NUTRIENT AND ANTI-NUTRITIONAL COMPOSITION OF WATERMELON (*Citrullus lanatus*) SEED: A REVIEW

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Abstract: The paper reviewed the nutrient contents and anti-nutritional properties of watermelon seed. Various published articles on proximate composition, nutrient contents and anti-nutrient properties of watermelon seed were critical reviewed. The reviewed proximate composition of watermelon seed showed that the values of moisture, crude protein, crude fat, ash, crude fibre and carbohydrate contents ranging from 5.06 – 8.50%, 25.33 – 49.70%, 32.90 – 50.48%, 2.98 – 4.90%, 2.10 – 6.10% and 6.06 – 10.68%, respectively. Also, the minerals contents showed that the values of calcium, sodium, iron, phosphorus, magnesium, zinc and potassium ranging from 20.80 – 755.20 mg/100g, 7.00 – 94.40 mg/100g, 3.42 – 8.40 mg/100g, 375.90 – 614.30 mg/100g, 25.60 – 509.10 mg/100g, 3.22 – 10.40 mg/100g and 482.30 – 1036.68 mg/100g, respectively while amino acid composition of watermelon seed revealed that values of isoleucine, histidine, leucine, lysine, phenylalaline, methionine, threonine, valine, aspartic acid, glutamic acid, serine, arginine and alaline ranging from 0.42 – 0.99%, 0.40 – 0.78%, 1.20 – 2.12%, 0.01 – 0.84%, 0.91 – 2.28%, 0.30 - 0.70%, 0.45 – 1.11%, 0.70 – 1.48%, 1.34 – 2.88%, 0.60 – 6.01%, 0.93 – 1.43%, 0.52 – 4.29% and 0.86 – 1.31%, respectively. Anti-nutritional properties showed that the values of saponin, phenol, alkanoid, flavonoids and tanninranging from 1.55 – 2.33 mg/100g, 0.11 – 1.37 mg/100g, 0.36 – 33.79 mg/100g, 2.00 – 2.31 mg/100g and 0.52 – 0.61 mg/100g, respectively. The review disclosed that watermelon seed have lower anti-nutritional properties, contained appreciable amount of mineral and protein contents which could be useful for fortifying carbohydrate based food. Also, it could serves as possible source of oil/fat for food, cosmetics and pharmaceutical industries.

Keywords: Watermelon seed, nutrient contents, anti-nutritional properties, fortifying, potential applications

Introduction

Watermelon (*Citrullus lanatus*) is a member of Cucurbitaceae family which is connected to pumpkin and other crop plants that grows on vines on the ground (Rheka and Rose, 2016). It is an annual herb with long stems creeping on the ground widely planted in every part of India and in all tropics nations including Nigeria (Milala *et al*., 2018). Watermelon fruit which is one of favourite fruits in the world are normally oblong or ovoid in shape and has a smooth external surface rind (Harith *et al*., 2018; Milala *et al*., 2018). The fruits are widely consumed as snack without due regards to the seed which are discarded (Duduyemi *et al*., 2013). It is largely comprises water, which is about 6% sugar and 92% water by weight (Harith *et al*., 2018). Watermelon fruits has plentiful minerals and vitamins contents especially potassium, magnesium, calcium, iron, vitamin A and vitamin C with small quantities of vitamin B_1, B_2, B_6, niacin and folate (Adejumo *et al*., 2015),The seeds are contained in the pulp of watermelon fruit and seeds of various varieties differ in size, thickness and texture (Milala *et al*., 2018).The seeds are normally extracted from the rind by manual maceration and washing of decayed fruits in a basket and sundry to reduce its moisture content (Adejumo *et al*., 2015). Watermelon seed comprises 31.90% protein, 57.10% fat, 8.20% fibre, 6.20% ash, 4.40% carbohydrates, 130 mg calcium, 456 mg phosphorus, and 7.5 mg iron (Adejumo *et al*., 2015). Adejumo *et al*. (2015) reported that there is high production rate of watermelon and also little published information about the advantages of its seeds and the seed has been neglected which resulted in loss.

Pulps of numerous fruits which including watermelon are consumed daily in Nigeria without consuming the seeds and rind, butrind and seeds are always dispose as wastes with unfavaourable health and environmental implications (Egbuonu, 2015a). Since, there is increasing cultivation and consumption rate of watermelon, and its seeds are discarded as waste, there is need to find out the nutritional contents of watermelon seed which could give insight of its potential utilizations. The study is aimed to review some nutrient contents and anti-nutritional properties of watermelon seed and disclose its possible applications.

