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Nutritional composition of different varieties of watermelon (*Citrullus lanatus)* fruit at gewane, Northeastern Ethiopia

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Abstract
Watermelons belong to the family Cucurbitaceae. The plant has fruits and grows on vines and on the ground like cantaloupe, pumpkin. Fruit with good antioxidant properties used to prevent non-communicable diseases (NCDs). However there is knowledge gap in nutritional composition and antioxidant activity of watermelon fruits in our context. Four varieties of watermelon grown in Gewane, Ethiopia were studied for their proximate composition, mineral content, and total phenolic content (TPC). Results found for proximate composition of varieties watermelon flesh and seed part ranged as follows: Protein; 0.397 – 0.657% (flesh) and 19.87 – 24.60% (seed), Fat; 0.074 – 0.105% (flesh) and 23.35 – 25.25% (seed), Ash; 1.72 – 1.989% (flesh) and 2.4 – 2.6% (seed), Fiber; 0.127 – 0.213 (flesh) and 28.66 – 34.35% (seed), Moisture; 91 – 95% (flesh) and 2.7 – 4.55% (seed), Carbohydrate; 2.122 – 0.016% (flesh) and 10.66 – 20.3% (seed), Kcal; 11.715 – 28.633% (flesh) and 360.55 – 375.21% (seed). The mineral content of citrullus lanatus fruit, for Fe ranged between 0.8 - 3.143 and 2.454 – 4.919 mg/100gm (in flesh & seed), for Zn 0.057 – 0.144 and 3.223 – 4.476 mg/100gm (in flesh & seed), for Ca 5.625 – 7.771 and 11.922 – 33.326 mg/100gm (in flesh and seed), for P 10.826 – 19.037 and 375.90 – 476.96 mg/100gm (in flesh & seed), for Na 6.15 – 11.58 and 3.87 – 11.96 mg/100gm (in flesh & seed) and for K 96.55 – 111.01 and 708.66 – 1036.68 mg/100gm (in flesh & seed) was found. This finding showed that there is significance difference in nutritional composition of fruit, flesh and seed part of watermelon in the sample varieties.

Keywords: fruit, mineral content, nutrient, watermelon flesh, watermelon seed, watermelon varieties

Introduction
Watermelon (*Citrullus lanatus* (Thunb.) Matsum & Nakai) is sweet and juicy fruity horticultural crop [1]. It account for 5.4% of the harvested area devoted to vegetable production in 2008 in Africa and this contributed about 4.6% the world watermelon production 99,194,223 tonnes [2].

Many research reports showed that, watermelon is very rich in micronutrients and lycopene and red carotenoid pigment which acts as antioxidant during normal metabolism [3]. A cup of watermelon provides 24.3% vitamin C, and 11.1% vitamin A of the daily requirement [4]. Due to its antioxidant properties; lycopene helps cells and other structures in the body to protect from oxygen damage and prevent heart disease [5]. The antioxidant property of watermelon helps in prevention of non-communicable diseases (NCD). According to World Health Organization, 34% of death in Ethiopian is due to cardiovascular disease, cancer and pulmonary disease. The estimated prevalence of disease is 15%, 4%, 4% and 2% for cardiovascular disease, cancer, pulmonary disease and diabetes mellitus respectively [6]. One of the causes of non-communicable diseases is lack of appropriate dietary intake. Improvement of dietary condition, focusing on use of fruits and vegetables that have good antioxidant properties and nutritional composition is the main strategies in prevention of NCD. There is little information about the nutritional and anti-nutritional composition as well as the antioxidant properties of different varieties fruit of the different varieties of watermelon produced in Ethiopia [5].

Cancer, chronic respiratory diseases and cardiovascular diseases (CVD) are among the major health problem in the world and they are non-communicable diseases (NCDs). The contribution of this disease to mortality, and morbidity is projected to increase tremendously by the year 2030. Unhealthy diets, tobacco use, harmful use of alcohol, exposure to environmental carcinogens and physical inactivity are mentioned to be the major causes of NCDs.

