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A study on the acceptability, nutrient composition and storage stability of under exploited *Averrhoa bilimbi* and *Flacourtia jangomas* products (Jam, Squash and Wine) made using cane sugar and palm sugar

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Abstract
Fruits are considered to be nature's valuable gifts. They are rich source of vitamins and essential minerals, nutrients and various beneficial phyto-chemical constituents. Fruits have been part and parcel of our day today diet. Fruits help in maintaining normal physiological balance of body and maintain healthy state of mind. Fruits also help for immunological response occurrence of infections. Considering its importance and perishable nature, methods of preserving fruits are widely accepted across the globe. In the present study the widely available under exploited edible wild fruits namely *Averrhoa bilimbi* and *Flacourtia jangomas* were exploited for the preparation of jam squash and wine. Variations of the products were derived using cane sugar and palm sugar and evaluated for its sensory characters physic chemical parameters and nutrient composition. Microbial analysis showed good storage stability of the products. The cane sugar variations were having higher acceptability than that of palm sugar. The products were eligible for further marketing as they met the standards and recommendations.

Keywords: *Averrhoa bilimbi, Flacourtia jangomas, Averrhoa bilimbi* jam, *Averrhoa bilimbi* squash, *Averrhoa bilimbi* wine, *Flacourtia jangomas* jam, *Flacourtia jangomas* squash, *Flacourtia jangomas* wine, cane sugar, palm sugar, nutrient analysis, storage stability

Introduction

Underutilised fruits are highly nutritious and important source of food [1]. The ethnic people residing in the fringe of the forest are dependent on this potential local food resouses [2]. Recently, the use of underutilised fruits as a food has increased due to improvement and hybridisation in cultivated fruit plants.

Many of the fruits are underutilised even though it has high nutritive value. Some of these fruits which are locally available are not utilised to full extent. *Averrhoa bilimbi* and *Flacourtia jangomas* are such frits which are available commonly in kerela. *Averrhoa bilimbi* is available throughout the year were as *Flacourtia jangomas* is a seasonal fruit during the month of September to November.

Averrhoa bilimbi is multipurpose, long lived tropical plant commonly known as bilimbi, cucumber tree belonging to family oxalidaceae. The plant has an enormous fiscal value since most of the part like leaves, bark, flowers, fruits, seeds, roots or the whole plant are used as alternative medicines to treat a variety of diseases especially diabetes.

Flacourtia jangomas is a low land tree usually cultivated in south east and East Asia grows to a height of 10 meter. It is commonly known as lukluki, pokroi, paniamala, paniali and widely found in sylhet, Chittagong hill – tracts and coxs bazar. It is a small tree often armed with heavy thorns and branches with simple spines. Fruits are 80- 23 mm long and when ripe look brownish purple and tastes sweet [3].

This plant has some medicinal as well as economic values. It is mainly cultivated for its edible fruit and hard wood. The fruits are either eaten raw or used for making jams and preserves. Different plant parts are also pharmaceutically used for the treatment of asthma, pre and post- natal blood purification etc. the fruits are used in bilious conditions and in diarrhea [4].

Food preservation is a process of treating and handling food in a way that preserves its value as food. Fruit and vegetable processing projects also aims to replace imported products like squash, jams, pickles, sauces etc. besides earning foreign exchange by exporting finish or semi processed products. Preservation brings out new fruit products as well as to store surplus fruits for prolonged periods. The preserved products are the cheapest of the processed ready to eat products in the country. The production of preserved products has increased many folds. These products are nutrient dense and are highly acceptable among consumers.

The main objective of fruit and vegetable processing is to supply whole some, safe nutritious and acceptable food to consumers though out the year. Hence a study on the acceptability nutrient composition and storage stability of under exploited *Averrhoa bilimbi* and *Flacourtia jangomas* products (jam, squash and wine) made using cane sugar and palm sugar was under taken with the following objectives.

- To identify and exploit the under exploited and wild fruits- *Averrhoa bilimbi* and *Flacourtia jangomas*
- To formulate preserved products- jam, squash and wine using cane sugar and palm sugar.
- To study the acceptability of the prepared win and fruit preserved product through organoleptic preservation and to select the best.
- To estimate physicochemical parameters of the selected products.
- To estimate the nutrient content of the selected product.
- To study the storage stability of the selected product.

