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Research Paper

Product Development, sensory and Chemical composition of spiced watermelon juice

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Abstract. The aim of this study was to prepare and evaluate the sensory and chemical properties of spiced watermelon juice. Spiced juice was prepared using watermelon and three concentration levels (0.5, 0.8 and 1.6%) of four different spices Ehuru (*Monodora myristica*), Uziza (*Piper guineense*), Clove (*Syzygium aromaticum*) and Garlic (*Allium sativum*). The result of sensory evaluation shows that 100% watermelon juice (control), and Ehuru spiced watermelon juice at level of 0.5% and 0.8% were the most preferred. The sensory test on a hedonic scale was a means of elimination and the most preferred showed good acceptance by panelists. The result of proximate analysis on the preferred samples ranged from 91.35 to 95.85%, 0.1 to 0.7%, 0.02 to 0.14%, 0.35 to 0.60% and 0.23 to 0.36% for moisture, ash, fat, protein and crude fiber, respectively. The result of functional properties of the spiced watermelon juices ranged from 0.05 to 0.28%, 1.34 to 1.35, 4.4 to 9.9 and 4.06 to 5.91 for total titratable acidity (TTA), refractive index (RI), ^{0}brix and pH, respectively.

Keywords: Watermelon, spices, juice, sensory evaluation, proximate.

INTRODUCTION

Juice is the liquid that is naturally contained in fruit or vegetable tissue, which is prepared by mechanically squeezing or macerating fresh fruit or vegetables without application of heat or solvent (Wikipedia - juice, 2010). It can also be described in the most general sense as the extractable fluid content of cells or tissues (James et al., 2009).

Fresh fruit juice is a good source of minerals and vitamins which help in activation of enzymes and co-enzymes, when vegetable and fruits are juiced, enzymes stay in their raw state when the juice is consumed, the body is able to absorb vitamins and minerals from fruit and vegetables more easily when it is taken in form of juice than when the fruit is taken whole, this is because the nutrients are trapped within the fiber content of the fruit in its whole state, when the fruit is processed into juice it breaks the fiber releasing the important nutrient. Implication is that if the aim of consuming fruit and vegetables is to absorb the important nutrient, it is better taken as juice, but if the aim is to consume more fiber, then whole fruit and vegetables should be preferred.

Codex Alimentarius defines juices as "unfermented but fermentable juice, intended for direct consumption, obtained by mechanical process from sound ripe fruits, preserved exclusively by physical means". The juice may be turbid or clear, may have been concentrated and later reconstituted with water suitable for the purpose of maintaining the essential composition and quality factors of the juice (FAO, 1992). Fruit juices are becoming an important part of modern diet in many homes and restaurants because they offer good taste and provide variety of nutrient fund naturally in them.

Juices of varying fruits, are high in nutritional value, the nutritive content vary because of cultivar, local practice, difference in soil and processing methods (Okaka, 1997). According to Alan and Sutherland (1994), fruit juices

have high levels of iron, calcium and sugars and they are excellent source of vitamins A and C. Fruits and their juices are good source of phytochemicals and watermelon is high in carotenoids such as lycopene (Perkins-Veazie et al., 2006).

Spices are widely used as seasoning or condiment and for medicinal purpose. The spicy pungent flavor mellows and sweetens considerably with cooking (Germot, 2005). Spices have been found to have antibacterial, antiviral, and antifungal activity *in vitro* studies. It is also claimed to prevent heart disease (including atherosclerosis, high cholesterol, and high blood pressure) and cancer (Ackermann et al., 2001). Despite these health's benefits, spices have also been known to contain manganese, dietary fibre, vitamin C and K, Omega-3 fatty acid, flavonoids, calcium, magnesium and some essential oil extract (Ackermann et al., 2001).

In addition to the growing awareness of the role of phytonutrients, vitamins and minerals in the biochemical processes of the human body which can be amply supplied by fruits and vegetables, there has been a growing trend toward adding value to raw agricultural products. As population has become more urban, this trend has accelerated as demand for quality juice and juice type beverage has markedly expanded.

