

DEVELOPMENT OF COCONUT SAP BASED NON-ALCOHOLIC READY TO DRINK BEVERAGE

SPMG Gunawardhana¹, HPDT Hewapathirana^{2*}, LLWC Yalegama², and PLN Lakshman¹

¹Department of Food Science & Technology, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka

²Coconut processing Research Division, Coconut Research Institute, Bandirippuwa Estate, Lunuwila, Sri Lanka

ABSTRACT

This study was aimed to develop a cost effective non-alcoholic ready to drink beverage using unfermented coconut sap (*Meera*). Four experiments (each with 3-4 treatments and 3 replicates) were conducted with complete randomized design to find out organoleptically acceptable dilution ratio of sap: water, type of flavor, concentration of flavor and effect on carbonation. Sensory evaluations were conducted for each experiment to select best treatment with 20 number of semi trained panelists. The final products were pasteurized at 95 °C for 7 minutes and stored 4±2°C. Shelf-life evaluation was done in two weeks interval. The dilution ratio of 2:3 (sap: water; v/v) and 0.56 % natural lemon flavor were the best combinations for both carbonated and non-carbonated beverages. The initial physico-chemical parameters (pH 4.04, Brix 9.0, ash 0.69 %, alcohol 0%) were not significantly different for both carbonated and non-carbonated beverages. However, significantly higher (p<0.05) sucrose (10.7 %), glucose (3.0 %), fructose (1.9 %), ascorbic acid (1.83%), sodium (26 ppm), potassium (35 ppm) and magnesium (7 ppm) were present in the non-carbonated beverage. Final products were acceptable for 4 months.

Key words: Carbonated, non-carbonated, ready to drink beverage, unfermented coconut sap

INTRODUCTION

Coconut palm (*Cocos nucifera*) is a versatile plantation crop which belongs to the family Arecaeae and is cultivated in tropical countries. The phloem sap (*meera*, unfermented sap, sweet toddy) is one of the natural drinks, being traditionally tapped from unopened inflorescence of coconut palm. The unfermented sap is golden in colour with a 7.3 - 7.4 pH and it has a high nutritional value (Singaravadivel *et al.*, 2012). Sugar is the key ingredient of fresh sap and it has low Glycemic Index (GI). Therefore, it can be used as a therapeutic agent for type II diabetes mellitus (Syamala Devi *et al.*, 2015). Coconut sap is an abundant source of minerals like Na, K, P, Mg and micronutrients like Zn, Fe and Cu. It is high in Potassium

(3.16 mg/100 ml) and sodium (6.95 mg/100 ml), essential for electrolyte balance, regulating high blood pressure and sugar metabolism (Barh and Mazumdar, 2008). Fresh coconut sap undergoes rapid fermentation after contacting with wild yeast preferably under aerobic condition. The long duration between exudation and concentration of sap permits microbial activity, leading to biochemical changes in sweet toddy sugars. Bark of *Vateria acuminata* ("*hal*"-Sinhala) is the main substrates commonly placed in pots to reduce the fermentation. It imparts harsh odor, unacceptable color and quality is not suitable for beverage making. An improved method for coconut sap collection was recommended by Coconut Research Institute (CRI) in order to collect the sap in unfermented stage. The collection de-

*Corresponding author: dilthihewa@gmail.com

vice is comprised with a cooling compartment, collecting vessels, fixing unit and outer cover. Because, value addition of unfermented coconut sap as a flavored carbonated or non-carbonated ready to drink beverage will have a great opportunity to promote coconut sap as a healthy nutritious beverage for alternative to the soft drinks in the market. Hence, this study was conducted to develop a most preferred formulation for value added non-alcoholic ready to drink beverage from unfermented coconut sap with the aim of diversification of coconut sap-based products.

MATERIALS AND METHODS

Fresh sap was collected from the tapping coconut palms of Bandirippuwa estate using modified sap collection method recommended by CRI. Coconut sap was diluted by three different ratios of water (40 %, 50 % and 60 % v/v). The best dilution ratio was selected from sensory evaluation (five point hedonic scales) with 20 numbers of semi-trained panelists. Different types of fruit pulps and their volumes were tested on trial and error basis with a view to select a best flavoring agent for coconut sap. Natural lemon flavor (0.56 % v/v) and artificial mandarin flavor (0.8 % v/v) were added to increase the taste of the product. The acceptability of selected diluted samples were evaluated through sensory evaluation.

