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# An overview of quality status of selected commercial brands of juices and jams based on public perception and laboratory analysis

**M. S. Kayshar[1*], M. Saifullah[2], A. Rahman[3] and M. B. Uddin[4]**

[1]Department of Food Engineering and Technology, Sylhet Agricultural University, Sylhet-3100, [2]Department of Process and Food Engineering, Universiti of Putra, Malaysia and [3&4] Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh-2202, *E-mail : mamunbau06@gmail.com

## Abstract

The study was done to evaluate the quality status of selected commercial brands of juices and jams based on laboratory analysis and public perception. The entire research work was carried out in two phases to evaluate the quality of juices and jams, available in local market. In phase I, a comprehensive baseline survey was done to know the public perception and this revealed that, according to the notion of most respondents, commercial juice and jam products available in market were adulterated by harmful food colors, low grade fruits and harmful preservatives and these were harmful for health. Besides, some outcome from this survey, such as, avoiding low quality products and adopting BSTI standard, enforcing law and imposing punishment and social motivation of food consumers to prevent adulteration. In phase II, chemical analysis and sensory evaluation of selected samples were done. The collected samples were four different brands of mango juices, two different brands of mango jam, two different brands of pineapple jam and apple jam from one brand. Different parameters of collected samples like moisture content, ash content, total soluble solid content, pH, acidity as citric acid, total plate count, yeast and mold count, preservative (Sulphur dioxide and Sodium benzoate) content and heavy metal (As, Pb, Cu, Zn and Sn) content were analyzed. Heavy metal content in every sample was below the detection level. Microbial load was in safe level according to gulf standard. However, preservative content in few samples was quite higher than acceptable limit. Other parameters of collected samples were in acceptable limits. Sensory evaluation showed that all commercial jam and juice samples were more or less equally acceptable and all products obtained satisfactory total score from sensory evaluation.

**Keywords:** Food quality, Adulteration, Juice, Jam

## Introduction

Bangladesh is a subtropical country; here, like other agricultural produce, large volumes of different types of seasonal fruits are available in market in peak season, which causes post-harvest losses of fruits and sometimes farmers do not get actual price of their products. To solve these problems, fruits are processed into juice, jam, jelly, concentrates and other products by many industries. Among all the products, juice and jam has occupied a large portion of processed fruit products in the market but researches on assessment of their quality are really very less in context of Bangladesh. Quality denotes the degree of excellence of a product. It is indicated in terms of grade, standards and specifications. It includes all attributes that influence a product's value to the consumer. Due to presence of sugar and high moisture content the quality of juice is very susceptible to microbial growth and quality degradation. On the other hand, high sugar content of jam suggests that these products should resist spoilage by microorganisms. However, even 68% sugar solids is not a guarantee against the growth of certain molds and yeasts, particularly molds. It might be mentioned that an *Aspergillus glaucus* mold has been found that will grow readily in 68% sugar solutions and requires heating to $74^0$C for 20 minute for inactivation (Desrosier, 1977). pH and $a_w$ of the product, processing condition, hygienic practice storage temperature and concentration of the preservative can prevent or minimize the growth of microorganisms in product (Troller, 1983 and Jay, 1987). Water used for product preparation can be a major source of microbial contaminants such as total coliforms, faecal coliforms, faecal streptococci, etc. (Gill *et al*., 1996). In developed countries the quality of processed food is strictly maintained but in developing countries the processor does not concerned about the quality of the products. The aim of this study is to know respondents opinion about the quality of processed juices and jams; assess the physicochemical quality parameters of Mango juice and different types of jam available in local market; detection of adulterants and contaminants and perform sensory evaluation to assess the quality.

## Materials and Methods

Before starting laboratory analysis a comprehensive baseline survey was conducted randomly and purposively covering the people of different arenas of society such as academician, scientists, doctors, researchers, traders and consumers. Thousand (1000) questionnaires were distributed among the respondents and complete questionnaires were received from them. Quantitative and Qualitative data were converted into scoring wherever necessary.

For laboratory analysis, mango juice of four different processors, mango jam of two different processors, pineapple jam of two different processors and apple jam of one processor were collected from local market in Mymensingh city. Four samples from each brand were collected for analysis and coded to avoid biasness in sampling. Samples were coded like **A, B, C, D** for Mango Juice; Mango Jam-**1** and Mango Jam-**2** for mango jam; Pineapple Jam-**1** and Pineapple Jam-**2** for pineapple jam; Apple Jam-**1** for apple jam. These samples were analyzed in the laboratories of Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh; Bangladesh Standards and Testing Institution, Dhaka and Bangladesh Council of Scientific and Industrial Research, Dhaka.

