American Journal of Food and Nutrition, 2019, Vol. 7, No. 4, 113-119
Available online at http://pubs.sciepub.com/ajfn/7/4/1
Published by Science and Education Publishing
DOI:10.12691/ajfn-7-4-1

Nutritional and Microbiological Evaluation on Jams and Jellies Available in Bangladesh

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Received September 10, 2019; Revised October 14, 2019; Accepted October 25, 2019

Abstract The study was performed to evaluate the nutritional composition, heavy metal contents and microbiological quality of ten different types of jams and jellies available in local market of Bangladesh. Physicochemical properties, vitamin, minerals, preservatives and heavy metals concentration and microbiological quality were determined for all the samples. The results of this study suggest that the selected jams and jellies are good source of nutrient, antioxidant like vitamin C, energy and total soluble solid. Heavy metals as well as microbiological quality were analyzed to assess the safety in terms of physical and chemical hazards associated with jams and jellies. No heavy metal contamination was found in the samples. The selected samples were free from the risk of microorganisms. Jams and jellies also contain considerable amount of minerals which is good for health. The results of this study were compared with existing results and recommendations which will be helpful for consumers to consider the nutritional quality and safety of jams and jellies.

Keywords: *nutritional composition, preservative, jam, jelly*

Cite This Article: B. Mumtaz, M. J. I. Mozakkin, M. Motalab, S. Jahan, T. Ferdous, and B. K. Saha, "Nutritional and Microbiological Evaluation on Jams and Jellies Available in Bangladesh." *American Journal of Food and Nutrition*, vol. 7, no. 4 (2019): 113-119. doi: 10.12691/ajfn-7-4-1.

1. Introduction

Fruits and vegetables, in its both raw and processed form, have long been important items of human diet. With the passage of time as the society advanced, the demand for food in the processed or "ready-to-use" form increased. The advanced society now a day is in the need of readily served products; the breakfast, lunch and dinner should now be processed and ready to serve on the spot. The processing of fruits and vegetables into squashes, juices, jams, jellies, marmalades, pickles and fruit in syrup etc. offers a variety of ways of consuming fruits and vegetables. The popularity of such products is on increase. It is hard to think of the hot and long summer without a daily refreshing glass of some squash or juice. Jam and jelly, and fruit-in–syrup are being used by more and more people as dessert while jams and marmalades are finding way on to the breakfast tables of an ever greater number of people [1].

Jams, jellies and marmalade can be made from a variety of fruits and some vegetables such as carrot and pumpkin. They are sometimes referred to collectively as preserves. They are nutritious foods and can play a significant part in a healthy diet because they offer good taste and a variety of nutrients found naturally in fruits. Juices, jam, jelly, sauces are of various food products available in our country. Jam is defined as a semisolid food made from not less than 45% (by weight) fruit and 55% (by weight) sugar [2]. This substrate is concentrated to 65% or above soluble solids. Flavoring and coloring agents may be added. Pectin and acid may be added to overcome the deficiencies that occur in the fruit itself. Standard formulations are developed according to their end use, consumer preferences, market demand, food laws, buyer's specifications and economic utilization of inputs required. Gel formation occurs only within a narrow range of pH values. Optimum pH conditions are found near 3.2 for gel formation. The optimum solids range is slightly above 65%. It is possible to have gel formation at 60% solids, by increasing the pectin and acid levels. The quantity of pectin required for gel formation is dependent upon the quality of the pectin. It's slightly less than 1% is sufficient to produce a satisfactory structure [2].

Jelly is made from filtered fruit juice, no pieces of fruit or insoluble solids present . Jelly is made from sugar, pectin, acid, and fruit juice and is a clear spread that is firm enough to hold its shape.

The main areas of quality control that are needed to produce uniformly high quality products are as follows: fruit preparation, accurate weighing and mixing of ingredients, hygienic preparation of fruits and fruit juices, correct acidity, moisture content and final total soluble solids content [3].

One important feature of preserves is the high acidity which prevents the growth of food poisoning bacteria and also helps maintain the color and flavor of most fruits.

However, some moulds and yeasts are able to grow at levels of high acidity and these can spoil the food. They are prevented from spoiling jams by ensuring that the sugar content of the preserve is at least 68%. If for any reason the sugar content is lower than this, moulds will start to grow on the surface of the product. The preservation principle of jam and jelly involve the correct combination of acidity, sugar level and pectin content . All three must be correct to obtain a satisfactory product.

