properly packaged against external conditions.

The ash content was found to be 6.13% which was moderate and it compared favourably with the range value of 3.00-5.8% reported for those of legumes like cowpea, groundnut, and fluted pumpkin seed [24]. Since, ash content gives an idea about the inorganic mineral content; it implies that the seed could provide essential, valuable and useful minerals needed for good body growth and development as well as speed up metabolic processes.

The fat content in the sample was in close agreement with earlier report of 33.93% reported [25]. The fat content is higher than range value of 14.05-20.30% reported for soybean, locust bean and cotton seed, which are commercially exploited and classified as oil seed. Thus, the seed would be considered as an oil seed. Like groundnut, melon etc. Lipids are essential because it provides the body system with maximum energy compared to other macronutrients.

Fibre is desirable in the maintenance of human health as it has been known as an effective laxative food component, reduces cholesterol level and risk of cancer in the body [14]. The crude fibre content of 4.58% that was recorded for the *L. cylindrica* is low when compared with previous report by [22] (10.84%) and reports for watermelon seeds (29.7%-30.9%) and *Luffa aegyptiace* seed (7.50%) [26,27]. The low level of fibre in *L. cylindrica* indicates that it might be desirable in their incorporation in weaning diet since it won't result in the irritation of gut mucosa.

The carbohydrate content in *Luffa cylindrica* was 13.67% which is higher than 24.12% in *L. aegyptiace* [26] and 6.93% reported for pumpkin but lower than 33.00% reported for *Bombcapsis glabra* [28]. The total carbohydrate of the luffa seeds powder suggests that, the powder could be used as an additive to other materials for forming gel in food products. Based on this research, the sample could not be considered as a potential source of carbohydrate when compared to the content of some conventional source like cereals. The energy content obtained for sample was 503.37 kcal which was higher compared to previous reports [22] and high when compared to recommended content by FAO/WHO [29]. This depicts that the consumption of the *L. cylindrica* seed can give adequate energy needed for the body's metabolic and physical activities.

Table 2 shows the mineral composition of *Luffa cylindrica* seed. The most abundant mineral in the sample was Phosphorous with 30.63 mg/100 g. The value obtained for other mineral were Sodium (8.18 mg/100 g), Zinc (3.43 mg/100 g), Iron (4.72 mg/100 g), Magnesium (28.93 mg/100 g), Potassium (13.86 mg/100 g), Calcium (2.12 mg/100 g), Manganese (2.77 mg/100 g), Copper (3.33 mg/100 g); with Chromium being the lowest in composition (0.25 mg/100 g). Other values obtained are Na/K (0.59), Ca/Mg (0.07) and Ca/P ratio (0.07).

Phosphorus is bound in the blood and cells, nucleic acids, phospholipids, ATP and sugar phosphate thereby plays important role as buffer. The combination with phosphorus makes it possible for nutrients to cross the cell membrane [30]. However, the phosphorous content of the sample is 30.63 mg/100 g which is higher than the values reported for *Luffa aegytica* (0.42 mg/100 g) and *Castenea Spp*. (0.38 mg/100 g)

[28]. Magnesium (Mg) has been known to prevent growth retardation, muscle degeneration, impaired spermatogenesis, bleeding disorder which can also lead to abnormal bone development [31]. The magnesium content is 28.93 mg/100 g which is higher than the values obtained in other *Luffa spp.* seeds [18,28].

Table 2. Mineral composition of *Luffa cylindrica*

Minerals	Composition (mg/100 g)
Phosphorus	30.63
Sodium	8.18
Potassium	13.86
Iron	4.72
Zinc	3.43
Calcium	2.12
Magnesium	28.98
Copper	3.33
Manganese	2.77
Chromium	0.25
Na/K	0.59
Ca/Mg	0.07
Ca/P	0.07

The concentration of sodium in the sample is 8.18 mg/100 g which is lower than the values reported in defatted *L. cylindrica* sample which was 10.80 mg/100 g [18]. Sodium is required in regulating blood pressure and blood volume. It also helps in the proper functioning of the muscles and nerves in the body.

The Iron content in the analyzed *L. cylindrica* seed is 4.72 mg/100 g which is approximately in agreement with reports of *L. cylindrica* (4.61 mg/100 g) [18]. Iron is reasonably high which is required for blood formation and also important for normal functioning of the central nervous system. It also combines with other elements are used in the body as anti-oxidant micronutrients that boost the immune system [31].

The concentration of Zinc in the sample is 3.02 mg/100 g which is higher than the amount reported for *Luffa aegytica* (2.34 mg/100 g) and *Castenea Spp*. (1.41 mg/100 g) by [28]. Zinc is a heavy metal although it is an essential component of several enzymes participating in the metabolism of carbohydrates, lipids, and other micro-nutrients. It helps to maintain molecular structure of cellular and membrane structures [31].

Calcium is necessary for the building of rigid structure such as bone and teeth, muscle contraction, transmit nerve impulses, blood clotting and as a co-factor in some enzyme catalysis [32]. The low calcium content (2.12 mg/100 g) in *L. cylindrica* suggests that it may be good as a therapy in hypocalcaemic state like osteoporosis. The values are lower than 800-1200 mg/daily recommended dietary allowance (RDA) [33] which means that *Lujfa cylindrica* might not be good source of Calcium.

Ca/P, Na/K and Ca/Mg ratios are used by several authors to appreciate nutritional benefit of food [31,34] such as the sample's Na/K ratio (0.59) was less than one, which implies that the sample will not promote high blood pressure. Ca/P ratio is 0.07 and suggests a very low potential aptitude of the *Luffa cylindrica* to provide calcium and its absorption in small intestine. Generally, the *L. cylindrica* seed shows good mineral composition which could contribute to its medicinal value. Thus, *L. cylindrica* seed can be a good source of mineral elements needed by the body of both man and animals.

4. CONCLUSION

The study investigated the proximate and mineral composition of *Luffa cylindrica* seeds. The study revealed that the seed has a high concentration of protein and lipid. This indicates that the seed is a potential industrial stock for protein and fat extract. Thus, the study indicates the potential of *Luffa cylindrica* seed as a vegetable protein and mineral source which has been an underutilized seed. However, further studies are on the potential of *L. cylindrica* in human nutrition as a form of dietary supplements and possibly for livestock feed production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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