Adamawa State University Journal of Scientific Research
ISSN: 2251-0702 (P)
Volume 6 Number 1, April, 2018; Article no. ADSUJSR 0601019
http://www.adsujsr.com

Proximate Composition and some Elemental Analysis of Watermelon Seed (*Citrullus lanatus thumb*)

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Abstract

This work was designed to explore the proximate composition and some elemental screening on the seed of watermelon. The proximate composition of the watermelon seed showed for defatted peeled flour is, Ash: 1.12; carbohydrate 20.19, crude fibre 8.00, crude protein 60.69, fat/lipid 4.50, moisture 5.50, while for the undefatted peeled samples the Ash is 1.16; carbohydrate: 2.34, crude fibre: 6.00, crude protein: 38.50, fat/lipid :45.30 and moisture is 6.70.The proximate composition of the unpeeled flour showed Ash: 1.01; carbohydrate 59.09, crude fibre 9.00, crude protein 21.90, fat/lipid 2.5, moisture 6.50 for defatted sample, while Ash: 1.04; carbohydrate 36.20, crude fibre 4.30, crude protein 22.25, fat/lipid 27.66, and moisture 8.30, for undefatted unpeeled sample. Values are all in percentage. The result of the elemental analysis carried out on the watermelon seed showed Cu, 20.00; Fe, 7.50; Mg, 32.00; Zn, 3.23; Na, 19.70; K, 110.50 for the seed shaft. The elemental analysis shows Cu, 90.43; Fe, 98.23; Mg, 120.58; Zn,72.87; Na, 157.80; K, 966.31 for defatted peeled sample and Cu, 69.18; Fe, 80.65; Mg, 125.09; Zn, 45.13; Na, 94.89; K, 591.40, for undefatted peeled sample. The elemental screening revealed Cu, 51.02; Fe, 61.24; Mg, 112.25; Zn, 18.71; Na, 69.73; K, 510.20 for defatted unpeeled sample while that of undefatted unpeeled sample shows Cu, 64.24; Fe, 55.56; Mg, 119.79; Zn,19.10; Na, 92.01; K, 381.94 all concentration in mg/100g. The ash, crude protein, fat/lipid are higher in the peeled samples while carbohydrate and moisture are higher in the unpeeled samples. The crude fibre was higher in the defatted unpeeled sample. Potassium showed the highest concentration with zinc being the least in all the samples. Peeled samples showed higher concentration in all the elements analyzed. It was concluded that both the peeled and unpeeled samples contained some useful nutrients that could be useful in nutritional, pharmaceuticals and oil industries.

Keywords: Watermelon; Proximate composition; Defatted and undefatted flour

Introduction

Watermelon (*Citrullus lanatus)* is one of the major underutilized fruits grown in the warmer part of the world. The juice or pulp from watermelon is used for human consumption while the rind and seeds are major solid wastes..*Citrullus lanatus* is a member of the *Curcurbitaceae* or the *Cucumber* family, commonly referred to as Gourd family with the synonyms *Citrallus vulgaris*, Commonly referred to as *Kankana* in Hausa. (Hotz and Gibson, 2007) Water melon is a warm, long season crop, which is widely consumed by human, but its seeds are discarded in most places. Watermelon is easy to grow from seeds and summer is the best time for it, the seed planted in a well-drained soil and full sun; water and fertilizer, takes about 80 – 100 days to have a juicy watermelon The rind can be utilized for products such as pickles and preserves for extraction of pectin. The seed can be potential source of protein and lipids (Cordain, 1999). The term rind usually refers to the skin or peel of a fruit. Watermelon outer green part is also considered a low pesticide fruit because of the hard skin and thick rind the pesticide don't make it inside. The inner part is very sweet when ripe. The whitish rind when eaten raw has a bland taste and not as soft as the red part.