Moisture content and ash content of the samples were determined by adopting AOAC (2005) method. TSS of the samples was determined by using refractometer (Model no. 8987 PujiKuki Ltd. Tokyo, Japan). Total Soluble Solids of the samples was read directly from the refractometer. The pH of the samples was measured by using PERKINFLMER Metrion-V pH meter at an ambient temperature. Acidity as citric acid was determined by following the methods of Rangana (2005). AOAC (986.15), AOAC (972.25), AOAC (973.34), AOAC (971.20), AOAC (985.16) method was used for the determination of arsenic, lead, copper, zinc and tin respectively. BDS1581:2011 (App-C) method was used for the determination of sulphur dioxide in juice and BDS520:2001 (App-A) was used for the determination of Sodium benzoate in jam samples. The standard plate count was done according to the method described in “Recommended Method for Microbiological Examination of Food” (American Public Health Association, 1967). Aerobic plate count (APC) was performed by pour plate method using plate count agar (PCA) and Potato Dextrose Agar (PDA) was used to count the yeast and mould colony.

Finally, commercial juice samples were evaluated by a panel of fifteen judges for sensory characteristics like color, taste, flavor, texture and overall acceptability at room temperature as described by the Larmond (1977). Scoring was done according to 9-Point-Hedonic Scale. 9= Like extremely, 8= Like very much, 7= Like moderately, 6= Like slightly, 5= Neither like nor dislike, 4= Dislike slightly, 3= Dislike moderately, 2= Dislike very much, 1= Dislike extremely. The preference difference and quality of juice were evaluated from the total value of the score. For jam samples, organoleptic parameters on the physical tests (Sensory evaluation) measured by using an instruction card for giving score established by BSTI (2012). The parameters were as follows: 1. Color and texture; 2. Taste and flavor; and 3. Absence of defects.

## Results and Discussion

This study was performed to assess the quality of juices and jams by studying their physicochemical parameters, heavy metal and preservative content, microbial load and by performing sensory evaluation.

### Baseline survey results

**Status of Adulteration:** This survey was generated to know the opinions about the status of adulteration of commercial juice and jam products from the respondents. Thousand (1000) questionnaires were distributed among the respondents and most of the respondent’s opinion is shown in Table 1.

**Table 1. Status of adulteration in selected processed products (fruit juice and jam)**

| Total respondent | Responses | | Valid % | |
|---|---|---|---|---|
| | Adulterated | Not-Adulterated | Yes | No |
| 1000 (Juice) | 970 | 30 | 97 | 3 |
| 1000 (Jam) | 960 | 40 | 96 | 4 |

Table 1 represents that 97% and 96% respondents commented that juices and jams available in local market are adulterated.

On the basis of status of adulteration the respondents revealed their views towards commercial juice and jam products and their opinion are shown below (Table 2 and 3).

According to the public perception, different adulterants used in fruit juices and jams and among these, use of harmful food colors was high. Different respondent interpreted from different points on quality and safety issue of juices and jams available in the market and in both cases for juices and jams, their assumption revealed that consumption of these could be harmful for health. Most of the respondents recommended for adopting BSTI standard thinking that most preventive measure to control adulteration in fruit juice and jam products (Table 2 & 3).

**Table 2. Survey result on fruit juices**

| Sl no. | Respondents view | Total Respondent | Parameters | Respondent No. | Percent Respondent | Remarks |
|---|---|---|---|---|---|---|
| 1. | Adulterants used in juice | 970 | i) Not-permitted artificial sweeteners | 369 | 38.04% | |
| | | | ii) Excessive permitted preservatives | 315 | 32.47% | |
| | | | iii) Harmful food colors | 727 | 74.95% | First |
| | | | iv) Artificial flavor | 681 | 70.21% | Second |
| | | | v) Harmful preservatives | 407 | 41.96% | Third |
| | | | vi) Others | 24 | 2.47% | |
| 2. | Status of quality and safety of processed fruit juice | 970 | i) Are healthful for the children's | 56 | 5.77% | |
| | | | ii) Are harmful for the consumers | 477 | 49.18% | First |
| | | | iii) Do not contain fruit juices | 432 | 44.54% | Second |
| | | | iv) Contain little fruit juices | 273 | 28.14% | |
| | | | v) Contain fruit flavor only | 366 | 37.73% | Third |
| 3. | Preventive measures to control adulteration in fruit juice | 970 | i) Enforcing law and imposing punishment | 785 | 80.93% | Second |
| | | | ii) Social motivation of food processor | 572 | 58.97% | |
| | | | iii) Adopting BSTI standards | 798 | 82.27% | First |
| | | | iv) Social motivation of food consumers | 727 | 74.95% | Third |
| | | | v) Strengthening supervision by legal authority | 603 | 62.16% | |
| | | | iv) Others | 87 | 8.97% | |

