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Elemental analysis of *Citrullus colocynthis* (L.) using atomic absorption spectrometer

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ABSTRACT

Citrullus colocynthis (L.) Schrad. (Watermelon) belongs to Cucurbitaceae family. Watermelon can be correctly referred as either fruit or vegetable. The watermelon has attracted attention of many researchers due to various kinds of its medicinal properties. A watermelon has basically four parts as rind, white flesh, red flesh and seed. There are a number of varieties of watermelon in which the central ripped part may be dark red, light red, pink, or yellow. The new variety is watermelon is also available without seed or very few seed called seedless watermelon. In the present investigation the dark red flesh variety of watermelon was chosen. Ca, Cu, Fe, Mg, Mn and Zn were investigated in rind, white flesh, dark red flesh and seed. It was found interesting that the amount of calcium (Ca) in all these four parts was very high and highest in the white flesh (unripped) of watermelon.

Keywords: Watermelon, *Citrullus colocynthis* L, Elemental analysis, AAS

1. INTRODUCTION

Watermelon (*Citrullus Colocynthis Lanatus*) belongs to Cucurbitaceae (Cucumber) family. It is large, oval, round or oblong tropical fruit [1]. The skin is smooth with dark green rind or sometimes pale green stripes that turn yellowish green when ripped [2]. The size can vary from small 2 kg to a monstrous 100 kg. More than 1200 cultivars of watermelon range in

weight from 1 kg to 100 kg. Some watermelon types have higher sugar content and some varieties have different coloured rind and flesh. The most common watermelon is with ruby red pulp, but watermelon can also be light pink, orange, yellow pulp as shown below.



Fig. 1(a). Full Size Watermelon



Fig. 1(b). Flower of Watermelon



Fig. 1(c). Green Leaf of Watermelon



Fig. 1(d). Male and Female Flowers

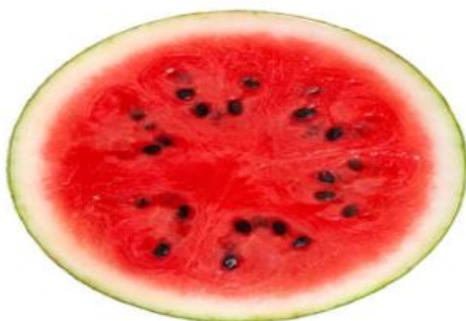


Fig. 2(a). Red flesh watermelon

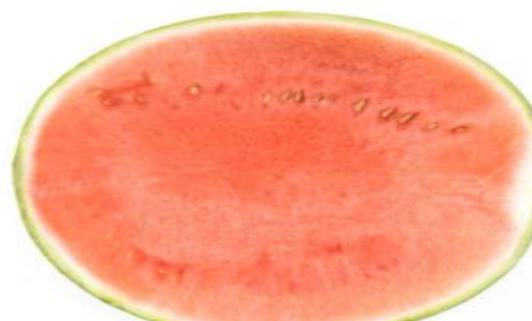


Fig. 2(b). Light red flesh Watermelon



Fig. 2(c). Pink flesh Watermelon



Fig. 2(d). Yellow flesh Watermelon

There are 4 basic types of watermelon: Seedless, picnic, icebox and yellow/orange fleshed. Seedless watermelon was created in 1990's, but growing it is a bit complex. Seedless watermelons have tiny underdeveloped only few seeds. The yellow flesh in yellow watermelon is a natural mutation. The fruit is a sweeter, honey like flavor as compared to red fleshed watermelon. The picnic type watermelon is normally to be larger of 8-10 Kgs or more. It is quite sweet with red flesh which get matured at around 80 days or so. Some varieties of picnic watermelons are Charleston gray, Black Diamond, Jubilee, Allsweet and Crimson Sweet. Iceberg Watermelon has 2 varieties known as Sugar baby and Tiger baby. These are normally of smaller size. The pulp is sweet and the rind is dark green but the tiger babies are golden once matured. The yellow/Orange watermelons are seedless and seeded. The seeded varieties includes: Desert king, Yellow Baby, Yellow Doll and Tendergold. The seedless varieties include Chiffon and Honeyheart.

