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Evaluation of nutritional composition, physico-chemical and sensory properties of 'Robo' (a Nigerian traditional snack) produced from watermelon (*Citrullus lanatus* (Thunb.) seeds

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Abstract

This study evaluated the nutritional composition, physico-chemical and sensory properties of 'Robo' (a Nigerian traditional snack) produced from watermelon seeds in order to improve the utilization of watermelon seeds in producing value-added products, acceptable to the consumers. Watermelon seeds were dehulled, dried and used to prepared 'Robo' in the laboratory and control samples were prepared from melon seeds. The proximate analysis, amino acid profile, vitamin, mineral and heavy metal profile and consumer acceptance of the 'Robo' samples were determined using standard methods. The results showed that there were no significant differences ($p \geq 0.05$) in the proximate composition of the 'Robo' samples from watermelon and melon seeds. There were significant differences ($p \leq 0.05$) in amino acid, vitamin and mineral profile of 'Robo' samples from watermelon and melon seeds. The amino acid concentration in g/100 g crude protein of 'Robo' for lysine, arginine and leucine were 4.58±0.01, 1.82±0.00 and 4.92±0.01 respectively for 'Robo' produced from watermelon seeds while 4.91±0.01, 2.01±0.00 and 5.16±0.01 respectively were recorded for 'Robo' produced from melon seeds. The study showed that the 'Robo' samples contained high amounts of vitamin B-complex and minerals and low amounts of heavy metals. In conclusion, the 'Robo' samples from watermelon seeds and control samples had high sensory scores and were well acceptable to the consumers. With these research findings, watermelon seeds could be used for the production of 'Robo' as a promising raw material. This will create ready-made market for the underutilized watermelon seeds and as well as creating more income to watermelon farmers.

1. Introduction

Watermelon *(Citrullus lanatus)* belongs to the family Cucurbitaceae, a vine-like flowering plant of Africa origin (Maynard and Maynard, 2012; Renner *et al., 2014)*. It is mostly cultivated for its fruits. The subdivision of this species is divided into two varieties, watermelons (*Citrullus lanatus* (Thunb.) var. *lanatus*) and citron melons (*Citrullus lanatus* var. *citroides)*. Watermelon, a special kind of berry with hard rind, lacking internal division was reported to be grown in tropical and subtropical areas worldwide (Renner *et al.,* 2014). Obviously, watermelon has sweet and juicy flesh and colour varying from deep red to pink, with many black seeds while seedless varieties are also common (Ogodo *et al.,* 2015). The fruits can be eaten raw, cooked or pickled and could also be made into fruit salad (Ogodo *et al*., 2015).

In 2016, global production of watermelons was reported to be about 117 million tonnes, with China accounting for 68% of this (FAOSTAT, 2018). Turkey,

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Iran, Brazil, Uzbekistan, Algeria, the United States, Russia, Egypt, Mexico, and Kazakhstan are secondary producers with more than one percent of world production (FAOSTAT, 2018).

Watermelons are very popular sweet and fruit of summer; the fruits are consumed in many ways varying from being made into slices and mixed with other fruits to make fruit salads, or to prepare juice (USDA, 2017; USNIH. 2017). Watermelon juice could also be used with other fruits to produce fruit wine (Ogodo *et al*., 2015).

The seeds were reported to have nutty flavour and are dried and roasted, or ground into flour for other culinary uses (Brady, 1982). The seeds are used in many ways in different cultures, they are eaten at Chinese New Year celebrations (Shiu-ying 2005) and seeds are consumed during the Vietnamese New Year's holiday, '*Tết*', as a snack (Brady, 1982). Watermelon is used for pickles (Wehner, 2008), or could be eaten as a vegetable, stir-fried or stewed (Brady, 1982; Bryant 2009).

