PROXIMATE COMPOSITION SENSORY PROPERTIES OF JUICE FROM WHOLE WATERMELON AND FRACTIONS.

ABSTRACT

this research work studied the juice gotten from different whole watermelon and its fractions through the assessment of proximate analysis and sensory properties of the juice samples. A Completely Randomized Design (CRD), was used in the design of the experiment. A total of 5 samples were obtained and used for the analysis of proximate composition and sensory properties. Result of the proximate composition showed that the samples differed significantly ($p<0.05$) and had values that ranged between 94.45 – 93.20%, 1.02 – 0.32%, 0.22 – 0.10%, 0.36 – 0.13%, 5.45 – 4.29% for moisture, ash, fat, protein and carbohydrate respectively. Sensory evaluation carried out on the juice samples showed that the samples differed significantly ($p<0.05$) in terms of Appearance, Flavor, Aroma, Mouth feel and Overall acceptability. It was observed from the study that juice made from whole watermelon had the best acceptability. This implies that the incorporation of the different parts of watermelon will effect better nutrition to meet the demand for nutrient balance among the populace.

Keywords: watermelon, proximate analysis, sensory properties.

1. INTRODUCTION

Fruit is the sweet and fleshy product obtained from trees or other plant containing seeds and can be consumed as food (Oxford University Press, 2018). In food scientific term, fruits are succulent part of plant taken as appetizer or desert. Botanically, fruits develop from ovary and form seed of reproductive organ of flowering plant which are diverse, perishable and seasonal by nature (Asha *et al*., 2014). Fruits contain a significant number of antioxidants, minerals, vitamins and dietary fiber which are vital to human body. Thus, the consumption of fruits could help reduce the risk of many illnesses such as diabetes, cancer, cardiovascular diseases and other illnesses (Hanzah *et al.,* 2018). According to Akusu *et al.* (2016), fruits are highly perishable non-staple foods which make-up about 39% of the food intake (fresh state or processed form) of people living in developing countries. Consumption of fresh juices is increasing all over the world due to their freshness, high vitamin content, low caloric content and ability to reduce risk of many diseases such as diabetes, heart diseases and cancer (Rathnayaka, 2013). Furthermore, consumers are increasingly aware of the health benefits of fruits consumption. WHO (2012) stated that low consumption of fruits and vegetables is the environmental cause for 31% of ischemic heart diseases and 11% of stroke worldwide.

Fruit growth, maturation and ripening depend on fruit specie or variety (Nirmal *et al.,* 2012). According to Nirmal *et al.* (2012), and Jimenez-Sanchez *et al.* (2015), fruits contain vitamins such as vitamins A, C, E and K, minerals such as Na, Ca, K, Mg, fibers, phyto-chemicals, organic acid and other nutrients that are essential to humans. Fresh fruits have typically between 75 and 95 percent water which accounts for the juicy refreshing distinguishing feature of fruits. Generally, most fruits are more acidic than the others and the most common acids associated with fruits include citric acid, malic acid, and tartaric acid. Fruits are equally high in carbohydrates depending on the type of fruit and its maturity (Singh and McLellan, 2018). Research indicates that fruits are natural source of antioxidants, playing proactive roles against chronic degeneration and aging and also protects against any form of deterioration that may occur in the human body (Costescu *et al.,* 2006; Pereira-Netto, 2018). In fact, fruits constitute an inexhaustible source of nutrients, the secondary metabolites of which are among the most important (Grigoras, 2012). The quantity and type of antioxidant determines the bioavailability of the antioxidants. Tropical fruits such as guava, orange, watermelon, etc. are higher in antioxidants in comparison with some other fruits grown in temperate regions, in essence can be of benefit in enriching the human diet (Pereira-Netto, 2018).

Taking cognizance of the perishability of fruits and their seasonal nature, the need to devise affordable and adoptable ways to process these fruits into shelf stable and acceptable products such as juices, jams and jellies, which can now be utilized when the fruits are out of season. Alternatively, processing of fruits help to minimize the post-harvest losses and also save cost (Ukeyima *et al.,* 2017). Value addition to fresh fruit products remain one of the aims amongst others of fruit processing which can be achieved by application of any of these methods of processing such as drying, freezing, canning, etc. and also new product creation (Sharma *et al.*, 2016).

Nutritional composition, quality characteristics, microbiological and acceptability of various fruits and fruit juices (such as watermelon, pineapple, orange), have been reported (Ogunbanwo *et al.,* 2013; Naz *et al.,* 2014; Ijah *et al.,* 2015; Ohwesiri *et al.,* 2016; Okwori *et al.,* 2017). The intake of fruits is highly recommended due to the known facts that fruits provide essential vitamins and minerals and other nutrients which are fundamental to human health. Example is the reduction of some cardiovascular diseases and reduction of excess calorie intake. The consumption of fruit juices could have both positive and negative effects on the part of consumers.