Seedless melons are triploid has 33 chromosomes while the seeded watermelon are called diploid having 22 chromosomes. Chemical process is used to produce seedless watermelon by doubling the number of chromosomes. So 22 chromosomes are double to 44, called a tetraploid. Then, the pollen from a diploid is placed on the female flower of the plant with 44 chromosomes. The resulting seed has 33 chromosomes, a triploid or seedless watermelon. The following chemicals have been reported in literature [3,13-21]:

- Citrulline $C_6H_{13}N_3O_3$
- Arginine $C_6H_{14}N_4O_2$
- Phenolic antioxidants C_6H_5OH
- lycopene $C_{40}H_{56}$
- Vitamin A Lutein
- Zeaxanthin $C_{40}H_{56}O_2$
- Cryptoxanthin $C_{40}H_{56}O$

Citrulline is found as a nonessential amino acid and antioxidant. The body breaks down the citrulline and converts into arginine. Arginine helps to heal faster, cell division and removes ammonia. It has been reported that more citrulline in yellow or golden watermelon than reddish watermelon. The citrulline-arginine relationship helps heart health, the immune

system and may prove to be very helpful for those who suffer from obesity and type 2 diabetes,” said Patil. “Arginine boosts nitric oxide, which relaxes blood vessels, the same basic effect that Viagra has, to treat erectile dysfunction and maybe even prevent it

Lycopene is a red pigment found in watermelon. It is a powerful antioxidant. It helps in preventing atherosclerosis, prostate cancer and heart disease. It also fights with free radicals that destroy cells in our body. Lycopene does not occur in our body naturally and therefore watermelon is a good source of lycopene [4]. Watermelon has ingredients that deliver Viagra-like effects to the body’s blood vessels and may even increase libido. Beneficial ingredients in watermelon is known as phytonutrients, naturally occurring compounds that are bioactive, or able to react with the human body to trigger healthy reactions [5]. He further stated that watermelon relax blood vessels without any drug side effects. The arginine helps the urea cycle by removing ammonia and other toxic compounds from our bodies. Watermelon could significantly reduce blood pressure in overweight individuals at rest and while under stress. The pressure on the aorta and on the heart decreased after consuming watermelon extract [6]. A study was made to investigate the composition of indigenous watermelon seeds grown in two districts in Limpopo Province and quite differences were observed [7]. Nutritional and mineral analyses of watermelon seeds have been reported and data are available for a few elements [8]. Ca, Mg, Mn, P and K have been reported in a considerable amounts in watermelon seed oil and flour [9]. The therapeutic effect of watermelon has been reported and has been ascribed to antioxidant compounds (Table 1) [10].

Nutritional Composition of Watermelon has been reported as an amounts per 100 g (3 ½ oz) edible portion by USDA 2003 (Table 1) [11,12].

Table 1. Nutritional Composition of Watermelon

	Fruit	Seeds
Water (%)	91.51	5.05
Energy (kcal)	32.80	557.00
Protein (g)	0.62	28.33
Total Lipid (g)	0.43	47.37
Carbohydrate (g)	7.18	15.31
Calcium (mg)	8.00	54.00
Iron (mg)	0.17	7.00
Magnesium (mg)	11.00	515.00
Phosphorus (mg)	9.00	755.00
Potassium (mg)	116.00	648.00
Sodium (mg)	2.00	99.00

Zinc (mg)	0.07	10.20
Copper (mg)	0.032	0.686
Manganese (mg)	0.037	1.614
Selenium (μg)	0.10	
Vitamin C (mg)	9.60	0.00
Thiamin (mg)	0.080	0.190
Riboflavin (mg)	0.020	0.145
Niacin (mg)	0.200	3.55
Pantothenic acid (mg)	0.212	0.346
Vitamin B6 (mg)	0.144	0.089
Folate, total (μg)	2.00	58.00
Vitamin A (IU)	366.00	0.00
Vitamin E (mg ATE)	0.150	