Incidences of NCD are rising in Ethiopia; this is attributed to regular consumption of processed food, refined food, white sugar, flour and junk food. The objective of this study is to determine the level of nutritional compositions of four varieties of watermelon fruit [6].

Materials and Methods

Description of the study area

The experiment was conducted at Gewane Agricultural Technical and Vocational Training College demonstration site, Afar Regional State. It is located in Gewane District at 10°10' N latitude, 40°32' E longitude, and 356 km North East from Addis Ababa. The altitude of the study area is about 626 meters above sea levels. The experimental area average annual rainfall of about 400 mm and characterized as a semi-arid climatic zone. The mean annual temperature of the experimental site is about 30 °C with 39 °C maximum and 22.5 °C minimum.

Analysis of nutritional composition

Sample preparation

Fruits of different watermelon local varieties were washed. These fruits cut into small pieces by knife. The seeds were removed from fruits and washed, allowed to drain and placed on aluminum foil. The pulp was chopped into small pieces, allowed to drain and placed on another tray lined with foil, which was then transferred into an oven. This was maintained at 50 °C in oven to dry for composition analyses. The seeds were dried in oven for 24hours. The dried samples were removed and pulverized separately in a steel-bladed grinding mill [7].

Moisture content determination

Crucible to be used for moisture determination were washed and dried in oven at 1050c for one hour and transferred to the desiccator to cool for 30 minutes. Weights of empty crucible were measured (W1). The samples were mixed and five gram of each sample were transferred to the dried and weighed crucible (W2) and dried at 105^0C for 3hr. After drying, it keeps in a desiccator to coolant room temperature it is again weigh (W3). Drying for 30 minutes of the sample and cooling was repeated for two or more times until a constant weight obtained.

$$\text{Moisture content in percent (\%)} = \frac{W2-W3}{W2-W1} \times 100\%$$

Crude protein analysis

Protein was determined by kjeldhal method. All nitrogen is converted to ammonia by digestion. The ammonia released after alkalization with sodium hydroxide is steam distilled into boric acid and titrated with hydrochloric acid.

Digestion

The samples weigh 0.5 g was taken in flask tube and 6ml of concentrated sulfuric acid was added and mixed. Then 3.5 ml of 30% hydrogen per oxide were added into digestion flask. The flasks were shaken and observing violet reaction. As soon as the violet reaction had ceased, three gram of catalyst (0.5g) of copper sulfate with 100g of potassium sulfate) was added into each flask tube. When the temperature of digester reached 3700c, the flask tubes were placed into the digester and the digestion was continued until a clear solution was obtained about 3 to 4hrs. The flask tubes in the rack were then transferred into hood for cooling. The content in flask tube was diluted with distilled water and shaken to avoid precipitation of sulfate in the solution.

Distillation

A 25ml of 40% sodium hydroxide solution was added into the solution. A 250ml conical flask contacting 25ml of boric acid, 25ml of distilled water and indicator solution was placed under the condenser of the distiller with its tip immersed into the solution. The distillation was continuing until a total volume become between 200 and 250ml. The tip also rinsed with a few ml of water before the receiver is removed.

Titration

The distilled solution was then titrated with 0.1N hydrochloric acid to a reddish color.

$$\text{Nitrogen (\%)} = \frac{\text{VHcl in L} \times \text{N Hcl} \times 14}{\text{Wo}} \times 100$$

Where, V- volume of HCL in L consumed to the end point of titration
N- The normality of HCL (0.1N)
Wo- weight of sample
14.00- the molar weight of nitrogen
Protein (%) = 6.25 × % nitrogen

Crude fat content determination

Extraction cylinder were cleaned with hot water, dried in drying oven at 700c for one hour and cooled in desiccator for 30 minute, and weighed. The bottom of the extraction thimble was covered with thinly layer of fat free cotton. Two gram of sample were weighed and transferred into extraction thimble, and then the thimble was covered with cotton. The thimbles with the samples content were placed into soxhlet extraction chamber. Fifty ml of petrolatum ether was added to the extraction flask through condenser. The extraction was conducted for four hours, after that the extraction flask with their content were removed from the extraction chamber an d placed in drying oven at 700c for about1 hr, and cooled in the desiccator for about 30 minutes and weighed.