Traditionally only a handful of fruit and vegetable juices had served the market and particularly in Nigeria. Juices such as oranges, grapes, pineapple, apple, tomato and their blends are attracting new attention (Bates et al., 2003), but little is known in terms of documentation, production, processing and usage of watermelon and its blends.

Watermelon has a high claim to health benefits. Though there is an increase in the rate of watermelon consumption as whole fruit, little attempt has been made to develop a value added product from it locally. The main objectives of this study were to prepare and assess spiced watermelon juice in relation to determine its sensory and chemical parameters.

MATERIALS AND METHODS

Materials

Watermelon fruits were purchased from Rumuokwuta Market, while the spices (Uziza, Ehuru, Clove, and Garlic) were purchased from Mile 1 Market, all in Port Harcourt, Rivers State, Nigeria.

Chemicals

All the chemicals and equipment used in these study were of analytical grade and were obtained from the Food Chemistry Laboratory, National Agency for Food and Drug Administration and Control (NAFDAC), Port – Harcourt, Rivers State, Nigeria.

Methods

Extraction of watermelon juice

The watermelon fruits were washed with saline (30%), and allowed to dry. The fruits were then cut with a sharp sterile kitchen knife and the seeds removed. The edible pink portion was cut into small bits for extraction. Juice was extracted from the cut bits using Master chef food processor, JBL, 2102. The extracted juice was then filtered using three fold muslin cloths.

Preparation of spice extract

The dry spices (Ehuru, Uziza and Clove) were washed with distilled water and dried in an electric oven at 105°C for 2 h, Ehuru was deshelled. Each of the spices was milled using NAKAI dry mill Blender model No. 442. Forty grams (40 g) each of the milled spices were mixed in 500 ml sterilized water, the mixture was boiled, and filtered using Whatman filter paper (4), while the garlic was peeled, washed with distilled water and blended, 40 g of the blended garlic was also passed through the same process of preparation.

Formulation of spiced watermelon juice

Different volumes of the spice extracts (30, 50, and 100 ml) were made up to 500 ml each, with (470, 450 and 400 ml) of the watermelon juice, to produce the different samples of the spiced watermelon juice for sensory evaluation. The various juices were then bottled in a pre-sterilized bottle and pasteurized at 72°C for 15 min, cooled at room temperature ±32°C and stored for analysis.

Sensory evaluation

A 20 member taste panel consisting of staff and industrial training students from National Agency for Food Drug Administration and Control (NAFDAC) Laboratory Port Harcourt, Rivers State, Nigeria participated in the sensory evaluation of the juices. Semi-trained panelists who were regular consumers of fruit juices as well as whole watermelon fruit and were neither sick at the time of evaluation nor allergic to fruit juices nor spices. They were asked to assess the samples based on the following attributes; taste, color, texture (mouth feel), and general acceptability.

A 9 – point hedonic scale according to Meilgaard et al. (1999), nine being equivalent to dislike extremely, five neither like nor dislike and one like extremely, was used to score the juices.

Results were analyzed statistically by the analysis of variance (ANOVA) and the difference between means

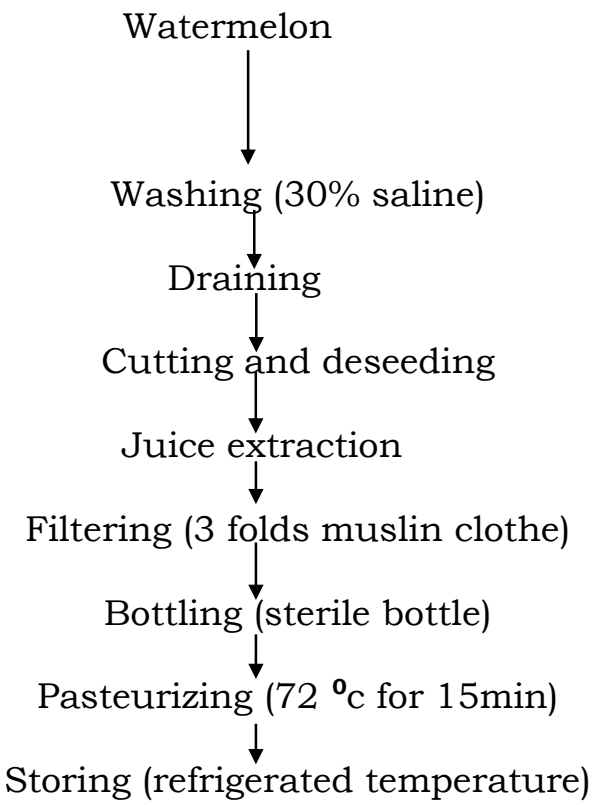

Figure 1: Flow diagram for watermelon juice extraction.

separated.

