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Analysis of microbiological and physiochemical quality of commercially prepared mixed fruit nectar in Sri Lanka

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Abstract

Health conscious public show a growing trend in consumption of fruit juices and fruit nectar obtained by natural fruits over other carbonated soft drinks because fruit juice drinks and fruit nectar consist of high nutritive values and pose considerably less harmful effects on health. In Sri Lanka many brands of fruit nectar are available to meet with this high demand. In Sri Lanka, preservation of commercially prepared fruit nectar is done using both chemical preservatives and heat treatment.

This study was done in order to find out whether locally manufactured mixed fruit nectar available in the Sri Lankan market comply the Sri Lanka Standards and whether they are suitable for consumption. Five brands of mixed fruit nectar were selected for this study and chemical and microbiological quality of these samples was analyzed.

The pH values of the five samples were found in the range of 3.31 to 4.06. The titrable acidity was found in the range of 0.22 to 0.30, the brix value in the range of 13.0 to 15.2 and vitamin C content in the range of 1.600×10^{-3} to 2.250×10^{-3} mol/dm³. Considerable microbial growth was observed in three out of five sample brands.

This study reveals that three of the five samples were not suitable for consumption as their microbiological safety cannot be assured.

Key words: *acidity, microbial safety, preservation*

1. Introduction

Tropical countries like Sri Lanka have a wide variety of fruits growing throughout the year. But, most of these fruits are wasted due to their high perishability. In order to minimize this wastage they can be subjected to some kind of fruit processing such as production of fruit juices and fruit nectar. According to Vasavada, 2003, Fruit juices are important trade commodities in most countries. Health conscious public show a growing trend in consumption of fruit juices and fruit nectar obtained by natural fruits over other carbonated soft drinks because fruit juice drinks and fruit nectar consist of high nutritive values and pose considerably less harmful effects on health.

Juices are fat-free, nutrient-dense beverages rich in vitamins, minerals and naturally occurring phytonutrients that contribute to good health (Franke *et al.* 2005). Consumption of natural juices can provide health benefits due to the antioxidants and high content of vitamins and minerals (Edwards *et al.*2003). Fruit juice is important in human nutrition. Most fruits contain carbohydrates, proteins and minor nutrients such as minerals and vitamins.

Fruit nectar is the unfermented but fermentable product obtained by adding water with or without the addition of sugars, honey, treacle and/ or syrups, and/ or non-nutritive sweeteners to fruit juices/ puree or to a mixture of those products. Mixed fruit nectar can be obtained from two or more different kinds of fruit (SLS 1328:2008).

There are many brands of fruit nectar available in the market. These drinks had gained the attraction of the consumers as they are believed to be more nutritious than other carbonated drinks.

According to Tahiri *et al.*, 2006, spoilage of fruit juices is mainly due to the presence of osmophillic microflora. This microflora (yeasts) causes fermentation and produces a buttermilk-like off-flavour (Tournas *et al.*, 2006). Adding chemical preservatives is the most frequently used method for preservation of fruit juice drinks and nectar. Chemical preservatives, such as sodium benzoate and potassium sorbate, are commonly used in fruit

juices and beverages to extend their shelf life (Walker and Phillips, 2008). Potassium metabisulphite and sodium metabisulphite are the next common chemical preservatives. In Sri Lanka, preservation of commercially prepared fruit nectar is done using both chemical preservatives and heat treatment. Shelf life of fruit juice drink and nectar packaged in PET (Polyethylene terepthalate) bottles is about six months when recommended amount of chemical preservatives are added.

This study was done in order to find out whether locally manufactured mixed fruit nectar available in the Sri Lankan market are suitable for consumption by analyzing their chemical and microbiological quality. Five brands of locally manufactured mixed fruit nectar samples were selected for this study to find out whether they are within the acceptable limits of chemical and microbiological parameters according to Sri Lanka standards.

Table 1.1 Standard levels for mixed fruit nectar

Fruit nectar type	TSS Min. (%)	Min. Fruit Juice Content (%)	Acidity Expressed as Citric Acid Max (%)
Mixed Fruit Nectar	15	20	1.5

(Prevention of food adulteration (ii Amendment) rules, 2005)

Table 1.2 gives the standard microbiological limits for fruit nectar according to Sri Lanka Standards.

Table 1.2 Microbiological limits for fruit nectar

Test	Limit
Standard plate count	Less than 50 per ml
Yeast and mold count	Absent in 1 ml
Coliforms	Absent in 1 ml

(SLS 1328 : 2008)

2. Materials & Methods

2.1 Sample Selection

Random samples of five brands of commercially prepared mixed fruit nectar available in the local market of Sri Lanka were selected randomly. The samples selected were packaged in PET bottles and four months old since the date of manufacture.

2.2 Microbiological analysis of commercially prepared mixed fruit nectar samples

A dilution series of 10^{-1}, 10^{-2} and 10^{-3} was made for each sample. Each dilution of the sample was subjected to microbiological analysis i.e. yeast and mold count, standard plate count and Coliform test.

2.2.1 Determination of yeast and mold count

Plates were prepared by adding 15ml Potato Dextrose Agar (PDA) medium for each petridish. One milliliter from each dilution of a sample was added to each petridish and allowed spreading for even distribution. The petridishes were incubated at 25°C for 48 hours and were observed for the presence of yeast. The presence of molds was observed after 96 hours of incubation.