$$\text{\% Fat content} = \frac{W2 - W3}{W}$$

Where
W1 = Weigh of the extraction flask (g)
W2 = weigh of the extraction flask plus the dried crude fat (g)
W = Weigh of sample (g)

Ash content determination

Porcelain dishes used for the analysis were placed into a muffle furnace for 30 minute at 550^0c. The dishes were removed and cooled in desiccators for 30 minutes, and the dished was weighed. Weighed 2.5g sample was added into each dish. The dishes that contain the sample were placed on a hotplate under a fume hood and the temperature was slowly increased until smoking ceased and the samples become thoroughly charred. Then the dishes were placed inside the muffle furnace at 550^0cfor 5 hrs. After that removed from the muffle furnace and allowed to cool in

desiccator, and weighed. The amount of total ash was calculated by using the following formula.

$$\text{Total ash (\%)} = \frac{M3 - M1}{M2 - M1}$$

Where
M1 = Mass of crucible
M2 = Mass of sample with crucible
M3 = Final mass of sample with crucible

Carbohydrate value
The available carbohydrate identify by the difference as 100 - (moisture + protein + fat + ash + total dietary fiber).
The total energy content in each sample was calculated as follows:

Total energy (%)= (9×crude fat+4×crude protein+4×utilizable carbohydrate)

Mineral analysis
Crucibles and glass wares were washed with 10% nitric acid and placed in oven at105 ^{O}C for one hour. Crucibles were cooled in desiccators for 30 minutes. Each four sample weighing 2.5g were transferred to the crucible and charred on hot plate until the smoke ceased to appear. The samples were then ashed in muffle furnace which was maintained at 550 ^{O}C for 5 hours. The ash was later taken out from the furnace and cooled in desiccators and weighted. Some drops of deionized water were added to the ash and evaporated on hot plate. Some drops of concentrated nitric acid were added and evaporated again using hot plate and ashed once more for 30 minutes to ensure its complete ashing.
The ash was suspended in 7ml of 6N Hcl and subsequently dried using lower temperature hot plate. Then, 15ml of 3N Hcl was added into the ash, heated on hot plate until the solution boils, cooled and filtered through filter paper into 50 ml graduated flask. Again, 10 ml of 3N Hcl was transferred to the crucible and heated until the solution boils, cooled and filtered into graduating flask. Crucibles were washed with deionized water three times and the solution was filtered in to a flask. The filter paper was thoroughly washed with deionized water and the solution was collected in to the flask. Lanthanum chloride solution (2.5ml) was added per 50 ml of solution. Finally, the contents of the flask was diluted and marked to 50ml with deionized water. The sample solutions were transferred to the urine cap bottle. The blank was prepared by taking the same amount of reagents following the same procedure. Mineral content was determined using the following formula. Finally, Fe, Zn, Ca, P, Na and K content were determined by using;

Calculation

$$\text{Metal content in mg/100g of} = \frac{[(CS - Cb)*V]}{(10*W)}$$

Where,
Cs = Concentration of sample in ppm
Cb= Concentration of blank in ppm
V= Volume (ml) of the extract
W = Weight (g) of sample

Result and Discussion

Flesh and seed part of four varieties *Citrullus lanatus* fruit were used for mineral contents and nutrient composition were determined in different methods was used for mineral contents and nutrient composition determination. The findings are presented as follow:

Ethno botany of watermelon
Four different watermelon varieties were identified in agricultural fields. Name and morphological characters of the four varieties are described in Table 1.

Table 1: Description of four different watermelon varieties

Local Name	Description
Lahat	Seeded fruit type, open field growing system, grayish with green strips of fruit skin color, deep red flesh color, oblong in fruit shape
Augusta	Seeded fruit type, open field growing system, deep green of fruit skin color, carmine rose or reddish pink flesh color, spherical in fruit shape
Ria	Seeded fruit type, open field growing system, light green with dark green strips of fruit skin color, red flesh color, oval in fruit shape
Candy	Seeded fruit type, open field growing system, grayish white of fruit skin color, red flesh color, round in fruit shape

Source: Ministry of Agriculture, Ethiopia (2017)

Proximate composition of watermelon fruit (flesh and seed part)
The mean value for moisture, crude protein, crude fat, total ash, carbohydrate and total energy calorie value of flesh and seed part of four local varieties of watermelon are presented in Table 2 and 3.

