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Chemical and Storability of Fruit-Flavoured (*Hibiscus sabdariffa*) Drinks

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Abstract: Roselle-fruit flavoured drinks were prepared from dried calyces of *Hibiscus sabdariffa* and fruits: apple, orange and pineapple. These were stored at three storage conditions: ambient, refrigeration and freezing. pH, titratable acidity and microbial quality of the samples were determined. pH decreased while titratable acidity increased with time for samples at ambient and refrigeration conditions. While microbial load of samples at ambient and refrigeration increased with time, those of samples at freezing condition decreased. Samples at ambient storage had a shelf-life of less of than five days while those at refrigeration condition stored for about a week and the samples at freezing condition could store for more than two weeks.

Key words: Chemical % storability % roselle % fruits % drinks

INTRODUCTION

Roselle (*Hibiscus sabdariffa*) belongs to the family Malvacea. It is an annual herb cultivated for its leaves, stem, seed and calyces [1]. The crop is native to India but was introduced to other parts of the world such as Central America, West Indies and Africa. It is best grown in tropical and sub-tropical regions.

The physico-chemical characteristics of Roselle was studied and it was characterized as a highly acidic fruit with low sugar content. Succinic acid and oxalic acid were quantified as two predominant organic acids in Roselle. Roselle was found to contain higher amount of ascorbic acid compared to orange and mango [2].

A hundred gram serving of frozen roselle would supply 100 percent of current RDA (20 mg/day). It was found to be a fair source of vitamin A [3]. It is also rich in riboflavin, niacin, calcium and iron [4, 5]. It also contains antioxidants including flavonoids, gossypetine, hibiscetine and sadderetine. Some of the anthocyanins of roselle identified by chromatographic process include delphinidin-3-sambubioside, cyaniding-3-sambubioside and delphinidin-3-glucose [6].

Many parts of roselle are of value. The young leaves are eaten as cooked vegetables especially with soup. The seeds are pounded into meal which is used as oily soup or sauce after roasting. Oil extracted from the seed is a substitute for castor oil while the residue is used in a fermented form as soup or cake [7]. In countries like India, roselle calyces are utilized in producing refreshing beverages, jellies, jam, sauces and food preserves [8]. In Nigeria, the dried roselle calyces are prepared into a refreshing drink called 'zobo'. The drink is becoming popular because it is easily processed at home and served chilled, packaged in plastic bottles or polythene films. It serves as income generation source for many women.

Fruits are health, protective foods containing a number of essential nutrients such as vitamin A, vitamin C, minerals, carotene and dietary fibre [9]. They are also known for their unique flavour characteristics that makes them appealing to taste. Roselle drink had been improved nutritionally by producing fruit-flavoured roselle drinks, which are richer in vitamins and minerals by addition of different fruits with higher consumer acceptability [10]. The objectives of present research were to determine the storability of fruit-flavoured roselle drinks at different storage conditions and their acceptibility.

MATERIALS AND METHODS

Dark red dried roselle calyces were obtained from a local market in Ibadan.

Preparation of fruits-flavoured zobo and storage: One hundred and fifty gram of the calyces were washed in clean water. Four litres of water was added and was left overnight after which it was filtered through a clean cheese cloth and the liquid was boiled on an electric

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heater for 20 min. Fruits (apple, orange and pineapple) about 400 g each were washed, peeled and cut. Seeds were removed from the apples and oranges. The fruits were separately squeezed, filtered and pasteurized at 95°C for 5 min. The zobo drink and the fruit juices (separately) were mixed at ratio 1:3. It was allowed to cool before packaging into polythene films (200 mL).

The roselle-apple (RA), roselle-orange (RO) and roselle pineapple (RP) drinks were stored at three different conditions: Ambient (27±2°C), refrigeration(5±2°C) and freezing conditions for two weeks.

Physical , chemical and microbial analyses: pH and titratable acidity were determined according to standard method as desribed by Kirk and Sawyer [11]. Aerobic plate count was determined according to Harrigan and McCance [12].