Nigeria is blessed with several varieties of traditional snacks which are eaten in all parts of Nigeria, common among them are 'Robo', 'Kulikuli', 'fura' (Sobukola, 2003). These local foods have their processing technologies, methods of distribution and storage based on the indigenous knowledge of the people. 'Robo' is traditionally produced from the seeds of melon (*Citrullus vulgaris*) and is widely consumed in the western part of Nigeria. Several researchers have worked and reported on the recipes for 'Robo' production and processing procedures (Sobukola, 2003; Sobukola *et al*., 2008; Sobukola *et al*., 2009; Jimoh and Adedokun, 2014).

'Robo' is a ready-to-eat traditional snacks produced from the cake obtained from oil extraction of melon. It is commonly consumed with high carbohydrate-rich meals such garri from cassava, ogi and agidi from cereal. Most snacks are generally considered as junk foods with little or no nutritional value and are seen as contributing little to general health and nutrition of the people. However, 'Robo' is being produced from nutrient-rich legumes and contains protein and some essential amino acids that could contribute to and complement the cereal or starch-rich meals by supplying the necessarily needed protein (Jimoh and Adedokun, 2014).

Watermelon (*Citrullus lanatus* (Thunb.) production in Nigeria in recent years has increased tremendously, unfortunate there is little or no industrial uses of the seeds. Also, information on comparative analysis of the nutrient composition and consumer acceptance of 'Robo' from watermelon seeds is very scanty. This necessitated this research work to develop and assess the nutritional composition, physico-chemical and sensory properties of 'Robo', a traditional snack produced from watermelon (*Citrullus lanatus* (Thunb.) seeds.

This study evaluated the nutritional composition, physico-chemical and sensory properties of 'Robo' (a Nigerian traditional snack) produced from watermelon seeds in order to improve the utilization of watermelon seeds in producing value-added products, acceptable to the consumers.

2. Materials and methods

2.1 Sample collection

Watermelon fruits and melon seed samples were obtained from Bodija market in Ibadan, Oyo State, Nigeria. Other materials/ingredients such as common salt, onion, pepper and vegetable oil used in this study were also bought at the same market. The watermelon fruits were cut, the seeds were removed and dried before dehulling. The dehulled seeds of watermelon and melon were processed into 'Robo'. The important parameters relevant to the study were analyzed. All chemicals and reagents used were of food and analytical grade.

2.2 Preparation of 'Robo'

'Robo' samples were prepared in the laboratory by using the method of (Makinde and Ibim, 2015). Watermelon and melon seeds were dehulled manually and then sundried for 8 hrs. The shelled watermelon and melon seeds were roasted separately in an open dry pot using electric stove. The seeds were turned constantly until they became brown (10-15 mins). The roasted seeds were cooled and then milled into paste without adding water using attrition mill. The paste (1 kg) was thoroughly kneaded until oil was coming out and pepper (30 g), onion (100 g), salt (a pinch) and seasonings (one cube of knorr cube) were added The kneading continued until oil was flowing out for about one hour in a bowl and the cake became harder and firmer. The cake was rolled into small round balls and then fried in oil extracted from the cake. The 'Robo' samples were cooled down at room temperature and packaged in airtight bottles. The flow charts for watermelon and melon 'Robo' production were shown in Figures 1 and 2 respectively. A total of fifty samples of each 'Robo' from watermelon and control (melon seeds) were prepared and the laboratory analyses were conducted immediately after preparation.

2.3 Proximate analysis

'Robo' samples were subjected to proximate analysis and these were carried out in triplicates according to the

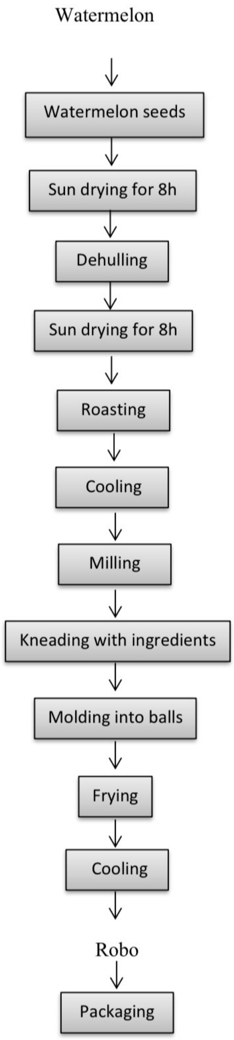

Figure 1. Flow chart for watermelon 'Robo' production (Makinde and Ibim, 2015 with modification)

