Direct Research Journals

Vol.5 (10), pp. 333-337, October 2017
ISSN 2354-4147
DOI: https://doi.org/10.26765/DRJAFS.2017.8912
Article Number: DRJA19528912

Direct Research Journal of Agriculture and Food Science
http://directresearchpublisher.org/aboutjournal/drjafs

Research Paper

Effect of Preservatives on the Physicochemical Properties of Watermelon and Soursop Fruit Blend

***Gabriel Adeyemi Francis, Igwemmar Noela Chinyelu, Ilodinke Ebele, Omoniyi Ahmed Olalekan and Adeyemo Babatunde**

Department of Chemistry, Faculty of Science, University of Abuja, P.M.B. 117, F.C.T., Abuja, Nigeria.
*Corresponding author E-mail: yemigabriel@yahoo.com.

Received 10 August 2017; Accepted 19 September, 2017

Blend of watermelon and soursop is not popularly known. Therefore, this study was conducted to investigate the effect of storage temperature and preservatives (organic and inorganic) on the physicochemical properties of unstrained watermelon and soursop blend (smoothie). Blended juice of watermelon and soursop in the form of smoothie, were partitioned into three: A (treated with sodium benzoate), B (treated with lime fruit) and C (without preservative). The refrigerated samples were subjected to physicochemical analysis at day 1 and day 10. The results obtained revealed that vitamin C content ranged from 77.57 – 53.24 mg/100g, pH from 4.16 – 3.72, titratable acidity from 0.08 – 0.05%, total solid from 92.59 – 90.00%, total soluble solid from 11.50 – 8.50% and moisture content from 93.00 – 90.60%. All the parameters except moisture content decreased in the stored samples. These results showed that unstrained watermelon and soursop blend has rich quality characteristics without addition of preservatives; it supported the fact that essential physicochemical properties of fruits blends progressively decrease with advancement of storage period. In addition, presence of preservatives (organic and inorganic) contributed to the loss of vitamin C and dry matter in the fruits blend. The fruits blend is therefore better in food content without preservatives.

Key words: Physicochemical properties, Soursop, Preservatives, Sodium benzoate, lime fruit.

INTRODUCTION

Over the past decades, considerable attention has been given to reliable methods of processing fruits into valuable beverages such as juice, jam purée, wine and other fruit drinks, as a result of increase in fruit crop farming and varieties of fruits in many tropical countries coupled with the risk of post-harvest wastage (Vwioko *et al*., 2013). Tropical fruits like watermelon, soursop, pineapple, cucumber, orange and carrot have gained global importance because of their rich nutrients, flavour, exotic aroma, colour and medicinal values (Adeola and Aworh, 2010; Osemwegie *et al*., 2005).Fruit blending is an excellent method of improving the nutritional quality of juices. It can increase the vitamin and mineral contents depending on the kind and quality of fruits and vegetables used (De Carvalho *et al*., 2007). There are several studies about fruit blends and its characteristics on watermelon and pawpaw blend. Adedeji and Oluwalana, (2013) researched the quality characteristics of watermelon and pawpaw blend, Awsi and Dorcus (2012) reported the nutritional quality of pineapple, carrot and orange blend, Adou *et al*. (2012) studied the physicochemical properties of cashew and apple juice. These studies and many others reported that the nutritional composition of juice blends surpassed that of single fruit juice. However, literature also revealed that the nutrients of fruits blends progressively decreased with advancement of storage time.

The perishable nature of these fruits blends spurred scientist to devise methods of prolonging the shelf life of processed fruits among which is the addition of preservatives (natural and synthetic) (Vwioko *et al*., 2013; Quek *et al*., 2012). Chemical preservatives such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), ethoxyquine, tetrazines, are very effective in prolonging shelf life due to their bacteriostatic and fungistatic capacity. Although, natural biological preservatives are also employed in preserving juice blends, however, they are not as popularly explored as their synthetic counterpart (Vwioko *et al*., 2013).