The watermelon rind contains less sugar and water than the flesh and more fiber. This gives the heavier consistency and less sweet taste. Whereas the red flesh has the antioxidant lycopen, the rind has a higher concentration of the amino acid Citrulline in it. Study has found the rinds to contain Citrulline, an amino acid that plays an important role in the human body's urea cycle, which removes nitrogen from the blood and helps convert it to urine. That's where citrulline helps create arginine, another amino acid one in which some people are deficient. These amino acids are a stimulator of nitric oxide which relaxes and expands blood vessels, lowering blood pressure and enhance blood flow. Watermelon is 92% H_2O and 6% sugar. The rind, seed, flesh and even the outer green skin can be juice to get the whole compliment of nutrient this melon has to offer. Watermelon seed can be eaten as a salty snack

or stuck on sweetened deserts. Cooks ground the seeds and use like regular flour and melon seed paste. They can also be the ingredients for hot and cold drinks. Allen, R. *et al.,* (1982), Swallowed without chewing you won't get the benefit. You need to chew it raw or preferably after it is baked as a snack or ground into flour and made into a tasty dish. The ground seeds can also be used as an exfoliate for the skin Allen, R. *et al.,* (1982), Watermelon is a member of the gourd or cucubitaceae family along with cucumbers, pumpkin etc. China is currently the world's largest producer of watermelon. (Dan and Liv, 2007)

Methodology

Collection of Sample

The samples were collected from Jangergere Dadinkowa of Gombe State. It was then identified by Prof. Mohammed Saquip, Department of Biological Sciences Adamawa State University, Mubi.

Pretreatment of the raw material (watermelon seed)

The watermelon seed sample was shelled by removal of husk seeds, and of foreign particles. After which, the seeds were dried and then grinded into fine particles size using a mechanical grinder.

The watermelon seed sample was shelled by removal of husk seeds, and of foreign particles. After which the seeds were air dried and divided into two parts, one portion was peeled and grinded, and the second portion was left unpeeled and grinded. The shaft from the peeled sample was also grinded and used for elemental analysis. While the peeled and unpeeled grinded flour was used for proximate and elemental analysis.

Extraction Process Using Soxhlet Extractor

The principle of soxhlet extractor operation involves a repeated extraction of the crude product, of natural origin by hot solvent. 25g of the ground watermelon seed sample was placed in the thimble, the round bottom flask filled with 200mls of hexane sufficient enough for the extraction was placed in the electro thermal heating mantle. The soxhlet extraction was mounted on the flask and a condenser connected to rubber tubing for inlet and outlet water flow for cooling. A retort stand was used to hold the set up in place. The vent of the condenser was made air tight to disallow the escape of the solvent. The extraction process commenced by switching on the heating mantle, the heating continued and the extraction was allowed to run for one hour. The procedure was repeated. Aduku A.O. (2004).

Result Table 1 shows the proximate analysis obtained for defatted and undefatted peeled flour of watermelon seeds. This defatted peeled flour has shown ash content of 1.12%, carbohydrate of 20.19%, Crude fibre 8.00%, crude protein 60.69%, Lipid 4.50% and moisture 5.50%.Table 2 shows the proximate analysis obtained for undefatted peeled flour with ash content of 1.16%, carbohydrate 2.34%, Crude fibre 6.00%, crude protein 38.50, lipid 45.30% and moisture 6.70%.

Table 1: Proximate analysis of defatted and undefatted peeled flour

Composition	Defatted peeled flour (%)	Undefatted peeled flour (%)
Ash	1.12	1.16
Carbohydrate	20.19	2.34
Crude fibre	8.00	6.00
Crude protein	60.69	38.50
Fat/Lipid	4.50	45.30
Moisture	5.50	6.70

Table 2: Proximate analysis of defatted and undefatted unpeeled flour

Composition	Defatted Unpeeled flour (%)	Undefatted Unpeeled flour (%)
Ash	1.01	1.04
Carbohydrate	59.09	36.20
Crude fibre	9.00	4.30
Crude protein	21.90	22.50
Fat/Lipid	2.50	27.66

Moisture	6.50	8.30

Table 3: Elemental Analysis of shaft

ELEMENTS	Values in mg/100g
Cu	20.00
Fe	7.50
Mg	32.00
Zn	3.23
Na	19.70
K	110.50
Cr	ND
Pb	ND

Table 4: Elemental Analysis of Defatted and Undefatted Peeled Flour

Composition	Defatted Unpeeled flour mg/100g	Undefatted Unpeeled flour mg/100g
Cu	90.43	69.18
Fe	98.23	80.65
Mg	120.58	125.09
Zn	72.87	45.13
Na	157.80	94.89
K	966.31	591.40
Cr	ND	ND
Pb	ND	ND

Table 5: Elemental Analysis of Defatted and Undefatted Unpeeled flour

Composition	Defatted Unpeeled flour mg/100g	Undefatted Unpeeled flour mg/100g
Cu	51.02	64.24
Fe	61.24	55.56
Mg	112.25	119.79
Zn	18.71	19.10
Na	69.73	92.01
K	510.20	381.94
Cr	ND	ND
Pb	ND	ND

Key: ND not detected

Discussion

Table 1 shows the proximate analysis obtained for defatted and undefatted peeled flour of watermelon seeds. This defatted peeled flour has shown ash content of 1.12%, carbohydrate of 20.19%, Crude fibre 8.00%, crude protein 60.69%, Lipid 4.50% and moisture 5.50%.Table 2 shows the proximate analysis obtained for undefatted peeled flour with ash content of 1.16%, carbohydrate 2.34%, Crude fibre 6.00%, crude protein 38.50, lipid 45.30% and moisture 6.70%.