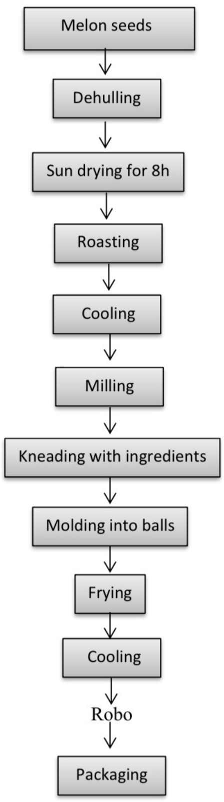

Figure 2. Flow chart for melon 'Robo' production (Makinde and Ibim, 2015 with modification)

standard method of AOAC. 2001.11-2005.

2.4 Amino acid profile

The amino acid compositions of the 'Robo' samples were determined by the method of AOAC method 2001.11-2005.

2.5 Analysis of vitamin B_1 (thiamin)

Vitamin B_1 was analyzed in 'Robo' samples by using the method of AOAC 2001.13-2001.

2.6 Analysis of vitamin B_2 (riboflavin)

Vitamin B_2 was analyzed in 'Robo' samples using the method described by AOAC 2001.13-2001.

2.7 Analysis of vitamin B_3 (niacin)

Vitamin B_3 was analyzed in 'Robo' samples using the method described by AOAC 2001.13-2001.

2.8 Determination of mineral elements

This was determined by using flame photometer. The 'Robo' samples were first taken into solution using the metal ash. The solution of the element was sprayed into a flame photometer which measures the intensity of the light produced by the transition of electrons of the element to the higher energy levels. The intensity of the radiation was measured and the concentration of the metal was quantitatively determined. Mineral elements detected were sodium, potassium, and calcium. Other elements (Mg, Fe, Zn, and P) were determined with digested sample ash with a SOLAAR M Atomic Absorption Spectrophotometer (AOAC. 2001.11-2005).

2.9 Determination of heavy metals

Heavy metals Ar, Pb, Hg, Cd, and Cr concentration were determined by the method of (AOAC. 2001.11-2005). The digested 'Robo' samples were analysed for Ar, Pb, Hg, Cd and total Cr concentration using SOLAAR M Atomic Absorption Spectrophotometer. All determinations were carried out in triplicate and reported as mean mineral content in g/100 g.

2.10 Sensory evaluation

Consumer acceptance test was used to evaluate the sensory attributes of the 'Robo' samples as described by Hough *et al*. (2006). Untrained panelists consisting of 50 men and 50 women were selected who are familiar with 'Robo'. Panelists evaluated the 'Robo' samples on a 9-point hedonic scale with 9- like extremely, 8-liked very much, 7-liked, 6- liked mildly, 5- neither liked nor disliked, 4-dislike mildly, 3- disliked, 2-disliked very much and 1-disliked extremely. The sensory evaluation

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was carried out to determine the taste, colour, texture, aroma, appearance and overall acceptability.

2.11 Data analysis

The data are means of triplicates ± standard deviation and were subjected to statistical analysis using IBM SPSS version 21.0 software. One-way analysis of variance (ANOVA) with random model was done on appearance, colour, texture, taste, aroma, appearance and overall acceptability. Mean differences were compared using Duncan's Multiple Range Test (p≤0.05) to study the difference among means. Differences between melon sources were evaluated using independent T- test.

