**STANDARDIZATION AND
CHARACTERIZATION OF
VALUE ADDED WATERMELON JUICE
(*Citrullus lanatus*)
READY-TO-SERVE BEVERAGE**

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Abstract

An experiment was conducted to study the feasibility of blending pineapple and watermelon juice in different ratio for preparation of blended RTS beverage. The formulated RTS beverages were evaluated for various chemical, organoleptic and microbial qualities. The titrable acidity, ascorbic acid, total soluble solids (TSS) and total sugars of freshly made RTS beverages increased while pH decreased with the increased concentration of pineapple juice from 10-30%. Tukey's test results revealed that, the mean scores for all assessed organoleptic characters varying significantly ($p < 0.05$) in the freshly made pineapple blend watermelon RTS beverages. The formulated beverage with 80:20 watermelon and pineapple juice was found to be superior in quality and could be stored at $30 \pm 1^\circ\text{C}$ for a minimum period of three months without any significant changes in quality attributes.

Keywords: Pineapple, quality characteristics, Ready-To-Serve beverage, watermelon.

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INTRODUCTION

Fruit and Vegetable sector has much potential to contribute to increase the level of national income, export revenue, generate new employment opportunities, increase farm income and enhance the nutrition and health of the people. The potential for cultivating fruit and vegetable crops for the domestic and export markets is high. Sri Lanka's per capita consumption of fruits and vegetables remains far below the required average daily intake. According to Medical Research Institute (2011), the daily per capita requirement of fruits for a balanced diet should be 30-40g (edible portion), which is approximately equivalent to 25-40 kg fresh fruit per head per year. Consuming fruits and vegetables of all kinds has long been associated with a reduced risk of many lifestyle-related health conditions.

Watermelon (*Citrullus lanatus*) is an important cucurbitaceous crop, whose fruits serve as a dessert to the common people in summer. These fruits are available in May to June in the markets throughout Sri Lanka. Watermelon is consumed as a fresh fruit and for its dry seeds. The watermelon fruit contains 93% water, with small amounts of protein, fat, minerals, and vitamins. The major nutritional components of the fruits are carbohydrates, especially sugars (6.4g/100g), vitamin A (590 IU), and lycopene (4,100µg/100g, range 2,300–7,200), an anti-carcinogenic compound found in red flesh watermelon (USDA Nutrient Database, 2009). Only a few studies have dealt with drying of watermelon, mainly with osmotic dehydration of the pulp (Falade *et al.*, 2007) and spray-drying of the juice (Quek *et al.*, 2007).

Pineapple (*Ananas comusus*) belongs to the family of Bromeliaceae. The fibrous flesh of pineapple is yellow in colour and has a vibrant tropical flavour that balances the tastes of sweet and tart. It is an excellent source of vitamin C which is required for the collagen synthesis in the body. It is also available in the same season from May to June of which watermelon are available in Sri Lanka.

Juice blending is one of the best methods to improve the nutritional quality of the juice. It can improve the vitamin and mineral content depending on the kind and quality of fruits and vegetables used (De Carvalho *et al.*, 2007). Apart from nutritional quality improvement, blended juice can be improved in its effects among the variables, thus it cannot depict the net effects of various parameters on the reaction rate. Moreover, one could think of a new product development through blending in the form of a natural health drink, which may also be served as an appetizer. The watermelon fruit juice blend that could lower the risk of cardiovascular disease has been created by Cyril *et al.* (2009). Polyphenols are found in fruits as diverse in red watermelon. Their beneficial effect on health is well known, with a diet rich in polyphenols correlating with a reduced risk of cardiovascular disease.

According to the Sri Lanka Standard Institute specifications, RTS fruit beverage should not exceed its total acidity more than 1% (as anhydrous citric acid). The fruit and sugar content should not be less than 5% by mass and preservatives should not exceed the limit of Sulphur dioxide (70 ppm) and benzoic acid (120 ppm). Adding preservatives such as Sulphur dioxide and benzoic acid can increase

the shelf life of RTS beverages. Colouring matter and clarifying agents can be added to the product, to increase attractiveness and addition of flavouring ingredients is allowed only in the product prepared by using mango.