Bulk production was done with preservation technique. Unfermented sap was filtered with a piece of muslin cloth and pasteurized at 70 °C for 15 minutes. Then the contents were diluted as selected ratio with 0.4 % (w/v) of common salt. Thereafter, selected volumes of flavors were added into the pasteurized coconut sap and treated coconut sap was filled into 200 ml sterilized glass bottles and sealed. All samples were pasteurized in 95 °C for 7 minutes and followed by keeping refrigerated temperature (4±2 °C) until cooling. Finally, carbonization was done using 2.4 g/l of dry ice in sterilized plastic bottles. The final products were stored in refrigerated temperature (4±2 °C).

Total Soluble Solid (TSS), pH, sugar composition (High Performance Liquid Chromatography), alcohol content, ascorbic acid content, minerals and ash (AOAC, 1998) were analyzed. Total Plate Count (TPC) and Yeast and Mould Count (YMC) were analyzed in two weeks intervals for shelf life evaluation. Sensory data, physico-chemical and proximate data were statistically analyzed by Minitab 14.0 software at 95 % confidence interval. Mean separation was done by “Duncan multiple range test”. The microbiological data were compared with Sri Lankan Standard Institution (SLSI) values.

RESULTS AND DISCUSSION

Initial pH values of the beverages were around 4. Most of the commercially available soft drinks have low pH value and products were similar to commercial soft drinks. pH value of the non-carbonated product was not significantly different up to the 4 months of storage ($p>0.05$) as against initial pH value. pH of carbonated beverage changed significantly ($p<0.05$) with time due to carbonic acid production. Considering two products, after 4 month, higher pH value was observed in non-carbonated beverage. The low pH in carbonated beverage may be due to formation of carbonic acid with dissolved CO₂. Therefore, non-carbonated product remains comparatively at high pH at the end of 4 month.

Total Soluble Solid (TSS) content of soft drinks is within the range of 7-14 %. Initially the brix level of the two types of beverages was 9 %. In carbonated product, TSS content started to change significantly after 4th month of storage ($p<0.05$). In contrast, TSS content of the non-carbonated product was not significantly changed ($p>0.05$) during the storage (up to 4 months). Sucrose is the major compound which causes the increase in TSS of a formulated beverage. Usually higher brix value indicates higher sugar content, good taste and good shelf life (Borbe, 2011). Similarly, with storage time, sugar may be converted to alcohol and acetic acid and these compounds may cause for

the reduction of brix value in carbonated beverage.

Results of alcohol analysis revealed that, both products had zero percent alcohol content at initial stage. Therefore, they can be recognized as non-alcoholic beverages. Alcohol content of non-carbonated beverage has increased slightly ($p>0.05$) after 4month of storage. Carbonated beverage has zero percent alcohol content during the storage of four months. Changes in physico-chemical properties are presented in Table 1.

Ascorbic acid is a potent anti-oxidant which is important for human health. Coconut sap is a rich source of ascorbic acid and it contains 3.5 mg/100 ml (Singravadivel *et al.*, 2012). Due to dilution of fresh sap (40 %) and during the heat treatment, some amount of ascorbic acid may have been destroyed. Therefore, both products contain low ascorbic acid concentrations compared to the fresh sap. Non-carbonated product contains significantly ($p<0.05$) high amount (1.83 mg/100 ml) of ascorbic acid than carbonated product (1.39 mg/100 ml). There was a significant difference ($p<0.05$) in ascorbic acid content with storage time in both carbonated and non-carbonated products.

Results further revealed that, developed beverage contains high amount of sucrose and low amount of glucose, fructose and zero level of galactose. Non-carbonated and carbonated products contain 10.68 % and 8.54% of initial sucrose percentage respectively and these values were significantly different ($p<0.05$). Carbonation process can be one reason for low level of sucrose content in carbonated beverage.