The results for the analysis of the defatted and undefatted unpeeled watermelon seed flour as presented in Table 2 shows ash content of 1.01%, Carbohydrate 59.09%, Crude fibre 9.00%, Crude protein 21.90%, Lipids 2.50% and Moistures of 6.50%, while undefatted unpeeled watermelon seeds flour which has Ash content of 1.04%, Carbohydrate 36.20%, Crude fibre 4.30%, Crude protein 22.50%, Lipid 27.66%, and Moisture of 8.30%.

Elemental analysis of the shaft of watermelon seeds Table 3 shows Cu, 20.00mg/100g; Fe, 7.50mg/100g; Mg, 32.00mg/100g; Zn 3.23mg/100g; Na 19.70mg/100g; K, 110.50mg/100g. This results show that the shaft is still useful in production of animal feeds and even biscuits due to the mineral it contain. The various minerals present in the shaft occur quantitatively in the following order K>Mg>Cu>Na>Fe>Zn.

The defatted peel flour Table 4 contain Cu, 90.43mg/100g; Fe, 98.23mg/100g; Mg, 120.58mg/100g; Zn 72.87mg/100g; Na 157.80mg/100g; K, 966.31mg/100g, while the undefatted peeled flour contains Cu, 69.18mg/100g; Fe, 80.65mg/100g; Mg, 125.09mg/100g; Zn 45.13mg/100g; Na 94.89mg/100g; K, 591.40mg/100g. The defatted unpeeled flour was found to contain Cu, 51.02 mg/100g; Fe, 61.24mg/100g; Mg, 112.25mg/100g; Zn 18.71mg/100g; Na 69.73mg/100g; K, 510.20mg/100g. while that of the undefatted unpeeled flour are Cu, 64.24mg/100g; Fe, 55.56mg/100g; Mg, 119.79mg/100g; Zn 19.10mg/100g; Na 92.01mg/100g; K, 381.94mg/100g.

Ash refers to the inorganic residue remaining after either ignition or complete oxidation of organic matter in food stuff. The ash content represents the total mineral content in foods. With these values obtained, watermelon seeds could be used for human consumption and animal feed formulation.

Carbohydrate plays an important role in human nutrition as energy reserves e.g. glucose and can be converted into many natural substances such as fats, proteins and vitamin (Suzanne, 2002). The values obtained in this research have shown that the seed is a good source of carbohydrate. This seed has shown also to be a good source of fibre as fibre consumption from variety of foods help protect against colon cancer and help normalize blood lipids thereby reduce cardiovascular disease (Suzanne, 2002).

Proteins have unique functional property and are important for biological functions and cells structure, this study have shown that this seeds are potential source of protein. The lipids content of this seeds are of great importance as lipids are fatty substance widely distributed in foods and plays variety of rolls in cell e.g. maintain of optimum body temperature and as source of energy as 1g when metabolize give 9kcal of energy. Moisture is a quality factor that serves in preservation of products and computations of nutritional value of foods.

The ash content of undefatted peeled flour is higher compared to the defatted peeled flour. The carbohydrate, Crude fibre and crude protein of defatted peeled flour were higher compare to those of undefatted peeled flour.

The ash content for defatted peeled and undefatted peeled are lower compared to that of whole wheat flour 1.7, butter 2,9 (Suzanne, 2002) and those of *guna* seed 4.83% in undefatted flour, and 3.5% in protein content rate (Beatrice *et al.*, 2013). Despite it values being low it still falls within the recommended range ash or seeds 1.5 – 2.5% (Pomeranz and Clifton, 1981)

The carbohydrate content of defatted peeled flour was higher compare to 10.6% reported for *egusi* melon, coloncynthis citrullus 5.1% (Osage and Eka, 1998, Ojieh *et al*., 2008) bid lower compare to that of defatted *guna* seed to that of defatted *guna* seed 27.22% report by (Beatrice *et al.*, 2013), this value still falls. Within value for legumes which is 20.0 – 60.0% (Ojieh *et al.*, 2008).