The difference between jelly and jam is that jelly is made strictly from the juice of fruit while jam is made from crushed fruit. Jelly is typically firmer than jam, but not so firm that it's gummy-like. According to government regulations, jelly must contain at least 55% fruit juice. Unlike most all jellies, jam may not contain pectin, as the mashed fruit will often give it sufficiently good consistency for spreading. The jelly will spread pretty evenly, while the jam will tend to be a little lumpy. Fruit “butters” are generally just a variety of jelly. For whatever reason, jelly is significantly more popular with kids than jam and jam is significantly more popular with adults than jelly.

People are getting busier day by day and hence the demand for ready to eat food/drink is increasing rapidly. To meet the increasing demand and huge opportunity to make money from this sector, a large number of new brands of jams and jellies have appeared in the market. In most cases they are not aware about presence of heavy metals in the final product. Also, they are using preservatives to delay their decomposition and to increase the shelf life of the product. Sodium benzoate, Ascorbic acid, Citric acid, Sulphites (or sulphites) - sometimes also labeled as sulfur dioxide, sodium sulphite, sodium and potassium bisulphate, sodium or potassium metabisulphite etc. are being used as preservatives in these types of products. The existing food safety and regulatory management of Bangladesh is governed by many enactments and governmental bodies and more than dozen of laws deal with the food safety affairs excluding the common law provisions. It was found in a study that the food industries are ignoring the existing food regulations in Bangladesh. The reasons like regulatory failures, choice of product, good price, lack of consumer awareness and educational and cultural influences are accountable for the existing food safety concerns in Bangladesh [4].

Adulteration becomes a serious threat to public health, especially in a country like Bangladesh. Since high-priced fruits command premium prices, producers of fruit-based products such as jams, jellies, squashes and fruit preparations might be tempted to blend these products with cheaper fruits. These products are also being adulterated through using harmful food colors, prohibited artificial sweeteners, excessive use of permitted preservatives and harmful preservatives in small amount. When consumers buy product from market, they are able to judge the sensory aspects of food products such as shape, color, texture, taste, and aroma. But they are not in a position to make a statement on the level of adulteration and the nutritional value of a given product. The quality evaluation of commercial fruit products is a difficult task. Sensory quality evaluation cannot present the proper difference because quality scale may vary strongly from one person to another. By considering all these facts, the present study was conducted to prepare new and updated information about the nutritional composition of jams and jellies available in Bangladesh and also to magnitude the concentration of heavy metals and preservatives in these products. The authors believe that this study will help consumers purchase jams and jellies which have more nutritive properties and also this will give them an idea about the status of preservatives, heavy metals and microbiological quality in these products.

2. Materials and Methods

This study was conducted to evaluate the quality of jams and jellies by studying their physico-chemical, microbiological properties, vitamin, trace-elements, minerals, preservatives and heavy metals content. Three samples of each type of jams and jellies were collected for this experiment. Each value represents the average from three replications and the outcomes expressed as mean values ± standard deviations (SD). All the results were expressed as gram (g), percentage (%), kilocalorie (Kcal), milligram (mg) and microgram (μg) per 100 g of jams and jellies.

2.1. Sample Collection and Preparation

2.1.1. Sample Collection

This experiment was carried out at Institute of Food Science and Technology, BCSIR, Dhaka. Ten different types of jams and jellies from dissimilar producers were analyzed in this study. The selected jams and jellies were collected from different markets and superstores in Dhaka city. Collected samples were fresh, sealed and free from any kind of deterioration.

2.1.2. Sample Preparation

The sample was homogenized and accurate amount was weighed as required for different analysis. Three samples of each type of jams and jellies were selected for measurement.

2.2. Physicochemical and Nutritional Analysis

The pH was determined with a digital pH-meter and titratable acidity was estimated with the visual acid-base method [5]. The moisture content was determined by the digital moisture analyzer (AnD MX-50). The total soluble solid (TSS) was determined with a hand refractometer (iTavah, COMINHKPR121676). Crude fiber, total fat was determined by the standard AOAC methods (978.10; 920.39) and the estimation of total protein was made by the method described -by Kirk and Sawyer [6]. The content of total carbohydrate and energy was determined by the method [7]. Ascorbic acid was determined by using the standard AOAC methods (967.21). Ash was determined by the process [5]. Minerals and heavy metals were determined by Atomic Absorption Spectrometric method described -by Kirk and Sawyer [6].