Nutritional composition of watermelon seed

Table 1 shows the proximate composition of watermelon seed as reported by Oyeleke *et al*. (2012), Ugwuanyi (2012), Kiin-Kabari and Akusu (2014), Omoboyowa *et al*. (2015), Otutu *et al*. (2015) and Milala *et al*. (2018). The proximate composition of watermelon seed showed that the values of moisture, crude protein, crude fat, ash, crude fibre and carbohydrate contents ranging from 5.06 – 8.50%, 25.33 – 49.70%, 32.90 – 50.48%, 2.98 – 4.90%, 2.10 – 6.10% and 6.06 – 10.68%, respectively. The values (5.06 – 8.50%) reported for moisture content of watermelon seed were higher than the moisture content (4.00%) of guava seed reported by Mathew *et al*. (2014) while the moisture content of avocado pear seed (13.09%) reported by Egbuonu *et al*. (2018) is higher than the values reported for watermelon seed. However, the moisture content (8.32%) reported for sweet orange seed by Egbuonu and Osuji (2016) is within the range of values reported for watermelon seed. Since the moisture content reported for watermelon seed is low, it is expected to have stable and longer shelf life. The range of values (25.33 – 49.70%) reported for crude protein content of watermelon seed were higher than the crude protein of mango seed (10.02%), guava seed (8.05%), sweet orange seed (6.77%) and avocado pear seed (2.64%) reported by Fowomola (2010), Mathew *et al*. (2014), Egbuonu and Osuji (2016), and Egbuonu *et al*. (2018), respectively. The values reported for crude protein content showed that watermelon seed is rich protein which could be useful for fortifying carbohydrate based food. Also, the crude fat content (32.90 – 50.48%) of watermelon seed were higher than the crude fat contents of mango seed (14.80%), guava seed (19.01%), sweet orange seed (11.08%) and avocado pear seed (0.33%) reported by Fowomola (2010), Mathew *et al*. (2014), Egbuonu and Osuji (2016) and Egbuonu *et al*. (2018), respectively. Since the fat content of watermelon seed is high, Oyeleke *et al*. (2012) disclosed that watermelon seed could be classified as oilseed The values of ash content reported for guava seed (3.00%),

sweet orange seed (3.02%) and avocado pear seed (3.82%) by Mathew *et al*. (2014), Egbuonu and Osuji (2016), and Egbuonu *et al*. (2018) respectively were within the values (2.98 – 4.90%) reported for watermelon seed while the ash content (2.62%) of mango seed reported by Fowomola (2010) is lower than the ash content of watermelon seed. Since watermelon seed have average quantity of ash content, it is expected that watermelon seed has appreciable amount of mineral contents. The crude fibre of mango seed (2.40%), sweet orange seed (2.98%) and avocado pear seed (2.87%)) reported by Fowomola (2010), Egbuonu and Osuji (2016), and Egbuonu *et al*. (2018) respectively is within the range reported for the watermelon seed (2.10 – 6.10%) while the crude fibre content (12.00%) of guava seed reported by Mathew et al (2014) is higher than that of watermelon seed. The carbohydrate contents of mango seed (70.12%), guava seed (53.95%), sweet orange seed (67.83%) and avocado pear seed (80.12%) reported by Fowomola (2010), Mathew *et al*. (2014), Egbuonu and Osuji (2016), and Egbuonu *et al*. (2018), respectively were higher than values (6.06 – 10.68%) reported for watermelon seed.

Table 1: Proximate composition of watermelon seed

Proximate composition (%)	a	b	c	d	e	f
Moisture content	6.90	5.15	8.50	6.93	5.16	5.06
Crude protein	27.40	32.38	25.33	27.53	38.92	49.70
Crude fat	47.90	50.48	47.85	48.06	37.87	32.90
Ash	4.10	4.90	4.20	4.13	3.45	2.98
Crude fibre	3.80	6.10	3.85	3.93	3.91	2.10
Carbohydrate	9.90	NR	8.18	9.40	10.68	6.06

NR – Not Reported

Source: [a]Oyeleke *et al*. (2012); [b]Ugwuanyi (2012); [c]Kiin-Kabari and Akusu (2014); [d]Omoboyowa *et a*l. (2015); [e]Otutu *et al*. (2015), [f]Milala *et al*. (2018)

Table 2: Mineral composition of watermelon seed

Minerals (mg/100g)	a	b	c	d	e
Calcium	42.09	32.00	20.80	758.20	54.00
Sodium	33.58	94.40	11.96	7.10	87.00
Iron	3.42	8.40	4.04	4.50	7.08
Phosphorus	NR	513.00	375.90	NR	614.30
Magnesium	232.41	318.00	Nr	25.60	509.10
Zinc	3.22	10.40	3.92	4.10	10.13
Potassium	NR	482.30	1036.68	722.10	524.00

NR – Not Reported

Source: [a]Ali (2006), [b]Umar and Shuaibu (2013), [c]Samuel (2016), [d]Morais *et al*. (2017), [e]Egbuonu (2015a)