Fresh coconut sap contains 0.12 g/100 ml of ash and mainly it contains sodium, potassium, calcium and magnesium as minerals (Singravadeivel *et al.*, 2012). Ash content of non-carbonated and carbonated beverages significantly ($p<0.05$) changed with the storage time from 0.69 % to 0.44 %. According to the results, non-carbonated and carbonated products contains significantly higher amount of potassium (3.51 mg/100 ml and 3.46 mg/100 ml respectively) than sodium (2.64 mg/100 ml and 2.59 mg/100ml respectively). It means beverages have a good isotonic behavior. The developed product also contains calcium and magnesium in considerable amounts.

Initial microbial results analysis showed that, Total Plate Count of both products were at zero level. Therefore, heat treatment was suf-

Table 1: Change in physico-chemical parameters in carbonated and non-carbonated beverages with storage time

Months	Non-carbonated			Carbonated		
	pH	TSS	Alcohol	pH	TSS	Alcohol
Initial	4.07±0.005a	9±0.000a	0.0±0.00a	4.05±0.005a	9±0.000a	0.0±0.00a
1 st Month	4.07±0.005a	9±0.000a	0.0±0.00a	4.05±0.005a	9±0.000a	0.0±0.00a
2 nd Month	4.07±0.005a	9±0.000a	0.0±0.00a	4.05±0.005a	9±0.000a	0.0±0.00a
3 rd Month	4.07±0.005a	8.9±0.076a	0.0±0.00a	4.05±0.005a	8.9±0.076a	0.0±0.00a
4 th Month	4.06±0.251a	8.8±0.028a	0.06±0.057a	4.01±0.01b	8.46±0.057b	0.0±0.00a

Mean values of same letter are not significantly different from the initial product

ficient to destroy initial load of micro-organisms. However, TPC increased with storage time but it is acceptable according to the Sri Lanka Standard Institute (SLSI) standard level (TPC<50CFU/ml) up to 4 months in both products. Both carbonated and non-carbonated products have zero count for yeast and moulds during the 4 months period of storage. SLSI recommended level for yeast and moulds zero count per 1ml for ready to drink beverage. Therefore, product is microbiologically safe for 4 months at refrigerated (4±2 °C) condition. However, utilization of modern techniques of filling with special packaging, carbonation for the production protocol and application of preservatives like Sodium benzoate, Potassium Metabisulfite may possibly increase the shelf-life of the product more than 4 months.

CONCLUSION

A value added flavored non-alcoholic ready to drink beverage can be successfully developed from unfermented coconut sap by using 40 % (v/v) dilution, 0.56 % (v/v) natural lemon flavored, with carbonation or without carbonation and at 95 °C for 7 minutes of thermal preservation. The product is microbiologically safe up to 4 months under refrigerator condition (4±2 °C).

REFERENCES

- AOAC (Association of Official Analytical Chemists) 1998 Official Method of Analysis. North Fredric Avenue, Maryland, U.S.A.
- Barh D and Mazumdar BC 2008 Competitive Nutritive Values of Palm Saps before and after Their Partial Fermentation and Effective Use of Wild Date (*Phoenix sylvestrisroxb.*) Sap in Treatment of Anemia. Journal of Medicine and Medical Science.173-176.
- Singaravadivel K, Alagusundaram K and Hariharan B 2012 Physicochemical Properties of Fresh and Stored Coconut Palm Toddy. [online] Available at <http://omicsonline.org/scientific-reports/srep397.php> [Accessed 30th July 2016].
- Syamala Devi N, Hari Prasad T, Ramesh K and Merugu R 2015 Antioxidant Properties of Coconut Sap and Its Sugars. International Journal of Pharm Tech Research. 8:160-162
- Borbe JS, 2011 Coconut Syrup Philillines. [online] Available at <http://coconutsyrupphilippnes.com/maplevscocosyrup.php> [Accessed 1st August 2016].
- Joy A and Prasetha KC 2016 Processing Technology for Coconut Neera & Neera Products at CIT. Indian Coconut Journal. 58:10-13.