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Nutritional Composition of Watermelon (*citrullus lanatus)* Fruit Obtained From Ilorin, North Central Nigeria.

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ABSTRACT

Watermelon is a popular fruit consumed widely by the locals in Ilorin and its environs, this study was carried out to access the nutritional quality obtained in Ilorin. Watermelon (*citrullus lanatus)* was separated into its various components (pulp, seed, rind, juice and flesh). The seed was processed and defatted to get the seed oil, also the flesh was processed to separate the juice. Proximate analysis and mineral contents of the pulp, seed, rind, juice and flesh was carried out. Physicochemical analysis was of the seed oil indicate that it can be used in soap and cream making. Similarly, the physicochemical results showing the iodine value, acid value, saponification value, peroxide value, and specific gravity showed it as edible oil. Proximate analysis was carried out on the five separated parts in which some nutritional components like protein, carbohydrate; fat, crude fibre, moisture and ash were gotten. Also the mineral composition of the parts were determined in which about eleven metals were obtained which include Ca, Na, Mg, Mn, Zn, Cr, Cd, Fe, and Cu. Thus, watermelon can be considered as a good source of nutrient and the seed oil is found useful in some manufacturing industries.

Key words: Watermelon, proximate analysis, nutrition, mineral composition

INTRODUCTION

Watermelon *(Citrullus Lanatus)* is of the kingdom Plantae and *cucurbitacea* family, it is thus related to the cantaloupe, squash and pumpkin that grows on vines on the ground. It is a tropical fruit widely consumed around the world and particularly among Malaysians (Wasylikowa and Van der Veen, 2004). Watermelon originated close to the Kalahari Desert where wild forms can still be found. It has been in cultivation for at least 4000 years in Egypt. It spread through the Sahara Desert region to the Middle East during antiquity. By the 10th century it was introduced to China, which today is the world greatest producer and consumer of watermelon. Watermelon was grown in Europe by the 13th century, and it was introduced into North America during the 17th century (Paris et al, 2012) Watermelon accounts for 6.4% of the world area devoted to vegetable crops (FAOSTAT, 2016). China is the largest producer of watermelon with 69.3 million tons of the total world production (People's Daily Online, 2017). Other major producing countries are Turkey, Iran, Brazil,

the United States, Egypt, Russia and Mexico (FAOSTAT 2016). Watermelon is grown throughout the world for human food; it is consumed as a dessert fruit, as a source of drinking water or for its edible seeds (Szalay, 2017). It is also used as animal feed in some areas (Schaffer and Paris, 2016). Although watermelon is primarily eaten fresh, it is also eaten as cooked vegetable in Africa. In Russia, watermelon is eaten after being pickled or used for production of syrup by boiling the sugary flesh, (International Tropical Fruits Network, 2016). In China, firm fleshed cultivars are cut into slices and dried for pickled or glass candy. In Sudan and Egypt the seeds are roasted, salted and eaten. Another use of watermelon is the use of the fruits as a source of drinking water during drought seasons, which is a well-known use in parts of Sudan and Nigeria. Sudan is a country of diversified ecological conditions including climate, vegetation and soil, which result in an enormous wealth of diversified indigenous genetic resources of crops of which watermelon is an example (FAO, 2015). The Western part of Sudan is an important region for the diversity of watermelon where different cultivars and uses are known, especially in the Kordofan region (Vossen, 2004).

Watermelon is found to contribute significantly to human health. Fresh watermelon may be eaten in a variety of ways and is also often used to flavor drinks and smoothies. As with many other fruits, it is a source of vitamin C. It is not a significant source of other vitamins and minerals unless one eats several kilograms per day. Watermelon contains vitamins A, C, B6, and potassium. It is fat-free, and high in energy, (International Tropical Fruits Network, 2016). Watermelon extract supplementation has been reported to reduce ankle Blood Pressure, brachial Blood Pressure, and carotid wave reflection in obese middle aged adults with prehypertension or stage 1 hypertension. Additionally, watermelon consumption reduced body weight and blood pressure while improving blood lipid profile and antioxidant status, which suggests that fresh watermelon, when consumed in place of conventional refined carbohydrate snacks, may help reduce appetite and assist with weight management while reducing cardiovascular risk factors (Figueroa *et al*, 2012).

This works thus aims at assessing the nutritional quality of watermelon found in Ilorin metropolis.

Material and Methods

Sample Collection.

The sample, *Citullus lanatus* was bought from local market in Tanke, Ilorin, Northwestern Nigeria. The samples were transferred into the laboratory in different polythene bags.

Sample Preparation.

The sample was rinsed with distilled water, cut and separated into pulp, seeds, juice, rind and flesh with clean laboratory knives. The pulp, seed, rind and flesh were then air dried for two weeks.