Methodology

A. Selection of fruits and sugars

Fully matured and ripened fruits of *Averrhoa bilimbi* and *Flacourtia jangomas* have been selected and it was marked as A and B for the study. The sources of sugar that used are cane and palm. The products jam, squash and wine which prepared from *Averrhoa bilimbi* were named as A1, A2 and A3 respectively. The products jam, squash and wine which prepared from *Flacourtia jangomas* were named as B1, B2 and B3 respectively.

B. Preparation of *Averrhoa bilimbi* jam, squash and wine.

1. Preparation of *Averrhoa bilimbi* jam

A known quantity of *Averrhoa bilimbi* was steamed and pulp was extracted. It was blended along with required amount of sugar until the required consistency. Two variations was made and categorised as A1a and A1b for cane sugar and palm sugar respectively.

2. Preparation of *Averrhoa bilimbi* squash

A known quantity of *Averrhoa bilimbi* was steamed and pulp was extracted. It was blended along with required amount of sugar syrup. Two variations was made and categorised as A2a and A2b for cane sugar and palm sugar respectively.

3. Preparation of *Averrhoa bilimbi* wine

A known quantity of *Averrhoa bilimbi* was Steamed and crushed. It was blended along with required amount of sugar and yeast. It was stored for 21 days fermentation process. The procedure of wine prepared with cane sugar was named as A3.

C. Preparation of *Flacourtia jangomas* jam, squash and wine

1. Preparation of jam

A known quantity of *Flacourtia jangomas* were pressure cooked with required amount of water. The steamed and crushed fruits were sieved for removal of seeds and the pulp was extracted. It was blended along with required amount of sugar until the required consistency. Two variations was made and categorised as B1a and B1b for cane sugar and palm sugar respectively.

2. Preparation of squash

A known quantity of *Flacourtia jangomas* were pressure cooked with required amount of water. The steamed and crushed fruits were sieved for removal of seeds and the pulp was extracted. It was blended along with required amount of sugar syrup. Two variations was made and categorised as B2a and B2b for cane sugar and palm sugar respectively.

3. Preparation of wine

A known quantity of *Flacourtia jangomas* were pressure cooked and crushed. It was blended along with required amount of sugar and yeast. It was stored for 21 day fermentation process. The procedure of wine prepared with cane sugar was named as B3.

D. Organoleptic evaluation of prepared jam squash and wine

Sensory evaluation was done and the sensory characteristics like appearance, flavour, taste, consistency and over all acceptability were evaluated through 5 point hedonic scale from 25 panel members.

The mean acceptability score was calculated.

E. Physico-chemical analysis of selected jam, squash and wine

The pH, total soluble solids, acidity, ash and moisture for all the selected products were estimated by using standard procedures. The percentage of ethanol was evaluated for the prepared wine.

F. Nutrient analysis of the selected jam, squash and wine

The energy, carbohydrate, protein, vitamin C, calcium, Iron and total antioxidant activity were estimated for selected *Averrhoa bilimbi* and *Flacourtia jangomas* jam, squash and wine by using standard procedures of AOAC (2000).

G. Storage stability of prepared jam squash and wine

1. Sensory evaluation

The prepared jam and squash both using cane sugar and palm sugar and wine using cane sugar was stored in PET bottles at room temperature for 90 days. The sensory attributes were evaluated for every 15th day during the study period (90 days) to find out the storage stability.

2. Microbial analysis

The storage stability (1st and 90th day) was assessed through microbial analysis, i.e. total plate count, yeast and mould count.

H. Statistical analysis

The results obtained were tabulated and statistically analysed. The statistical tools like mean, standard deviation and two way ANOVA were used for interpreting the results.