Codex Alimentarius Commission defined fruit juice as the unfermented but fermentable liquid obtained from the edible part of sound, appropriately matured and fresh fruit maintained in sound condition. Post-harvest surface treatment and fruit juice can be obtained by mechanical expression processes, reconstitution of concentrated fruit juice with potable water and diffusion with water of pulpy whole fruit or dehydrated whole fruit (FAO, 2005). Fruit Juices are the aqueous liquids expressed or otherwise extracted usually from one or more fruits (Bello *et al.*, 2014). Within fruit juice category, the regulated products (fruit juice, etc.) have been defined based on their composition, production and processing methods. The fruit juice may be produced from a single fruit or a combination of fruits (FAO, 2005). An instance can be seen from the extraction of watermelon juice or combination of watermelon and pineapple to extract their juices. In most part of the world, fruit juice contains 100 percent fruit. A blend of fruit juices with other ingredient, for example water, is regarded as a fruit drink. Fruit drinks are obtained by addition of water to specific quantity of fruit juice. Recently, a number of fruits have become essential raw materials in the production of fruit juices and also high moisture content of some of these fruits have prompted many researchers to use them in fruit processing (Nirmal *et al.,* 2012; Singh and McLellan, 2018).

Fruit juices processed under hygienic conditions could play important role in enhancing consumer's health through inhibition of breast cancer, congestive heart failure (CHF) and urinary tract infection (Bello *et al.,* 2014). However, freshly extracted juices may not always be safe owning to the heavy load of microbes. The consumption of fruit juice as supplements of the main fruit has been proved to have some health benefits to the consumer and processing these fruits help to reduce post-harvest losses and equally enhance their utilization (Heyman *et al.*, 2017). The American Academy of Pediatrics (AAP), recommends that fruit juices are of no nutritional benefits to infants rather malnutrition have been associated with excessive consumption. It is important to note that fruit juices are not used in place of water in the treatment of dehydration (Heyman *et al.,* 2017). Juices are prepared mechanically by squeezing or macerating the pulp of fresh fruits or vegetables without application of heat or solvent to give an unfermented, clouded, unclarified and untreated juice ready for consumption. Diluting or blending is a common practice as many fresh juices are either too acidic or too strongly flavored to be pleasant for consumption (Asha *et al.*, 2014).

Major ingredients of fruit juices such as water, sugar, natural fruit pulp, etc may also carry some microbial contaminants which may cause spoilage of the drinks or gastrointestinal disorders to consumers (Asha *et al.*, 2014). The food market has stimulated the development of new products that present good sensory acceptance and of high nutritional value. Contaminants from raw materials and equipments, additional processing conditions, improper handling, prevalence of unhygienic conditions, contributes substantially to the entry of microbial pathogens in juices prepared from fruits (Ameh *et al.,* 2015). Processing of the fruits to juice could therefore be the solution to the spoilage of fruits.

Watermelon juice, as a beverage, is found almost exclusively as an over- the- counter drink made by hand. Watermelon juices are rare, with commercially available packaged watermelon juice drinks still in developing countries (Alam *et al.*, 2013).

2. MATERIALS AND METHODS

2.1 Materials and Sample Collection

The material required for the preparation was fully matured, ripe and fresh watermelon fruit which was procured from Eke Awka Market in Awka South Local Government Area of Anambra State, Nigeria.

2.2 Research Design

The research design that was used in this study is completely randomized design (CRD).

2.3 Sample Preparation

Whole watermelon fruits were cleaned of extraneous materials. Quality check of the watermelon fruits was conducted. The quality parameters of colour, ripeness, maturity and wholeness were checked before the fruits were selected. The selected fruits were washed first under running tap water. Then, they were washed with 5% hypochlorite solution to get rid of microbes and contaminants and then rinsed again immediately under running tap water. The whole fruits were cut longitudinally using a sterile knife, carefully fractionated and the different parts cut into small pieces. The different fractions were separately transferred into sterile blender and homogenized until sufficient juice was produced. The entire slurry was transferred into a sterile muslin cloth to filter off the unwanted particles. The juices were pasteurized using a low temperature long time (LTLT) at 60^0C held for 10 min as reported by Ohwesiri *et al.* (2016) and Okwori *et al.* (2017). The juice was aseptically transferred into clean sterile airtight bottles. The samples were cooled and evaluated for proximate and sensory properties.

