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Effect of Two Extractants on the Chemical Composition of the Defatted Seed of Luffa Cylindrica

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ABSTRACT

Proximate analysis, Anti-nutritional factors, Mineral content, Phytochemical screening and functional property of the defatted seed of Luffa cylindrica (sponge gourd) in different extractants (solvents) were determined using standard analytical procedure. The proximate content (%) are Moisture content (8.00) and (8.31), Ash content (7.50) and (8.96), Ether extractives (22.80) and (15.19) Crude fibre (8.43) and (10.84), crude protein (45.06) and (50.06), Carbohydrate (8.21) and (6.02) and energy value (kJ/a) (1746.018) and (1518.45) when defatted with n-Hexane (n-H) and Petroleum Ether (PE) respectively. The anti-nutritional factor analysis (mgKOH/lOOg) gave Phytate (63.45) and (39.55), oxalate (2.00) and (3.69), total phenols (0.00) and (0.00) with n-Hexan and Petroleum Ether respectively. The Mineral content (ppm) were calcium (54.50) and (56.00), Mg (2.46) and (2.42) Na (11.20) and (10.08), K (620.00) and (530.02) and iron (Fe) (3.98) and (4.61) in defatted sample with n-Hexane and Petroleum ether respectively, the Phytochemical screening revealed that Tannins, Saponins, Alkaloids, and Flavonoids were all absent in both samples except in Petroleum Ether (PE) extracted defatted sample where only Saponins were found to be present. With low level of anti-nutrients, high level of mineral contents and good functional properties, the seed of Luffa cylindrica (sponge gourd) can therefore be exploited as a good source of nutrients to both man and animals.

Keywords: Luffa cylindrical, Proximate analysis, Anti-nutritional factors, Mineral analysis, Photochemical screening, Functional properties.

INTRODUCTION

Seeds have nutritive and energy values which makes them important in our daily diet. They are also regarded as good source of edible oils and fats (Odoemelam, 2005). The significance of seed legumes in the diet of animals and man in the developing countries is well documented (Oke *et al*; 1995 and Agbede, 2000). They are rich in nutrients such as digestible proteins with good array of amino acids and minerals (Ologhobo, 1980). Leguminous seed have been reported to be an excellent source of energy (Del Rosario et al, 1981 and Oke et al; 1995) in animals and human diets. Apart from the domestic use of oil and fat as cooking oil, they also find wide and major application in industries for soap, creams, paints, fertilizers, cosmetics production etc. (Odoemelam, 2005). The crude protein percentage of seed legumes ranged half of 100% dry weight, (Apata 1990, Igene, 1993) and has been judged as a good source of minerals (Oke et al; 1995 and Oyeleke 2011).

Seeds also have nutritive and calorific values which makes them necessary in diet (Agatemor, 2006).The insufficient availability of animal protein sources and high cost of few plant protein sources has prompted an intense research into harnessing the nutrient potentials of some underutilized legumes and oil crop (Hassan et al; 2008, Enujuigha and Akanbi, 2005). A protein poor diet weakens the immune system and the antibodies that the body produces to combat microorganism and foreign substance. The strategy to reduce the nutrient deficiencies in resources poor area is to intensify effort through exploitation of easily available and cheap local resources to meet the needs of the increasing population. Knowledge of the nutritive value of local dishes, soup, ingredients and local food stuffs is necessary in order to encourage the increased cultivation and consumption of those that are highly nutritive (Achu et al; 2005).

Cucurbits (*Cucurbitaceae*) seeds have been found to be a good source of food particularly oils and proteins (Younis et al; 2000, Akwaowo et al; 2000, Akpabio et al; 2005, Hassan et al; 2008,) and this has made them to be widely accepted and recognized. Curcubits seeds are underutilized in many part of the world especially in Africa, where the seeds abound, they were found to contain about 50% oil and 35% protein (Achu et al; 2005). Example of these cucurbitaceae include Luffa cylindrica, (sponge gourd), Curcubita pepo, Cucurbita maxima, Cucurbita moshata and host of other gourds.