Therefore, this research was carried out to formulate an acceptable quality of RTS beverage using watermelon and pineapple at different combinations considering SLS requirements and to assess the chemical, organoleptic and microbial qualities of pineapple blend watermelon RTS beverage after formulation and during storage.

MATERIALS AND MEEHODS

Undamaged, disease free, healthy, mature and ripe watermelon (*Variety - Thillina*) and pineapple (*Variety - Mauritius*) fruits were purchased from the Commercial Horticultural Farms of the Department of Agriculture, Sri Lanka.

Juice preparation

Fruits were washed with clean running water to remove dust particles and to reduce the microbial load on the surface of the fruits. Peeled pineapples were crushed with mixer cum juicer for the extraction of juice. Watermelons were cut with the help of stainless steel knives into pieces and seeds were removed manually. The fleshs were passed through the juicer for extraction of juice. Six formulations were prepared by mixing watermelon juice and pineapple juice in different ratios with sugar, acidity as anhydrous citric acid and 70 ppm of potassium metabisulphite (KMS). The amount of added sugar, citric

acid and potassium metabisulphite were kept as same for each treatment.

The prepared beverages were filtered through the strainer (200 μ m) to get a clarified juice and filled in previously sterilized glass bottles (200 ml) leaving 2.5 cm head space and sealed airtight by crown corking covered with aluminium foil. Then the bottled juice were sterilized at 105°C for 10 min and cooled to room temperature of 30 $\pm$ 1°C.

The following treatment combinations were formulated:

T₁ - RTS beverage with 100% watermelon juice

T₂ - RTS beverage with 90% watermelon juice and 10% pineapple juice

T₃ - RTS beverage with 85% watermelon juice and 15% pineapple juice

T₄ - RTS beverage with 80% watermelon juice and 20% pineapple juice

T₅ - RTS beverage with 75% watermelon juice and 25% pineapple juice

T₆ - RTS beverage with 70% watermelon juice and 30% pineapple juice

Chemical Qualities

Chemical qualities of the RTS beverage were analysed using recommended standard AOAC methods (2002). The titrable acidity was determined by titrating the RTS beverages of various juice

combinations with 0.1N NaOH and the results were expressed as percentage of anhydrous citric acid.

Ascorbic acid content of beverages was titrimetrically estimated by indophenol dye method. The pH was determined by an Electronic pH meter (Mettler Toledo, UK). Lane-Eynon method was performed to determine the total sugar content of the formulated beverages.

Hand-held refractometer (ATAGO-S-28E model) was used to estimate the total soluble solids (TSS) and the values were expressed as °Brix. The analyses were replicated thrice.

Microbial Test

The prepared beverages were studied for microbial quality and safety. The total microbial load was calculated by standard plate count method. The standard plate count was done according to the method described by Arachchi (2003) in raw mango RTS beverages.

Sensory Evaluation

In sensory evaluation, the samples were subjected to nine-point hedonic scale test and the acceptability of samples was judged by 11 trained panelists to determine sensory preference. The sensory characteristics such as colour, flavour, taste, thickness and overall acceptability of the RTS beverages were judged by the panelists.

Shelf Life Evaluation

RTS beverages were subjected to storage studies at room temperature for a period of 3 months by drawing samples at bimonthly intervals to

evaluate changes in chemical, organoleptic parameters and microbial spoilage.

Statistical Analysis

Data obtained in chemical analysis were subjected to Analysis of Variance (ANOVA) and mean separation was done with Duncan's Multiple Range Test (DMRT). Descriptive statistics was done on sensory attributes and the means were compared using the Tukey's test ($p < 0.05$).

RESULTS AND DISCUSSION

Titration Acidity

According to the Sri Lanka Standard Institute Specifications, the limits of acidity for RTS preparation are 0.3-1% as anhydrous citric acid (SLS 729:1985). The titration acidity of the RTS beverage samples varied significantly and increased from 0.16 to 0.42% with increase the concentration of pineapple juice from 10 to 30% as shown in Figure 1. This can be attributed partly to the contribution of the inherent acid naturally present in the pineapple juice. Pineapple is acidic, which 87 % is citric acid and 13 % is malic acid. According to Samson (1986), the fresh pineapple juice has 0.7-1.6 g citric acid /100 ml.