**Table 3. Survey result on fruit jam**

| Sl no. | Respondents view | Total Respondent | Parameters | Respondent No. | Percent Respondent | Remarks |
|---|---|---|---|---|---|---|
| 1. | Adulterants used in juice | 960 | i) Not-permitted artificial sweeteners | 401 | 41.77% | |
| | | | ii) Excessive permitted preservatives | 263 | 27.40% | |
| | | | iii) Harmful food colors | 745 | 77.60% | First |
| | | | iv) Artificial flavor | 649 | 67.60% | Second |
| | | | v) Harmful preservatives | 408 | 42.50% | Third |
| | | | vi) Others | 23 | 2.40% | |
| 2. | Status of quality and safety of processed fruit juice | 960 | i) Are healthful for the consumers | 70 | 7.292% | |
| | | | ii) Are harmful for the consumers | 494 | 51.46% | First |
| | | | iii) Do not contain fruit pulp | 406 | 42.29% | Second |
| | | | iv) Contain little fruit pulp | 324 | 33.75% | Third |
| | | | v) Contain fruit flavor only | 324 | 33.75% | |
| 3. | Preventive measures to control adulteration in fruit juice | 960 | i) Enforcing law and imposing punishment | 785 | 81.77% | Second |
| | | | ii) Social motivation of food processor | 572 | 59.58% | |
| | | | iii) Adopting BSTI standards | 798 | 83.13% | First |
| | | | iv) Social motivation of food consumers | 727 | 75.73% | Third |
| | | | v) Strengthening supervision by legal authority | 603 | 62.82% | |
| | | | iv) Others | 87 | 9.06% | |

## Physicochemical Analysis

The physicochemical analysis results are represented in Table 4. In case of juice samples highest amount of moisture content was in sample **A** (86%) and lowest amount of moisture content was in sample **D (**84%). Highest amount of moisture content present in commercial mango juice is 89.22% (Tasmin *et al.,* 2010). On the other hand, among the jam samples Pineapple Jam-**1** contain highest amount of moisture 32% and Pineapple Jam-**2** contain minimum amount of moisture 26.50%. Mango Jam-**1**, Mango Jam-**2** and Apple Jam-**1** contain 31%, 27.50% and 29% respectively. Product having high moisture content has minimum shelf life (Ayub *et al.*, 2005). Ash content indicate cumulative amount of mineral present in food. The ash contents were ranged from 0.031% to 0.079% in commercial mango juice samples. Maximum ash content was found in sample **D** among the commercial juice samples. Besides this, the ash contents were ranged from 0.023% to 0.092% in commercial brand jam samples. Maximum ash content was present in Mango Jam-**2**. Most of the bacteria grow at near neutral pH. The overall range of pH is 2 to 5 for common fruits with the most frequent figures being between 3 and 4 (Tasnim *et al.,* 2010). In this study pH of mango juice varies from 2.5 to 3.5 and in case of fruit jam it was ranges from 1.70 to 2.42. pH of fruit juices may increase during storage (Sivakov *et al.*, 1990). Organic acids take the lead in importance for characteristics and nutritive value of fruit juices and confer individual originality among natural beverages. Acidity plays very important role in the flavor of the products (Ullah *et al.* 2005). According to results, in case of juice samples, acidity was higher in sample **B** (0.40%) and lower in sample **C** (0.23%) and among jam samples highest amount of acidity present in Mango Jam-**1** (0.86%) followed by Pineapple Jam-**1** (0.78%) and Pineapple Jam-**2** (0.70%). On the other hand, acidity in Apple

Jam-**1** was (0.54%). Total soluble solids (TSS) contents are related directly to both the sugars and fruit acids as these are the main contributors. Three juice samples **A**, **B**, **C** contain 13% TSS and sample **D** contain 12% total soluble solids. According to Bangladesh standards (BDS 513:2013) brix (TSS) percent in fruits or vegetables juice is minimum 12% and for fruit jam it is ≥ 65. In case of jam samples, result showed that all samples except Mango jam-**1** contain total soluble solids within the reference range (Table 4).