Result and discussion

A. Impact of sensory analysis of *Averrhoa bilimbi* jam, squash and wine.

1. Mean score and ANOVA of *Averrhoa bilimbi* jam

Table 1: Mean score and ANOVA of *Averrhoa bilimbi* jam

S.No	Criteria	*Averrhoa bilimbi* jam cane sugar (A1a)	*Averrhoa bilimbi* jam palm sugar (A1b)
1	Appearance	4.92 ± 0.27	3.12 ± 0.33
2	Colour	4.60 ± 0.50	3.12 ± 0.33
3	Consistency	4.84 ± 0.37	3.28 ± 0.40
4	Flavour	4.92 ± 0.27	3.20 ± 0.40
5	Taste	4.72 ± 0.45	3.24 ± 0.43
	Overall acceptability	4.80 ± 0.37	3.19 ± 0.38

The *Averrhoa bilimbi* jam prepared using cane sugar and palm sugar was good. The *Averrhoa bilimbi* jam prepared with cane sugar (A1a) scored a high mean score for its appearance (4.92 ± 0.27), colour (4.60 ± 0.50), consistency (4.84 ± 0.37), flavour (4.92 ± 0.27) and taste (4.72 ± 0.45). *Averrhoa bilimbi* jam prepared using palm sugar (A1b) had mean scores as follows for its appearance 3.12 ± 0.33, colour 3.12 ± 0.33, consistency 3.28 ± 0.40, flavour 3.20 ± 0.40 and taste 3.24 ± 0.43. The overall acceptability of *Averrhoa bilimbi* jam using cane sugar was higher (4.80 ± 0.37) when compared to *Averrhoa bilimbi* jam using palm sugar.

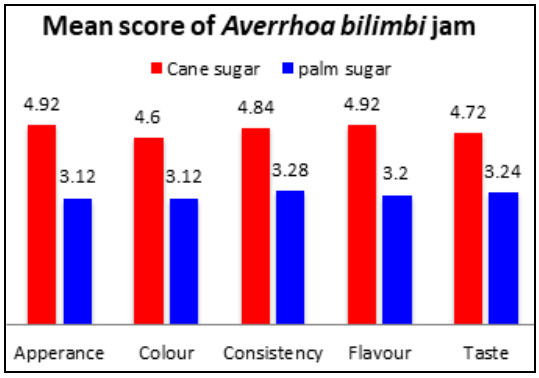

Fig 1

2. Mean score and ANOVA of *Averrhoa bilimbi* squash

Table 2: Mean score and ANOVA of *Averrhoa bilimbi* squash

S.No	Criteria	*Averrhoa bilimbi* squash cane sugar (A2a)	*Averrhoa bilimbi* squash palm sugar (A2b)
1	Appearance	4.72 ± 0.45	3.20 ± 0.40
2	Colour	4.72 ± 0.45	3.20 ± 0.50
3	Consistency	4.36 ± 0.63	3.68 ± 0.63
4	Flavour	4.56 ± 0.50	3.44 ± 0.71
5	Taste	4.68 ± 0.55	3.00 ± 0.57
	Overall acceptability	4.60 ± 0.51	3.30 ± 0.56

The overall acceptibility of *Averrhoa bilimbi* squash prepared with cane sugar had the highest score of 4.60 ± 0.51. The appearance, colour, consistency and flavour of *Averrhoa bilimbi* squash prepared with cane sugar had a mean score of 4.72 ± 0.45, 4.72 ± 0.45, 4.36 ± 0.63, 4.56 ± 0.50, 4.68 ± 0.55 respectively. The appearance, colour, consistency and flavour of *Averrhoa bilimbi* squash prepared with palm sugar had a mean score of 3.20 ± 0.40, 3.20 ± 0.50, 3.68 ± 0.63, 3.44 ± 0.71, 3.00 ± 0.57 respectively. The *Averrhoa bilimbi* squash prepared with cane sugar (A2a) scored a highest mean score for its taste 4.68 ± 0.55 when compared to squash with palm sugar (A2b) (3.00 ± 0.57).

