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Effect of Piper guineensees on Physicochemical and Organoleptic Properties of Watermelon (Citrulus lanatus) Juice Stored in Refrigerator and Ambient

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Abstract: Extracted juice from watermelon containing 0.01g Piper guineenses stored in refrigerator (6±2 oC) and on the shelf (28±1oC) using polyethylene bottles was evaluated for physicochemical and organoleptic changes. pH, total soluble sugars, titratable acidity and organoleptic evaluation of the juice was carried out till deterioration sets in. Results showed that the sample stored in the refrigerator kept for 7 days while the sample on the shelf lasted for 3 days. pH value decreased from 5.40 to 4.80 and 5.70 for the sample stored in the refrigerator and on the shelf respectively while TSS increased from 0.064%Brix to 0.435% Brix and 0.578%Brix for sample stored in refrigerator and shelf respectively. Titratable acidity decreased from 2.90 % to 0.20% and 0.50% for samples for the juice stored in the refrigerator and on shelf respectively. All these changes were statistically significant ($p<0.05$). The sample stored on the shelf lost its organoleptic qualities on the third day with an average value less than 2 for taste, smell and colour. However, the juice stored in the fridge lost its organoleptic qualities at the 7th day with an average value of 3.0, 2.90 and 2.80 for taste, smell and colour respectively. From the results, juice extracted from water melon cannot be kept at ambient temperature beyond 3 days without proper refrigeration and an additive. This calls for alternative way of extending its shelf life in the absence of electricity supply using local spice like P. guineenses and to make it available during off season.

Keywords: Brix; pH; quality; shelf life; titratable acidity; total soluble sugar

INTRODUCTION

Fruit is a structural part of plant that contains seeds, normally fleshy, sweet and edible in the raw states, which include: oranges, grapes, strawberries, juniper berries, pineapple, and water melon etc. All contain a high percentage of water averaging 85%. Fat, protein and carbohydrate (cellulose and starch) are present in small amount [1,2]. Fruits are best consumed in fresh form however due to their high

perishable nature and seasonality, they are scarce and expensive and the consumption level changes with season. This poses a problem since they are usually demanded for and needed for their nutritional and organoleptic purposes in and out season. Processing and preservation of these fruits becomes paramount if they must be made available throughout the year. Fruits can be processed into pickled, frozen, and canned fruits, fruit juices, dehydrated juice and wine [3]. Juices are the presses of fruits obtained by mechanical (fermentable and unfermented) processes. Juices have characteristics colour, odour and flavour, typical of the fruit they came from [4]. Watermelon contains almost 92% water, chlorophyll, vitamins A, B1, B6, and C. It is also rich in lycopene (a red pigment responsible for making watermelon a good anti-carcinogenic fruit), and a good source of minerals such as zinc, potassium, magnesium, and iodine and other digestive enzymes. Watermelon can be viewed as a more nutritious alternative to having energy drinks or supplements prior to exercise Watermelon gives more nutrients per calorie because of its higher water content and lower calorie unlike other fruits [3,5,6]. It is therefore ranked one of the best fruits for human consumption because of its nutritional and medical benefits. Watermelon deteriorates faster than other fruits due to its high moisture content and this characteristic makes it highly susceptible to microbial spoilage caused by gram positive bacteria which are very sensitive to low acidity [7,8]. This gives watermelon a skunky taste and an obvious change in the colour and flavour of the juice. This deterioration may be delayed or curbed by the use of refrigeration and preservatives. *Piper guineense* is a spice derived from its dried fruit is known as West African pepper, Ashanti pepper, Benin pepper, false cubeb, Guinea cubeb, uziza pepper or (ambiguously) "Guinea pepper", and called locally kale, kukauabe, masoro, sasema and soro wisa. It used as flavouring for stews, increases bioavailability of nutrients, weight and stress management, preservative, antimicrobial and anti-oxidant [9-11]. Babarinde *et al*., and Omodamiro and Ekeleme have reported the preservative potentials [12-17], antioxidant and antimicrobial activities of *P. guineenses* respectively. The temperature of the storage conditions which juices are subjected to can affect its deterioration rate and even its chemical qualities or attributes, positively or negatively. Thus, the aim and objective of this research is to evaluate the physicochemical and organoleptic changes associated with storage of watermelon juice spiced with *P. guineenses* in a refrigerator and at ambient.