Watermelon (*Citrullus lanatus*) and soursop (*Annona muricata* L) have gained global recognition for their rich nutrient composition. Watermelon is rich in antioxidant lycopene, which helps in reducing the risk of cancers, cardiovascular diseases, arteriosclerosis diabetes and arthritis and protects against macular degeneration (Adedeji and Oluwalana, 2013). Soursop fruit juice is also reported to be rich in nutrients such as amino acids, vitamins especially ascorbic acid, fiber, proteins, unsaturated fats and essential minerals (Vwioko *et al*., 2013). However, to date, juice blend of watermelon and soursop has not been reported. Therefore, this study investigated the physicochemical properties of watermelon and soursop blend, and how storage duration and preservatives (natural and synthetic) affect their nutritional value.

MATERIALS AND METHODS

Collection of samples

Fully ripe watermelon, soursop and lime fruits were purchased from Gwagwalada market in Gwagwalada, Federal Capital Territory, Abuja, Nigeria during the raining season of year 2016.

Preparation of fruits blend

The soursop, watermelon and lime fruits were thoroughly washed with 5% sodium hypochlorite solution to get rid of germs, and they were adequately rinsed with clean water. The soursop fruit was manually peeled, cored, deseeded under a hygienic condition; and was blended with small quantity of water to obtain a creamy thick purée. The watermelon was cut with sterile knife into smaller parts, deseeded, and was blended to obtain a light pink juice. The lime which is to serve as natural preservative, was sliced, juiced manually into a glass cup, strained with a clean muslin cloth, and the residue was discarded leaving only the clear juice. The soursop purée and watermelon juice were mixed together in 40:60% v/v respectively to form a thick fruits blend (smoothie), which was further blended to obtain a smooth unstrained fruits blend. Preservatives were added to the fruits blend, transferred into sterile PET containers with airtight screwcap and refrigerated prior to analyses. The containers with different content were labelled A, B, C as indicated (Table 1).

PHYSICOCHEMICAL ANALYSIS OF THE FRIUTS BLEND

The soursop puree and watermelon juice formulated in the ratio 40:60 v/v to obtain a thick fruits blend (smoothie) containing all the fibers and plant nutrients were examined for their quality characteristics.

Determination of pH

The pH of the samples was determined using digital pH meter (JENWAY 3510) according to method reported in AOAC (2010).

Determination of titratable acidity (%TA)

The method described by AOAC (2010) was used to determine titratable acid value of the samples. 10 ml of the sample was transferred into a conical flask and 25 ml of distilled water was added. 50 ml of 0.1 M NaOH was filled into the burette and titrated against the sample using 3 drops of 0.5% phenolphthalein as indicator. The end point of the titration was indicated by a sharp appearance of pink colour, after which the corresponding burette reading was taken. The titratable acid value was calculated using the formula:

$$Titratable\ acidity\ (\%) = \frac{titre\ x\ blank\ x\ normality\ of\ base\ x\ ml\ eqv\ of\ citric\ acid}{weight\ of\ sample}$$

Where $ml\ equivalent\ of\ citric\ acid = 0.064$

Determination of moisture content

The moisture content was determined using the method described by AOAC (2010). Clean crucibles were labeled and weighed; 5 g equivalent of the juice sample was introduced into the weighed crucibles, recorded, and was dried in air oven at 105 °C for about 12 h until a constant weight was obtained. It was then cooled in a desiccator and weighed again. The moisture content was calculated with the formula below:

$$Moisture\ content\ (\%) = \frac{weight\ of\ wet\ sample - weight\ of\ dry\ sample}{weight\ of\ dry\ sample - weight\ of\ crucible}\ x\ 100$$

Determination of vitamin C

The vitamin C (Ascorbic acid) was determined by redox

Table 1. Soursop and watermelon fruits blend ratio.

Label	Content
A	Soursop and watermelon fruits blend (40:60 v/v) with 0.1% sodium benzoate (synthetic preservative)
B	Soursop and watermelon fruits blend (40:60 v/v) with 0.3% lime juice (natural preservative)
C	Soursop and watermelon fruits blend (40:60 v/v) (without preservative)

titration with iodine according to the procedures of AOAC (2010). 20 ml of aliquot sample was pipette into 250 ml conical flask; 150 ml of distilled water and 1ml of starch solution indicator were added. The sample was titrated with 0.005 M iodine solution. The endpoint of the titration was indicated by the first permanent trace of a dark blue-black colour due to the starch-iodine complex. The titration was repeated with further aliquots of the sample to obtain an average titre value. The amount of vitamin C in the sample was calculated in mg/100 ml.