2.3. Preservatives analysis

Sulpher di-oxide was determined by titration process [5] and Sodium Benzoate was determined by the method [6].

2.4. Microbiological Analysis

For the quantitative determination of total count of mesophilic bacteria, total coliform, the standard procedure was followed [8]. Aerobic plate count (APC) was performed by pour plate method using plate count agar (PCA), which was incubated at 35±100C for 48±2h. Lauryl tryptose broth was used for isolation of *Escherichia coli*. Gassing tube was selected for *E.coli* enumeration using most probable number (MPN) method. Enumeration of fungi was performed on rose Bengal agar medium.

2.5. Statistical Analysis

Statistical analyses were carried out by using python programming language (version 3.6.6). The results obtained in the present study are reported as mean values (obtained from the three replications) ± standard deviation (SD). The significant differences between mean values were analyzed using p values obtained from two-tailed t-tests for two samples and using one-way ANOVA (Analysis of variance) for more than two samples with significance level of $p<0.05$.

3. Results and Discussion

3.1. Physico-chemical and Nutritional Properties

The results of the physico-chemical and nutritional analysis were given in Table 1 and Table 2. It is evident that moisture content was found maximum in sample I (21.07±0.07%) and minimum in sample III (17.83±0.06%). Product having high moisture content has minimum shelf stability [9]. Although the selected samples were high in moisture content, it also contained a high amount of sugar and a low pH. This reduces the water activity (a_w) and inhibits the growth of diseases causing microorganisms in the selected samples. Previous study shown that the moisture content of fruit jam and jelly varies from 25 to 35 (World Journal of Agricultural Sciences, 2005). The moisture content of the selected fruit items more or less similar to the reference value.

Ash contents reveal cumulative pictures of different minerals present in the food. The ash contentof given samples was ranged from 0.01±0.01% to 0.08±0.01%. Maximum ash contents were found in sample I (0.08±0.01%) and minimum in sample III (0.01±0.01%). Ash content increases with the increase of fruit juice. Variation in ash content of the commercial brands may also be due to presence of artificial sweeteners, salt, preservatives etc. The lower ash content indicates low fruit contents in the product. The total content of mineral salt as ash in fruits varied from 0.2% to 1.5%. But the analyzed data shows that the range is 0.01% to 0.08%, which showed dissimilarity with the present study due to variation in formulation of each manufacturer.

Most of the common fruits are low in protein. High level of protein content was investigated in sample II (0.09±0.01%) and low level in sample VII (0.01±0.01%). RDA for protein is 13-14gm for infants, 16-28gm for children, 45-63gm for adult males, 46-50gm for adult females, 60gm for pregnant woman [10]. The range of protein found was 0.01% to 0.09%, which is not a good source of protein.

Sugars are one of the most important quality parameters, because of its contribution to the flavour, quality, palatability and discoloration of jams and jellies [21]. The highest quantity of reducing sugar (RS) (50.30±1.20%) was recorded in sample VIII, while lowest in sample VI (28.27±0.72%). Da Silva Junior developed a jelly from cactus pear fruit which contains 21.6% reducing sugar [2]. Desrosier and Desrosier emphasized that a balance is required between the sucrose and invert sugar content of the jelly [2]. Low inversion may result in crystallization, high inversion in granulation of dextrose. Egan claimed that manufacturers prefer the reducing sugar content to fall within the range of 20-40 (calculated as a percentage of preserve) in order to prevent separation of crystals during storage. Non reducing sugar (NRS) content was highest in sample VI (19.73±1.40%) and lowest in sampleI (7.08±0.08%). The presence of low non-reducing sugar is contradictory to the claims of Desrosier and Egan . This may be due to the addition of mixtures of sweeteners, still attaining acceptable texture without using conventional ratio 60% of sucrose. The highest amount of total sugar [TS] (61.00±0.88%) was found in sample VIII and lowest (46.10±1.90 %) in sample IV.