**Table 4. Physicochemical analysis result of juices and jams**

| Parameters | Sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mango Juice (**A**) | Mango Juice (**B**) | Mango Juice (**C**) | Mango Juice (**D**) | Mango Jam-**1** | Mango Jam-**2** | Pineapple Jam-**1** | Pineapple Jam-**2** | Apple Jam-**1** |
| Moisture content (%) | 86 | 85 | 85 | 84 | 31 | 27.5 | 32 | 26.5 | 29 |
| Ash content (%) | 0.031 | 0.031 | 0.053 | 0.079 | 0.090 | 0.092 | 0.023 | 0.031 | 0.068 |
| pH | 3.5 | 2.5 | 3 | 2.8 | 1.75 | 2.42 | 1.75 | 2.40 | 1.70 |
| Acidity as citric acid, % m/m | 0.25 | 0.40 | 0.23 | 0.28 | 0.86 | 0.69 | 0.78 | 0.70 | 0.54 |
| TSS | 13 | 13 | 13 | 12 | 64.00 | 70.50 | 65.00 | 71.50 | 67.50 |
| Total sugar (%) | 11.56 | 11.54 | 11.56 | 11.56 | 58.96 | 65.20 | 59.97 | 66.30 | 62.20 |

Increase in TSS during storage has been reported by Mahajan (1994). It may be occurred due to storage duration difference among the samples. Very slight variation was observed in case of total sugar content among the mango juice samples. But in case of jam it was varied from sample to sample as well as from type of fruit to fruit. The difference between total soluble solid and total sugar may be soluble salt or artificial sweeteners (Table 4).

Heavy metals are non-nutritive toxic element. Its presence above certain limits is normally an indication of contamination. In ready-to-drink beverages permissible limits are zinc 5.0 ppm, copper 2.0 ppm and lead 2.0 ppm (Pearson, 1976; FAO, 1980). The reference value given by BSTI is only for lead and tin and their limit is 1.0 mg/kg and 250 mg/kg respectively for jam. In this study BSTI analysis result confirmed that concentration of As, Pb, Cu, Zn and Sn in all samples were below detection limit.

Microbiological analysis of commercial brand juices and jams sample showed that total plate count and total yeast count was less than 10 cfu/ml or gm for each sample. The microbiological quality of all the commercial products was within the limits of the Gulf standards for fruit juices (Gulf Standards, 2000).

**Table 5. Content of preservatives in juice and jam samples**

| Preservatives | Mango Juice (**A**) | Mango Juice (**B**) | Mango Juice (**C**) | Mango Juice (**D**) | Mango Jam-**1** | Mango Jam-**2** | Pineapple Jam-**1** | Pineapple Jam-**2** | Apple Jam-**1** |
|---|---|---|---|---|---|---|---|---|---|
| Sulphurdioxide mg/kg | 22.26 | 20.51 | 40.62 | 39.33 | - | - | - | - | - |
| Sodiumbenzoate, mg/kg | - | - | - | - | 119.59 | 659.85 | 150.34 | 663.65 | 121.19 |

Sulphur dioxide and Sodium benzoate are quite effective in inhibiting both microbial growth and enzymatic and non-enzymatic browning (Taylor *et al*., 1986; Luck & Jager, 1997). These are common preservative in juice preservation. Maximum amount of $SO_2$ was found in sample **C** (40.62 mg/kg) and lowest amount was found in sample **B** (10.51 mg/kg) (Table 5). Biological studies have shown that very high levels of sulphites can lead to gastric reactions and it is very detrimental to respiratory (Fowlie *et al*., 2006). As a result, in 1994 the European Commission's Scientific Committee on Food (SCF) set an acceptable daily intake (ADI) for sulphur dioxide of 0.7 mg/kg body weight/day. The maximum approved level to human consumption is 10 ppm (Parish, 1997).

Maximum amount of Sodium benzoate was found in pineapple Jam-**2** (663.65 mg/kg) and lowest amount was found in mango Jam-**1** (119.59 mg/kg) among all selected jam samples. In Bangladesh, BSTI reference value for sodium benzoate is 150.0 mg/kg. From lab analysis, it revealed that the use of sodium benzoate to some extent was excess in amount and it was found in Mango Jam-**2** (659.85mg/kg) & Pineapple Jam-**2** (663.65mg/kg) (Table 5). This is due to increase the shelf-life of products for long time. This may also happen to mask the use of actual amount of fruit pulp according to standard formulation. Care should be taken to prevent the use of excessive amount of preservatives; otherwise it may cause an adverse effect on health and our sufferings in the long run.