Sensory analysis: A ten member panel familiar with zobo drink from the Institute of Agricultural Research and Training, Moor-Plantation, Ibadan were asked to assess the samples. The attributes assessed were colour, taste, flavour and overall acceptability. Scores were based on the nine-point hedonic scale, where one equals extremely like and nine equals extremely dislike. Data obtained were subjected to analysis of variance (ANOVA) and means were separated by Duncan Multiple range test [13].

RESULTS AND DISCUSSIONS

Table 1 shows the pH of the drinks. Initial pH value of the drinks was in the range of 3.1-3.6. The low pH value of the drinks was due to the acidic nature of the roselle calyces and the fruits. Roselle is characterised as a highly acidic fruit rich in organic acids: oxalic, tartaric, malic and succinic [2]. The pH of the drinks stored at ambient condition decreased rapidly, becoming more acidic within three to five days while pH of the samples at refrigeration condition was unchanged in the first three days and then slightly decreased from the fourth day. The pH of the drinks at freezing condition was unchanged throughout the storage period.

Table 2 shows the titratable acidity of the drinks. Initial titratable acidity was within the range of 2.02-2.30%. The titratable acidity increased steadily within five days in the samples stored at ambient condition. Titratable acidity of the samples stored at refrigeration temperature did not increase steadily until after a week of storage. The titratable acidity of sample at freezing condition did not change with time of storage. The high rate of change in

Table 1: Changes in pH of stored roselle-fruit drinks

		pH		
Samples	Storage days	Ambient temperature	Refrigeration temperature	Freezing temperature
Roselle-apple drink	1	3.32±0.01	3.32+0.01	3.32±0.01
	5	2.19±0.02	3.11±0.01	3.30±0.01
	10	ND	3.00±0.02	3.25±0.01
	14	ND	2.95±0.03	3.21±0.02
Roselle-orange drink	1	3.54±0.02	3.54±0.02	3.54±0.02
	5	2.50±0.01	3.43±0.03	3.53±0.01
	10	ND	3.11±0.01	3.48±0.01
	14	ND	2.80±0.02	3.40±0.01
Roselle-pineapple drink	1	3.62±0.01	3.62±0.01	3.62±0.01
	5	2.55±0.01	3.51±0.02	3.62±0.01
	10	ND	3.21±0.02	3.55±0.01
	15	ND	3.00±0.01	3.50±0.02

Means of three readings ± standard deviation, ND: Not determined

Table 2: Changes in Titratable acidity of Roselle-fruit drinks

		Titratable acidity (%)		
Samples	Storage days	Ambient temperature	Refrigeration temperature	Freezing temperature
Roselle-apple drink	1	2.12±1.00	2.12±0.40	2.12±0.20
	5	2.85±0.55	2.19±0.90	2.13±0.60
	10	ND	2.20±0.30	2.15±0.40
	15	ND	3.11±0.53	2.17±0.30
Roselle-orange drink	1	1.91±0.20	1.90±0.30	1.90±0.52
	5	2.92±0.66	1.93±1.00	1.91±0.11
	10	ND	1.95±0.54	1.92±0.22
	15	ND	2.25±0.23	1.94±0.22
Roselle-pineapple drink	1	2.10±0.44	2.10±0.70	2.10±0.22
	5	3.09±0.80	2.15±0.20	2.12±0.31
	10	ND	2.20±0.44	2.14±0.11
	15	ND	2.25±0.50	2.15±0.14

Means of three readings ± standard deviation, ND: Not determined

pH and titratable acidity of samples stored at ambient temperature could be due decomposition of fermentatable substrate especially the carbohydrates in the fruits and sugar added thereby increasing the acidity. The sample stored at refrigeration temperature exhibited slight change in pH showing that the combined effect of low temperature and low pH slowed down the rate of growth of microorganisms. Molds and yeasts are microorganisms commonly associated with decompositional changes and spoilage at low pH and low temperatures [14]. Lower pH values and higher titratable acidity were also recorded for the fruit-flavoured drinks in comparison with roselle drink alone. Higher rate of change in pH of the fruit-flavoured roselle drinks in comparison with that of the roselle drink alone could be due to presence of higher fermentable substrate iin the fruit-flavoured drinks as a result of addition of fruits.