2. EXPERIMENTAL DETAILS

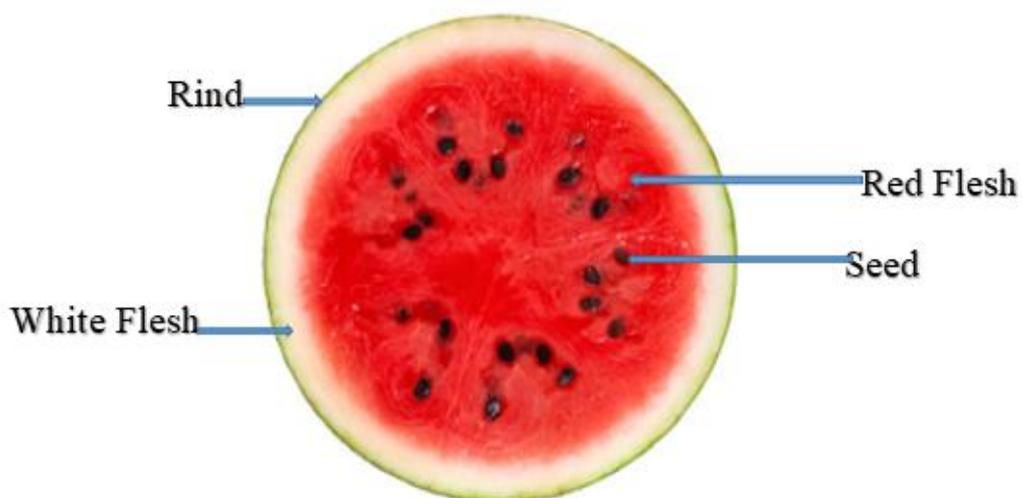


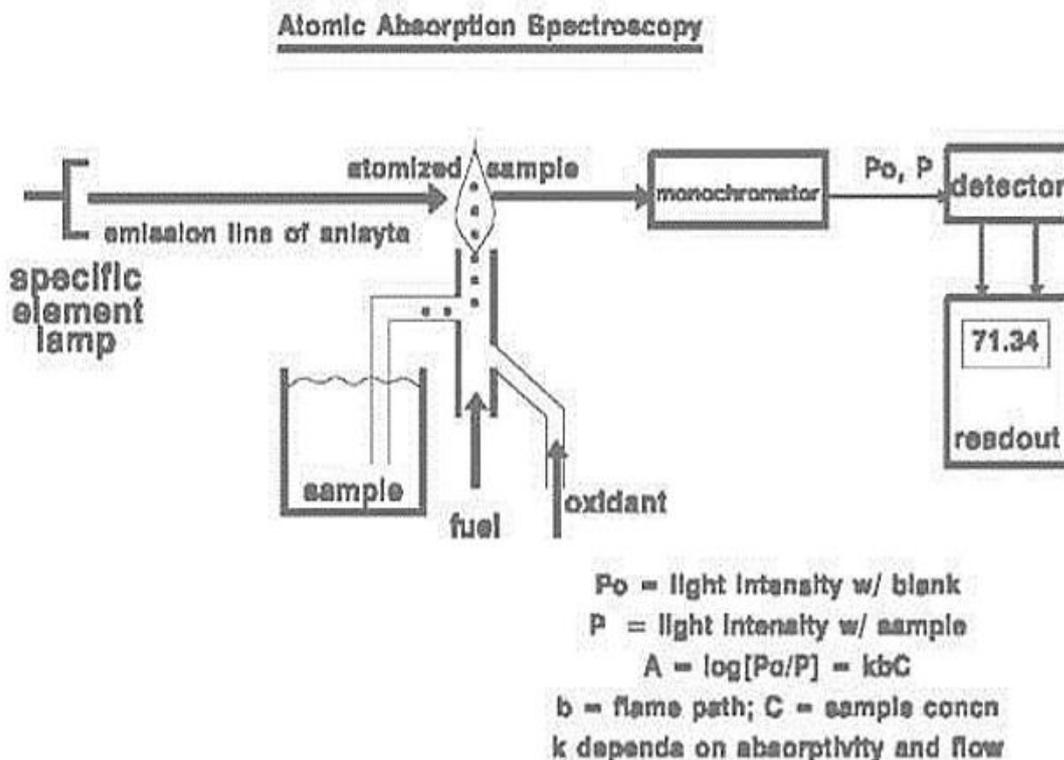
Fig. 3. A Slice of watermelon

Whole size watermelon was picked up from a farm. It was washed properly with normal water and then it was washed with deionized water. A slice was cut and then the rind was peeled off carefully about 15g and collected in a crucible. Then the outer part of the white flesh (un-ripped) part was cut carefully about 15 g and collected in another crucible.

Then the ripped flesh (red flesh) was cut about 20g and collected in another crucible. Seeds about 15g were chosen from the red flesh and collected in another crucible.