### Sensory evaluation

In case of juice samples, some variation among the commercial brands was found regarding sensory characteristics such as color, flavor, taste, texture and overall acceptability. This variation might occur due to difference in ingredients, recipes and processing conditions of the samples. Results showed that

Mango Juice **A** secured highest score according to hedonic scale rating and all juices obtained acceptable score regarding organoleptic properties (Table 6). Statistical analysis was done after getting scoring data from the panelists.

**Table 6. Sensory evaluation results of different brands of mango juices**

| Sensory Attribute | Sample | | | |
|---|---|---|---|---|
| | Mango Juice (**A**) | Mango Juice (**B**) | Mango Juice (**C**) | Mango Juice (**D**) |
| Color | 7.0 | 6.0 | 5.0 | 5.0 |
| Flavor | 8.0 | 7.0 | 7.0 | 7.0 |
| Taste | 7.0 | 7.0 | 6.0 | 6.0 |
| Texture | 8.0 | 6.0 | 6.0 | 8.0 |
| Overall acceptability | 7.0 | 6.0 | 7.0 | 8.0 |
| Total | 37 | 32 | 31 | 34 |

**Table 7. ANOVA Table (Juice samples)**

| Source | Sum of Squares | df | Mean Square | F-Ratio | P-Value |
|---|---|---|---|---|---|
| Between groups | 4.2 | 3 | 1.4 | 1.87 | 0.1759 |
| Within groups | 12.0 | 16 | 0.75 | | |
| Total (Corr.) | 16.2 | 19 | | | |

The ANOVA table decomposes the variance of the data into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 1.86667, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to 0.05, there is not a statistically significant difference between the means of the 4 mango juice samples at the 95.0% confidence level (Table 7).

On the other side, in case of jam samples, Apple Jam-**1** scored highest and Mango Jam-**1** scored lowest by the panelists, although every sample was within the satisfactory range according to BSTI scoring range (Table 8). This is due to difference in ingredients and processing conditions of the samples.

**Table 8. Average score for color & texture, taste & flavor and absence of defects for different jam samples**

| Factors | Average score for different jam Samples | | | | | BSTI Range |
|---|---|---|---|---|---|---|
| | Mango Jam-**1** | Mango Jam-**2** | Pineapple Jam-**1** | Pineapple Jam-**2** | Apple Jam-**1** | |
| Color & Texture | 22.5 | 21 | 22 | 22.5 | 22.5 | 20-25 |
| Taste & flavor | 43.5 | 42.6 | 43 | 44 | 44 | 40-50 |
| Absence of defects | 22.5 | 23 | 23 | 23 | 23.5 | 20-25 |
| Total score | 88.5 | 86.6 | 88 | 89.5 | 90 | 80-85 |

**Table 9. ANOVA Table (Jam samples)**

| Source | Sum of Squares | Df | Mean Square | F-Ratio | P-Value |
|---|---|---|---|---|---|
| Between groups | 2.36933 | 4 | 0.592333 | 0.00 | 1.0000 |
| Within groups | 1455.24 | 10 | 145.524 | | |
| Total (Corr.) | 1457.61 | 14 | | | |

The ANOVA table decomposes the variance of the data into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 0.00407035, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is greater than or equal to 0.05, there is not a statistically significant difference between the means of the 5 variables at the 95.0% confidence level.

## Conclusion

The baseline survey of this study denotes most that juice and jam products available in market are adulterated. But upon analysis in respective laboratories of BAU, BSTI and BCSIR it was revealed that there is no harmful chemical compound and heavy metals in commercial brands of juice and jam. Microbial level in all samples was in safe level according to BSTI reference value. According to the results obtained from analysis, these products should be recommended as safe for consumption. As the

consumer is in darkness to judge the innate quality and due to lack in consumer's awareness about the quality of juice and jam, it can be said, in most cases, public perception towards commercially processed fruit product is erroneous to some extent. But it was found that commercially processed juice and jam sample contain scant amount of pulp and excess amount of preservatives. The name of the preservatives used in processed products and their specific quantity should be declared on the label. The government authorized agency such as Bangladesh Council of Scientific and Industrial Research and Bangladesh Standard and Testing Institute should take control and regular monitoring to check physicochemical and microbial quality of processed food. In addition, enforcing law and imposing punishment, social motivation of food processor, adopting BSTI standards, social motivation of food consumers and strengthening supervision by legal authority to control adulteration and improve the quality of fruit products.

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