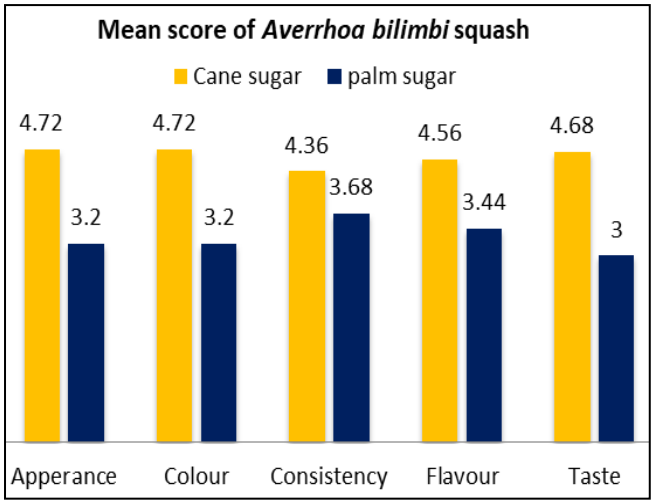

Fig 2

3. Mean score and ANOVA of *Averrhoa bilimbi* wine

Table 3: Mean score and ANOVA of *Averrhoa bilimbi* wine

S. No	Criteria	*Averrhoa bilimbi* wine cane sugar (A3)
1	Appearance	4.60 ± 0.57
2	Colour	4.64 ± 0.48
3	Consistency	4.60 ± 0.50
4	Flavour	3.96 ± 0.53
5	Taste	4.88 ± 0.33
	Overall acceptability	4.53 ± 0.48

The *Averrhoa bilimbi* wine prepared A3 had a mean score of 4.60 ± 0.57 for its appearance, 4.64 ± 0.48 for colour, 4.60 ± 0.50 for consistency, 3.96 ± 0.53 for flavour and 4.88 ± 0.33 for taste. The overall mean score was found to 4.53 ± 0.48. This indicates that the wine prepared was highly acceptable.

B. Impact of sensory analysis if *Flacourtia jangomas* jam, squash and wine.

1. Mean score and ANOVA of *Flacourtia jangomas* jam

Table 4: Mean score and ANOVA of *Flacourtia jangomas* jam

S.No	Criteria	*Flacourtia jangomas* jam cane sugar (B1a)	*Flacourtia jangomas* jam palm sugar (B1b)
1	Appearance	4.88 ± 0.33	3.68 ± 0.63
2	Colour	4.92 ± 0.27	3.12 ± 0.33
3	Consistency	4.64 ± 0.48	3.28 ± 0.40
4	Flavour	4.64 ± 0.48	3.20 ± 0.40
5	Taste	3.88 ± 0.66	3.12 ± 0.33
	Overall acceptability	4.59 ± 0.44	3.19 ± 0.41

Mean score of *Flacourtia jangomas* jam prepared using palm sugar (B1b) was 3.68 ± 0.63, 3.12 ± 0.33, 3.28 ± 0.40, 3.20 ± 0.40, 3.12 ± 0.33 for its appearance, colour, consistency, flavour, taste respectively. The appearance, colour, consistency, flavour and taste of *Flacourtia jangomas* jam using cane sugar (B1a) scored high mean score when compared to *Flacourtia jangomas* jam prepared using palm sugar and the scores were as follows 4.88 ± 0.33, 4.92 ± 0.27, 4.64 ± 0.48, 4.64 ± 0.48, 3.88 ± 0.66 respectively. The overall acceptability of *Flacourtia jangomas* jam prepared with cane sugar and palm sugar were found to be 4.59 ± 0.44, 3.19 ± 0.41 respectively.

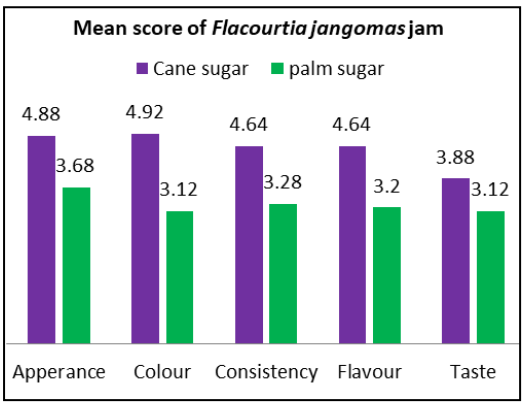

Fig 3

2. Mean score and ANOVA of *Flacourtia jangomas* squash

Table 5: Mean score and ANOVA of *Flacourtia jangomas* squash

S.No	Criteria	*Flacourtia jangomas* squash cane sugar (B2a)	*Flacourtia jangomas* squash palm sugar (B2b)
1	Appearance	4.60 ± 0.57	3.40 ± 0.50
2	Colour	4.84 ± 0.37	3.28 ± 0.50
3	Consistency	4.60 ± 0.57	3.96 ± 0.53
4	Flavour	4.96 ± 0.53	3.16 ± 0.37
5	Taste	4.00 ± 0.50	3.40 ± 0.37
	Overall acceptability	4.40 ± 0.50	3.44 ± 0.45