3. Results and discussion

3.1 Proximate composition of 'Robo' from watermelon (Citrullus lanatus (Thunb.) *and melon (Citrullus vulgaris)*

Table 1 shows the proximate composition of 'Robo' samples from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*). The protein contents of 'Robo' ranged from 30.18±0.10 to 30.90±0.10% indicating that the products are good sources of protein. The results showed that there was no significant difference (p≤0.05) between watermelon 'Robo' and melon 'Robo'. However, the protein contents of 'Robo' from watermelon and melon are comparable to the value of 32.4% and 33.43% recorded by Aletor and Ojelabi (2007) and Makinde and Ibim (2015). The high protein contents of 'Robo' from watermelon seeds could be used to complement high carbohydrate and starchy foods from developing countries especially in Nigeria where 'Robo' is a common traditional snack (Makinde and Ibim, 2015). The results showed that the moisture contents (%) of 'Robo' samples from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) were 8.13±0.05 and 7.36±0.05, respectively. The low moisture could be as a result of deep frying of the snack and could help in keeping quality of the products and also prevent rancidity of the products. The fat contents (%) were 37.52±0.10 and 39.24±0.10, respectively. These values were very high and not surprising as watermelon and melon are oil seeds (Jimoh and Adedokun, 2014; Makinde and Ibim, 2015). Deep frying of 'Robo' could also be a contributing factor to the high-fat contents. Fats have been shown to enhance the taste and acceptability of foods. Fats could also prolong satiety and facilitate the absorption fat-soluble vitamins (FAO, 2010). Fats also help in determining the texture, flavour and aroma of foods. However, high-fat content could predispose 'Robo' to rancidity under high relative humidity and high ambient temperature ((Makinde and Ibim, 2015). 'Robo' samples from melon (*Citrullus vulgaris*) had the higher value of fat compared to 'Robo' samples from watermelon (*Citrullus lanatus* (Thunb.). The results for fat obtained from this study agreed with the work of Jimoh and Adedokun, 2014; Makinde and Ibim, 2015.

Table 1. Proximate composition (%) of 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*)

Components	Watermelon 'Robo'	Melon 'Robo'
Moisture	8.13±0.05^{d}	7.36±0.05^{d}
Protein	30.18±0.10^{b}	30.90±0.10^{b}
Fat	37.52±0.10^{a}	39.24±0.10^{a}
Crud Fibre	5.97±0.05^{e}	6.31±0.05^{e}
Ash	5.04±0.05^{f}	5.82±0.05^{f}
Carbohydrate	13.16±0.08^{c}	10.37±0.08^{c}

Data are means of 3 replicates ± S.D. Data with the same superscripts in the same row are not significantly different at p≤0.05

The crude fibre (%) were 5.97±0.05 and 6.31±0.05, respectively for 'Robo' from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*). The values of crude fibre obtained for 'Robo' from watermelon and melon, although lower but are comparable to values of 7.04% reported by Makinde and Ibim (2015). The high crude fibre could be of great health benefit to consumers as consumption of vegetable fibre has been found to reduce serum cholesterol, risk of coronary heart disease, colon and stomach cancer and hypertension; enhance glucose tolerance and increase insulin sensitivity (Hassan and Umar, 2004; Makinde and Ibim, 2015).

The ash contents (%) were 5.04±0.05 and 5.82±0.05, respectively for 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*). 'Robo' from melon (*Citrullus vulgaris*) has the highest ash content. The difference in ash content could be due to the varietal difference

The carbohydrate contents (%) were 13.16±0.08 and 10.37±0.08, respectively for 'Robo' from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*). The values of carbohydrate content of 'Robo' samples from watermelon (*Citrullus lanatus* (Thunb.) was higher than in melon (*Citrullus vulgaris*).

3.2 Amino acids profile of 'Robo' from watermelon (Citrullus lanatus (Thunb.) *and melon (Citrullus vulgaris)*

The amino acid composition of 'Robo' from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) is presented in Table 2. In watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) 'Robo', the values in g/100 g crude protein of lysine, arginine and leucine were 4.58±0.01,

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1.82±0.00 and 4.92±0.01 respectively for 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) while 4.91±0.01, 2.01±0.00 and 5.16±0.01 respectively were for 'Robo' produced from melon (*Citrullus vulgaris*) seeds. On the non-essential amino acids, glutamic acid, aspartic acid and glycine were abundant amino acids in 'Robo' samples produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*).