Table 1. Physico-chemical properties of studied jams and jellies

Sample	n	Moisture content(%)	P^H	Titratable acidity(%)	TSS(%)	RS(%)	NRS(%)	TS(%)
Sample I	3	21.07±0.07a	2.70±0.04c	0.78±0.05a	65.00±0.05c	50.17±1.20a	7.08±0.08g	57.25±0.87b
Sample II	3	19.00±0.02d	2.80±0.12b	0.88±0.13a	63.00±0.10e	35.26±0.89c	16.92±0.19a	52.18±1.10c
SampleIII	3	17.83±0.06f	2.60±0.04c	0.90±0.01a	64.00±0.32d	40.16±1.45b	13.09±0.23d	53.25±1.67c
SampleIV	3	18.57±0.03e	2.60±0.05c	1.05±0.06a	65.00±0.12c	37.25±0.50c	8.85±0.05f	46.10±1.90d
SampleV	3	19.80±0.06c	2.50±0.11c	0.87±0.05a	67.00±0.10b	32.10±0.80d	15.39±0.48b	47.49±1.2d
SampleVI	3	18.00±0.12f	2.80±0.04b	0.95±0.12a	67.00±0.32b	28.27±0.72e	19.73±1.40a	48.00±0.95d
SampleVII	3	21.00±0.05a	2.90±0.05b	0.98±0.15a	66.00±0.05c	41.28±1.25b	8.73±0.20f	50.01±1.51c
SampleVIII	3	20.50±0.05b	3.10±0.10a	0.75±0.05b	65.00±0.10c	50.30±1.20a	10.7±1.10f	61.00±0.88a
SampleIX	3	19.57±0.11c	3.10±0.08a	1.02±0.12a	65.00±0.06c	41.00±1.45b	12.00±0.01e	53.00±1.10c
SampleX	3	20.15±0.15b	3.40±0.15a	0.96±0.15a	68.00±0.21a	35.00±1.23c	14.87±1.25c	49.87±0.95c

Note: Results were expressed as mean values ± standard deviation. Values followed by different letters are significantly different from each other ($p<0.05$) . Preference has given aphetically from highest to lowest. N.D. = Not Detected.

Table 2. Nutritional properties of studied jams and jellies

Sample	n	Crude fiber (%)	Total carbohydrate(%)	Total energy(Kcal/100g)	Total protein(%)	Total fat(%)	Total ash(%)
Sample I	3	0.18±0.01a	78.58±0.81e	314.71±1.90b	0.07±0.20b	0.01±0.01a	0.08±0.01a
Sample II	3	0.19±0.03a	80.66±0.05b	323.12±0.58a	0.09±0.01a	0.01±0.01a	0.04±0.01b
SampleIII	3	0.10±0.02b	81.99±0.55a	328.25±2.71a	0.05±0.02a	0.01±0.01a	0.01±0.01b
SampleIV	3	0.10±0.03b	81.20±0.83a	325.12±2.54a	0.06±0.10a	0.01±0.01a	0.06±0.05a
SampleV	3	0.10±0.02b	80.02±0.81b	320.43±1.88b	0.04±0.01b	0.02±0.02a	0.02±0.01b
SampleVI	3	0.09±0.01b	81.82±0.05a	327.6±0.48a	0.03±0.02b	0.02±0.01a	0.02±0.01b
SampleVII	3	0.08±0.01b	78.88±0.20d	315.66±0.58b	0.01±0.01b	0.01±0.01a	0.02±0.02b
SampleVIII	3	0.16±0.020a	79.28±0.55c	317.30±1.88b	0.02±0.02b	0.01±0.01a	0.02±0.01b
SampleIX	3	0.10±0.07b	80.19±0.44b	321.28±2.54b	0.06±0.02a	0.03±0.01a	0.05±0.02a
SampleX	3	0.12±0.02b	79.66±0.24c	318.88±1.88b	0.04±0.02a	0.01±0.01a	0.03±0.01b

Note: Results were expressed as mean values ± standard deviation. Values followed by different letters are significantly different from each other ($p<0.05$) . Preference has given aphetically from highest to lowest. N.D. = Not Detected.

Usually fat content of different fruits is not greater than 1% [11,12]. In this study, fat content among the samples varied from 0.01±0.01% to 0.03±0.01%. The highest value of fat 0.03±0.01% was exhibited by sample IX and for rest of the samples 0.01±0.01% respectively. In this study the range of fat content was in between 0.01% to 0.03% which is a very poor indication of fat content.

Results regarding the effect of various preservatives on pH of jelly showed that the preservatives decrease pH of jelly. Among the jams and jellies were analyzed, sample X contained the highest value 3.4 of pH and the least value 2.5 of pH was found in sampleV. These items had a low pH value because they are comparatively rich in acid. The overall range of pH is 2 to 5 for common fruits with the most frequent figures being between 3 and 4 (Quality Assessment of Industrially Processed Fruit Juices Available in Dhaka City, Bangladesh, 2010). In this study, the range of pH remains between 2.5 to 3.4, which support the reference value. The variation of pH occurs due to the variation of the formulation of the manufacturing process and during processing the pH decrease and total acid content may increase [13].