Physicochemical Analysis

Moisture content

Each sample (2 g) was weighed into a pre weighed crucible and heated in an oven at 105^{o}C for five hours after which a constant weight was obtained (AOAC 1990). The moisture content was then calculated using equation 1.

$$\% \text{ Moisture} = \frac{weight\ after\ drying\ X\ 100}{\text{Weight before drying}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Ash Content

A known amount (2 g) of each sample was weighed into a pre weighed crucible and heated in a muffle furnace for 5 hours at 550^{o}C (AOAC 1990). The percentage ash content was estimated using equation 2.

$$\%Ash = \frac{Mass\ of\ Ash\ X\ 100}{Mass\ of\ Sample} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Crude Lipid

The crude lipid was determined using a soxhlet apparatus, 2 g of each of the samples was weighed into a pre-weighed filter paper and tied with a white thread and thrown into a thimble placed on an extraction chamber. The chamber was suspended above a round bottom flask containing n-hexane and was extracted continuously for 6 hours, (AOAC 1990).

Crude Fiber

A known weight (2 g) of each sample was weighed into a round bottom flask to which 25 ml of 1.25% H_2SO_4 was added and boiled for 30 minutes. The resultant mixture was cooled, filtered and the residue was placed in another flask. A 25 ml of 1.25% NaOH was added to this flask and its contents, reflux for 30 minutes and then filtered. The residue was dried, weighed, and incinerated in a muffle furnace at 550^{o}C for 5 hours (AOAC 1990). The crude fiber was calculated using equation 3.

$$\text{Crude Fiber} = \frac{Weight\ of\ crude\ fibre\ X\ 100}{Weight\ of\ Sample} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Crude Protein

The crude protein was determined in three stages using the Kjedahl method.

Digestion: The digestion process involve the addition of 5 g of Na2SO4, 0.5g of CuSO4, Pinch of selenium Oxide catalyst into a Kjedahl digesting flask, followed by the addition of 25 ml of conc. H_2SO_4 with 2g of each sample. The flask was heated on a bunsen burner in a fume cupboard until the content becomes clear. The digest was transferred quantitatively into 250 ml volumetric flask and made up to the mark with distilled water.

Distillation and Titration: The digest sample (5 ml) was pipette into a Markham distillation set, 6 ml of 40% NaOH was added to make the solution a strong alkaline and to liberate ammonia from the solution, steam was passed into the solution to flush out the ammonia and was distilled into 5 ml Boric acid indicator in a conical flask placed below the tip of the condenser until about 50 ml was collected, the distillate was then titrated against 0.01 M HCl until a blue color end point was observed, equation 4 was used to calculate the percentage crude protein (AOAC 1984).

$$\%\ \text{Protein} = \frac{14X10^{-5}\ X\ \{Vs-Vb\}X250X10}{5Xm} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Where Vs= Volume of Acid; Vb= Volume of base and M= Mass

Physicochemical analysis

The seed oil was extracted using solvent extraction and physicochemical properties of the seed oil were analyzed.

Saponification Value

The oil sample (2 g) was weighed into a flask, 25 ml of 0.5 KOH and 20 cm^3 of ethanol was added. Another solution was prepared with the same content as above but excluding the oil sample as the blank. The two flasks were refluxed on a water bath for 1 hour and were cooled slightly, 10 drops of phenolphthalein indicator was added and titrated against 0.05 M HCl, equation 5 was used to estimate the saponification value (AOAC 1990).

$$\frac{B-A}{W} \times 28\ (A\ CONSTANT) \ldots\ldots\ldots\ldots (5)$$

Where B = volume of acid used for blank; A= volume of acid used for sample; W= weight of sample taken

Specific Gravity

This was carried out using a 25 ml specific gravity bottle. The bottle was washed and oven dried for 5 minutes, it was then filled with the sample and weighed after which it was filled with distilled water and weighed, (ASTM, 2016). Equation 6 was used to determine the specific gravity of the sample

$$SG = \frac{weight\ of\ sample}{weight\ of\ distilled\ water} \ldots\ldots\ldots\ldots (6)$$

Acid Value

The sample was weighed (2 g) into a 250 ml conical flask, 50 ml of ethyl ethanol was added followed by 10 drops of phenolphthalein, the solution was boiled for five minutes and titrated against standard KOH when hot, the acid value was estimated using equation 7.

$$Acid\ Value = \frac{56.1 \times V}{W} \ldots\ldots\ldots\ldots (7)$$

Where V = volume of the titrant; w = weight of the sample;

Iodine Value

A known amount (0.25 g) of the sample was weighed into a conical flask, 25 ml of Wij's solution was added and closed with a stopper, and 20 ml of 10% KI was added and shaken. Another solution was prepared having the same content as above but excluding the sample to represent the blank. The two contents were kept in the dark for 1 hour and were titrated against 0.1 N NaS_2O_3 to a colorless solution, (AOAC 1990). The iodine value was thus determined using equation 8

$$\frac{B-A}{W} \times 1.27(a\ constant) \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where B = the difference between the volumes, in mL, of sodium thiosulfate required for the blank and for the sample; A = is the normality of sodium thiosulfate solution; and W = weight of the sample.

MINERAL ANALYSIS

The cations were determined using flame atomic absorption spectrophotometer, 2 g of each sample was weighed into 250 ml conical flask, 10 ml of aqua regia (HNO_3 and HCl of ratio 1:3) was added and the mixture was heated on a hot plate until the black fumes disappeared leaving the white fume. The resulting sample was then made up to 250 ml using distilled water and then filtered into a clean sample bottle for atomic absorption spectrometric analysis (AAS). (AOAC 2006).