Chemical analysis of the preferred samples

Moisture content of the juices was determined using Sartorius (MA 50) moisture analyzer. Procedure followed the standard operating procedure of the instrument. 2ml of the juice was introduced into a tarred aluminum pan in the analyzer, and the value of moisture displayed on the LCD screen in percentage.

Ash and fiber were determined by the gravimetric method as described by Egan et al. (1981). The fat content of sample was determined by the (Rose Gottiled, 1982) method. Crude protein was by the Macro Kjeldahl method, while carbohydrate content was determined by difference and percentage (%) energy calculated using the Atwater factor (4:9:4) for protein, fat, and carbohydrate respectively.

Functional properties of preferred samples

The pasteurized, preferred samples were subjected to initial functional analysis of the following parameters pH, brix, refractive index, and total titratable acidity.

The pH of the juices was determined using a digital pH meter (mettle toledo mv/ord). The pH meter was first calibrated using Buffer 4.01 and 7. The percentage brix was determined using a digital sugar refractometer (Atago RX 7000k) while refractive index was measured using a refractometer (Abbe refractometer).

The total titratable acidity was determined using the volumetric method described by food and drugs manual of chemical methods of analysis (Food and Drug, 1982).

RESULTS AND DISCUSSION

Sensory evaluation result of spiced water melon juice

Table 1 shows the mean sensory scores for the sensory evaluation of spiced watermelon juice, prepared with different spice extracts at different levels of concentration.

Sensory analysis evaluated the following attributes such as taste, color, mouth feel and general acceptability.

At 0.5, 0.8 and 1.6% spice extract addition, color ranged from 1.9 to 4.6, 2.9 to 4.5 and 3.9 to 5.4, respectively. Color attribute of sample B_1 (0.5% Ehuru spiced watermelon juice) was significantly different from the other samples ($p \leq 0.05$) and was the most preferred while samples A_1, A_2, A_3, B_3, C_1, C_2, and C_3 were the