Total Soluble Solid (TSS) is one of the more important quality factors for most fruit products. TSS contents are related directly to both the sugars and fruit acids as these are the main contributors. It is well known that the higher of the total solids the better will be the quality of the end product. Sample X was found higher for TSS (68±0.21%) whereas sample II was found lower for TSS (63±0.10%). According to, karla, S.K 20 brix for mango beverages may make a very sweet drink, and 60 to 70 brix for jam and jelly [14]. In this study the TSS of the analyzed samples were similar as the suggested market value.

Two important quality attributes of processing fruits are pH and titratable acidity (TA). The acidity of the fruit is also important as a contributor to the flavor of the fruit products. In this study, total titrable acidity varied significantly in different types of samples. Maximum content of total titrable acidity (1.02±0.12%) was recorded in sample IX while it was minimum (0.75±0.05%) in sample VIII.

3.2. Preservatives and Vitamin C

The selected samples were tested for sodium benzoate and sulfur dioxide, which acts as preservatives. Benzoic acid and its salts are used as a food preservative represented by the E-numbers E210, E211, E212, and E213. Benzoic acid inhibits the growth of mold, yeast and some bacteria. The efficacy of benzoic acid and benzoate is thus dependent on the pH of the food. Sodium benzoate is most suitable for use as an antimicrobial agent in foods and beverages which naturally are in the pH range below 4.5%; it is not recommended as a preservative at pH ranges higher than 4.5. Sodium benzoate content of selected jams and jellies were varied from 7.58± 0.50 mg to 10.12± 0.11 mg (Table 4). Sulfur preservatives, such as sulphites and Sulfur di-oxide inhibit the growth of microorganisms and prevent discoloration of jams and jellies. Sulfur di-oxide content of selected jams and jellies were varied from 1.25 ± 1.0 mg to 1.80 ± 0.02 mg (Table 4). Checking food labels for sulphites, sulfur dioxide and E-numbers in the range of 220-228 is helpful; however, companies are only required to list sulphites as an ingredient when the amount is above 10 mg/liter or 10 ppm. The problems include stomach-ache, hives, bronchospasm and even anaphylactic shock.

Vitamin-C and trace-element content of the studied jams and jellies were revealed in Table 3. fruits and fruit products are considered as a good source of vitamin C . Ascorbic acid not only restores nutritional value lost during processing, but also contributes to the product appearance and palatability [15]. The vitamin C contents of studied jams and jellies were ranged between 15.00±0.13 to 58.00±0.30 mg/100g. Sample I contain the highest amount of Vitamin C, 58 mg/100g and sampleV contain the lowest amount of Vitamin C, 15 mg/100g. RDA for vitamin-C is 30-35mg (for infants), 40-45mg (for children), 50-60mg (adult males and females) and 70mg (for pregnant women) [10]. These results show that these selected products are able to fulfill the daily requirement of vitamin C.

3.3.Trace Elements, Minerals and Heavy Metals

The amount of trace elements was given in Table 3. The trace elements that were found in selected samples are copper and iron. The highest amount of copper was found in sample I, 0.760 ± 0.001 mg/100g. No amount of copper was found in samples- III,IV,V,VI . Most fruits and fruit

products contain a small amount of copper ranging from 0.005 ± 0.004 mg to 0.072 ± 0.01 mg. Recommended Dietary Allowance (RDA) for copper is 900 µg/day for both adult male and female [11]. Copper in fruits recommended by WHO/FAO is: 40 mg/Kg dry weight [16]. But in jams and jellies, the amount of copper does not support the recommended value due to manufacturing process.

The highest amount of iron was found in sample III 0.910 ± 0.007 mg/100g and iron was not found in sample V,VI and IX , may be due to variation in manufacturing process. According to USDA the daily recommended intake of iron is 8mg for adult male and 18mg for adult female**.** According to the present study these samples are very good source of Iron.

Manganese were not detected in the selected samples. Zinc content varies from 0.02±0.01 to 0.06±0.01 mg/100g. The U.S. recommended dietary allowance (RDA) for zinc is listed by gender and age group, the RDA for zinc (8 mg/day for adult women and 11 mg/day for adult men) appears sufficient to prevent deficiency in most individuals [17]. Thus, consumption of these fruit products can be suggested as a food based strategy to alleviate or improve the unsatisfactory dietary iron intake of adolescents.