Determination of total solid

The total solid was determined using the air oven method reported by AOAC (2010). A clean petri dish was dried in oven for about 10 min and cooled in a desiccator; the petri dish was labeled, weighed and recorded. 3 g of the sample was scooped into the petri dish and weight taken; it was then subjected to oven drying for about 2 h at 105 °C. The sample was removed from the oven, cooled in a desiccator, and weighed. The total solid was calculated using the formula:

$$Total\ solid\ (\%) = \frac{weight\ of\ dry\ sample}{weight\ of\ wet\ sample}\ x\ 100$$

Determination of total soluble solids (TSS)

The total soluble solid was determined using a digital refractometer (ABBEY digital Refractometer) as enumerated by AOAC (2010). The prism of the refractometer was cleaned with alcohol; two drops of the sample were released onto the prism, and the value for the total soluble solid was displayed on the screen of the refractometer.

RESULTS AND DISCUSSION

The physicochemical properties of the fruits blend examined include: Moisture content (MC), pH, titratable acidity, ascorbic acid (vitamin C), total solid and total soluble solid (TSS).

Tables 2 and 3 show the results obtained for the physicochemical properties of the fruits blend samples at day 1 and day 10 respectively.

Moisture content

The moisture contents during the storage period ranged between 90.60 and 93.00% and were within the range of 90.6-91.2 % for fruits blends after day one of mixing. The moisture content of all the samples gradually increased during the storage period. This increase might be due to simultaneous decrease in total solid and total soluble sugar, which may have resulted from sugar fermentation. The results revealed that moisture content is inversely proportional to total solid (TS) and total soluble solid (TSS), although, this relationship was not stated in the literature of similar study (Adubofuor *et al*., 2010; Kirk and Sawyer, 1997). At day 10, sample A (containing synthetic preservative) recorded a moisture content of 92.00%, which is slightly lower than 93.00% of sample B (containing natural preservative); this implies that the rate of fermentation was slightly slower in sample A than in sample B. Sample C (without preservative) recorded the lowest moisture content of 91.00% due to slowest rate of fermentation in it.

pH

The pH results ranged between 4.16-3.72 at the end of storage period. Significant decrease in pH of all the samples during storage might be due to increase in their titratable acidity, as acidity and pH are inversely proportional to each other. This decrease in pH with storage time, also affects the organoleptic qualities of fruits blends (Awsi and Dorcus, 2012; Ukwo *et al*., 2010).The pH range 3.83 – 3.90 of the samples A, B and C is within the expected range of 3 - 5 for fruits and vegetable juices (Adubofuor *et al*., 2010; Harris *et al*., 1991). It has been reported that the pH which supports the growth of most microbes ranges from 6.6 - 7.5 (Bor and Jasper, 1988), and common bacteria grow well over a range of pH of 6 to 9 (Atlas, 1994). Therefore, the low pH of the samples would effectively delay the growth of most microorganisms. Similarly, as samples A, B and C recorded the pH of 3.90, 3.72 and 3.83 respectively after ten days of storge, these values show that natural preservative (lime) would delay the growth of microbe more than synthetic preservative (sodium benzoate), and therefore extend the shelf life of the fruits blend better. This is contrary to what was reported by Vwioko *et al*. (2013) that natural preservatives (garlic, ginger and their mixture) were less effective in prolonging the shelf life of

Table 2. Physicochemical parameters of fruits blend analyzed at day 1.

Samples	MC (%)	pH	TA (%)	Vita. C (mg/100g)	TS (%)	TSS (%)
A	90.60	4.02	0.08	77.57	91.75	10.40
B	91.20	3.87	0.08	59.27	90.10	11.40
C	90.80	4.16	0.05	61.03	92.59	11.50

Table 3. Physicochemical parameters of fruits blend analyzed at day 10.

Samples	MC(%)	pH	TA (%)	Vita C (mg/100g)	TS (%)	TSS (%)
A	92.00	3.90	0.10	59.40	91.30	8.50
B	93.00	3.72	0.10	53.24	90.00	8.60
C	91.00	3.83	0.07	60.50	91.99	8.80

Keys:
MC (Moisture content), **TA** (Titratable acidity), **Vita C** (Vitamin C), **TS** (Total solid), **TSS** (Total soluble solid);
A - Soursop and watermelon fruits blend with 0.1% sodium benzoate (synthetic preservative)
B - Soursop and watermelon fruits blend with 0.3% lime juice (natural preservative)
C - Soursop and watermelon fruits blend (without preservative).

juices (made from soursop) compared to synthetic sodium benzoate. This contrary view may be attributed to the different natural preservatives and different fruits used in the two studies.