The genus Luffa cylindrica belongs to family Cucurbitaceae. The other common names of Luffa cylindrica are Vegetable sponge, Wash sponge, Gourd towel, Dishcloth gourd, Rag gourd, Sponge Gourd and Loofah. In Nigeria, it is normally called “KainKain Oyinbo” (Whiteman sponge) in Yoruba, fluion — Oyibo in Edo, Nza in Igbo, and baskal soosoo in Hausa. (Oyeleke, 2011). Sponge gourd is a popular vegetable in most countries in Africa, Asia, even in Arab countries (Xie and Yu, 1996). It is a sub-tropical plant which requires warm summer temperature and long frost — free growing season when grown in temperate region. It is an annual climbing plants which produce fruit containing fibrous vascular system. It is a summer seasoned vegetable,

It is difficult to design with accuracy the indigenous area of Luffa species. They have a long history of cultivation in the tropical countries of Asia and Africa. Indo — Burma is reported to be the centre of diversity for sponge gourd. The main commercial production countries are China, Korea, India, Japan and central America (Oboh, and Aluyor, 2009). The plant is a large climbing, hairy with a smooth vine reached a length of 5 meters stems are four angled, 10 — 20cm wide, shallowly 5 to 7 angled or lobed with a pointed tips and heart shaped bases. Fruit is oblong, cylindrical, smooth and green during immature.

The seed are black smooth (Slightly tubercle) when the fruit becomes old and dry the endocarp becomes a persistent fibrous muscular network which is used in various ways (Ahmad et al; 2010) such as when used as water filter (Dairo et al; 2007). The leaves of sponge gourd are used in the treatment of asthma, anaemia and sunnicitis fever. All species of ridge gourd of sponge gourd are edible and are usually consumed before they mature or else they will be too woody and fibrous to eat (Jawen et al; 1993).

Sponge gourd contain dietary iron and low in fat and caloric (Jansen et al; 1993). Porterfield, 1955 reported that seeds of sponge gourd (i.e. the kernel) contain 45 — 51% oil. Over half of the sponge gourd seed kernel is oil which is composed mainly of oleic and Linoleic acids. The extract from the seed (oil) possess good anti-inflamatory, bronchodilator, and antimicrobial activity. The oil is good lubricant and externally used for shingles and boils, leprosy and skin diseases. The oil is used in mineral based make up to give a softer and smoothers appearance.The antifungal activity of the oil makes it good for facial cleanser and body oil. Its anti inflammatory and anti-tumor properties prevent the synthesis of certain protein and also considered toxic to skin cancer cells. (Sangh et al; 2011). Sponge gourd is becoming an indispensable crop because of its wide industrial application such as water filters and many medicinal properties, (Oboh and Aluyor, 2009).

The seed oil of sponge gourd contains oil with percent of free fatty acids. In the pure state, the oil is colourless liquid at an ordinary temperature and of semi-drying type which can be used for food. (Mirghani, 1990). The sponge gourd seed flour has a higher crude protein which could play a valuable role as a supplemental nutrient source to some farm products used food formulation for animals and human most especially in developing countries where hunger is endemic (Abitogun and Ashogbon, 2010). The fiber can be recycled into mats or pillows when they finally wear down (Newton, 2006). ¡n oriental medicine, sponge gourd has effect on the treatment of fever, enteritis and swell etc. The extract from vines alive is used as an ingredient in cosmetics and medicine (Lee and Yoo, 2006). The fibres when dried are used for bathing, removing toxin and regenerating skin. They help varicose veins and cellulite by stimulating circulation. Immature fruit is used as vegetables which are good for diabetes (Bal et. al; 2004).

Oyeleke, (2006) reported that the leaves of sponge gourd are used in the treatment of diseases like anaemia and the seeds have laxative properties. The dried fruit fibres are used as abrasive sponges in skin care to remove dead skin. They are also commonly used for washing and' the fruit is the source of the popular commercial sponge gourd or vegetable sponge which comes from the hard fibres vascular network found within the rope fruit after intervening tissues has rotten away. The objective of this work was to determined

MATERIALS AND METHODS

SAMPLE COLLECTION

The sample (*Luffa cylindrica*) dried fruit were collected at an uncompleted and abandoned building structure at eyin-Ade in Iree and at the fence walls near refuse dumping site in Esa-Odo, Osun State Nigeria.

METHOD

After extraction with n-Hexane and Petroleum ether, the defatted samples was analyzed according to the official methods of analysis described by Association of Official Analytical Chemist (A.O.A.C 1990). All analyses were carried out in duplicate.