These crucibles with samples of different categories were kept in a electric oven to get dried at a temperature of 70 °C. It was noticed that the rind was found dried about 25 minutes and then this crucible was removed. The crucible with white flesh took about 50 minutes, seeds about 50 minutes and the red flesh about 100 minutes to get dried and then removed accordingly. These dried samples were made in the powder form and dissolved using aqua regia and heating for a short period of time. Additional deionized water was added to make a solution of 100ml each in different conical flasks.

Flame Atomic Absorption Spectrometry technique is a common, widely established and accepted analytical technique capable of quantitative detection of trace and ultra-trace elements and metals in a wide variety of sample solutions. In order to carry out an analysis, the element of interest must be compatible to the hollow cathode lamp used. The liquid sample is fed into the flame via a nebulizer which converts the sample into atoms at approximately 2300 °C. Radiation released from the hollow cathode lamp passes through the flame. Some of the radiation is absorbed by the atomized element and then passes through the monochromator. The light that reached the detector is then measured to the intensity of the light that hit the detector when the sample was not present. The processor then calculates the results obtained by the detector and the amount is outputted on the display screen.



3. OBSERVATION

Table 2. Concentration of different elements in different parts of watermelon.

Description of Samples	PARAMETERS					
	Ca mg/kg	Cu mg/kg	Fe mg/kg	Mg mg/kg	Mn mg/kg	Zn mg/kg
Rind	31000.0	4.72	23.4	95700.0	52.1	200.0
White Flesh	36800.0	nd	90.0	19700.0	31.7	245.0
Red Flesh	14400.0	nd	137.0	nd	1.00	113.0
Seed	23200.0	1.58	139.0	nd	41.7	349.0