The appearance of *Flacourtia jangomas* squash prepared using cane sugar (B2a) and palm sugar (B2b) got a score of 4.60 ± 0.57 and 3.40 ± 0.50 respectively. 4.84 ± 0.37 and 3.40 ± 0.50 was the mean score of colour for *Flacourtia jangomas* squash prepared with cane sugar and palm sugar respectively. The taste of *Flacourtia jangomas* squash prepared using cane sugar scored a highest mean score of 4.00 ± 0.50.

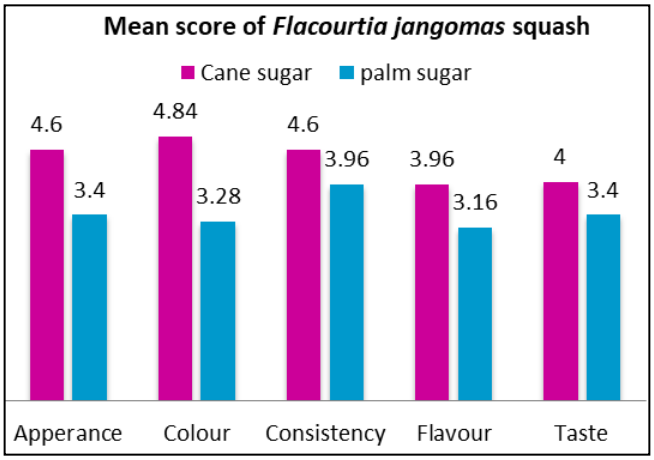

Fig 4

3. Mean score and ANOVA of *Flacourtia jangomas* wine

Table 6: Mean score and ANOVA of *Flacourtia jangomas* wine

S.No	Criteria	*Flacourtia jangomas* wine cane sugar (A3)
1	Appearance	4.84 ± 0.37
2	Colour	4.64 ± 0.48
3	Consistency	4.88 ± 0.33
4	Flavour	4.92 ± 0.27
5	Taste	4.84 ± 0.37
	Overall acceptability	4.82 ± 0.36

The *Flacourtia jangomas* wine prepared B3 had a mean score of 4.84 ± 0.37for its appearance, 4.64 ± 0.48 for colour, 4.88 ± 0.33 for consistency, 4.92 ± 0.27for flavour and 4.84 ± 0.37 for taste. The overall mean score was found to 4.53 ± 0.48. This indicates that the wine prepared was highly acceptable.

C. Selection of Best Products.

From the prepared *Averrhoa bilimbi* and *Flacourtia jangomas* jam squash and wine the best one with high overall acceptability was selected.

Table 7: Selection of best products

S. No	Selected products	overall mean score
1	*Averrhoa bilimbi* jam (cane sugar)	4.80 ± 0.37
2	*Averrhoa bilimbi* squash (cane sugar)	4.60 ± 0.51
3	*Averrhoa bilimbi* wine (cane sugar)	4.53 ± 0.48
4	*Flacourtia jangomas* jam (cane sugar)	4.59 ± 0.44
5	*Flacourtia jangomas* squash (cane sugar)	4.40 ± 0.50
6	*Flacourtia jangomas* wine (cane sugar)	4.82 ± 0.36

It was found that the prepared products namely jam and squash from *Averrhoa bilimbi* and *Flacourtia jangomas* using cane sugar was highly acceptable when compared to the variation prepared using palm sugar. As the wine was prepared only with cane sugar, the same was selected as it was highly acceptable.