Table 2 shows some mineral contents of watermelon seed as reported by Ali (2006), Umar and Shuaibu (2013), Egbuonu (2015a), Samuel (2016) and Morais *et al*. (2017). The values of calcium, sodium, iron, phosphorus, magnesium, zinc and potassium ranging from 20.80 – 755.20 mg/100g, 7.00 – 94.40 mg/100g, 3.42 – 8.40 mg/100g, 375.90 – 614.30 mg/100g, 25.60 -509.10 mg/100g, 3.22 – 10.40 mg/100g and 482.30 – 1036.68 mg/100g, respectively. The calcium content (20.80 – 758.20 mg/100g) of watermelon seed is higher than the calcium content of guava seed (3.03 mg/100g) and sweet orange seed (2.00 mg/100g) reported by Mathew *et al*. (2014), and Egbuonu and Amadi (2016), respectively while the calcium content of mango seed (111.30 mg/100g) and moringa seed (128.33 mg/100g) reported by Fowomola (2010) and Ijarotimi *et al*. (2013) respectively were within the values reported for watermelon seed. The sodium content (7.10 – 94.40 mg/100g) of watermelon seed is higher than the sodium content of guava seed (2.91 mg/100g) and sweet orange seed (0.33 mg/100g) reported by Mathew *et al*. (2014), and Egbuonu and Amadi (2016), respectively while the sodium content of moringa seed (295.10 mg/100g) reported by Ijarotimi *et al*. (2013) is higher the values reported for watermelon seed. However, the sodium content (21.00mg/100g) of mango seed reported by Fowomola (2010) is within the values reported for watermelon seed. The iron content of mango seed (11.90 mg/100g) and guava seed (12.32 mg/100g) reported by Fowomola (2010) and Mathew *et al*. (2014) respectively were higher the values reported for watermelon seed (3.42 – 8.40mg/100g) while the value reported for moringa seed (7.33mg/100g) by Ijarotimi *et al*. (2013) is within the values reported for watermelon seed.The phosphorus content (375.90 – 614.30mg/100g) of watermelon seed is higher than the phosphorus content of moringa seed (103.33 mg/100g) and guava seed (6.01 mg/100g) reported by Ijarotimi *et al*. (2013) and Mathew *et al*. (2014), respectively. The magnesium content (25.60 – 509.10 mg/100g) of watermelon seed is higher than the magnesium content of guava seed (3.28 mg/100g)and sweet orange seed (0.33 mg/100g) reported by Mathew *et al*. (2014),and Egbuonu and Amadi (2016), respectively while the values reported for mango seed (94.80 mg/100g) and moringa seed (26.33 mg/100g) by Fowomola (2010) and Ijarotimi *et al*. (2013) respectively were within the values reported for watermelon seed. The zinc content (4.23 mg/100g) of guava seed reported by Mathew *et al*. (2014) is within the values reported for watermelon seed (3.22 – 10.40 mg/100g) while the value reported for mango seed (1.10 mg/100g) is lower than zinc content of watermelon seed. The potassium content (482.30 – 1036.68 mg/100g) reported for watermelon seed is higher than the potassium content of moringa seed (52.55 mg/100g), guava seed (4.84 mg/100g) and sweet orange seed (0.82 mg/100g) reported by Ijarotimi *et al*. (2013), Mathew *et al*. (2014), and Egbuonu and Amadi (2016), respectively. Also, Egbuonu (2015a) revealed that watermelon seed comprises Vitamin A (70.10 mg/100g), Thiamine (0.02 mg/100g), riboflavin (0.15 mg/100g), niacin (3.32 mg/100g), vitamin C (6.81 mg/100g) and pyridoxine (0.09 mg/100g) while Omoboyowa *et al* (2015) reported Vitamin A (34.21 mg/100g). Vitamin E (20.62 mg/100g), Vitamin C (22.095 mg/100g), Thiamine (0.115 mg/100g), Riboflavin (0.135 mg/100g) and Niacin (1.332 mg/100g)

Since, watermelon seed have considerable quantity of mineral and vitamin contents, thus, watermelon seed could serves as alternative source of minerals and vitamins as Egbuonu (2015a) revealed that the plentiful of mineral contents in watermelon seed require physiological and nutritional attention.