2.2.2 Determination of standard plate count

One milliliter of each dilution of sample was added to petridishes and 15ml of nutrient agar medium was added and allowed to set. The plates were incubated at 37°C for 24 hours and colony counts were taken.

2.2.3 Detection of Coliforms

One milliliter of each dilution from sample was added to 5ml of EC broth containing inverted Durham tubes and were incubated at 37°C for detection of Coliforms for 48 hours and it was observed for the accumulation of gas.

2.3 Physiochemical analysis of commercially prepared mixed fruit nectar samples

pH value, brix value, acidity and vitamin C content of each sample were tested. Acidity was determined using a standard acid base titration using Sodium hydroxide solution. Vitamin C content was determined using a redox titration using Iodine solution.

2.4 Statistical Analysis

The data obtained were analyzed and interpreted by analysis of variance (ANOVA) using pre-packaged computer statistical software MINITAB version 14.

3.Results and Discussion

3.1 Physiochemical properties

3.1.1 pH

According to results given in table 3.1 the highest pH was measured in sample C, then sample A and lowest was recorded in sample B. ANOVA test results indicates that the pH values of five samples were significantly different ($p<0.05$). Mean separation was done using the method of least significant difference.

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Table 3.1 pH of nectar samples

Sample	pH
A	3.6[a]
B	3.31[b]
C	4.06[c]
D	3.43[d]
E	3.50[e]

Values are means of duplicate determinants. Values within the column with the same superscript indicate that there is no significant difference. ($p < 0.05$)
The pH values of the mixed fruit nectar samples indicate that the pH values are within the acceptable level.

3.1.2 Acidity

According to results given in table 3.2 the highest acidity was measured in sample B, then sample A and lowest was recorded in sample C. ANOVA test results indicates that the acidity of five samples were significantly different ($p<0.05$). Mean separation was done using the method of least significant difference.

Table 3.2 Acidity of nectar samples (%)

Sample	Acidity
A	0.26[a]
B	0.30[b]
C	0.22[c]
D	0.25[d]
E	0.24[e]

Values are means of duplicate determinants. Values within the column with the same superscript indicate that there is no significant difference. ($p < 0.05$)
The acidity values of three mixed fruit nectar samples indicate that the acidity is within the acceptable level that is suitable for consumption. (Prevention of food adulteration (ii Amendment) rules, 2005)

3.1.3 Brix value

According to results given in table 3.3 the highest brix value was measured in sample B, then sample C and lowest was recorded in sample A. ANOVA test results indicates that the brix value of five samples were significantly different ($p<0.05$). Mean separation was done using the method of least significant difference.

3.3 Brix value of nectar samples (%)

Sample	Brix value
A	13.0[a]
B	15.2[b]
C	15.0[c]
D	15.0[d]
E	14.8[e]

Values are means of duplicate determinants. Values within the column with the same superscript indicate that there is no significant difference. ($p < 0.05$)
Brix value for the mixed fruit nectar samples indicates that four out of five samples has brix value within the acceptable limit. In sample B the brix level is slightly higher than the acceptable limit. (Prevention of food adulteration (ii Amendment) rules, 2005)

3.1.4 Vitamin C content

According to results given in table 3.4 the highest vitamin C content was measured in sample A, then sample E and lowest was recorded in sample C. ANOVA test results indicates that the vitamin C content of five samples were significantly different ($p<0.05$). Mean separation was done using the method of least significant difference.

Table 3.4 vitamin C content of nectar samples ($\times 10^{-3}$) (mol/dm^3)

Sample	Vitamin C content
A	2.250[a]
B	1.625[b]
C	1.600[c]
D	1.735[d]
E	1.786[e]

Values are means of duplicate determinants. Values within the column with the same superscript indicate that there is no significant difference. ($p < 0.05$)

3.2 Microbiological results

Table shows the results for microbiological analysis of nectar samples available in the market. Standard

plate count of sample C is within the acceptable microbiological limit according to SLS standards and it is higher in samples A, B and D. The highest count was recorded in sample B. Samples A, B and D were not suitable for consumption according to SLS standards. Yeasts and molds were absent in all three samples. Coliforms were also absent in all five samples. Yeast and mold count and Coliform count is within the acceptable limits according to SLS standards.

Table 3.5 Microbiological results of nectar samples

Sample	Standard plate count	Yeast and mold count	Coliform test
A	78 CFU per 1 ml	Absent in 1 ml	Absent in 1 ml
B	370 CFU per 1 ml	Absent in 1 ml	Absent in 1 ml
C	30 CFU per 1 ml	Absent in 1 ml	Absent in 1 ml
D	96 CFU per 1 ml	Absent in 1 ml	Absent in 1 ml
E	43 CFU per 1 ml	Absent in 1 ml	Absent in 1 ml

4. Conclusions

The chemical parameters of the mixed fruit nectar samples were within the acceptable limits. Microbiological analysis of the commercially produced mixed fruit nectar samples indicates that three samples of shelf-life of four months each show considerable bacterial growth. But no fungal growth was observed. Even though these samples consist of added chemical preservatives preservation was not achieved and was unsuitable for consumption. So the microbiological safety of three of the mixed fruit nectar cannot be assured and they have become unsuitable for consumption even before the expiry date indicated on the product.

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