Note: The values are means of triplicates
Vertical bars indicate the standard errors.

Ascorbic Acid

Note: The values are means of triplicates
Vertical bars indicate the standard errors.

Ascorbic acid is an essential nutrient for humans because it aids in the synthesis of collagen in addition to protecting against oxidative damage. Watermelon juice contains 5.81 mg/100 ml of ascorbic acid (Patil, 2000).

The ascorbic acid content increased significantly from 5.64 to 15.63 mg/100 ml with an increase in the concentration of pineapple juice from 10 to 30% in the RTS beverage formulations (Figure: 2). These findings are reported that maximum ascorbic acid (15.9 mg/100 ml juice) was recorded in RTS beverage with 70% watermelon juice and 30% pineapple juice.

pH

The presence of free hydrogen ions and buffering capacity of the juices influence the pH value of the beverage (Shubhangi, 2002). The pH of freshly made pineapple blend watermelon RTS beverages was below 5.25. According to DMRT, the pH reduced significantly ($p < 0.05$) with the increasing concentration of pineapple juice in RTS beverages is shown in the Table 1. The highest pH value 5.22 was obtained in the treatment T₁. The treatment T₆ (RTS beverage with 70% watermelon juice and 30% pineapple juice) had the least mean value.

Table 1: The pH and TSS of freshly made Pineapple blend Watermelon RTS Beverages

Treatments	pH	TSS (°Brix)
T ₁	5.22±0.002 ^a	13.1±0.02 ^a
T ₂	5.10±0.023 ^b	13.5±0.03 ^b
T ₃	4.90±0.003 ^c	13.9±0.09 ^c
T ₄	4.76±0.002 ^d	14.0±0.06 ^d
T ₅	4.64±0.016 ^e	14.2±0.04 ^e
T ₆	4.61±0.016 ^f	14.5±0.06 ^f

Note: The values are means of triplicates ± standard error

The results generally showed that the higher acidity, lower pH of pineapple RTS beverages. Similar study conducted by Awsi Jan and Dorcus (2012) found that there is a corresponding reduction in pH as the acidity increased in pineapple Juice blend with carrot and orange juice.

Total Sugar

Sugars, acids and their interactions are important to sweetness, sourness and overall acceptability in RTS beverages. The minimum total sugar content (as sucrose) for RTS preparation is 5% (SLS 729:1985). Sugars, acids and their interaction are important to sweetness, sourness and overall acceptability in RTS beverages. As shown in Figure: 3, the total sugar content of watermelon was 5.25%. Schmidt *et al*, (2005) found that the watermelon juice contained 32.2% fructose, 9.3% glucose, and 27.1% sucrose for a total of 68.6% of sugars on a dry matter basis.

Note: The values are means of triplicates. Vertical bars indicate the standard errors.

According to DMRT, the total sugar significantly ($p < 0.05$) differed between each treatment. The treatment T₆ had highest mean value and the treatment T₁ (RTS beverage with 100% watermelon juice) had a least mean value at 5% level of significance.

Total Soluble Solids (TSS)

TSS:Acid ratio is often better related to palatability of the fruits than either sugar or acid alone. The recommended TSS for commercial RTS production is 15°Brix (SLS 729: 1985). The TSS of RTS beverage formulation was adjusted initially. According to the DMRT, the TSS increased significantly ($p < 0.05$) with the increasing concentration of pineapple juice in RTS beverages is shown in the Table 1. The highest TSS value 14.5 (°Brix) was obtained in the treatment T₆. The treatment T₁ (RTS beverage with 100% watermelon juice) had the least mean value of 13.1 (°Brix).

Microbial Test for Freshly Made RTS Beverages

In the freshly made beverages, no bacterial growth was observed immediately after formulation. Therefore, there was no total plate count in these samples. Carter *et al.* (2007) reported that many products that could safely be maintained sterile by pasteurization process alone could be doubly preserved by the addition of potassium metabisulphite. The sulphite inhibits yeasts, moulds and bacteria (Doughari and Elmahmood, 2007). Therefore, the heat treatment was sufficient to destroy initial microbial load in the formulated fruit drinks.