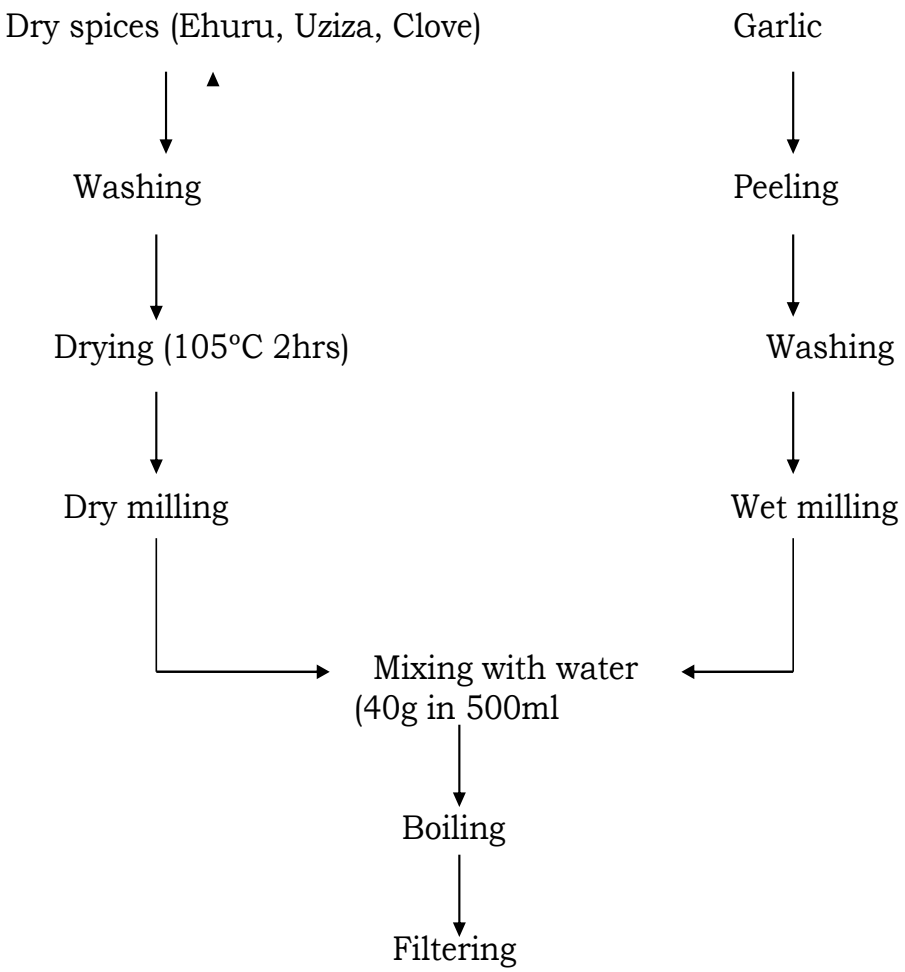

Figure 2: Flow diagram for the extraction of the different spices.

least preferred.

At 0.5, 0.8 and 1.6% spice extract addition level, taste ranged from 2.4 to 5.9, 2.8 to 7.1, and 4.6 to 7.6 respectively with samples B_1 and B_2 (0.5 and 0.8% Ehuru respectively) been the most preferred, while Samples A_2, A_3, C_3, D_2 and D_3 were the least preferred.

Mouth-feel for 0.5, 0.8 and 1.6% spice extract addition level ranged from 3.1 to 5.2, 3.3 to 5.3 and 3.9 to 6.1, respectively. While general acceptability at 0.5% level of spice extract addition ranged from 2.4 to 5.0, 0.8% addition 3.3 to 6.0 and 1.6% spice addition ranged from 4.4 to 6.8. Samples B_1, B_2 and E showed no significant different ($p > 0.05$) amongst them and were the most preferred for both mouth feel and general acceptability, while A_3, C_1, C_3, D_2, and D_3 were the least preferred.

Control (100% water melon) had 4.0, 2.0, 3.4 and 2.7 for color, taste, mouth feel and general acceptability, respectively.

The results of the present study showed that the higher the concentration of the spice extract the lower the acceptability of the juice.

Chemical composition result of the most preferred juice samples

Table 2 shows the chemical composition result of the three most preferred samples after sensory analysis namely samples B_1, B_2 and E (for 0.5, 0.8 and 1.6%, respectively). Moisture content ranged from 92.82 to 95.85% with sample E (100% watermelon juice) having the least value and sample B_2 (0.8% Ehuru spiced juice) having the highest value. The increase in moisture with an increase in spice extract addition may be attributed to the fact that it was a liquid extract of the spice that was used. The moisture content of the 100% watermelon juice (sample E) however falls within the value reported for single strength watermelon juice by Ezighighala et al. (2010) and USDA (2006).

Protein content ranged from 0.40 to 0.60%, and falls within the value reported by Ezighighala et al. (2010), as well as USDA (2006). There was no significant difference in protein value of the samples.

The value for crude fibre ranging from 0.29 to 0.36% is slightly lower than that reported by USDA National Data