Table 2. Amino acid profile (g/100 g crude protein) of 'Robo' from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*)

Components	Watermelon 'Robo'	Melon 'Robo'
Essential amino acids		
Lysine (Lys)	4.58±0.01^{b}	4.91±0.01^{b}
Histidine (His)	1.82±0.00^{e}	2.01±0.00^{e}
Arginine (Arg)	4.92±0.01^{b}	5.16±0.01^{b}
Threonine (Thr)	3.74±0.01^{c}	3.48±0.01^{c}
Valine (Val)	4.00±0.00^{b}	4.13±0.00^{b}
Methionine (Met)	2.19±0.00^{d}	2.06±0.00^{d}
Isoleucine (Ile)	3.47±0.00^{c}	3.18±0.01^{c}
Leucine (Leu)	7.47±0.01^{a}	7.14±0.01^{a}
Phenylalanine (Phe)	3.62±0.00^{c}	3.81±0.00^{c}
Non-essential amino acids		
Aspartic acid (Asp)	7.24±0.01^{b}	7.51±0.01^{b}
Serine (Ser)	3.48±0.00^{e}	3.79±0.01^{e}
Glutamic acid (Glu)	10.86±0.02^{a}	10.37±0.02^{a}
Proline (Pro)	3.52±0.00^{e}	3.81±0.00^{e}
Glycine (Gly)	6.90±0.01^{c}	7.03±0.01^{c}
Alanine (Ala)	5.82±0.00^{d}	6.07±0.00^{d}
Cystine (Cys)	0.86±0.00^{a}	0.82±0.00^{a}
Tyrosine (Tyr)	2.93±0.00^{c}	3.00±0.00^{c}
Tryptophan (Try)	3.72±0.01^{e}	3.96±0.01^{e}

Data are means of 3 replicates ± S.D. Data with the same superscripts in the same row are not significantly different at p≤0.05

In watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) 'Robo', the values in g/100 g crude protein of glutamic acid, aspartic acid and glycine were 10.86±0.02, 7.24±0.01 and 6.90±0.01 respectively for 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) while 10.37±0.02, 7.51±0.01 and 7.03±0.01 respectively were for 'Robo' produced from melon (*Citrullus vulgaris*) seeds.

Several authors reported similar observations for 'Robo' produced from groundnut (*Arachis hypogea*) and melon (*Citrullus vulgaris*) seeds (Aletor and Ojelabi, 2007; Jimoh and Adedokun, 2014). 'Robo' samples produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) have high essential amino acids. Arginine is essential for children growth and was present at reasonable levels in this study. Although, the lysine contents of the 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) were below the 6.3 g/100 g content of the reference egg protein. However, the quality present makes 'Robo' samples a good source of quality protein to complement carbohydrate rich Nigerian foods. Methionine was present in reasonable amounts in 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*). Methionine is needed for the synthesis of chlorine from lecithin and other phospholipids in the body (Adeyeye, 2009; Adeyeye and Aremu, 2010; Huda *et al*., 2012; Aremu *et al*., 2013; Adeyeye *et al*., 2019). Phenylalanine was also present in reasonable amounts in 'Robo' from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*).

3.3 Vitamins profile of 'Robo' from watermelon (Citrullus lanatus (Thunb.) *and melon (Citrullus vulgaris)*

Table 3. Vitamin Profile (mg/100g) of 'Robo' from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*)

Components	Watermelon 'Robo'	Melon 'Robo'
Ascorbic acid	0.93±0.00^{c}	0.90±0.00^{c}
Thiamine	2.21±0.01^{a}	2.69±0.01^{a}
Niacin	1.06±0.01^{b}	1.18±0.01^{b}
Riboflavin	1.00±0.01^{c}	0.68±0.00^{d}

Data are means of 3 replicates ± S.D. Data with the same superscripts in the same row are not significantly different at p≤0.05