2.4 Proximate Analysis of the juices

The moisture content, crude protein, ash content and fat content of the juices was determined in triplicate using established analytical procedures of AOAC (2010) except for crude protein which was determined as described by Northrop (2011). The carbohydrate content was estimated by difference from 100% after accounting for moisture, protein, ash and fat.

2.5 Sensory Evaluation of the juices.

As reported by Iwe (2010), the organoleptic analysis was carried out using twenty-five member panelists consisting of students in the department of food science and technology, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria who are familiar and regular consumers of watermelon fruit and juice was used. The sensory qualities that were evaluated include appearance, aroma, flavour, mouth feel and overall acceptability. The juice samples were served with clean, transparent plastic cups to each panelist. The order of presentation of the samples to the panels was randomized, potable water was also provided to rinse the mouth between evaluations. This was done using an evaluation sheet in form of questionnaire which was given to each panelist. The evaluation was conducted in an open space for easy clarification. Each sensory attribute was evaluated on a 9-point Hedonic Scale with 1 = disliked extremely, 2= dislike very much, 3= dislike moderately, 4= dislike slightly, 5=neither liked nor disliked, 6= like slightly, 7= like moderately, 8= like very much while 9 = liked extremely.

2.6 Statistical Analysis

Proximate composition and sensory evaluation data were analyzed using the Statistical Package for Social Sciences (SPSS) version 23. Analysis of variance (ANOVA) was done to detect significant differences ($p<0.05$) among the sample means. This was followed by the application of Duncan Multiple Range Test (DMRT) for the separation of the significant means.

Table 1. Treatment codes for five watermelon juice samples

Sample codes	Explanation of sample codes
JWW	Juice made from whole watermelon
JP	Juice made from the pulp
JPR	Juice made from the pulp and rind
JPP	Juice made from the pulp and peel
JR	Juice made from the rind

3. RESULTS AND DISCUSSION

3.1 Proximate composition of juice from whole watermelon and its fractions

The proximate composition of whole watermelon juice and the juices of its component fractions is shown in Table 2. The moisture content ranged from 93.20% in pulp-peel juice to 94.45% in whole watermelon and watermelon rind juices. Following the moisture in descending order were the carbohydrate (4.29- 5.45%), ash (0.32- 1.02%), protein (0.13-0.36%) and fat (0.10- 0.22%) contents.

The moisture content of the pulp juice (93.78%) and pulp-peel juice (93.20%) which did not differ significantly ($p<0.05$) were significantly lower than those of the pulp-rind (94.30%) and whole watermelon (94.45%) juices. The low moisture content of the pulp-peel juice maybe attributed to much lower moisture content of the peel as attempt to produce peel juice without adding water was impossible. Close observations showed that all juices with rind fractions/ components namely whole watermelon (94.45%), pulp-rind (94.30%), and rind (94.45%) had relatively higher moisture content indicating the contribution of the rind to the moisture content of the juices. Olayinka and Etejere (2018) reported that pulp and rind contained higher moisture (93.65 and 96.76%, respectively) of whole watermelon. Thus, however, contrasted the higher moisture content of rind observed in this work. According to Lixandry (2021), the white part of watermelon (rind) along with the sweet flesh (the pulp) have both over 90% water that helps consumers keep hydrated bwith benefits of dehydration-related tiredness, fatigue, dizziness, lethargy and headaches. Abu-Hiamed (2017) reported that moisture is the predominant component of watermelon and it ranges from 67.00 to 87.14%. Ugbogu and Ogodo (2015) observed the moisture content of 92.93% for water melon juice obtained from a local market in Nigeria. A range of 92.80% to 94.00% moisture was reported by Abdulazeez *et al.* (2020) for watermelon fruits from different farms in Lapai, Niger state of Nigeria. The result is in close range (75-95 %) moisture content for fruit juices as reported by Singh and McLellan (2018). Eke-Ejiofor *et al*. (2016) recorded moisture range of 92.82 to 95.85 % which is in close relationship with all the samples. It can be deduced from the table that watermelon contains high moisture.

The ash content of watermelon fruit juices as presented in Table 2 reveals that the whole watermelon and pulp-peel juices had significantly ($p<0.05$) higher ash content of 1.02% and 1.00% respectively than the test of the juices that had 0.32-0.33% ash. It is likely that the ash is mostly found in the peel which may be the reason only watermelon components/ fractions with peels had higher ash. Ugbogu and Ogbodo (2015) reported ash content of 0.94% for watermelon juice which is comparable to 1.02% ash for whole watermelon juice in this research. Olayinka and Etejere (2018) reported the ash content of 0.23% and0.31% respectively, for the rind and pulp fractions of watermelon. This is comparable to 0.32-0.33% obtained for watermelon components/ fractions juices in this work. A range of 0.20% to 0.30% ash was observed in the rind of watermelon from different farms in Lapai, Niger State of Nigeria Abdulazeez *et al.* (2020). Al-Sayed and Ahmed (2013) reported the ash content of watermelon rind of 13.90% (dry weight basis).