D. Physicochemical parameters of selected products.

1. pH of selected fruit products

Table 8: pH of selected fruit products

S. No	Product	pH
1	*Averrhoa bilimbi* jam (cane sugar)	2.4
2	*Averrhoa bilimbi* squash (cane sugar)	3.2
3	*Averrhoa bilimbi* wine (cane sugar)	3.6
4	Flacourtia jangomas jam (cane sugar)	3.1
5	Flacourtia jangomas squash (cane sugar)	3.5
6	Flacourtia jangomas wine (cane sugar)	4.2

The pH of the selected fruit products was analysed. The pH of *Averrhoa bilimbi* jam, *Averrhoa bilimbi* squash, *Averrhoa bilimbi* wine were 2.4, 3.2, 3.6 respectively. 3.1, 3.5, 4.2 were the pH of the fruit products namely *Flacourtia jangomas* jam, *Flacourtia jangomas* squash, *Flacourtia jangomas* wine respectively.

2. Total soluble solids of selected fruit products

Table 9: Total soluble solids of selected fruit products

S. No	Product	TSS (%)
1	*Averrhoa bilimbi* jam (cane sugar)	12.70
2	*Averrhoa bilimbi* squash (cane sugar)	6.5
3	*Averrhoa bilimbi* wine (cane sugar)	6.4
4	*Flacourtia jangomas* jam (cane sugar)	11.31
5	*Flacourtia jangomas* squash (cane sugar)	7.8
6	*Averrhoa bilimbi* wine (cane sugar)	8.6

The total soluble solids of the selected fruit products were analysed. The total soluble solids of *Averrhoa bilimbi* jam, *Averrhoa bilimbi* squash, *Averrhoa bilimbi*, *Flacourtia jangomas* jam, *Flacourtia jangomas* squash, *Flacourtia jangomas* wine were 12.70, 6.5, 6.4, 11.31, 7.8 and 8.6 ^{o}Brix respectively.

3. Acidity of selected fruit products

Table 10: Acidity of selected fruit products

S. No	Product	Acidity (%)
1	*Averrhoa bilimbi* jam (cane sugar)	0.46
2	*Averrhoa bilimbi* squash (cane sugar)	0.52
3	*Averrhoa bilimbi* wine (cane sugar)	0.31
4	*Flacourtia jangomas* jam (cane sugar)	0.39
5	*Flacourtia jangomas* squash (cane sugar)	0.34
6	*Flacourtia jangomas* wine (cane sugar)	0.28

The acidity of the selected fruit products was analysed. The acidity of *Averrhoa bilimbi* jam, *Averrhoa bilimbi* squash, *Averrhoa bilimbi* wine were 0.46, 0.52, 0.31% respectively. 0.39, 0.34, 0.28 % were the acidity of the fruit products namely *Flacourtia jangomas* jam, *Flacourtia jangomas* squash, *Flacourtia jangomas* wine respectively. The percentage acidity of the prepared squash and jam was found to be within the limits of FSSAI standards.

4. Ash of selected fruit products

Table 11: Ash of selected fruit products

S. No	Product	Ash (g)
1	*Averrhoa bilimbi* jam (cane sugar)	6.21
2	*Averrhoa bilimbi* squash (cane sugar)	4.30
3	*Averrhoa bilimbi* wine (cane sugar)	3.62
4	*Flacourtia jangomas* jam (cane sugar)	5.37
5	*Flacourtia jangomas* squash (cane sugar)	4.63
6	*Flacourtia jangomas* wine (cane sugar)	5.01

The Ash content of the selected fruit products was analysed. The Ash content of *Averrhoa bilimbi* jam, *Averrhoa bilimbi* squash, *Averrhoa bilimbi* wine, *Flacourtia jangomas* jam, *Flacourtia jangomas* squash, *Flacourtia jangomas* wine were 6.21, 4.30, 3.62, 5.37, 4.63 and 5.01 g respectively.

5. Moisture content of selected fruit products

Table 12: Moisture content of selected fruit products

S. No	Product	Moisture (g %)
1	*Averrhoa bilimbi* jam (cane sugar)	13.0
2	*Averrhoa bilimbi* squash (cane sugar)	29.8
3	*Averrhoa bilimbi* wine (cane sugar)	30.1
4	*Flacourtia jangomas* jam (cane sugar)	8.9
5	*Flacourtia jangomas* squash (cane sugar)	28.6
6	*Flacourtia jangomas* wine (cane sugar)	29.4

The Moisture content of the selected fruit products was analysed.