RESULTS AND DISCUSSION

Table 1: Proximate composition of *Luffa cylindrica* (%)

S/N	PARAMETERS	A	B
1	MOISTURE CONTENT, (%)	8.00 ± 0.20	8.31 ± 0.10
2	ASH CONTENT, (%)	7.50 ± 0.15	8.96 ± 0.11
3	ETHER EXTRACTIVES, (%)	22.80 ± 0.11	15.19 ± 0.04
4	CRUDE FIBRE, (%)	8.43 ± 0.20	10.84 ± 0.01
5	CRUDE PROTEIN, (%)	45.06 ± 0.27	50.06 ± 0.22
6	CARBOHYDRATE, (%)	8.21 ± 0.01	6.02 ± 0.14

Mean of Duplicate Analysis

A= *Luffa cylindrical* extracted with n-hexane, B= *Luffa cylindrical with petroleum extract*

Table 2: Anti-Nutritional Factors Analyses (mgKOH/100g)

S/N	PARAMETERS	A	B
1	PHYTATES, (mgKOH/100g)	63.45 ± 0.22	39.55 ± 0.31
2	OXALATES, (mgKOH/100g)	2.00 ± 0.01	3.69 ± 0.11
3	TANNINS, (mgKOH/100g)	0.00 ± 0.00	0.00 ± 0.00
4	TOTAL PHENOLS, (%)	0.00 ± 0.00	0.00 ± 0.00

Means of Duplicate Analysis

A= *Luffa cylindrical* extracted with n-hexane, B= *Luffa cylindrical with petroleum extract*

A= *Luffa cylindrical* extracted with n-hexane, B= *Luffa cylindrical with petroleum extract*

Table 3: Mineral Content Analysis (ppm) of *Luffa cylindrica*

S/N	PARAMETERS	A	B
1	CALCIUM (Ca)	54.50 ± 0.01	56.00 ± 0.03
2	MAGNESIUM (Mg)	2.46 ± 0.02	2.42 ± 0.01
3	SODIUM (Na)	11.20 ± 0.01	10.08 ± 0.01
4	POTASSIUM (K)	620.00 ± 0.03	530.00 ± 0.02
5	IRON (Fe)	3.98 ± 0.02	4.61 ± 0.01

Mean of Duplicate Analysis

A= *Luffa cylindrical* extracted with n-hexane, B= *Luffa cylindrical with petroleum extract*

Table 4: Results of Phytochemical Screening Test of *Luffa cylindrica*

S/N	PARAMETERS	A	B
1	SAPONINS	-ve	+ve
2	TANNINS	-ve	-ve
3	FLAVONOIDS	-ve	-ve
4	ALKALOIDS	-ve	-ve

Mean of Duplicate Analysis

A= *Luffa cylindrical* extracted with n-hexane, B= *Luffa cylindrical with petroleum extract*

Table 5: Results of Functional Properties Analysis

S/N	PARAMETERS	A	B
1	FORM CAPACITY (%)	20.10 ± 0.10	56.00 ± 0.03
2	FOAM STABILITY (%)	4.04 ± 0.02	2.42 ± 0.01
3	WATER ABSORPTION CAPACITY (%)	15.10 ± 0.03	10.08 ± 0.01
4	OIL ABSORPTION CAPACITY (%)	13.00 ± 0.13	530.00 ± 0.02
5	EMULSION CAPACITY (%)	86.75 ± 0.11	4.61 ± 0.01
6	EMULSION STABILITY (%)	82.77 ± 0.20	78.49 ± 0.22
7	LEAST GELATION CONC (h/cm3)	0.01 0.00	0.05 ± 0.00
8	BULK DENSITY (g/cm^3)	0.49 ± 0.00	0.46 ± 0.00

A= *Luffa cylindrical* extracted with n-hexane, B= *Luffa cylindrical with petroleum extract*