Table 3 shows some amino acid composition of watermelon seed as reported by Ali (2006), Taiwo *et al*. (2008) and Umar and Shuaibu (2013). The values of isoleucine, histidine, leucine, lysine, phenylalaline, methionine, threonine, valine, aspartic acid, glutamic acid, serine, arginine and alaline ranging from 0.42 – 0.99%, 0.40 – 0.78%, 1.20 – 2.12%, 0.01 – 0.84%, 0.91 – 2.28%, 0.30 - 0.70%, 0.45 – 1.11%, 0.70 – 1.48%, 1.34 – 2.88%, 0.60 – 6.01%, 0.93 – 1.43%, 0.52 – 4.29% and 0.86 – 1.31%, respectively. The reported amino acids were lower than the isoleucine (3.23%), histidine (2.31%), leucine (8.40%), lysine (3.13%), phenylalaline (4.46%), methionine (1.04%), threonine (2.04%), valine (3.80%), aspartic acid (6.33%), glutamic acid (13.00%), serine (2.93%), arginine (5.17%) and alaline (6.40%) reported for mango seed by Fowomola (2010).

Table 3: Amino acid composition of watermelon seed

Amino acid (%)	a	b	c
Isoleucine	0.66	0.99	0.42
Histidine	0.42	0.78	0.40
Leucine	1.22	2.12	1.20
Lysine	0.55	0.84	0.01
Phenylalanine	0.91	2.28	1.02
Methionine	0.54	0.70	0.30
Threonine	0.63	1.11	0.45
Valine	0.82	1.48	0.70
Aspartic acid	1.64	2.88	1.34
Glutamic acid	3.41	6.01	0.60
Serine	0.93	1.43	1.10
Arginine	2.60	4.29	0.52
Alanine	0.86	1.31	0.90

Source: [a]Ali (2006); [b]Taiwo *et al*. (2008); [c]Umar and Shuaibu (2013)

Table 4: Anti-nutritional properties of watermelon seed

Anti-nutritional properties (mg/100g)	a	b	c
Saponin	2.33	1.55	2.31
Phenol	0.11	1.37	0.12
Alkanoids	0.37	33.79	0.36
Flavonoids	2.00	2.31	2.03
Tannin	0.52	0.53	0.61

Source: [a]Johnson *et al*. (2012), [b]Omoboyowa *et al*. (2015), [c]Egbuonu (2015b)

Anti-nutritional properties of watermelon seed

Table 4 shows some anti-nutritional properties of watermelon seed as reported by Johnson *et al*. (2012), Omoboyowa *et al*. (2015) and Egbuonu (2015b). The values of saponin, phenol, alkanoid, flavonoids and tanninranging from 1.55 – 2.33 mg/100g, 0.11 – 1.37 mg/100g, 0.36 – 33.79 mg/100g, 2.00 – 2.31 mg/100g and 0.52–0.61 mg/100g, respectively. The saponin content of moringa seed (9.83 mg/100g) and avocado pear seed (8.10 mg/100g) reported by Ijarotimi *et al*. (2013) and Egbuonu *et al*. (2018), respectively were higher than the saponin content (1.55 – 2.33 mg/100g) reported for watermelon seed while saponin content (0.04 mg/100g) of mango seed reported by Fowomola (2010) is lower than the saponin content of watermelon seed. Also, the phenol content (0.11 – 1.37 mg/100g) of watermelon seed is lower than the phenol content of moringa seed (40.00 mg/100g) reported by Ijarotimi *et al*. (2013) while the phenol content (0.29 mg/100g) of avocado pear seed reported by Egbuonu *et al*. (2018) is within the range reported for watermelon seed. The alkaloids content of moringa (17.33 mg/100g) and avocado pear seed (2.15 mg/100g) were within the range reported for watermelon seed (0.36 – 33.79 mg/100g) while alkaloid content (0.01 mg/100g) of mango seed reported by Fowomola (2010) is lower than the alkaloid content of watermelon seed. The flavonoid content (2.00 – 2.31 mg/100g) of watermelon seed is lower than the flavonoid content (5.50 mg/100g) of moringa seed reported by Ijarotimi *et al*. (2013) while the flavonoid content (1.81 mg/100g) of avocado pear seed reported by Egbuonu *et al*. (2018) is within the range reported for watermelon seed. The tannin content (0.52 – 0.61 mg/100g) of watermelon seed is lower than the tannin content of mango seed (1.03 mg/100g), moringa seed (241.67 mg/100g) and avocado pear seed (1.14 mg/100g) reported by Fowomola (2010), Ijarotimi *et al*. (2013) and Egbuonu *et al*. (2018), respectively. It should be noted that anti-nutritional properties of watermelon seed is lower, however, Addo *et al*. (2018) disclosed that anti-nutritional contents of watermelon seed may be reduce through roasting and boiling processing and further stated that boiling is more appropriate in lowering the anti-nutritional level of watermelon seeds.

Conclusion

The review showed that watermelon seed have large quantity of protein, fat contents and better mineral contents especially calcium, sodium, potassium, magnesium and phosphorus with lower ant-nutritional properties which could be useful for fortifying carbohydrate based food. Also, it could serves as alternative source of oil for food, cosmetic and pharmaceutical industries.

Conflict of Interest

Author declares that there is no conflict of interest related to this study.

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