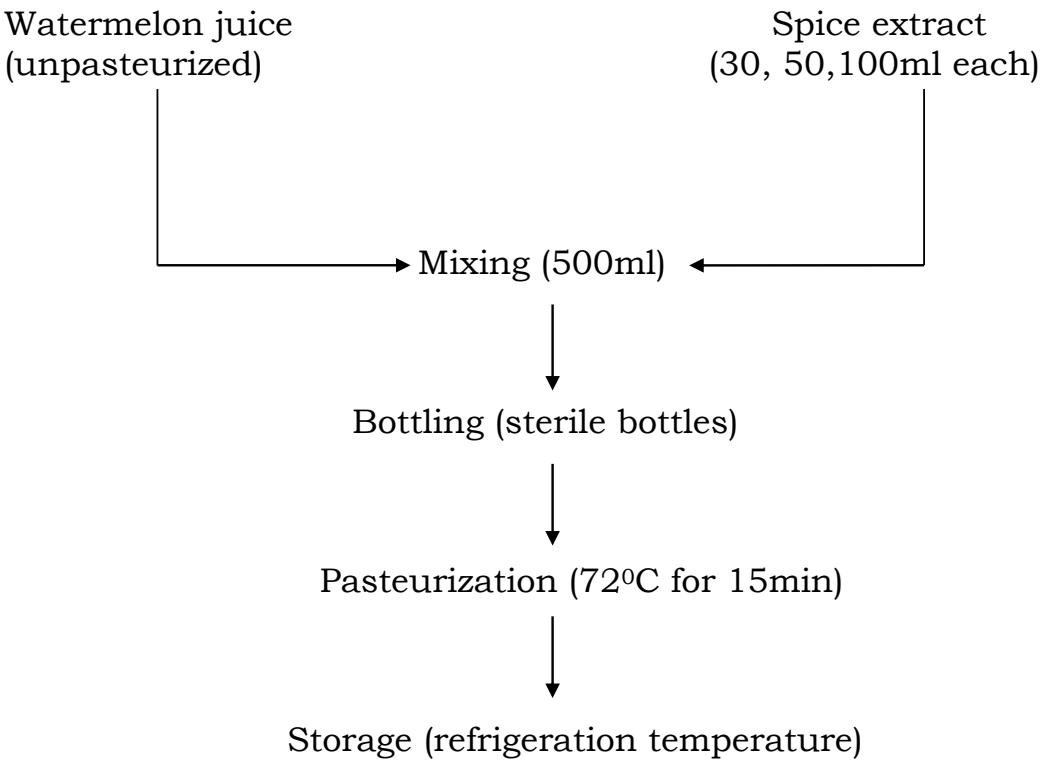

Figure 3. Preparation of spiced watermelon juice

Table 1. Sensory scores of spiced watermelon juices.

Sample	Taste	Color	Mouth-feel	General acceptability
A_1	5.9^c	4.6^d	3.6^c	5.0^c
B_1	2.4^a	1.9^a	3.1^b	2.4^a
C_1	4.6^b	4.3^d	5.2^d	4.0^b
D_1	5.2^c	3.4^c	5.2^d	4.2^b
A_2	7.1^d	4.3^d	4.6^c	6.0^d
B_2	2.8^a	2.9^c	3.3^b	3.3^a
C_2	5.2^c	4.5^d	4.1^c	4.1^b
D_2	5.6^d	3.5^c	5.3^d	5.6^c
A_3	7.6^d	5.3^d	6.1^d	6.8^d
B_3	4.6^b	4.3^d	3.9^c	4.4^b
C_3	6.7^d	5.4^d	5.5^d	5.0^b
D_3	6.4^d	3.9^c	5.4^d	6.2^a
E	4.0^b	2.0^b	3.4^b	2.7^a
LSD	1.4	1.3	1.3	1.1

Means with different superscript in the same column are significantly different ($p \leq 0.05$). Key: A_1, A_2, and A_3 are 0.5, 0.8, and 1.6 Uziza spiced watermelon juices. B_1, B_2, and B_3 are 0.5, 0.8, and 1.6 Ehuru spiced Watermelon juices. C_1, C_2, and C_3 are 0.5, 0.8, and 1.6 Clove spiced watermelon juices. D_1, D_2, and D_3 are 0.5, 0.8, and 1.6 Garlic spiced watermelon juice. E = 100% watermelon juice (control).

Base release 19 (2006). It however falls within the range reported by Ezighighala et al. (2010). There was no significant difference ($p > 0.05$) in protein and fibre values of the samples.