RESULTS AND DISCUSSION

The results of the proximate analysis of the samples are presented in Table 1. The table revealed that the flesh has the highest moisture content which is 70.84±0.08, followed by the pulp, the rind and the seed. These values are lower compared to the values reported by Fila et al. (2013) which is 48.75±0.01% for the seed and 91.82±0.01% for the pulp. This high value reported for the flesh may results in its low shelf life. The fiber contents reported for all the samples are very low, that of the seed 3.83±0.12% falls in line with 3.80±0.2% reported by Oyeleke *et al*. (2012a) this values shows these five parts of *Citrullus lanatus* are not rich in fiber. The crude fat result shows that the seed has the highest concentration of fat therefore the seed can be regarded as an oil seed. Also the seed has the highest percentage of protein 34.13±0.78% which also falls within the recommended daily allowance for children 23.0-36.0 (FNBC 1989). The carbohydrate

range also shows that watermelon is also an energy giver fruit. The values obtained in this research also fall within the range of values obtained for three varieties of watermelon samples analyzed and reported by Tabiri *et al* (2016).

Table 1: Result of Proximate Analysis

Sample	Moisture (%)	Crude Fibre (%)	Crude Lipid (%)	Crude Protein (%)	Ash Content (%)	Carbohydrate Value (%)
Seed	27.75±0.03	3.83±0.12	22.85±0.58	34.13±0.78	8.6±0.06	6.63±0.27
Pulp	68.47±0.48	3.19±0.01	6.0±0.81	8.0±0.08	1.23±0.05	14.16±2.0
Rind	60.73±0.13	3.17±0.11	4.43±0.07	5.91±0.09	2.78±0.09	26.15±0.18
Flesh	70.84±0.08	3.06±0.03	3.43±0.51	14.22±0.01	1.31±0.08	10.19±0.6

Values are reported as mean ± SD

Table 2 presents the results of the physicochemical analysis of the seed oil of watermelon *Citrullus lanatus*. The table indicates that the acid value of the seed oil was 17.9±0.4 mg/KOH/g, this low value indicates that the oil is good and edible (Acar et. al, 2012). Also the peroxide value reported for the seed oil is 4.5±0.01 mg/KOH/g, this value is an indication that the oil does not contain much of trace element and moisture which normally accelerates auto oxidation. Iodine value reported for the seed oil, 79.6±0.13Meq/mg shows that the oil contains low degree of unsaturation and can therefore be classified as non-drying edible oil because 80-100Meq/mg iodine value has been suggested for most edible oil (Peason *et al*.) The saponification value of the seed oil was found to be 217±0.5mg/KOH/100g which is higher than 148±0.5mg/KOH/100g reported by Fila et al. (2013) this value makes it useful in soap making. The specific gravity was found to be 0.91±0.0002 which falls in line with 0.91±0.1 reported by Oyeleke *et al*. (2012b). This value shows the oil is less dense than water and therefore be useful in cream production as it will make the oil flow and spread well on the skin.

TABLE 2: Result of physicochemical analysis of the seed oil.

Parameters	Result
Acid value	17.9±0.4 Mg/KOH/g
Peroxide value	4.5±0.01 Mg/KOH/g
Iodine Value	79.6±0.13 Meq/Kg
Saponification	217±0.5Mg/KOH/g
Specific gravity	0.911±0.0002

Values are reported as mean ± SD

The results of the mineral composition of the seed and pulp of the watermelon sample are presented in Table 3.

TABLE 3: Mineral compositions (100g/mg) of watermelon seed and pulp

SAMPLE	SEED (mg/100g)	Pulp (mg/100g)
Zn	0.40	1.23
Mg	5.0	6.86
Pb	0.05	0.025
Fe	1.0	4.375
Mn	3.66	1.05
Ca	8.93	10.63
Cu	0.81	0.26
Cd	0.05	0.05
Cr	0.038	0.13
Na	1.57	9.87
K	8.55	5.00

The results presented in Table 3 indicate that the pulp is richer in mineral composition than the seed. Calcium being the most abundant in the both the pulp and the seed while lead was the least, the mineral composition ranges from 0.025 10.63 mg/100 g of the samples. The values obtained in this study are comparable to those obtained in other studies, (Fila *et al*, 2013; Tabiri *et al*, 2016; George Mateljan Foundation, 2016)

CONCLUSION

This research work is an indication that great potential exists for the use of watermelon seed and pulp. As the juice and flesh is edible so is also the seed and the seed and the pulp, instead of throwing them away as waste after consuming the flesh they have some medicinal capacity as well domestically and industrial use. The seed could be used in infant food formulation and the seed- oil could also be a useful source of oil for both domestic and industrial uses instead of depending solely on palm oil and vegetable oils or peanut oil that are scarce and costly. Also the study shows the nutritional composition of the seed and the pulp, which makes us conclude that the watermelon seed and pulp are both edible.

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