Table 2 showed that the fat content of the juice ranged from 0.10% to 0.22%. Only the juice with peel component/fraction (pulp-peel juice) had significantly ($p<0.05$) the highest value above other juice samples. This shows the low level of fat in watermelon juice. The fat content was the lowest compared to other proximate parameters just as observed by Abu-Hiamed (2017) who reported a range of 0.64 – 1.09% (dry weight basis) for watermelon rind and pulp. Olayinka and Etejere (2018) reported the fat content of 0.13% in the rind and 0.21% in the pulp of watermelon which are comparable to the values in Table 2 Ugbogu and Ogodo (2015) observed a lipid value of 0.48% for watermelon juice from a local market in Nigeria while Abdulazeez *et al.* (2020) reported a range of 0.10 to 0.15% lipid for the rind of watermelon from different farms in Lapai, Niger state, Nigeria.

The protein content of the juice ranged from 0.13% in whole watermelon juice to 0.36% in pulp-rind juice (Table 2). Pulp, pulp-rind and pulp-peel juices with higher protein content (0.33-0.36%) differed significantly ($p<0.05$) from whole watermelon and rind juices (0.13% and 0.26% respectively) which in themselves also significantly differed ($p<0.05$). Olayinka and Etejere (2018), reporting the protein content of 0.53% for the pulp and 0.34% for the rind, noted that the protein were found out to be in high amount in the pulp when compared to the rind. The protein content of the watermelon juices (Table 2) was lower than the range of 0.55% to 0.80% reported for the rind of watermelon (Abdulazeez *et al*., 2020) and 1.22% for watermelon fruit juice from Nigerian local market (Ugbogo and Ogodo, 2015). A protein content of 11.17% (dry weight basis) was reported for watermelon rind by Al- Sayed and Ahmed (2013).

The carbohydrate content, shown in Table 2, ranged from 4.92% in the whole watermelon juice to 5.45% in the pulp juice (Table 2), indicating higher carbohydrate content in the pulp than any other watermelon components/fraction. The rind juice had lower carbohydrate content (4.85%) and its combination with the pulp increased the carbohydrate content to 4.90%. The higher the carbohydrate content in the pulp-peel juice (5.25%) than the pulp-rind juice (4.90%) may be indicating a higher carbohydrate content of the peel component in the pulp-peel juice. A carbohydrate content of 5.22% to 5.86% was reported for the rind by Abdulazeez *et al.* (2020) while Olayinka and Etejere (2018) observed 5.22% for the rind and 4.23% for the pulp of watermelon. The later contrasted higher carbohydrate content of the pulp juice observed in this work. Carbohydrate content of 4.89% was observed by Ugbogu and Ogodo (2015) for watermelon juice from Nigeria local market while a range of 62.00- 87.14% (dry weight basis) was reported by Abu-Hiamed (2017) who noted that approximately 82% of the carbohydrate in the flesh pulp of mature watermelon fruit are sugars namely fructose, glucose and sucrose.

Crude fiber was not detected in the watermelon juice. This was as a result of proper crushing of the fruits. This is in line with the report of Braide *et al*. (2012).

Table 2: Proximate composition of juice from watermelon samples

Sample code	Juice source	Moisture	Ash	Fat	Protein	CHO
JWW	Whole fruit	$94.45^{a}\pm0.05$	$1.02^{a}\pm0.02$	$0.11^{b}\pm0.01$	$0.13^{c}\pm0.03$	$4.29^{d}\pm0.01$
JP	Pulp	$93.78^{c}\pm0.07$	$0.33^{b}\pm0.02$	$0.10^{b}\pm0.01$	$0.34^{a}\pm0.01$	$5.45^{a}\pm0.02$
JPR	Pulp/Rind	$94.30^{b}\pm0.10$	$0.32^{b}\pm0.02$	$0.12^{b}\pm0.01$	$0.36^{a}\pm0.04$	$4.90^{c}\pm0.01$
JPP	Pulp/Peel	$93.20^{c}\pm0.10$	$1.00^{a}\pm0.00$	$0.22^{a}\pm0.02$	$0.33^{a}\pm0.03$	$5.25^{b}\pm0.02$

JR	Rind	$94.45^{a}\pm0.05$	$0.32^{b}\pm0.02$	$0.12^{b}\pm0.02$	$0.26^{b}\pm0.03$	$4.85^{c}\pm0.01$

Values are mean scores ± standard deviation of triplicate determinations. Values bearing different superscript differ significantly ($p < 0.05$). CHO= Carbohydrate.