DISCUSSION

As indicated in table 1 above, the proximate composition of defatted seed of Luffa cylindrica gave % Moisture content (8.00 ± 0.20) and (8.31 ± 0.10) with n-Hexane (n-H) and Petroleum Ether (PE) respectively. The values obtained are closer similar and also similar to 827 ± 0.00 obtained by Ibeto et. al; (2012) for Brachystegia eurycoma. The values indicates less chance of microbial growth on the samples so it can withstand long storage and transportation (Abitogun and Ashogbon, 2010), general requirement moisture content in crude drugs is ≤14% (British Pharmacopeia). % Ash content (7.50 ± 0.15) and (8.96 ± 0.11) were obtained for n-H and PE extracted samples respectively. Ash content is an indication of mineral composition of a sample, the defatted sample from PE contains higher concentration of minerals compared to that of n-H. % Ether extractives (22.80 ± 0.11) and (15.19 ± 0.04) for n-H and PE extracted sample respectively. The value of n-H agreed closely with the work of Oyeleke, (2011) that reported 28.62 ±0.02% for raw *Luffa cylindrica* seed. The values are of importance because the oil in food provides flavor, aroma and texture as well as increasing the feeling of satisfaction after meal (Oyeleke, 2011). % Crude fibre (8.43 ± 0.20) and (10.84 ± 0.01) were obtained for n-H and PE respectively. The values obtained for PE is higher than that of n-H, but both values are higher than 4.10 ± 0.10% and 3.50 ± 0.05% reported for Telfairia occidentalis and Cucurbita maxima respectively (Oyeleke and Olagunju, 2011). Crude fibres are made up of cellulose, hemi-cellulose, pectin and chitin which play an important role in the formation of bulk in the intestine which stimulate penstalsis and prevents constipation (Uddoh, 1980). The high fibre content in sample also indicated that the seeds could be of help in lowering the cholesterol level in the blood, reduces the risk of various cancers, bowel diseases, and thereby improves health and well-being (Anhawange et al, 2004 and Hassan et al, 2008). % Crude protein (45.06 ± 0.27) and (50.06 ± 0.22) were obtained for n-H and PE respectively. The value from PE is higher than n-H but both values were high when compared with 20.40-22.40% reported for some protein rich food such as soy beans, cowpea, pigeon peas, groundnut and some oil seeds (Oshodi et al, 1993). This high protein content therefore showed that the seed can be used as an alternative source of protein especially in the area where majority depends on starchy food. % Carbohydrate (8.21 ± 0.01) and (6.20 ± 0.14) were obtained for n-H and PE defatted samples respectively. The carbohydrate content for both samples were lower to that reported by Oyeleke, (2011) for raw *Luffa cylindrica* seed and 33.00% reported for Bombacopsis glabra seed by Olaofe et. al; (1994). The low carbohydrate content of the samples might be ideal for diabetic and hypertensive patients requiring low sugar diet. The calculated energy value (KJ/g) was found to be (1749.19 ± 0.18) and (1518.45 ± 0.01) for n-H and PE defatted sample respectively, which implies that the samples could be a concentrated source of energy.

Table 2 shows the anti-nutritional factors (mgKOH/100g) obtained in the defatted samples. Tannins and total phenol were absent in both samples while the phytates and oxalates levels were 63.45 ± 0.22 and 2.00 ± 0.01 in n-H and 39.55 ± 0.31 and 3.96 ± 0.11 in PE extracted samples. This observation could be explained in term of the effect of the different solvents on the level of anti-nutritional factors. The values for phytates and oxalates are far greater than 1.73 ± 0.01 mgKOH/100g and 0.81 ± 0.10 mgKOH/100g respectively reported for the raw loofah seed by Oyeleke, (2011). The values showed that the seed is rich in phytates which is an anti-nutrient that are toxicants in food sample which affect the bioavailability of some essential nutrients and, minerals in the body if the sample is consumed unprocessed.

The result of mineral analysis (ppm) is as shown in Table 3. The result indicated that the defatted samples contained Ca (54.50±0.01) and (56.00±0.03) for n-H and PE respectively. Ca in the body is responsible for the building of rigid structure such as bone and teeth, blood clotting, muscle contraction and as a co-factor in certain enzyme catalysis (Robert et.al, 2003). The values are lower compared to 343.42 ± 0.02mg KOH/100g reported for the raw *Luffa cylindrica* seed by Oyeleke, (2011), which showed that the extractants (i.e. the solvents) has affected the level of Ca in the two defatted samples. The values are lower than 800mg recommended daily allowance and therefore would need to be supplemented

(Oyeleke and Olagunju, 2011). Mg (2.46 ± 0.02) and (2.42 ± 0.01) in samples with n-H and PE respectively. The values were low compared to 18.50 ± 0.00 mgKOH/100g reported for another defatted seed by Abitogun and Ashogbon, (2010). Presence of Magnesium (Mg) in samples is known to prevent muscle degeneration, growth retardation, impaired spermatogenesis and bleeding disorder (Charturvedi et.al, 2004). Na (11.20 ± 0.01) and (10.80 ± 0.01) in defatted sample with n-H and PE respectively. The value obtained for n-H is a bit higher than that of PE, as this showed that the solvent PE might have affected the Na content in the sample. K (620.00 ±0.03) and (530.00 ± 0.02) in the two defatted samples with n-H and PE respectively. Basically, K has been found to be of higher concentration in most Nigerian plant food (Hassan and Umar, 2004 and Olaofe et. al, 2004). The values from both samples were found to be greater than 62.17 ± 0.3OmgKOH/100mg reported for Hura ereptian seeds by Adeleke et al; (2009). A ratio of Na/K < 1 is desirable for hypertensive people (Hassan et al; 2008). The ratios for both samples are 0.018 and 0.020 for n-H and PE respectively. Fe (3.98 ± 0.02) and (4.61 ± 0.01) in defatted samples extracted with n-H and PE respectively. Fe with other elements are used in the body as anti-oxidant micronutrients that boost the immune system. The seed can therefore be said to be of good source of mineral elements needed by the body of both man and animals. The mineral value in both samples follow the order Mg<Fe<Na<Ca<K.