MATERIALS AND METHODS

Juice extraction and spice preparation: Watermelon (*citrullus lanatus*) that was free from defect was obtained from Oyingbo market in Lagos State. Watermelon was transported using a plastic crate to Nigerian Stored Products Research Institute Processing Centre Lagos State, Nigeria. The fruits were thoroughly washed repeatedly with tap water to remove dirt before cutting prior to juice extraction. All glassware and knives were autoclaved at 121°C for 45 min and all other equipment was sanitized with 1 % hypochlorite solution prior to usage. The fruit was then peeled with a sharp kitchen knife and the rind and seeds was removed to get the pulp (edible portion). The pulp was cut into thin slices and crushed in a blender to obtain a homogenous mass which was then sieved using a muslin cloth into two clean bowls. The resulting juice was quantitatively transferred into a 50 mL polythene bottles. Screened seeds of *P. guineenses* were grinded using a mill and sieved to obtain a fine powder. They were transferred into a polythene packaging material for subsequent use. 0.01 g of finely grinded *P. guineenses* was added to 50mL of extracted juice. The set up was made in triplicates for both treatments (refrigerator and ambient). A sample containing no *P. guineenses* stored on the shelf was used as a control. The shelf-

stored juice were used as control in evaluating the organoleptic and physicochemical properties of the juice samples for the storage period.

Physicochemical Analysis: Titratable acidity, total soluble sugars and pH were carried out on the fresh juice and stored samples in both refrigerator and on the shelf using standard methods.

Total Soluble Solids: Total soluble solids (TSS) content of a solution was determined by the index of refraction as described by Tigist *et al*., [13]. An aliquot of juice was extracted using a juice extractor and 50 ml of the slurry was filtered using cheesecloth. The TSS was determined by Abbe refractometer with a range of 0 to 32 °Brix and a resolution of 0.2 °Brix by placing 1 to 2 drops of clear juice on the prism. Between samples the prism of the refractometer was washed with distilled water and dried before use. The refractometer was standardized against distilled water (0 °Brix TSS). The values were reported on %Brix.

pH: pH was carried out according to the procedure described by AOAC [16]. 5 mL of the juice (fresh and stored) was used for pH measurement using Jenway 3310 pH meter which have been previously calibrated with buffers of 4 and 9.

Titratable Acidity: Titratable acidity was carried out according to the procedure described by Tigist *et al*., [13]. An aliquot of the juice was titrated against standard sodium hydroxide solution. The titratable acidity expressed was percentage citric acid.

Organoleptic Evaluation: Organoleptic evaluation was carried out on the juice samples at the initial stage and during the storage period consecutively by 10 semi- trained panelists. A five-point hedonic scale was utilized based on the procedure adopted by Wakoma and Azigba [14]. They assessed the taste, colour, and smell of the samples using the five-point hedonic scale, where 1 = poor, 2= fair, 3= good, 4=better and 5 = excellent. A cut off mark of 3 was selected as a basis for acceptability.

Statistical Analysis: The data obtained were analyzed and interpreted by analysis of variance (ANOVA) test at a level of 5% of significance, using SPSS Version 20.0 software (SPSS Inc., USA). Values were presented as mean ±standard deviations of 3 replicates.