The results of the vitamin profile of 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) are presented in Table 3. The ascorbic acid content of 'Robo' from watermelon was 0.93±0.00 mg/100 g which was slightly higher than that of 'Robo' produced from melon seeds (0.90±0.00). The thiamine content in mg/100 g in 'Robo' from watermelon was 2.21±0.01 and that of melon was 2.69±0.01. The thiamine from melon 'Robo' was higher than that of watermelon 'Robo' and values obtained from the two sources are above the recommended daily intake of 0.2 to 1.0 mg for less than 1 year infant and less than 65 years adults (Belitz *et al.,* 2009). The riboflavin content in mg/100 g in 'Robo' produced from watermelon was 1.00±0.01 and that of melon was 0.68±0.00. The riboflavin from watermelon 'Robo' was higher than that of melon 'Robo' and values obtained from the two sources are within the range of the recommended daily intake of 0.3 to 1.6 mg for less than 1-year old infant and less than 65 years adults (Belitz *et al*., 2009). The niacin content in mg/100 g in 'Robo' produced from watermelon was 1.06±0.01 and that of melon was 1.18±0.01. The niacin from melon 'Robo' was higher than that of watermelon 'Robo' and values obtained from the two sources are below the

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recommended daily intake of 2 to 18 mg for less than 1-year old infant and less than 65-year old adults (Belitz *et al*., 2009).

3.4 Minerals profile of 'Robo' samples from watermelon (Citrullus lanatus (Thunb.) *and melon (Citrullus vulgaris)*

The results of the concentrations of minerals in the 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) are presented in Table 4. The concentrations (mg/100 g) of sodium, phosphorus, potassium, calcium and iron were significantly higher (p≤0.05) in melon 'Robo' (34.81±0.10, 22.99±0.08, 26.11±0.08, 17.63±0.05 and 6.20±0.01) than in watermelon 'Robo' (32.06±0.10, 21.88±0.08, 23.76±0.08, 16.21±0.05and 5.38±0.01) while zinc and magnesium were significantly higher (p≤0.05) in watermelon 'Robo' (2.69±0.01 and 10.11±0.02) than in melon 'Robo' (2.00±0.01 and 9.46±0.02). The results are in agreement with the findings of Makinde and Ibim, 2015. The high values of potassium and sodium were in agreement with earlier report of Olaofe and Sanni 1988 on the mineral elements of Nigerian agricultural produce.

Table 4. Mineral Profile (mg/100 g) of 'Robo' from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*)

Components	Watermelon 'Robo'	Melon 'Robo'
Sodium	32.06 ± 0.10^{a}	34.81 ± 0.10^{b}
Potassium	23.76 ± 0.08^{b}	26.11 ± 0.08^{a}
Calcium	16.21 ± 0.05^{c}	17.63 ± 0.05^{d}
Iron	5.38 ± 0.01^{e}	6.20 ± 0.01^{f}
Zinc	2.69 ± 0.01^{f}	2.00 ± 0.01^{g}
Magnesium	10.11 ± 0.02^{d}	9.46 ± 0.02^{e}
Phosphorus	21.88 ± 0.08^{b}	22.99 ± 0.08^{c}

Data are means of 3 replicates ± S.D. Data with the same superscripts in the same row are not significantly different at p≤0.05

'Robo' could be a good source of macro and micro mineral elements and may contribute to health, growth and development of human beings (Adeyeye, *et al.,* 2019). Zinc contents recorded in 'Robo' samples produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) were needed in small amounts (Adeyeye *et al*., 2019). Actually, zinc is needed only in small amounts by our bodies, for the body's defensive (immune) system to properly work; plays a role in cell division, cell growth, wound healing and the breakdown of carbohydrates and is also needed for the senses of smell and taste (Aremu *et al*., 2013; Adeyeye *et al*., 2019).