The Moisture content of *Averrhoa bilimbi* jam, *Averrhoa bilimbi* squash, *Averrhoa bilimbi* wine, *Flacourtia jangomas* jam, *Flacourtia jangomas* squash, *Flacourtia jangomas* wine were 13.0, 29.8, 30.1, 8.9, 28.6 and 29.4 g % respectively.

6. Percentage of ethanol in wine

Table 13: Percentage of ethanol in wine

S. No	Products	Percentage of ethanol (%)
1	*Averrhoa bilimbi* wine	2.14
2	*Flacourtia jangomas* wine	8.76

The percentage of ethanol in *Averrhoa bilimbi* wine was 2.14 % were as the percentage of ethanol in *Flacourtia jangomas* wine was 8.76%. It was found that the ethanol production in *Averrhoa bilimbi* was low in 3 months of fermentation.

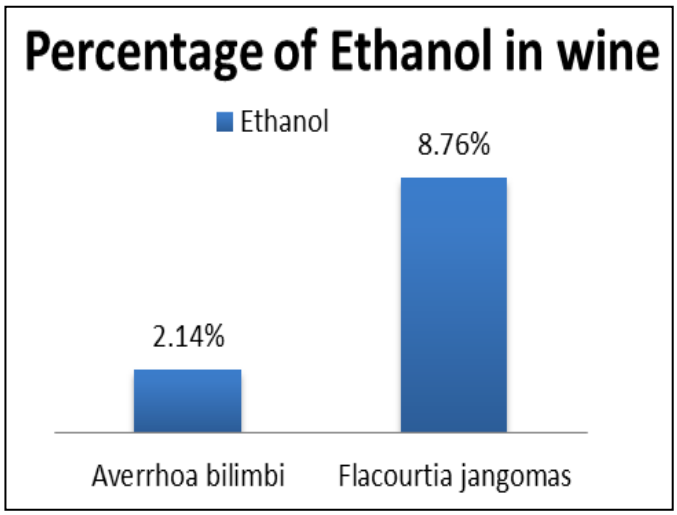

Fig 5

E. Nutrient composition of selected products.

Table 14: Nutrient composition of selected products

Products	Parameters						
	Energy (Kcal)	Carbohydrate (g)	Protein (g)	Vitamin C (mg)	Calcium (mg)	Iron (mg)	Total anti-oxidant activity (%)
Averrhoa bilimbi jam	345.2	86.3	7.03	40	11.7	1.5	47.42
Averrhoa bilimbi squash	237.2	59.3	1.62	45	18.3	0.3	45.14
Averrhoa bilimbi wine	260	65	1.70	40	15.31	0.97	69.20
Flacourtia jangomas jam	369.2	92.3	12.6	35	8.32	1.6	69.92
Flacourtia jangomas squash	244	61	3.75	40	13.31	0.77	64.21
Flacourtia jangomas wine	253	69	5.37	46	15.12	0.94	70.24

The energy content of *Averrhoa bilimbi* jam, squash and wine were 345.2 Kcal, 237.2 Kcal, 369.2 Kcal and the carbohydrate were 86.3 g, 59.3 g and 65 g respectively. 7.03 g, 1.62 g, 1.70 g were the protein content of prepared *Averrhoa bilimbi* jam, squash and wine. The amount of vitamin C was found to be good in *Averrhoa bilimbi* jam, squash and wine with the amount of 40 mg, 45mg and 40 mg sequentially. 11.7 mg, 18.3 mg, and 15.31 were the calcium content of prepared *Averrhoa bilimbi* jam, squash and wine. The iron content of *Averrhoa bilimbi* jam, squash and wine were 1.5 mg, 0.3 mg and 0.97 mg. The total anti - oxidant activity of the *Averrhoa bilimbi* jam, squash and wine were 47.425, 45.14 and 69.20 per cent and proved to be good.

The energy, carbohydrate and protein content of *Flacourtia jangomas* jam was 369.2 kcal, 92.3 g and 12.6 g respectively. 244 kcal, 61 g, 3.75 g was the energy, carbohydrate and protein content of *Flacourtia jangomas* squash. The prepared *Flacourtia jangomas* wine had 253 Kcal of energy, 69 g of carbohydrate and 5.37 g of protein. According to the results of prepared *Flacourtia jangomas* jam, squash and wine had a good amount of minerals and antioxidants.