Proximate composition of flesh part of watermelon fruit
Moisture content
The mean values moisture content of the four varieties of watermelon is presented in Table 2. It ranged from 91 to 94 %. The highest and lowest moisture content was found in flesh of Augusta and Lahat fruit respectively. The moisture content of Candy (92) and Ria (93) were significantly lower than Augusta (94) and Lahat (95) of flesh part watermelon fruit at (p<0.005) [8, 9]. indicated that the moisture content of watermelon fruit was 92.47% and 90.95% respectively, which is comparable with this study.

Crude protein content
In Table 2, the protein content of the local four varieties is also presented. The highest and lowest protein content was found in Ria and Augusta respectively. The protein content of watermelon varieties were range from 0.39% to 0.65%. The crude protein content of Augusta was significantly (p<0.005) lower when compared with Ria flesh. However, Candy and Lahat flesh was significantly higher than Augusta flesh but lower than Ria flesh at (p<0.005). These

finding are in conformity with the study of [7] that reported the crude protein content watermelon of fruit as 0.44%.

Crude fat content

The results of crude fat content of watermelon varieties flesh part are presented in Table 2. Crude fat contents of the varieties ranged between 0.038% in Candy to 0.105% of Lahat fruit flesh. There is significant difference in crude fat content among the four varieties. The result of Lahat and Ria flesh has a similarity with the study of [10] which indicated 0.1% to 0.15% fat content of watermelon.

Ash content

The ash content of a biological material is the inorganic residue that remains after organic matter has been burnt. The ash content of the watermelon fruits flesh ranges from1.72% in Ria to 1.98% Lahat fruit flesh. There is no significant difference between Candy flesh and Augusta flesh in their ash content, but they have higher significance difference with Lahat flesh but lower significance with Ria flesh. As [11] indicated, the ash value of some Nigerian fruit ranges from 0.3%-2.5%, watermelon flesh have the highest ash value (2.5%) than those Nigerian fruit that is related with this study. Fruit with high percentages of ash contents are expected to contain high concentrations of various mineral elements, which are expected to speed up metabolic processes and improve growth and development [11].

Crude fiber content

The results of the crude fiber content the four watermelon local varieties. The finding fruit of the varieties contain crude fiber ranging 0.12% in Augusta to 0.21% in Lahat fruit flesh. When comparing the varieties, there is significant difference (p<0.005) among them. The results are comparable with previous studies, [10] indicated that crude fiber content range from 0.3 to 0.4 %and [12] was indicated 0.2%.

Carbohydrate content

The present study showed that there is significant difference (p<0.005) in the level of carbohydrate among fruit flesh of the four local watermelon varieties. The carbohydrate content ranges from 2.12% in Lahat to 6.32% in Ria fruit flesh as shown in Table 3.The result of this study showed that there is significant difference (p<0.005) among the four varieties. The results are relatively similar with7.19% and 4% to 5% that was reported by [7, 10] respectively.

Total energy

The caloric values of the fruit flesh from the four local varieties presented in Table 2. They range from 11.71% in Lahat to 28.63% in Ria fruit flesh. The total energy values are significantly different among each other. The study finding revealed that fruits are poor sources of energy.

Table 2. Proximate composition of flesh part of watermelon fruit (%)

Sample type	Moisture	Protein	Fat	Ash	Fiber	CHO	Kcal.
CF	92± 0.00a	0.54±0.19b	0.03±0.00a	1.82±0.043b	0.15± 0.007b	5.43±0.062c	24.28±0.175c
AF	94± 0.001b	0.39±0.10a	0.07±0.00b	1.81±0.036b	0.12± 0.007a	3.58±0.046b	16.60±0.144b
LF	95± 0.001b	0.57± 0.00b	0.10±0.00d	1.98±0.014c	0.21± 0.001d	2.12±0.016a	11.71±0.060a
RF	91± 0.00a	0.65±0.14c	0.09±0.00c	1.72±0.027a	0.20± 0.001c	6.32±0.019d	28.63±0.961d

CF- Candy flesh, AF-Augusta flesh, LF-Lahat flesh, RF-Ria flesh

Data are average of triplicate ± SE. Mean value with different superscript in the column are significantly different (p<0.005). The result is reported on wet basis.