Crude fibre values for the defatted crude and undefatted peeled flour were higher compare to those reported for *guna* seeds 4.% undefatted flour and 6.0% defatted flour by Beatrice *et al.,* (2013) but lower than that of *egusi* melon 12.0% (Ojieh *et al.,* 2008).

The *d*efatted peeled flour recorded crude protein content of 60.69% which is higher than that of defatted *guna* seed 50.93% (Beatrice *et al.,* 2013) likewise they protein content of undefatted 38.50% is higher compared to *guna* seed undefatted 36.53%. These values compares favourably to other protein rich food like soya bean 45.83%. (Suzanne, 2002).

The undefatted peeled flour shows high lipid content 45.30% although lower than that of guna seeds 49.00% (Beatrice *et al.,* 2013) but still falls within the range of oil seeds 43 – 51% (Ige *et al.,* 1984). The low lipid content in the defatted flour was as a result of the defatting process. The moisture content of the undefatted was higher than that of the defatted peeled flour, but both still falls within the range reported for melons 5 – 10% (Osagie and Eka, 1998).

The value of ash content in defatted unpeeled flour is a little lower compare to that of undefatted unpeeled lower. In both cases the values are lower compare to that obtain for guna seeds 4.85% and 4.83% for defatted and undefatted (Beatrice *et al.,* 2013) but these values still fall within the recommended range for seeds. Defatted unpeeled flour and both values obtain are still higher compared to those reported for guna seeds 0.59% undeffated, 27.22% defatted (Beatrice, *et al.,*2013). The values obtained in this study falls within the range for legumes (Ojieh *et al.,* 2008). Defatted unpeeled flours still shows a high value of crude fibre than the undefatted unpeeled and also higher than that of undefatted, defatted *guna* seeds 4.00% and 6.00% as reported by Beatrice *et al.,* (2013). Although the value is below that obtain for *egusi* melon 12% (Ojieh *et al.,* 2008). Both the defatted and undefatted unpeeled flour have almost the same values which are higher than that of egg 12.9% but almost the same as that of beans 22.3% (Suzanne, 2002). The lipid content in defatted unpeeled is lower compared to undefatted unpeeled due to the defatting process of hexane. The values obtain for undefatted unpeeled flour compares favourably with that of Soya bean 18% (Suzanne, 2002). Moisture content of undefatted unpeeled flour is higher than that of defatted unpeeled flour but all still fall within the range reported for melons.

The ash content of the defatted flour and undefatted peeled flour are higher than those of defatted and undefatted unpeeled flour, carbohydrate content of defatted and undefatted peeled flour are lower compare to those of defatted, undefatted unpeeled flour. The crude fibre of defatted, undeffated peeled flour is lower compared to defatted unpeeled flour but still higher than the undefatted unpeeled flour. Crude protein values for both defatted, undefatted peeled flour is higher to those of defatted, undeffated unpeeled flour, likewise the lipid content. The moisture content of defatted, undefatted peeled flour is lower compared to those of defatted, undefatted unpeeled flour.

The result of the elemental analysis on the shaft able 5 has shown it useful in production of animal feeds and even biscuit. The various elements occur quantitatively in the order K>Mg>Cu>Na>Fe>Zn. In the defatted peeled sample the element with the highest concentration is potassium with the least being zinc. The occurrence orders of these elements are as follows: K>Na>Mg>Fe>Cu>Zn. In the undefatted peeled sample potassium is the highest and the least is zinc. The elements occur in the following order K>Mg>Na>Fe>Cu>Zn. From the result obtained from the analysis the elements are found to be higher in the defatted flour compare to the undefatted except for Mg which was higher in undefatted flour.

In the defatted unpeeled flour elements occur in the following order K>Mg>Na>Fe>Cu>Zn while in the undefatted unpeeled flour, these elements occur in the order K>Mg>Na>Cu>Fe>Zn. The concentration of these elements tends to be higher in the defatted unpeeled flour compare to the undefatted unpeeled flour which is still the case in terms of the defatted peel and undefatted peeled flour. Generally the result shows higher concentration of element in the peeled flour than in the unpeeled.