Table 4 shows the phytochemical screening test of the defatted flour. Tannins, sapomns, alkaloids and flavonoids were found to be absent in both samples except in PE defatted sample where saponins was found to be present. On comparing the results with that of Oyeleke, (2011) which also confirmed the presence of saponins and absent of tannins, alkaloids and flavonoids in the raw sponge gourd seed. The presence of saponins in the PE extracted sample could be explained that n-H has been able to neutralize saponins present while PE does not have effect on the saponins present in the sample. Therefore samples with PE would be of advantage as it contain saponins which helps to reduce the presence of cholesterol level in the body and in inhibiting tumor activities in animals. The absence of flavonoids, alkaloids and tannins in both sample would be regarded as a great loss as they play an important role in Phytornedicine, flavonoids provide better anti-oxidant abilities than vitamin C and vitamin E (Bachi et.al, 1999).

Table 5 showed the result of the functional properties (%) of the defatted samples. The water absorption capacities (WAC) (15.10 ± 0.03) and (10.20 ± 0.06) in samples with n-H and PE respectively. The value for PE is lower to that of n-H but both values are low when compared with 116.3 ± 0.1% reported by Ige et. al, (1984). The low WAC content of the sample showed that the seed sample would be less hydrophobic and therefore would be very useful in producing viscous food (Oyeleke et. al, 2012). The oil absorption capacity (OAC) (13.00 ± 0.13) and (14.30 ± 0.07) with n-H and PE respectively. The values are higher than 1.95 ± 0.03, 2.14 ± 0.04 and 2.31 + 0.06 reported for Nhyira, Tona and Adorn varieties of cowpea by Appiah et. al, (2011). These higher values showed the ability of protein in this seed to bind oil which makes them useful in food system where oil inhibition is desired. The flour could therefore have functional uses in food such as sausage production, enhancement of flavor and mouth feel when used in food preparation (Appiah et. al, 2011). The foaming capacity (FC) (20.10 ± 0.10) and (90.05 ± 0. 05) with n-H and PE respectively. The value for n-H (20.10 ± 0.10%) was in close agreement with that of water melon of 23.5 ± 0.10% as reported by Oyeleke et,al, (2012). The value obtained for PE is far greater than that of n-H and this high value of FC in PE suggest that it may be employed as a whipping or aerating agent in food system (Arawande and Borokin, 2010). The foam stability (FS) (4.04 ± 0.02) and (60.00 ± 0.10) with n-H and PE respectively. The high value of PE extracted sample suggests that PE would be the best between the two solvents as the feedstock can be used as foam enhancer in food system. The emulsion capacity (EC) and emulsion stability (ES) (86.75 ± 0.11)and (82.77 ± 0.20) with n-H, (80.23 ± 0.05) and (78.49 ± 0.22) with PE respectively. The values are higher than 7-11% reported for wheat flour (Lin et. al, 1974). These suggest that the seed flour can be used as additive for stabilization of emulsion in the production of soup and cakes (Aletor et. al, 2002). The least gelation concentration (LGC) (glcm3) (0.10 ± 0.00) and (0.05 ± 0.00) with n-H and PE respectively. The value obtained for n-H is higher than that of PE. The bulk densities (glcm3) of the two defatted samples are (0.49 ± 0.00) and (0.46 ± 0.00) with n-H and PE respectively. The values are lower than 0.69 ± 0.05 glcm3, 0.80 ± 0.O5gIcm3 and 0.79 ± 0.02 glcm3 reported for Nhyira, Tona and Adorn varieties of cowpea respectively (Appiah et.al, 2011). The lower values for bulk densities of the two feedstock revealed that the two samples would be lighter than Nhyira, Tona and Adorn, so would be easier to transport.

CONCLUSIONS

Competition amongst most common seeds for uses of their oil and seed cake by man and animals has prompted research for likewise useful alternatives amongst under-utilized seeds such as Luffa cylindrical. Generally the defatted seed sample possess low level of anti-nutrients, high level of mineral contents, good functional properties even when different extractants were used and can therefore be said to be a good source of nutrients for both man and animals.

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