3.2 Sensory Properties of whole watermelon juice and its fractions

The results of the sensory evaluation carried out on the samples are presented as mean ± standard deviation in Table 3. The sensory properties tested were appearance, flavor, aroma, mouth feel and overall acceptability.

The average scores on appearance ranged from 6.15 (moderately liked) for a rind juice to 8.57 (extremely liked) for the pulp juice. This is not surprising giving the bright red color of the watermelon pulp. This showed that the juices were positively liked with regard to appearance, the most liked or preferred juice being the pulp juice (8.57) and the least liked was rind juice (6.15). Both whole watermelon juice (7.92) and pulp-peel juice (7.96) were very much liked.

The preference of flavor ranged from 4.57 designated as neither liked nor disliked for the rind juice to 8.42 (very much liked) for the whole watermelon juice. The juice from pulp alone was much liked (7.46). Its combination with the rind (pulp-rind juice) decreased the preference to moderately liked whereas the introduction of the peel to the pulp in pulp-peel juice improved the preferences to very much liked (8.03). Hence, rind negatively impacted the preference of the pulp juice while the peel positively influenced it. Whole watermelon juice with all the fruit fractions gave the most preferred flavor.

The aroma of the pulp with peel fraction (pulp-peel juice) was best preferred with average score of 7.50 (very much liked). Again, the rind juice with average score of 4.65 (neither liked nor disliked) was least preferred. The aroma of pulp juice and whole watermelon juice (6.76 and 7.29, respectively) were much liked although the later was rated higher. The pulp-rind juice was moderately liked (5.88) indicating the negative effect of the rind on the aroma of the pulp.

Mouth feel is about the texture. The whole watermelon juice and pulp-peel juice were equally rated (8.26) and most preferred. They were very much liked; and followed by the pulp juice (7.46) which was much liked; and then the pulp-rind juice that was moderately liked (6.19).

In overall acceptability, whole watermelon juice was rated best with average score of 8.75 (extremely liked). This reflects on the score on appearance in which it was second to pulp juice; first in flavor and mouth feel and again second in aroma after pulp-peel juice. Rind juice was rated least in all sensory parameters and was in overall least accepted (5.53) and was moderately accepted.

Table 3: Sensory Properties of Watermelon juices

Sample codes	**Sample source**	**Appearance**	**Flavour**	**Aroma**	**Mouth feel**	**Overall acceptability**
JWW	Whole fruit	$7.92^{c}\pm1.52$	$8.42^{a}\pm0.98$	$7.29^{b}\pm1.35$	$8.26^{a}\pm1.28$	$8.57^{a}\pm0.70$
JP	Pulp	$8.57^{a}\pm0.70$	$7.46^{c}\pm1.33$	$6.76^{c}\pm1.24$	$7.46^{b}\pm1.27$	$7.92^{c}\pm1.19$

JPR	Pulp/ Rind	6.38^{d}±1.52	6.03^{d}±2.08	5.88^{d}±1.60	6.19^{c}±1.95	6.69^{d}±1.80
JPP	Pulp/ Peel	7.96^{b}±1.11	8.03^{b}±1.03	7.50^{a}±1.60	8.26^{a}±0.96	8.30^{b}±0.88
JR	Rind	6.15^{e}±2.25	4.57^{e}±2.31	4.65^{e}±2.39	4.26^{d}±2.25	5.53^{e}±2.17

Values are mean scores ± standard deviation of 25 panelists. Values in the same column bearing different superscript differ significantly ($p < 0.05$).

4. CONCLUSION

This research work studied the proximate properties of juice from whole watermelon and its fractions. As regards experimental design, sample JWW which was the juice gotten from blending the whole watermelon was more preferred among the other four samples. However, the sensory scores suggests that the fruit juice is not the best formulation but it can be enhanced to improve the appearance, flavor, aroma and mouth feel for it to be generally acceptable. It is observed that from the results obtained, the juice has little fat and no fiber as a result of the processing method used. It also shows that the energy values are low which indicates that watermelon juice are low energy juice which is of benefit to individuals with the intention of losing weight thereby reducing some cardiovascular diseases.

In classifying the acceptability of the watermelon juices in their decreasing order, we have; JWW>JPP>JP>JPR>JR.

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