Titratable acidity

Results on Table 2 shows how titratable acidity of all the samples increased with the passage of time. This trend agrees with the ones reported in literature. The titratable acidity ranged between 0.08 – 0.10 through the storage period, which is very low compared to the ones reported for other fruits blends by (Sarvesh and Pravesh, 2013; Adedeji and Oluwalana, 2013; Awsi and Dorcus, 2012). The reason for the unusually low titratable acidity for this particular fruits blend is not understood, therefore, it is worthwhile to conduct more research on this blend for clarification.
From the results obtained on day 10 from Table 3, samples A and B showed the highest titratable acidity, although, there is no difference in their values. Sample C recorded the lowest titratable acidity.

Vitamin C (Ascorbic acid)

The vitamin C levels in samples A, B and C after the storage period of this study are 59.40 mg/100g, 53.24 mg/100g and 60.50 mg/100g respectively. This observed diminution in vitamin C content is in agreement with what was reported in literature as vitamin C content is known to be an important parameter for assessing the nutritional quality of fruits blends as it degrades during storage (Inga *et al*., 2007; Corina *et al*., 2006; Franke *et al*., 2004). This degradation is perhaps due to the high sensitivity of vitamin C to oxygen, light and heat - and consequential oxidation in the presence of oxygen by both enzymatic and non-enzymatic catalyst (Anal *et al*., 2013; Awsi and Dorcus, 2012). Sample C recorded the highest vitamin C level (60.50 mg/100 g) due to slow rate of oxidation. While sample A gave higher vitamin C level (59.40 mg/100 g) than sample B with (53.24 mg/100 g); this implies that sodium benzoate preserved vitamin C more than lime during the storage period. The results in table 1 also shows that sodium benzoate (synthetic preservative) significantly boosted the vitamin C content of sample A when compared to sample B and C. Consequently, vitamin C contents of fresh fruits blends can be enriched using sodium benzoate as preservative, although, the abuse (excess addition) of such preservative has been linked to food poisoning/toxicity, immune depression and cancer in human (Vwioko *et al*., 2013).

Total solid

The results obtained shows that total solid slightly decreased with passage of time. This bit reduction might be due to the high level of dry matter in soursop coupled with the fact that the blend was not strained. After ten days of storage, sample C showed the highest total solid (91.99%), followed by sample A with 91.30%, and sample B with 90.00% being the minimum. These high total solid contents imply that the samples were able to retain almost all the fibers in the blend.

Total soluble solid

Total soluble solid gradually dropped in quantity with advancement of storage time in all the samples. This reduction in total soluble solid is due to the presence of micro-organisms that cause deterioration of fruits blends as a result of sugar fermentation (Anal *et al*., 2013; Rivas *et al*., 2006). From the results obtained after day ten of storage, Sample C showed the highest total soluble solid, followed by sample B with total soluble solid of 8.60%, and the lowest total soluble solid of 8.50% was observed in sample A. This result shows that addition of preservative lowered the total soluble solid in the fruit blend. Literature on the impact of preservatives on total soluble solid is scant. Consequently, it is necessary to conduct more studies on this property.

Conclusion

This research work confirmed and supported that vital physicochemical property of fruits blend such as vitamin C, pH, total soluble solid and total solid decrease with advancement of storage time. Addition of preservatives (natural and synthetic) was also noted to contribute to the loss of vitamin C and dry matter of the fruits blend. However, natural preservative (lime) may be said to be better than synthetic preservative as no negative impact on humans has been ascribed to its use in fruits blends. Finally, physicochemical analysis revealed that unstrained watermelon and soursop blend has good quality characteristics without the addition of preservatives. Therefore, fruits blend should be consumed fresh. It is therefore recommended that more research needs to be conducted to prove and establish the results reported in this work, especially on the effect of preservatives (natural and synthetic). Also, storage period should be increased and mineral composition should be analyzed in other fruit blend.