Significant difference in caloric values of fruit flesh could be attributed to varietal differences. The values of proximate composition of flesh part of *Citrullus lanatus*,that is moisture, crude fiber, ash, fat and protein agrees with the findings of [13, 14] that worked on nutrient components of food, reported a range value of fiber 0.1g-6.8g for fruits. Fruits are not very good sources of fat as reported by [7, 15]. Also reported that nitrogenous content of fruits is low (0.4g – 0.6g) as compared to seeds, leaves and some other plants parts. The carbohydrate content of the fruits is low (7.50% to 18.60%) that was reported by [11]. Fruit with low carbohydrate content might be ideal for diabetic and hypertensive patients who require for low sugar diets.

Proximate composition of seed part of watermelon fruit

The moisture content of seed of four local varieties of watermelon is presented in Table 3. The value of moisture content of the seed decreased in the order of Ria (4.55)> Augusta (4.20)> Lahat (3.00)> Candy (2.70). There is significant difference (p<0.05) between the varieties of seeds. The moisture content of watermelon seed that was reported by other studies, [17, 16] was 4.86% and 6.9% respectively. The protein content of watermelon seed was higher than that found in most legumes as reported by [18] and the protein quantity meets the daily requirement for adults. The protein content of watermelon seed was indicated (Table 3). Lahat has higher protein than Candy and Augusta but lower than Ria seed.

Studies have shown that the fat in watermelon is more of monounsaturated, polyunsaturated and omega-6 fatty acids. The monounsaturated and polyunsaturated fatty acids help reduce blood cholesterol while the omega-6 reduces the risk of heart disease and type 2 diabetes [2]. The fat content obtained in the present study for watermelon seeds are presented in Table 3. In Candy seed (23.75), Augusta seed (23.25) and Lahat seed (23.75) there is no significant difference (P>0.05) seen in fat value but Ria seed has higher fat content than the rest at (p<0.005).

The ash value of varieties of watermelon seeds was presented but there is no significant difference between them as given in Table 3.Candy seed (34.35) and Lahat seed (33.45) have higher fiber content than Ria seed (32.43) and Augusta seed (28.66). As shown in Table 4, the carbohydrate content of Ria seed (10.66%) was lower than Lahat (13.59%), Candy (16.82%) and Augusta (20.30%) seeds. The caloric value of Augusta seed (375.21%) was higher than Ria (366.03%), Candy (360.55%) and Lahat (362.53%) seeds.

When we compare the result of this study with others, [16] reported that the protein (27.4%), fat (49.7%), ash (4.1%) and fiber (3.8%), of watermelon seed, [10] reported that protein (38.59%), fat (17.78%), ash (3.17%) and fiber

(7.32%) content of watermelon seed. [17] reported that protein (27.59%), fat (46.83%), ash (2.87%) and fiber (4.68%) content of watermelon seed, [19] reported as protein (30.11%), fat (30.73%),ash (3.75%) and fiber (5.19%), [18] reported as protein (16.3%), fat (12.91%), ash (3.24%), fiber (2.24%) and CHO (58.36%). The results of this study are comparable with some of study.

Table 3: Proximate composition of seed part of watermelon fruit

Sample type	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	CHO	Kcal
CS	2.70±0.141a	19.87±0.176a	23.75±0.353a	2.5 ±0.141a	34.35±0.056d	16.82±0.016c	360.55±0.031a
AS	4.20±0.000c	21.19±0.000b	23.25±0.353a	2.4± 0.000a	28.66±0.042a	20.30±0.031d	375.21±0.019b
LS	3.00±0.141b	23.60±0.141c	23.75±0.353a	2.6 ±0.282a	33.45±0.233c	13.59±0.030b	362.53±0.014a
RS	4.55±0.070d	24.60±0.141d	25.25±0.353b	2.5 ±0.141a	32.43±0.035b	10.66±0.060a	366.03±0.018a

CS- Candy seed, AS-Augusta seed, LS-Lahat seed, RS-

Ria seed

Data are average of triplicate ± SE. Mean value with different superscript in the column are significantly different (p<0.005).

