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PRESERVATION OF TENDER COCONUT WATER OF SRI LANKAN TALL COCONUT VARIETY

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Abstract
Tender coconuts of 7-8 months' maturity of Sri Lankan tall coconut variety were selected and water of tender coconuts was hygienically collected and pasteurized at different temperatures (90^{o}C for 10 minutes and 100^{o}C for 10 minutes). Preservatives were added in required amounts (100ppm KMS and 0.05% CMC) at the end of heating and the processed tender coconut water(TC) was filled into glass bottles and stored at both ambient temperature (30±2^{o}C) and refrigerated temperature (4±2^{o}C) for a period of 6 months. The treatments used in this study were, T1: TC + 90^{o}C for 10 minutes+ preservatives+ ambient Temperature, T2: TC+100^{o}C for10 minutes +preservatives+ ambient Temperature, T3: TC+90^{o}C for 10 minutes+ preservatives+ refrigerated temperature and T4: TC+100^{o}C for 10 minutes + preservatives +refrigerated temperature.
The preserved tender nut water was analyzed in triplicate for total soluble solids (TSS), acidity, pH, microbial infestation, mineral content and sensory properties.
It was observed that TSS, acidity, pH and colony forming unit (CFU) count of samples stored at refrigerated temperature did not change significantly (p>0.05) on storage of 6 months. The total plate count was within the acceptable level up to 2 months in the case of samples stored at ambient temperature which indicated thatsamples were microbiologically safe for consumption at ambient temperature only for 2 months. It is revealed that, there was no significant difference (p>0.05) in mineral contents of preserved tender coconut water on storage of 6 months. However, the potassium content was greater compared to the amounts of sodium, calcium and magnesium in the processed tender coconut water.According to the results of sensory evaluation, samples processed at 90^o C for 10 minutes scored higher mean sensory scores compared to those of samples processed at 100^{o}C for 10 minutes.

Keywords: Tender coconut water, preservation, isotonic beverage, anti-carcinogenic property, electrolyte content

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1.INTRODUCTION

Coconut water presents anti-carcinogenic properties and can be used as a dehydrating solution administered orally or in intravenous form (Chowdhury et al., 2009, Sylianco et al., 1992, Magat and Agustin, 1997, Falck et al., 2000). Potassium, sodium, magnesium, calcium, phosphorus and chloride are the main minerals found in coconut water. (Nadanasabapathy and Kumar, 1999). It has been reported that coconut water is an isotonic beverage due to the presence of balanced electrolytes namely; potassium and sodium that help restore losses of electrolytes through skin and urinary pathways (Khan et al., 2003, Jackson et al., 2004). This wholesome beverage that nature has provided for people of the tropics and is consumed fresh, largely because once exposed to air and warm temperatures, it rapidly deteriorates. Sterilization of coconut water using high temperature destroys some of the nutrients and the flavour (Premasiri, 2011). There is a growing demand locally as well as globally for the consumption of natural food commodities (Damar, 2006). Therefore, tender coconut water has a high export market potential. The major problem with the export of tender coconut water is the physico-chemical changes that take place after harvest, during processing and transport up to the point of sale. Tender coconuts cannot be stored for more than a week at ambient temperature due to shrinkage and discolouration of the outer skin, the fall of perianth, microbial attack on the perianth region and decomposition of the nut water (Premasiri, 2011). If the technology could be developed to increase the keeping quality of tender nut water up to 6 months or more at room temperature without causing notable

losses to the quality, enormous export potential would exist to generate more income to the coconut growers. Therefore, the objectives of this study were to improve the preservation method to extend the shelf life of tender coconut water (TC), to determine the chemical and microbiological quality parameters of preserved tender coconut water and to determine the overall acceptance of preserved tender coconut water (sensory evaluation).

2. MATERIALS AND METHODS

Methodology

Tender coconuts of 7-8 months' maturity of Sri Lankan tall coconut variety were selected and water of tender nut was hygienically collected and pasteurized at different temperatures. Preservatives were added in required amounts (100ppm KMS and 0.05% CMC) at the end of heating and the processed tender coconut water was filled into glass bottles and stored at both ambient temperature (30±2^{o}C) and refrigerated temperature (4±2^{o}C) for a period of 6 months.