REFERENCES

Adedeji TO, Oluwalana IB. (2013). Physico-chemical, sensory and microbial analysis of wine produced from watermelon (*Citrullus lanatus*) and pawpaw (*Carica papaya*) blend. *Food Science and Quality Management*; 19 (2224-6088): 41-50.

Adeola AA, Aworh OC (2010). Development and sensory evaluation of an improved beverage from Nigeria's tamarind (*Tamarindus indica* L.) fruit. *African Journal of Food, Agriculture, Nutrition and Development*; 10: 4079-4092.

Adou M, Tetchi FA, Gbane M, Kouassi KN, Amani NG. (2012). Physico-chemical characterization of cashew apple juice (ANACARDIUM OCCIDENTALE, L.) from Yamalssoukro (Côte d'Ivoire). *Innovative Romanian Food Biotechnology*; 11: 32-43.

Adubofuor J, Aman Kwah EA, Arthur BS, Appiah F (2010). Comparative study related to physicochemical properties and sensory qualities of tomato juice and cocktail juice produced from oranges, tomatoes and carrots. *African Journal of Food Science*; 4 (7): 427-433.

Anal L, Cristina D, Oroian M, Sorina R (2013). Physicochemical parameters of fruit juices–evolution during storage. *Lucrări Ştünţifice - Seria Zootehnie*; 59: 213-217.

AOAC (2010). Official Methods of Analysis. 20th ed., Association of Official Analytical Chemists; Washington DC, USA.

Atlas RM (1994). Principles of microbiology.1st ed; 346.

Awsi J, Dorcus M (2012). Development and Quality of Evaluation of Pineapple Juice Blend with Carrot and Orange Juices. *International Journal of Scientific and Research Publications*; 6: 1-8.

Bor SL, Jasper GW (1988). Commercial vegetable processing. 2nd. Guy. Woodroof. NY; Pp. 596-594.

Corina C, Parvu D, Rivis A (2006). The determination of some physical-chemical characteristics for orange, grapefruit and tomato juices. *Journal of Agroalimentary Processes and Technologies*; 12 (2): 429-432.

De Carvalho JM, Maria GA, De Figueredo RW (2007). Development of a blended non-alcoholic beverage composed of coconut water and cashew apple juice containing caffeine. *Journal of Food quality*; 30: 664-681.

Frank AA, Custer LJ, Arakaki C, Murphy SP (2004). Vitamin C and flavonoid levels of fruits and vegetables consumed in Hawaii. *Journal of Food Composition Analysis*; 17 (1): 1- 35.

Harris A, Key J, Silcocks B (1991). Dietary carotene. 3rd ed. Prentice hall press, NY; pp 63-68.

Inga K, Maria M, Miroslawa S, Anna GS (2007). Effect of storage on the content of polyphenols, vitamin C and the antioxidant activity of orange juices. *Journal of Food Composition Analysis*; 20 (3-4): 313-322.

Kirk R, Sawyer R (1997). Pearson's composition and Analysis of foods. 9th ed. Chemical Publishing Inc. New York; pp 9-11.

Osemwegie OO, Igbokwe MS, Idu M (2005). Syrup extraction of Udara (*Chrysophyllum albidum* G.Don.), its preservation and microbial implication. *Journal of Applied Sciences*; 8: 4550–4561.

Quek MC, Chin NL, Yus YA (2012). Optimization and comparative study on extraction methods of soursop juice. *Journal of Food*, *Agriculture and Environment*; 10: 245–251.

Rivas A, Rodrigo D, Martinez A, Barbosa-Canovas GV, Rodrigo M (2006). Effect of PEF and heat pasteurization on the physical-chemical characteristics of blended orange and carrot juice. *Food Science and Technology*; 39: 1163-1170.

Sarvesh R, Pravesh K (2013). To Study the Storage Analysis of Developed Amla Mango Blended. *Advances in Bioresearch*; 4 (2): 109-117.

Ukwo SP, Ezeama CF, Ndaeyo NU (2010). Growth of different yeast strain during fermentation of soursop (*Annona muricata*) juice as influence by acetic acid bacteria. *Nature and Science*; 8:285-291.

Vwioko DE, Osemwegie OO, Akawe JN (2013). The effect of garlic and ginger phytogenics on the shelf life and microbial contents of homemade soursop (*Annona muricata*) fruit juice. *Biokemstri*; 25 (2): 31-38.