Sensory qualities of Freshly Made RTS Beverages

Sensory evaluation was made through panel of 11 trained judges. The panel evaluated colour, flavour, taste, thickness and overall acceptability. A 9-point hedonic scale was used for this purpose. As shown in Figure: 4, the sensory evaluation of the RTS beverage revealed that, there were significant differences between the treatments as the concentration of pineapple juice was increased from 10 to 30% for colour, flavour, taste, thickness and overall acceptability at 5% level of significance according to General Linear Models (GLM).

CONCLUSION

Based on the chemical analysis of the freshly made RTS beverages, there were significant increase in titrable acidity, ascorbic acid, total sugar and total soluble solids (TSS) and a significant decrease in pH with the increase in the concentration of pineapple juice from 10 to 30% in RTS beverages. According to the microbial test, the total plate

count was observed after three months of storage. Among the inoculated samples, there were shown some colony forming units (bacterial growth).

There was no drastic effect on the quality of the product due to microbial growth in three months at ambient temperature. Therefore, it is safe for consumption upon three months of storage. The sensory analysis revealed that, there were significant ($p < 0.05$) differences for the organoleptic characters between the treatments. According to Tukey's test, the highest overall acceptability was observed in the RTS beverage with 80% watermelon juice and 20% pineapple juice. The RTS beverage with 100% watermelon juice had low organoleptic characters and overall acceptability than the other RTS beverages. Therefore, the RTS beverage formulated with 80% watermelon juice and 20% pineapple juice is the best combination for the commercial preparation of pineapple blend watermelon RTS beverage without any significant changes in the nutritional, chemical and sensory characteristics with extended shelf life.

REFERENCES

- Anon (2008). Watermelon. Federal Agriculture Marketing Authority. News Letter No: 27. Tropical Research and Training Institute, Chatham, UK.
- AOAC (2002). Official Methods of Analysis. (17th Edn). Association of Official Analytical Chemists. Washington, USA.
- Arachchi, V. K. (2003). Incidence and severity of food borne pathogens in raw mango RTS beverages. *Journal of Food Protection*. **9**: 2172–2198.

- Archer, M. C. and Tannenbaum, S. C. R. (1970). Vitamins. *In: Nutritional and Safety Aspects of food Processing*. Marcel Dekker, Inc., New York, UAS. pp. 53-60.
- Awsi, J. K. and Dorcus, M. R. (2012). Development and Quality Evaluation of Pineapple Juice Blend with Carrot and Orange juice. *International Journal of Scientific and Research Publications*. **2(8)**: 2250-3153.
- Carter, H. W., Charley, V. L. S. and Bristol. C. (2007). The Preservation of fruit Juice Products with special reference to nutritional value. *Journal of Food Safety*. **88**: 112-118.
- Cyril, P. U., Sandrine, T. and Schini, L. H. (2009). Evaluation of different fruit juices and optimization of a red watermelon fruit juice blend. *Food Functions*. **21**:245-251.
- De Carvalho, J. M., G. A. Maia, R. W. and De Figueredo (2007). Development of a blended non-alcoholic beverage composed of coconut water and cashew apple juice containing caffeine. *J. Food Qual.* **30**: 664-681.
- Doughari, J. H. and Elmahmood, A. M. (2007). Effect of some chemical Preservatives on the shelf life of Sobo drink. *African Journal of Microbiology*. **2**:5-6.
- Patil, D. (2000). Development of value added nutritious products from watermelon. *M.Sc. Thesis*. University of Agricultural Sciences, Bangalore, India.
- Samson, R. B. (1986). Changes in nutritional composition and sensory qualities of the fresh pineapple juice during heat treatment and storage. *Journal of Food Quality*. **29**: 165-173.
- Shubhangini, A. J. (2002). Nutrition and dietetics. Tata McGraw Hill Publish Company Ltd, India. pp. 488-58. Smooth Cayenne cultivars. *Food Chemistry* 53: 75-79.
- Sri Lanka Standard Institute (1985). Standards and Specifications for ready-to-serve fruit drinks. SLS 729:1985, Colombo.