Minerals play an important role in maintaining proper function and good health in the human body. Inadequate intake of minerals in the diet is often associated with an increased susceptibility to infectious diseases due to the weakening of the immune system. Plants, animal foods and drinking water are an important source of essential elements [18]. Table 4 shows the mineral content of studied jams and jellies. These jams and jellies were also enriched with minerals like sodium and potassium. Sodium content of selected jams and jellies were ranged between 44.62 ± 0.20 mg and 71.45± 0.28 mg per 100g. Sodium variability of fruits sometimes relies on soil sodium, black soil contains a fair amount of sodium [10,11]. The 2010 Dietary Guidelines for Americans, as well as the Institutes of Medicine, recommend that healthy adults limit their sodium intake to between 1,500mg and 2,300mg per day. This study shows that jams and jellies contained considerable amount of Sodium .

Among the jams and jellies analyzed, the highest quantity of potassium was found in sample III, 50.11 ± 1.10 mg/100g. For the healthy adult, the RDA for sodium and potassium intake is not more than 2,400 mg and 4700 mg respectively per day [19]. Calcium and magnesium were not analyzed. Chromium was not detected in the studied samples.

Micronutrient deficiency is a common occurrence not only in developing countries but also in developed countries. According to WHO (World Health Organization), iodine, iron and vitamin A deficiency are the most widespread micronutrient deficiencies which in together affects about one third of the world's population. The best way to deal with this is to take foods rich in micronutrients.

Table 3. Vitamin-C and trace-element content of the studied jams and jellies

Sample	n	Vitamin C(mg/10)	Copper(mg/100g)	Iron(mg/100g)	Zinc(mg/100g)	Manganese(mg/100g)
Sample I	3	58.00±0.30a	0.760±0.001a	0.522±0.009c	0.06±0.01a	ND
Sample II	3	21.00±0.61g	0.315±0.002f	0.512±0.009c	0.02±0.01b	ND
SampleIII	3	47.00±0.38d	ND	0.910±0.007a	ND	ND
SampleIV	3	55.00±0.39b	ND	0.907±0.008a	ND	ND
SampleV	3	15.00±0.13j	ND	ND	ND	ND
SampleVI	3	43.00±0.20e	ND	ND	0.05±0.01b	ND
SampleVII	3	18.00±0.10h	0.551±0.001d	0.669±0.009b	ND	ND
SampleVIII	3	17.00±0.09i	0.491±0.005e	0.667±0.009b	0.09±0.01a	ND
SampleIX	3	51.00±0.23c	0.620±0.002b	ND	ND	ND
SampleX	3	40.00±0.40f	0.597±0.002c	0.520±0.007c	ND	ND

Note: Results were expressed as mean values ± standard deviation. Values followed by different letters are significantly different from each other ($p<0.05$) . Preference has given aphetically from highest to lowest. N.D. = Not Detected.

Table 4. Mineral and Preservatives content of selected jams and jellies

Sample	n	Sodium (mg/100g)	Potassium (mg/100g)	Cromium (mg/100g)	Sodium benzoate (mg/100g)	Sulfur dioxide (mg/100g)
Sample I	3	58.26±0.15d	31.26±0.98d	ND	9.51±0.21a	ND
Sample II	3	69.86±0.19b	44.10±1.0b	ND	8.81±0.11b	1.70±0.50a
SampleIII	3	56.01±0.01e	50.11±1.1a	ND	9.36±0.10a	ND
SampleIV	3	71.45±0.28a	35.56±1.2c	ND	7.58±0.50b	1.80±0.02a
SampleV	3	45.31±0.38g	38.10±1.5c	ND	10.12±0.11a	ND
SampleVI	3	61.03±0.25c	48.10±0.80b	ND	9.88±0.15a	ND
SampleVII	3	69.95±0.01b	31.11±1.5d	ND	7.60±0.65b	1.25±1.0a
SampleVIII	3	44.62±0.20g	26.10±2.0e	ND	8.91±1.10a	ND
SampleIX	3	52.26±0.98f	30.14±2.5d	ND	7.88±1.20b	ND
SampleX	3	55.85±0.80e	45.16±2.5b	ND	9.95±0.50a	1.28±0.90a

Note: Results were expressed as mean values ± standard deviation. Values followed by different letters are significantly different from each other ($p<0.05$) . Preference has given aphetically from highest to lowest. N.D. = Not Detected.