Treatments

T1: TC + 90^{o}C for 10 minutes + preservatives + ambient temperature, T2: TC+100^{o}C for10 minutes +preservatives+ ambient temperature, T3: TC+90^{o}C for 10 minutes + preservatives +refrigerated temperature and T4: TC+100^{o}C for 10 minutes + preservatives +refrigerated temperature.

The preserved tender nut water was analyzed in triplicate for total soluble solids (TSS), acidity, pH, microbial infestation, mineral content and sensory properties.

Statistical analysis

Statistical analysis was performed using ANOVA. The mean values and standard deviation were calculated from triplicate experimental data.

Table 1: TSS, acidity, pH and microbial changes of preserved tender coconut water during storage

Treatments	Storage period	TSS (%)	Acidity (%)	pH	CFU/ml
T1	1 st month	5.2±0.4^{a}	0.15±0.02^{b}	4.9±0.3^{c}	30^{d}
T2		5.1±0.4^{a}	0.12±0.03^{b}	4.9±0.2^{c}	35^{d}
T3		5.2±0.1^{a}	0.14±0.01^{b}	5.2±0.1^{c}	ND
T4		5.2±0.2^{a}	0.16±0.02^{b}	5.1±0.3^{c}	ND
T1	2 nd month	5.4±0.2^{a}	0.13±0.01^{b}	5.2±0.1^{c}	48^{e}
T2		5.3±0.1^{a}	0.11±0.03^{b}	5.1±0.2^{c}	42^{e}
T3		5.2±0.0^{a}	0.13±0.01^{b}	5.3±0.2^{c}	ND
T4		5.1±0.3^{a}	0.15±0.01^{b}	5.1±0.3^{c}	ND
T1	3 rd month	-	-	-	-
T2		-	-	-	-
T3		5.1±0.5^{a}	0.14±0.01^{b}	5.2±0.1^{c}	ND
T4		5.2±0.3^{a}	0.16±0.02^{b}	5.0±0.2^{c}	ND
T1	4 th month	-	-	-	-
T2		-	-	-	-
T3		5.3±0.2^{a}	0.14±0.01^{b}	5.1±0.3^{c}	ND
T4		5.3±0.4^{a}	0.16±0.02^{b}	5.2±0.1^{c}	ND
T1	5 th month	-	-	-	-
T2		-	-	-	-
T3		5.2±0.2^{a}	0.15±0.01^{b}	5.0±0.1^{c}	ND
T4		5.3±0.2^{a}	0.15±0.02^{b}	5.3±0.3^{c}	ND
T1	6th month	-	-	-	-
T2		-	-	-	-
T3		5.3±0.3^{a}	0.17±0.01^{b}	5.1±0.3^{c}	ND
T4		5.3±0.5^{a}	0.18±0.02^{b}	5.3±0.2^{c}	ND

Means with same superscript within the same column are not significantly different from each other at p>0.05 level.