The values obtained for copper are higher than that of guna seed reported by Beatrice *et al.,* (2013). 3.27mg/100g in undefatted flour, 1.31 mg/100g in defatted flour. It is also higher than value obtained for *lagenaria siceraria* 2.6mg/100g by Dunu *et al.,*

(1986). The values obtained for iron concentration in all samples were lower compared to those reported for guna seed 136.00mg/100g in undefatted flour, 180.00mg/100g in defatted flour (Beatrice *et al.,* 2013); but higher than that of *lagenaria siceraria* 43.5mg/100g (Dunu *et al*., 1986). Magnesium content in analyzed samples were higher than that reported by Beatrice *et al.*, (2013) for guna seed 81.00mg/100g in undefatted flour, 82mg/100g defatted flour. The content of zinc in the unpeeled flour samples falls just within the recommended range although that of the peeled flour was very high compared to those reported for guna seed flour 62.50mg/100g (Beatrice *et al.,* 2013) and egusi 1.2mg/100g (Ojieh *et al.,* 2008).

The values obtained for sodium from the analyzed samples are higher than that of egusi melon 13mg/100g (Ojieh, *et al.,* 2008). The values obtained for potassium from analyzed samples were very high but still falls below the recommended value by WHO/FAO (1996) 2500mg/day. The daily recommended value of sodium is 2400mg – 5175mg/day even 8050mg; zinc 3mg – 25mg per day; Magnesium 150 – 450mg per day; iron 10 – 18mg; copper 0.34 – 1.3mg/day.

Copper is one of the micro – mineral required in milligram quantities per day. Copper is a mineral that facilitate the absorption of iron and it's also required in the body for enzyme production and biological electron transfer (Suzanne. 2002; Clifton, 1971) Iron is also a trace mineral required for blood formation (Adeyeye and Fagbolon, 2005). Iron is part of the hemoglobin and myoglobin molecules involve in oxygen transport to and within the cells (Suzanne, 2002). Magnesium is a mineral involve in neural conduction and muscle contraction. It is also important in calcium metabolism in bones, it prevent circulatory diseases, regulates blood pressure and insulin release (Onyirinka *et al.,*1997; Umar *et al.,*2005).

Zinc is also a trace minerals required in milligram. Zinc in haemoglobin helps to prevent anaemia (Lippard and Jeremy, 1994). Sodium is an important element essential for muscle and nerve activity, it also helps to maintain water balance in the body while potassium on the other hand is present largely in the fluid within the body cells. It has a complementary action with sodium in the function of cells in disease such as Kwashiorkor where tissue breakdown as well as diarrhea potassium is important. In severe cases of potassium depletion, heart failure may result unless supplement is given. Potassium is an essential element in enzyme system for protein and carbohydrates metabolism. The presence of potassium in relatively high concentration in watermelon seeds renders it effective in the deficiency that may occur in diabetic acidosis and renal disease.

Chromium and lead were not detected in all the samples. Chromium is a metal called essential trace element because very small amount is necessary for human health; it is used for improving blood sugar control in people with prediabetes type 1 and type 2 and high blood sugar, due to taking steroids. It is also used for lowering bad cholesterol and raising good cholesterol in people taking heart medications called beta blockers, but uptake of too much chromium can cause health effect such as allergic reactions (skin rash, nose irritation), and nose bleed. Other side effect includes upset stomach and ulcers, respiratory problems, weakened immune system, kidney and liver damage, alteration of genetic material, lungs cancer and death. The health hazards associated with exposure to chromium depends on its oxidation state. Aduku A.O. (2004).

Lead is a heavy metal and has a great toxicological effect on man which include inhibition of hemoglobin formation, sterility, hypertension and mental retardation in children. Aduku A.O. (2004).

Conclusion

Considering the proximate analysis of watermelon seed (*Citrilus lanatus*) flours defatted undefatted peeled, and defatted, undefatted unpeeled flours has considerable amount of carbohydrate and lipid flours for provision of energy to the body, protein which enhance enzymes activity in the body. The amount of lipids obtained from this seed has shown that, the seed can be exploited for oil on a commercial basis and cake used in the production of biscuits and animal feeds. The ash, crude protein, fat/lipids, shows higher concentration in the peeled sample than the unpeeled sample, while carbohydrate and moisture are higher in the unpeeled sample.

The elemental analysis has further shown the great quality of minerals deposited in the seed. Potassium show the highest value with zinc being the least in all the samples while chromium and lead were not detected. This has shown that the seeds can be used as a source of mineral in diet and also as part of drugs in pharmaceuticals.

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