Table 3 shows the rate of microbial growth in the drinks. Samples at ambient storage reached a count of 10^3 Cfu mL^{-1} in five days while those at refrigeration

Table 3: Changes in Microbial counts of Roselle fruit-drinks

Samples	Storage days	Microbial counts (Cfu mL^{-1}) Ambient temperature	Refrigeration temperature	Freezing temperature
Roselle-apple drink	1	$3.2x10^2$	$3.2x10^2$	$3.2x10^2$
	5	$2.6x10^3$	$6.5x10^2$	$1.5x10^2$
	10	ND	$2.1x10^3$	$2.3x10^1$
	14	ND	$4.7x10^3$	$1.5x10^1$
Roselle-orange drink	1	$2.4x10^2$	$2.4x10^2$	$2.4x10^2$
	5	$3.6x10^3$	$4.6x10^2$	$2.0x10^2$
	10	ND	$7.6x10^2$	$6.3x10^1$
	14	ND	$1.5x10^3$	$4.8x10^1$
Roselle-pineapple drink	1	$3.7x10^2$	$3.7x10^2$	$3.7x10^2$
	5	$3.3x10^3$	$8.7x10^2$	$2.2x10^2$
	10	ND	$1.4x10^3$	$6.3x10^1$
	14	ND	$6.6x10^3$	$2.2x10^1$

Means of two readings, ND: Not determined

Table 4: Sensory qualities of roselle-drinks at two weeks storage

Samples/storage condition	Taste	Colour	Flavour	Overall acceptability
Roselle-apple drink (refrigeration)	5.0^b	7.1^a	5.3^b	5.5^c
Roselle-apple drink (freezing)	6.1^a	7.3^a	7.2^a	7.6^a
Roselle-orange drink (refrigeration)	4.1^c	4.3^c	4.3^c	4.0^d
Roselle-orange drink (freezing)	6.3^a	7.3^a	7.1^a	7.2^a
Roselle-pineapple drink (refrigeration)	6.0^a	4.5^c	4.2^c	4.5^d
Roselle-pineapple drink (freezing)	6.5^a	6.0^b	7.2^a	6.5^b

Means not followed by the same letter in the same column differ at 5% level of significance

storage at lower count of 10^2 Cfu mL^{-1} in the first week, which increased by the second week. The microbial load of the frozen samples decreased from the initial load of 10^2 to 10^1Cfu mL^{-1} at the end of two weeks storage. Fennema [15] reported that freezing storage causes denaturation of cellular proteins and induces temperature shock in some microorganisms especially the thermopliles and the mesophiles. The microbial cells which are still viable after freezing die gradually when stored in the frozen state due to metabolic injury to the cells. This could be the reason for the reduction in microbial count of the stored frozen samples.

Table 4 shows the sensory analysis of the stored drinks at refrigeration and freezing conditions. The fruit-flavoured drinks stored at ambient condition were acceptable for two to three days, while the refrigerated samples were acceptable for a week and the frozen samples were most preferable at the end of two weeks. Comments from the panelists for non-acceptability of the samples stored at ambient after two to three days was due to its high souring taste which could be associated with the lower pH.

In conclusion, present research has shown that the storage condition has effect on stability and acceptability the fruit-flavoured drinks. While the refrigeration condition was able to stabilize the drinks for a week, the freezing condition was able to preserve the drinks for more than a week. Fruit-flavoured zobo is therefore recommended for storage under refrigerated or frozen storage or taking in its freshly prepared form within two to three days.

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