Table 2: Mineral content of preserved tender coconut water on storage

Treatments	Storage period	Na+ (%)	K+ (%)	Ca2+ (%)	Mg2+ (%)
T1	1 st month	0.40±0.03^{a}	0.61±0.02^{b}	0.21±0.02^{c}	0.03±0.001^{d}
T2		0.41±0.04^{a}	0.59±0.02^{b}	0.20±0.01^{c}	0.02±0.003^{d}
T3		0.41±0.01^{a}	0.60±0.03^{b}	0.19±0.02^{c}	0.02±0.001^{d}
T4		0.39±0.03^{a}	0.58±.0.02^{b}	0.18±0.01^{c}	0.03±.0.003^{d}
T1	2 ndmonth	0.38±0.01^{a}	0.62±0.03^{b}	0.21±0.03^{c}	0.02±0.001^{d}
T2		0.39±0.02^{a}	0.60±0.01^{b}	0.21±0.01^{c}	0.01±0.002^{d}
T3		0.41±0.00^{a}	0.60±0.02^{b}	0.20±0.04^{c}	0.01±0.003^{d}
T4		0.40±0.02^{a}	0.59±.0.04^{b}	0.19±0.01^{c}	0.01±.0.004^{d}
T1	3 rdmonth	-	-	-	-
T2		-	-	-	-
T3		0.39±0.04^{a}	0.59±0.03^{b}	0.21±0.02^{c}	0.02±0.001^{d}
T4		0.41±0.02^{a}	0.63±.0.02^{b}	0.19±0.03^{c}	0.03±.0.001^{d}
T1	4 th month	-	-	-	-
T2		-	-	-	-
T3		0.41±0.02^{a}	0.58±0.03^{b}	0.19±0.01^{c}	0.01±0.002^{d}
T4		0.42±0.01^{a}	0.61±.0.02^{b}	0.20±0.03^{c}	0.03±.0.001^{d}
T1	5 thmonth	-	-	-	-
T2		-	-	-	-
T3		0.39±0.03^{a}	0.64±0.03^{b}	0.21±0.03^{c}	0.01±0.002^{d}
T4		0.41±0.03^{a}	0.61±.0.02^{b}	0.21±0.01^{c}	0.02±.0.001^{d}
T1	6th month	-	-	-	-
T2		-	-	-	-
T3		0.38±0.04^{a}	0.62±0.02^{b}	0.21±0.04^{c}	0.01±0.003^{d}
T4		0.39±0.03^{a}	0.61±.0.03^{b}	0.19±0.03^{c}	0.02±.0.001^{d}

Means with same superscript within the same column are not significantly different from each other at p>0.05 level.

Differences were compared by Turkey test for all experiments and considered significant at $p<0.05$.

3. RESULTS AND DISCUSSIONS

TSS, acidity, pH and colony forming unit (CFU) count of samples stored at refrigerated temperature did not change significantly ($p>0.05$) on storage up to 6 months (Table 01). However, it was observed that there was deposition of white sediments upon storage. This may be due to deposition of denatured proteins during pasteurization. After 2nd month of storage, T1 and T2 developed off flavour and taste. The total plate count was within the acceptable level (less than 50 in 1 ml) up to 2 months in the case of samples stored at ambient temperature which indicated that samples were microbiologically safe for consumption at ambient temperature only for 2 months (Table1). The pH values obtained for tender coconut water are compatible with the pH values of pasteurized king coconut water which has more or less the same composition of tender coconut water (Gunathilaka and Rathnayake, 2012). However, if the pH is adjusted to 4.4, the shelf life can be extended. It is reported that the limiting pH for most food poisoning bacteria is 4.5 (Jay, 1996).

Results (Table 2) revealed that, there is no significant difference ($p>0.05$) in mineral contents of preserved tender coconut water on storage of 6 months. However, the potassium content was greater compared to the amounts

of sodium, calcium and magnesium in the processed tender coconut water.

According to the results of sensory evaluation, samples processed at 90^{o} C for 10 minutes scored higher mean sensory scores compared to those of samples processed at 100^{o}C for 10 minutes (Table 3). This may be due to the lower processing temperature in T3 compared to T4.

Table 3: Results of sensory properties of preserved tender coconut water on the 6th month of storage

Treat-ment	Colour	Taste	Appe-arance	Overall Accepta-bility
T1	-	-	-	-
T2	-	-	-	-
T3	4.5^{a}	4.3^{a}	4.9^{a}	4.5^{a}
T4	3.8^{b}	3.8^{b}	3.5^{b}	3.6^{b}

Means with same superscript within the same column are not significantly different from each other at p>0.05 level.

4. CONCLUSIONS

The TSS, acidity, pH and colony forming unit (CFU) count of tender coconut water samples stored in glass bottles at refrigerated temperature did not change significantly (p>0.05) on storage of 6 months indicating that tender coconut water could be stored in glass bottles for more than 6 months at refrigerated temperature irrespective of the processing temperature (90 ^{o}C for 10 minutes or 100 ^{o}C for 10 minutes). The total plate count was within the acceptable level up to 2 months in the case of samples stored at ambient temperature which indicated thatsamples were microbiologically safe for consumption at ambient temperature only for 2 months irrespective of the processing temperature (90^{o}C for 10 minutes or 100 ^{o}C for 10 minutes). Tender coconut water samples processed at 90^{o}C for 10 minutes scored higher mean sensory scores compared to those of samples processed at 100^{o}C for 10 minutes due to lower processing temperature in the case of former.

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