Generally, the proximate composition of watermelon seed especially the protein and fat content have a good implication for the communities with high protein deficiency and can be used as complement protein with cereals and other plant foods in the diets. The fats are essential because they provide the body with maximum energy and the fat content indicate the importance of the seed for oil extraction that may be used for different food processing.

Mineral content of watermelon fruit

The analysis of the mineral constituents for iron, zinc, calcium, phosphorus, sodium and potassium content of watermelon fruit was presented in the following Table 4 and 5**.**The previous studies indicated as the mineral content of fruit affected by stage of development and ripening, [20] reported the concentration of mineral contents like Na, Fe and Zn were distinguishably higher in the ripe fruit, whereas the cultivars of watermelon showed their higher mineral concentration (K, Na and Mn) in the early stages of development and ripening. The recent studies of [19] referred the content of mineral elements in plants and fruit depends to a high degree on the soils abundance, including the intensity of fertility.

Mineral contents of flesh part

Iron

Accordingly to the results of this study (Table 4), the iron content watermelon flesh varieties have significance difference between them. The Lahat flesh (3.14 mg/100gm) and Augusta flesh (0.80 mg/100gm) have highest and lowest iron content respectively, whereas Ria flesh higher than Candy flesh at (p<0.005). The iron content of cultivated watermelon flesh ranged from 0.280 to 0.450 mg/100g in four different region of Turkey was reported by [22] that is less than results found in this study.

Zinc

There were a significance difference in zinc content of watermelon flesh varieties at (p<0.005). Zinc content ranged from 0.057 to 0.144 mg/100gm, in Augusta and Lahat flesh respectively [11]. Indicated that the zinc content of *Citrullus lanatus* flesh (7.5 mg/100g) was higher than nine different Nigerian fruit that also have higher results than this study.

Calcium

The calcium content of watermelon flesh part was presented in Table 5. There was significance (p<0.005) difference between Augusta (7.77), Ria (7.05), Lahat (6.50) and Candy (5.62) fruit flesh varieties. Other studies on calcium content of watermelon flesh is reported [21] was reported calcium content of 5.6 mg/100g, whereas [22] indicated that calcium content of *Citrullus lanatus* flesh ranged from 6.17 to 8.33mg/100g in agreement with present study.

Table 4: Mineral content of flesh part of watermelon

Sample type	Fe (mg/100g)	Zn (mg/100g)	Ca (mg/100g)	P (mg/100g)	Na (mg/100g)	K (mg/100g)
CF	1.51±0.021b	0.06±0.001b	5.62±0.002a	16.56±0.001c	8.31±0.044b	111.01±0.007b
AF	0.80±0.014a	0.05±0.000a	7.77±0.001d	14.29±0.001b	11.58±0.024c	127.12±0.033c
LF	3.14±0.001d	0.14±0.002d	6.50±0.001b	19.03±0.002d	10.66±0.043c	96.55±0.024a
RF	2.31±0.001c	0.12±0.002c	7.05±0.002c	10.82±0.002a	6.15±0.156a	107.42±0.003b

CF- Candy flesh, AF-Augusta flesh, LF-Lahat flesh, RF-

Ria flesh

Data are average of triplicate ± SE. Mean value with different superscript in the column are significantly different (p<0.005). The result is reported on wet basis.

Phosphorus

The phosphorus content of *Citrullus lanatus* flesh in this study is similar to that reported by [22] which ranged from14.82 to 17.95 mg/100gexcept for Ria flesh variety. The phosphorous content for four varieties of watermelon flesh was presented in Table 5, have a significantly different from one another (p<0.005).The highest and lowest phosphorus content was found in Lahat flesh (19.03 mg/100g) and Riaflesh (10.82 mg/100g) respectively.