F. Storage stability of selected jam squash and wine

1. Mean score of sensory attributes on storage

Table 15: Mean score of sensory attributes on storage

S. No	product	Mean score of sensory attributes on storage					
		15 days	30 days	45 days	60 days	75 days	90 days
1	*Averrhoa bilimbi* jam	4.5 ± 0.35	4.3 ± 0.38	4.0 ± 0.39	3.9 ± 0.32	3.6 ± 0.25	3.5 ± 0.28
2	*Averrhoa bilimbi* squash	4.5 ± 0.35	4.2 ± 0.32	4.1 ± 0.39	4.0 ± 0.42	3.8 ± 0.32	3.7 ± 0.33
3	*Averrhoa bilimbi* wine	4.3 ± 0.39	4.3 ± 0.49	4.2 ± 0.42	4.1 ± 0.38	4.0 ± 0.42	3.9 ± 0.33
4	*Flacourtia jangomas* jam	4.4 ± 0.45	4.2 ± 0.38	4.1 ± 0.45	3.9 ± 0.37	3.8 ± 0.28	3.3 ± 0.22
5	*Flacourtia jangomas* squash	4.1 ± 0.34	4.1 ± 0.34	4.0 ± 0.38	3.9 ± 0.33	3.8 ± 0.32	3.6 ± 0.28
6	*Flacourtia jangomas* wine	4.5 ± 0.42	4.3 ± 0.42	4.2 ± 0.42	4.1 ± 0.42	4.0 ± 0.42	3.9 ± 0.33

The organoleptic evaluation of selected fruit products were done in every 15 days for analysing the storage stability and acceptability of the products. The acceptability of sensory attributes of the product was good even on 90th day but the mean score was found to be less when compared to initial values.

2. Microbial analysis of selected jam squash and wine

Table 16: Microbial analysis of selected jam squash and wine

S.No	product	Total plate count		Yeast/ mould count	
		Initial	Final	Initial	Final
1	*Averrhoa bilimbi* jam	<10 cfu/g	02 x 10^3 cfu/g	<10 cfu/g	<10 cfu/g
2	*Averrhoa bilimbi* squash	<10 cfu/ml	02x 10^3 cfu/ml	<10 cfu/ml	<10 cfu/g
3	*Averrhoa bilimbi* wine	<10 cfu/ml	03x 10^3 cfu/ml	600 cfu/ml	03x 10^3 cfu/ml
4	*Flacourtia jangomas* jam	480 cfu/g	03 x 10^3 cfu/g	500 cfu/g	700 cfu/g
5	*Flacourtia jangomas* squash	<10 cfu/ml	02x 10^3 cfu/ml	<10 cfu/ml	<10 cfu/ml
6	*Flacourtia jangomas* wine	<10 cfu/ml	03x 10^3 cfu/ml	600 cfu/ml	03x 10^3 cfu/ml

The final total microbial count of *Averrhoa bilimbi* jam, *Averrhoa bilimbi* squash, *Averrhoa bilimbi* wine, *Flacourtia jangomas* jam, *Flacourtia jangomas* squash and *Flacourtia jangomas* wine were 02x10^3 cfu/g, 02x 10^3 cfu/ml, 03x 10^3 cfu/ml, 03 x 10^3 cfu/g, 02x 10^3 cfu/ml, 03x 10^3 cfu/ml respectively on the 90 days of storage. It was highly stable at room temperature without the addition of any preservatives.

Conclusion

The present study entitled a study on the acceptability, nutrient composition and storage stability of under exploited *Averrhoa bilimbi* and *Flacourtia jangomas* products (jam, squash and wine) made using cane sugar and palm sugar infer that the prepared jam, squash and wine from the selected edible wild fruits namely *Averrhoa bilimbi* and *Flacourtia jangomas* were found to have high acceptability.it was found to be good source of nutrients and anti-oxidants and hence it could be used for regular consumption. Hence it could be concluded that widely available *Averrhoa bilimbi* and *Flacourtia jangomas* could be extensively exploited by processing in various forms.

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