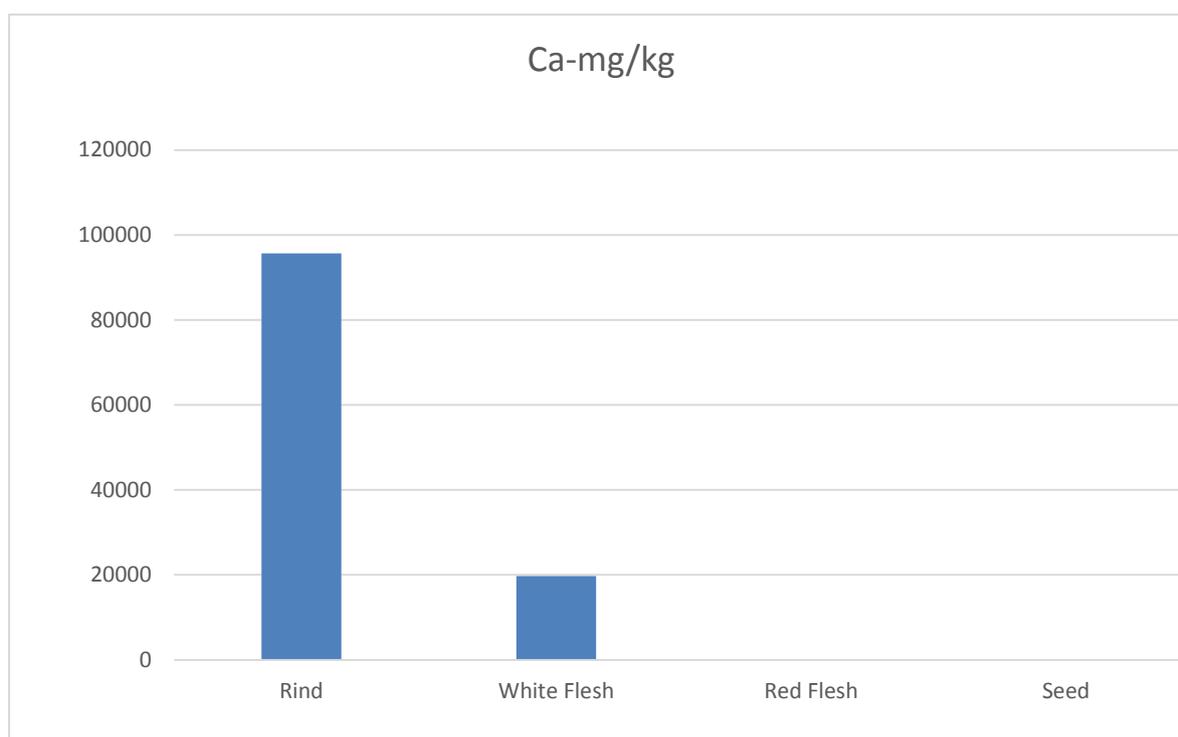


Fig. 4(a). Concentration of Calcium in different parts of Watermelon

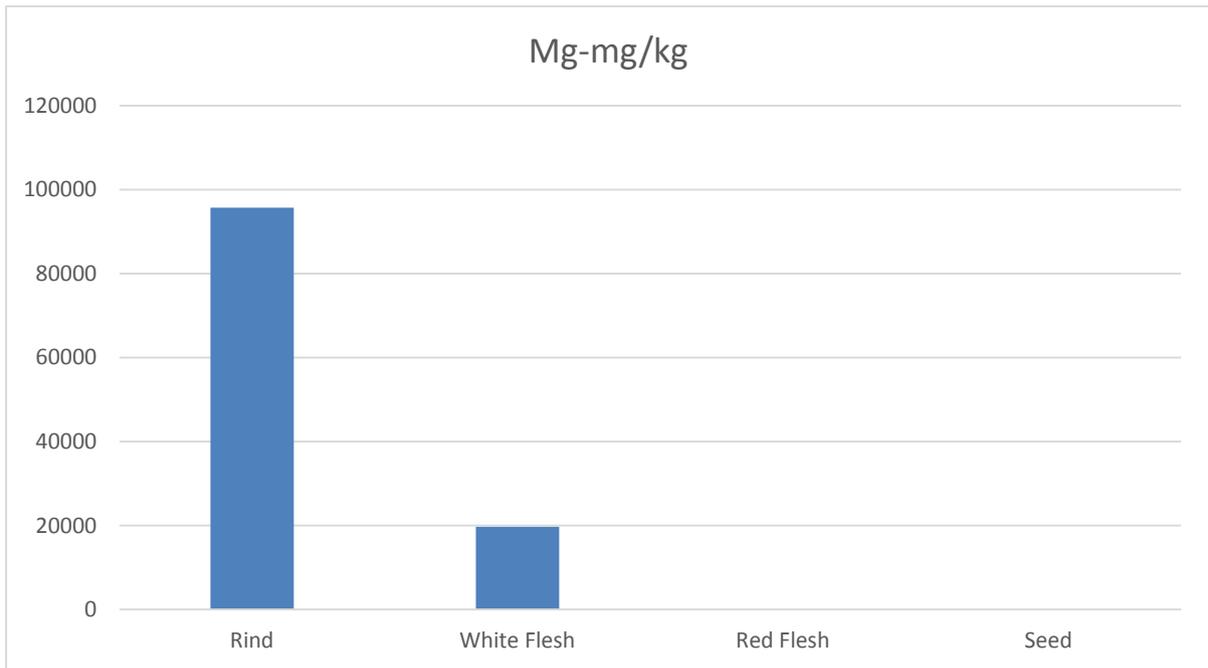


Fig. 4(b) Concentration of Magnesium in different parts of Watermelon

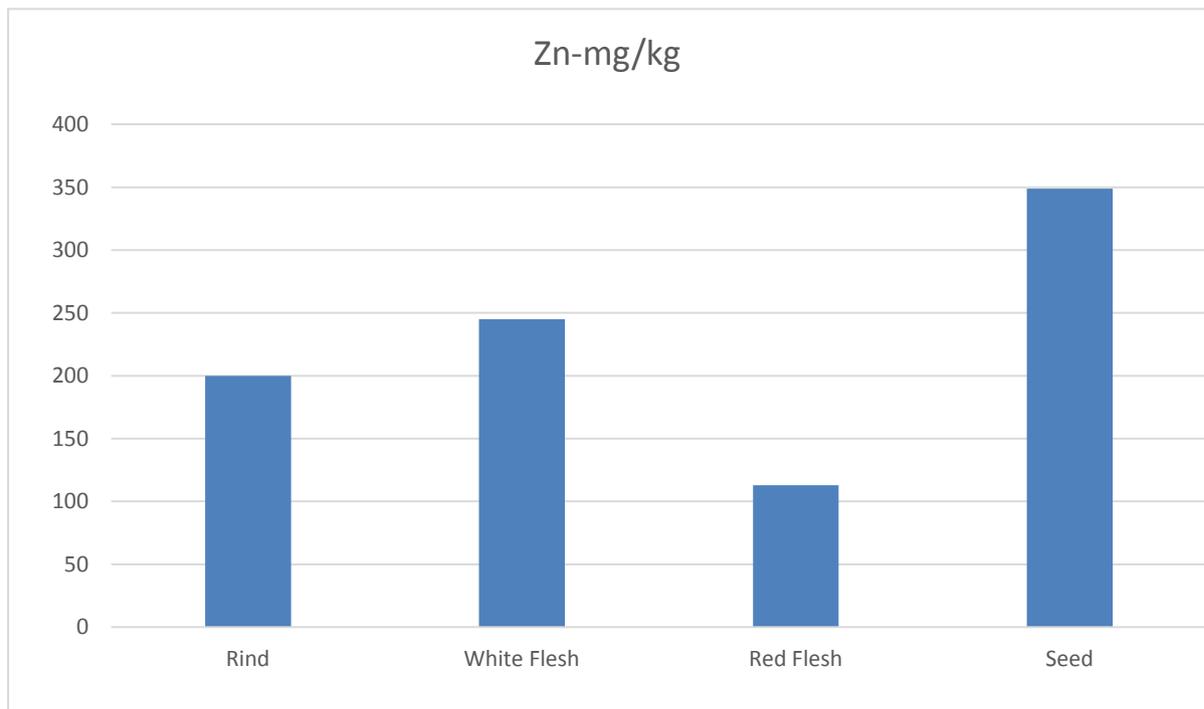


Fig. 4(c). Concentration of Zinc in different parts of Watermelon

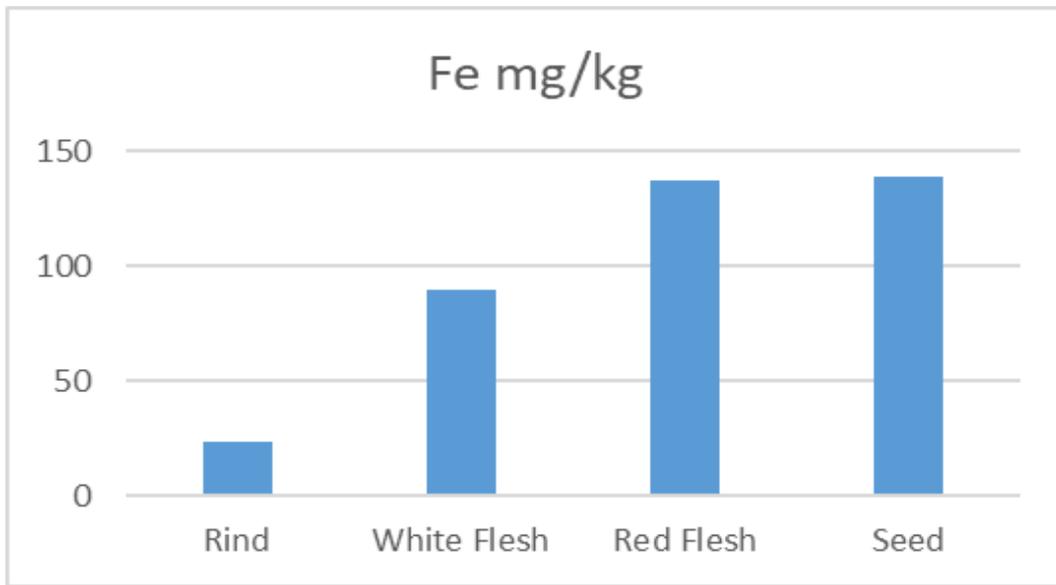


Fig. 4(d). Concentration of iron in different parts of watermelon

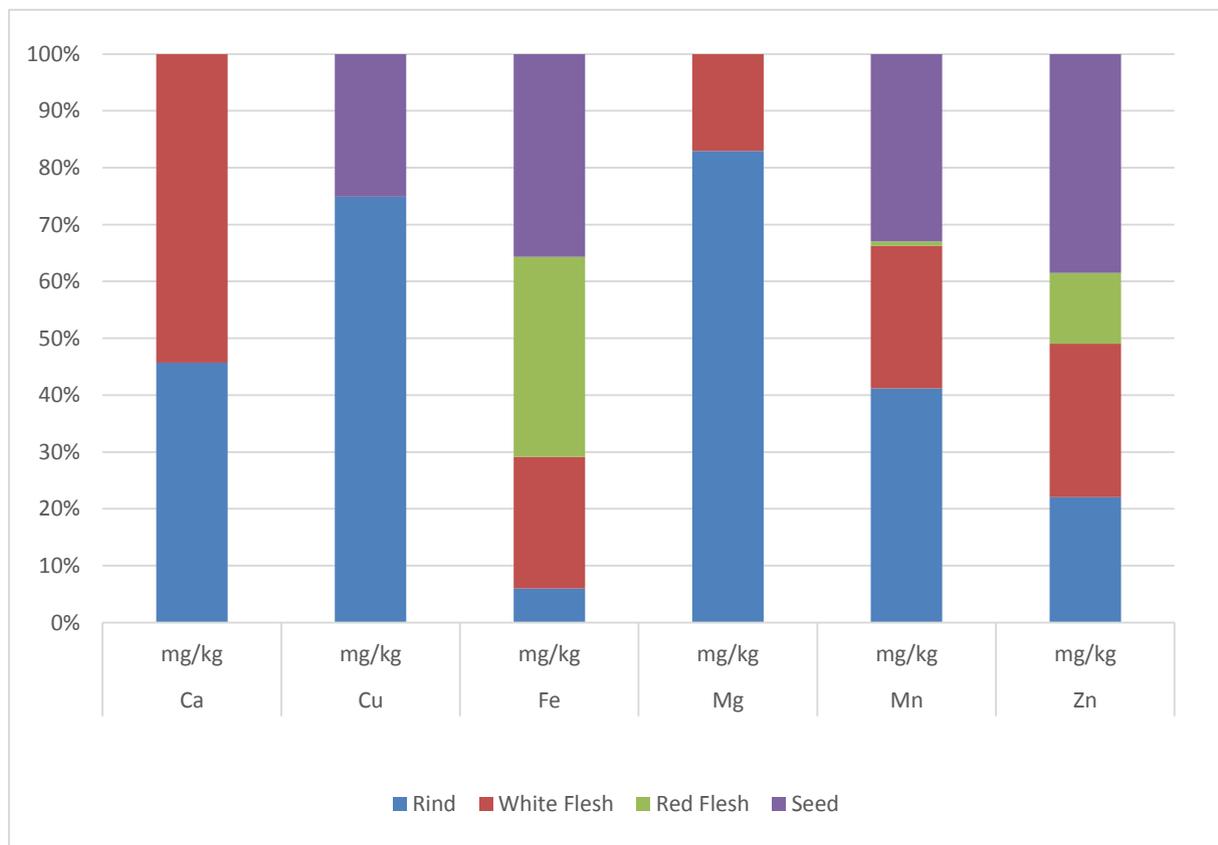


Fig. 5. Contribution to 100% for different elements by different parts of Watermelon

4. RESULTS AND DISCUSSION

The highest concentration of magnesium of an amount 95700 mg/kg is observed in the rind of watermelon and the second highest in the white flesh. This indicates that the rind and the white flesh of watermelon can be used for nutritional purposes by cooking and eating as a vegetable. Magnesium (Mg) is needed for healthy bones and blood vessels, muscle and energy formation. It is surprising that the red flesh and seed do not show any amount of magnesium. Calcium is observed in all parts such as rind, white flesh, red flesh and seed and highest concentration in white flesh of an amount 36800 mg/kg and second one the rind of an amount 31000 mg/kg. Copper is observed in rind only of little amount of 4.72 mg/kg. The earlier investigation [8] has been performed for the elements Ca, Fe, Mg and Zn where it has also been found that the concentration of magnesium is the highest of an amount 31800 mg/kg. This value is lower than my investigation. If there investigation is correct that this indicates that the amount of the elements vary where the watermelon is grown on the condition of soil and environment. Similarly, the other earlier reported elements as Ca, Fe and Zn have also lower concentrations (Ca - 3200 mg/kg, Fe - 84 mg/kg, Zn - 100 mg/kg).

5. CONCLUSION

The above discussion and the investigations reported earlier and present show that every part of watermelon i.e. rind, white flesh, red flesh and seed can be used as a healthy diet. The seeds can be used as a raw or baked.

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