Sodium

The mean total content of sodium in Candy flesh and Augusta flesh was 8.12 and 11.58 mg/100g receptively. However, there was significant decrease in sodium content on Lahat flesh and Ria flesh, which were 10.66 and 6.15 mg/100g respectively. Sodium content of this study was found to be similar to that reported by [22] that range 3.18 to 9.51mg/100g.

Potassium

In the present study, the potassium content of watermelon in Candy flesh, Augusta flesh, Lahat flesh and Ria flesh were presented 1036.68, 813.32, 708.66 and 720 mg/100g respectively. There is significance (p<0.05) difference among the varieties. The Candy flesh and Ria flesh are higher significance difference from Lahat flesh and Augusta flesh. [16, 22] are indicated as potassium content of watermelon flesh 125 mg/100gm and 98.27 to 156.18mg/100gm respectively.

Mineral content of watermelon seed

The analysis of the mineral constituents of the watermelon seeds showed a significant concentration of iron, zinc, calcium, phosphorus, sodium and potassium (Table 5). The iron content of seed varieties ranged from 2.454to 4.919 mg/100gm. Candy, Augusta and Ria seeds have higher content of iron than Lahat seeds. Zinc content didn't show significance difference among watermelon seed varieties. Concerning calcium content of seeds, Ria and Lahat seeds have higher content than Augusta seed as shown in Table 5. Regarding phosphorus, Ria seeds showed no significance difference from Candy and Augusta seeds but Lahat seed have higher significance difference from the rest at (p<0.005). Only Candy seed (11.96 mg/100gm) showed higher content than Augusta (3.87 mg/100g), Lahat (3.94 mg/100g) and Ria (4.00 mg/100g) seeds in sodium content. The potassium content of Augusta seed (813.32) was higher than Lahat (708.66) and Ria seeds (720.00) but lower than Candy seeds (1036.68) in mg/100g.

Table 5: Mineral content of seed part of watermelon

Sample type	Fe (mg/100g)	Zn (mg/100g)	Ca (mg/100g)	P (mg/100g)	Na (mg/100g)	K (mg/100g)
CS	4.04±0.311b	3.92±0.105a	20.80±0.866ab	375.90±0.067a	11.96±0.001b	1036.68±0.037c
AS	4.36±0.480b	3.22±0.108a	11.92±0.287a	415.65±0.013b	3.87±0.028a	813.32±0.220b
LS	2.45±0.061a	3.41±0.125a	31.14±0.701bc	476.96±0.098c	3.94±0.141a	708.66±0.007a
RS	4.91±0.210b	4.47±0.061a	33.32±0.073c	403.31±0.099ab	4.00±0.002a	720.00±0.000a

CS- Candy seed, AS-Augusta seed, LS-Lahat seed, RS-

Ria seed

Data are average of triplicate ± SE. Mean value with different superscript in the column are significantly different (p<0.005).

Other studies also reported on mineral content of watermelon seeds, [20] described the sample with the highest ash content had the highest probability of being the one with the highest mineral contents, it contained Fe (2.88), Zn (5.52), Ca (7.37) and Na (11.13) in mg/100gm. [21] also reported mineral content of watermelon seed like Zn (9.65),Ca (86.75), P (1073.3), Na (90.35) and K (598.95) in mg/100gm. Some of the mineral values found in this study have similarities with the two studies.

Conclusion

The proximate composition in four local varieties of watermelon grown and investigated with respect to the results obtained from this study, the following conclusions are made. The flesh part of watermelon fruit analyzed in this study was found to contain lower level of crude fat, crude fiber, protein and carbohydrate. The study therefore, showed that watermelon fruit flesh is poor source of macronutrients. In contrast, seed of the four local varieties contain appreciable content of protein, crude fat, crude fiber and carbohydrate. This indicates the possibility of using the seed to enhance the nutritional value of processed foods. Studying within the varieties has an implication in watermelon breeding for quality estimation and nutrition breeding. Furthermore, the results of the present study could be used giving information to the farmers to determine best production and by consumers to choose the cultivar with best nutritional quality.

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