3.5 Heavy metals profile of 'Robo' samples from watermelon (Citrullus lanatus (Thunb.) *and melon (Citrullus vulgaris)*

The results of the concentrations of heavy metals in the 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) are presented in Table 5. The concentrations (mg/100 g) of Ar, Cd and Hg were significantly higher (p≤0.05) in melon 'Robo' (1.01±0.01, 1.00±0.01 and 0.81±0.01) than in watermelon 'Robo' (0.96±0.02, 0.90±0.01 and 0.80±0.01) while Pb and Cr were significantly higher (p≤0.05) in watermelon 'Robo' (0.94±0.01 and 0.74±0.01) than in melon 'Robo' (0.93±0.01 and 0.64±0.01). The amounts of the heavy metals found in the 'Robo' from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) were generally below the maximum acceptable limits set by FAO/World Health Organization for Ar (0.3 ppm); Pb (0.3 ppm); Cd (0.2 ppm), Hg (0.2 ppm) and Cr (0.5 ppm) and hence pose no consumption risk (Adeyeye *et al*., 2016).

Table 5. Heavy metal composition (µg/kg) of 'Robo' from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*)

Components	Watermelon 'Robo'	Melon 'Robo'
Arsenic	0.96 ± 0.02^{a}	1.01 ± 0.01^{a}
Lead	0.94 ± 0.01^{a}	0.93 ± 0.01^{a}
Cadmium	0.90 ± 0.01^{a}	1.00 ± 0.01^{a}
Mercury	0.80 ± 0.01^{a}	0.81 ± 0.01^{a}
Chromium	0.74 ± 0.01^{a}	0.64 ± 0.01^{a}

Data are means of 3 replicates ± S.D. Data with the same superscripts in the same row are not significantly different at p≤0.05

3.6 Sensory evaluation of 'Robo' samples from watermelon (Citrullus lanatus (Thunb.) *and melon (Citrullus vulgaris)*

Table 6 shows the results of the sensory evaluation. The results showed that 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) had 7.20±0.12 and 6.92±0.10 for texture, 7.73±0.20 and 7.81±0.20 for appearance, respectively, while colour and taste were scored 7.18±0.15 and 7.46±0.18; 7.26±0.16 and 7.21±0.15, respectively. The aroma test showed that 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*) had 6.91±0.10 and 7.03±0.11. Overall acceptability scores were 7.26±0.15 and 7.39±0.16, respectively. The sensory analysis showed that 'Robo' samples from melon seeds had the higher scores for appearance, colour aroma and overall acceptability while 'Robo' from watermelon seeds had higher sensory scores for texture and taste. The results indicated that the overall consumer acceptance was highest for the 'Robo' produced from melon seeds and

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lowest for the 'Robo' samples produced from watermelon seeds. This was a trend agreed with the findings of Jimoh and Adedokun (2014) and Makinde and Ibim (2015). These scores may have been affected by the familiarity of the panelists with 'Robo' produced from melon seeds, the major traditional source of 'Robo' till date.

Table 6. Sensory evaluation of 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*)

Robo types	Watermelon 'Robo'	Melon 'Robo'
Texture	7.20±0.12^b	6.92±0.10^a
Appearance	7.73±0.20^b	7.81±0.20^b
Colour	7.18±0.15^a	7.46±0.18^b
Taste	7.26±0.16^b	7.21±0.15^a
Aroma	6.91±0.10^b	7.03±0.11^a

Data are means of 3 replicates ± S.D. Data with the same superscripts in the same row are not significantly different at p≤0.05

4. Conclusion

This study showed that good quality and consumer acceptable 'Robo' could be prepared from watermelon (*Citrullus lanatus* (Thunb.). The study gave information on the proximate, amino acid profile, mineral, vitamin and consumer acceptance of 'Robo' produced from watermelon (*Citrullus lanatus* (Thunb.) and melon (*Citrullus vulgaris*). The findings on 'Robo' from watermelon seeds compared favourably well with 'Robo' from melon seeds commonly used in Nigeria. With these research findings, watermelon seeds could be used for the production of 'Robo' as a promising raw material. This will create ready market for the underutilized watermelon seeds and as well as creating more income to watermelon farmers and stimulate the economy of the nation.

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