RESULTS AND DISCUSSION

The physicochemical tests and organoleptic assessment results of the fruit juice from watermelon containing *P. guineenses* are presented in Table 1. The pH values of extracted juice containing the spice in refrigerator gradually reduced from an initial value of 5.40 to 4.80 on the 7^{th} day while samples containing spice on the shelf increased to 5.70 on the third day. The control had a pH value of 6.20 on the second day. The observations were statistically significant ($p<0.05$). This decrease might be attributed to the effect of low temperature and *P. guineense*. *P. guineenses* due to its anti-microbial activity inhibit the growth of micro-organisms which might have cause certain biochemical reactions leading to production of compounds like ethanol, aldehydes etc. The low pH is an indicator of acidity and it signify good keeping quality. This is similar to result obtained by Akande and Ojekemi, [1] and Tigist *et al*., [13]. There was an increase in the titratable acidity of all samples in both refrigerator and on the shelf. Titratable acidity increased from an initial value of 0.064 % of citric acid to 0.578 % citric acid at the 7^{th} day for sample in the refrigerator and to 0.541 % of citric acid at the third day for sample on the shelf. This increase might be attributed to higher rate of hydrolysis of organic acids notably citric acid. This is not in agreement with Akande and Ojekemi, [1] that reported the level of titratable acidity in water melon juice and pineapple juice blend remaining constant during five weeks of storage. However, it was in agreement with Alam *et al*., [6] that reported

increase in acidity value for pasteurized watermelon juice stored for three months at 4°C-15°C.

Total Soluble Sugars of samples in the refrigerator and on the shelf decreased during the period of storage. TSS decreased from an initial value of 2.90 %Brix to 1.80%Brix at the end of 7th day storage for the sample stored in refrigerator while it decreased to 2.10%Brix at the 3rd day of storage for the sample on the shelf. These observed trends were statistically significant ($p<0.05$), however, the decrease in refrigerated sample was gradual compared to the sample on the shelf. This might be due to the fact that hydrolysis of sugar might have been slow down due to storage temperature and the addition of *P. guineenses*. This is in agreement with Akande and Ojekemi, [1]. More so, since TSS is a sum of sum of sugars, some acids and some minor components, micro-organisms might use some of the components as substrates for growth [15].

The organoleptic evaluation of samples stored in refrigerator showed that taste, odour and colour values decreased from an initial value of 5.0 to 3.5, 3.0 and 2.0 respectively within a period of 7 days while taste, odour and colour of samples stored on the shelf decreased from an initial value of 5.0 to 2.50, 2.0 and 1.5 respectively within a period of 3 days. Changes in the organoleptic attributes during the storage period may be due to a combination of biochemical and microbial changes. Overall, the organoleptic evaluation of samples stored in refrigerator was considered acceptable within 7 days of storage.

Table 1: Mean Values of Physicochemical and Organoleptic Attributes of Water Melon Juice Containing *P. guineenses* Stored in Refrigerator and on the Shelf (n=3)

Day	Storage	Taste	Odour	Colour	TSS(%Brix)	pH	Titratable Acidity
1	Refrigerator	5.00±0.00	5.00±0.00	5.00±0.00	2.90±0.01	5.40±0.01	0.064±0.03
	Shelf	5.00±0.00	5.00±0.00	5.00±0.00	2.90±0.01	5.60±0.02	0.069±0.01
2	Refrigerator	5.00±0.00	5.00±0.00	4.00±0.00	2.60±0.04	5.20±0.01	0.154±0.02
	Shelf	4.25±0.00	3.00±.00	4.00±0.0	2.60±0.04	5.70±00.3	0.211±0.01
3	Refrigerator	4.50±0.00	4.00±0.00	4.00±0.00	2.10±0.03	5.00±0.01	0.358±0.02
	Shelf	2.50±0.00	2.00±0.00	1.90 ±0.00	2.00±0.01	5.70±0.01	0.455±0.01
4	Refrigerator	4.30±0.00	3.80±0.00	3.80±0.00	2.00±0.00	5.00±0.00	0.455±0.00
5	Refrigerator	4.00±0.00	3.50±0.00	3.70±0.00	1.90±0.03	4.90±0.01	0.515±0.02
6	Refrigerator	3.30±0.00	2.90±0.00	3.00±0.00	1.90±0.01	4.90±0.01	0.541±0.03
7.	Refrigerator	3.00±0.00	2.90±0.00	2.80±0.00	1.80±0.01	4.80±0.02	0.578±0.00

CONCLUSION

The result obtained from this study indicated that storage temperature and the addition of *P. guineenses* have a profound effect on the physicochemical and organoleptic attributes on watermelon juice. However, the effect of pasteurization, microbial analysis and use of different dosage of *P. guineenses* need to be investigated further to ascertain the overall quality of the juice

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