Ash ranged from 0.1 to 0.75%, with sample E (100% watermelon juice) having the least value and sample B_2 (0.8% Ehuru spiced juice) having the highest value. Ash refers to any inorganic material, such as minerals present

Table 2: Chemical Composition (%) result of the most preferred juice samples

Sample	Moisture	Ash	Fat	Protein	Crude Fibre	CHO	Ph	^{0}Brix	RI	TTA	Energy (Kcal)
B_1	93.08^b	0.30^b	0.04^b	0.48^b	0.33^a	5.85^b	4.70^c	7.60^b	1.34^a	0.11^a	25.68^c
B_2	95.85^a	0.75^a	0.10^a	0.40^b	0.29^a	2.61^c	4.40^b	5.60^c	1.34^a	0.12^a	12.94^d
E	92.82^b	0.10^a	0.02^b	0.60^a	0.36^a	6.10^a	5.91^a	9.90^a	1.35^a	0.08^b	26.98^a

Means with different superscript in the same column are significantly different ($p \leq 0.05$). Key: B_1 = 0.5% Ehuru spiced watermelons juice; B_2 = 0.8% Ehuru spiced watermelon juice; E = 100% watermelon juice; CHO= Carbohydrate; TTA = Total titratable acidity; RI = Refractive Index.

in food, ash can include both compounds with essential minerals such as calcium and potassium and toxic material such as mercury. Essential minerals are very important in the biochemical reactions which aid physiological functioning of major metabolic process in the human body (Wahlquist, 2002). The result for ash showed no significant difference ($p > 0.05$) between the samples, the value was however lower than that reported by Eziaghighala et al. (2010) for single strength watermelon juice.

Fat ranged from 0.02 to 0.1% with sample E (100% watermelon juice) having the least value and sample B_2 (0.8% Ehuru spiced juice) having the highest value. Ehuru seed has a high component of essential oil (Koudou et al., 2007) and this can account for the increase in fat content as the concentration of the spice extract increased.

The carbohydrate content of the juice ranged from 2.61 to 6.1% with sample B_2 (0.8% Ehuru spiced juice) having the least value and sample E (100% watermelon juice) the highest value, while energy (Atwater factor) ranged from 12.94 to 26.98 kcal. Energy in kcal/100 g followed the same trend as carbohydrate. There was a decrease in the value of carbohydrate and energy as the volume of the spice extracts used increased; this could be due to the increased moisture content. Sample (E) 100% watermelon juice showed the highest value for carbohydrate and energy while sample B_2 showed the lowest value. The low calorie value of the juice samples makes them an excellent refreshing drink for persons on low calorie diet.

The chemical composition of the juices may have been slightly affected by the concentration of the spice extract. There was a significant difference ($p < 0.05$) in moisture, carbohydrate, and energy with an increase in the value of moisture, ash, and fat as the concentration of the spice extract increases. pH ranged from 4.4 to 5.9 with the pH of sample E (100% watermelon juice) significantly different from the other samples. The pH range of juice in this study falls within the value reported by Cook (2009). There was a decrease in the value of pH with the addition of the spice extract. pH of 100% watermelon juice (5.9) is however higher than the ideal maximum pH (≤ 4.6) for food canning. The decrease in the pH value with the addition of the spice extract will enhance the canning properties of the juices.

°Brix ranged from 5.60 to 9.90 with sample B_2 (0.8% Ehuru spiced watermelon juice) significantly different from the other samples. The result showed a drop in brix value as the volume of spice extract used increased.

Sample B_1 (0.5% Ehuru spiced watermelon juice) showed no significant difference from the control (sample E) .The brix value of sample E (100% juice) which is the control is higher than that stated by FDA for a single strength watermelon juice, (www.weissfoods.com). Brix is a measure of percentage solid in a given weight of juice; it is the summation of the sucrose, fructose, vitamins, minerals, amino acids, proteins, hormones, and other solids in a juice (Halliwell, 1997). Brix value is an index to describe the quality of a given juice. The result showed that moisture increased with a decrease in brix value.

Refractive index ranged from 1.34 to 1.35 and total titratable acidity from 0.08 to 0.12 with sample E as highest and lowest, respectively. The result showed no significant difference in the total titratable acidity and refractive index of the preferred samples.

CONCLUSION

The result from sensory evaluation has showed that the addition of 0.5% and 0.8% Ehuru extract were well accepted with an improved taste, while chemical analysis results showed that watermelon juice is a low energy juice, making it a very good juice for people on low calorie.

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