Table 5. Heavy metals content and microbiological analysis of the studied jams and jellies

Sample	n	Arsenic(mg)	Mercury(mg)	Lead(mg)	Cadmium (%)	Standard plate count (CFU/g)	Total coliform (MPN/g)	Total fungus (CFU/g)
Sample I	3	ND	ND	ND	ND	ND	ND	ND
Sample II	3	ND	ND	ND	ND	ND	ND	ND
SampleIII	3	ND	ND	ND	ND	ND	ND	ND
SampleIV	3	ND	ND	ND	ND	ND	ND	ND
SampleV	3	ND	ND	ND	ND	ND	ND	ND
SampleVI	3	ND	ND	ND	ND	ND	ND	ND
SampleVII	3	ND	ND	ND	ND	ND	ND	ND
SampleVIII	3	ND	ND	ND	ND	ND	ND	ND
SampleIX	3	ND	ND	ND	ND	ND	ND	ND
SampleX	3	ND	ND	ND	ND	ND	ND	ND

Note: Results were expressed as mean values ± standard deviation. Values followed by different letters are significantly different from each other ($p<0.05$) . Preference has given aphetically from highest to lowest. N.D. = Not Detected.

Nowadays some growers as well as traders in Bangladesh are commercially using some chemicals, namely Ripen, Gold-Plus, Profit etc. for the ripening of fruits which ultimately come into the products made of those fruits. Young generation's are the foremost consumers of fast food and they are at particular risk of the harmful side effects of food adulteration, which may lead to serious liver and kidney diseases including various forms of cancer and hepatitis [20].

Heavy metals are harmful and become toxic to health if they are taken above the limit of daily dietary allowance recommended. The heavy metals content of the studied samples is given in Table 5. Arsenic, mercury, lead and cadmium were not found in selected samples.

3.4. Microbiological Analysis

Microbiological test results of jams and jellies were given in Table 5. From table it is evident that total viable count, yeast & mold and coliform were not found in selected samples. Thus the microbiological qualities of these selected jams and jellies were acceptable and free from the risk of microorganisms.

In our country people have negative concept about the local branded jam and jelly. Most people think these all are adulterated. The jam and jelly were tasted to judge sensory quality by several people. According to them all the samples have satisfactory sensory attributes. According to the chemical analysis of the selected commercial jam and jelly it is clear that there are no chemical or microbial threats from these products. So the consumer's respond about these products is not acceptable. This is happened due to lack of awareness about the quality aspects of the food products. The Government authorized institute such as Bangladesh Council of Scientific and Industrial Research (BCSIR) and Bangladesh Standard Testing Institute (BSTI) should undertake pre-emptive investigations to check the microbial and nutritional quality of the jams and jellies as well as initiate increased public awareness programmes on contaminated and adulterated jam and jellies.

4. Conclusion

Present study has shown that the locally available jams and jellies contain safe levels of nutritional and microbial elements for human consumption and free from heavy metals contamination. The study also indicates that the jams and jellies are rich source of vitamin C, important minerals and TSS, TS, RS but poor source of protein, fat and fiber . Preservatives quantities added in jams and jellies are within the acceptable limit. Therefore, the present study suggests that the different varieties of the jam and jellies provide nutritional contents and important minerals which are supportive for health benefit of the consumers. If we enhance the regular intake of fruit products it will be possible to alleviate micronutrient deficiency problem from Bangladesh and if the food industry enhance more nutrient, pulp content and changing the processing and storage system, then it will be more healthy and they will be able to export these jam and jellies to the another country by having a good market value and earn foreign currency.

Competing Interests

The authors declare that there are no competing interests regarding the publication of the paper.

Acknowledgements

This study was carried out under the research and development (R&D) project entitle "Studies on the nutritional and qualitative evaluation of juice , jam, jelly, pickle and sauces available in the local market." of IFST, BCSIR. The authors are indebted to Chairman, Bangladesh Council of Scientific and Industrial Research (BCSIR) and Director, IFST, BCSIR, Dhaka for providing instrumental facilities to carry out this research work. Authors are also grateful to Mr. Aquib Ahmed for helping in extensive statistical analysis using Python programming language and all other lab colleagues of fruit technology research section for helping to carry out this study.

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