ORIGINAL SCIENTIFIC PAPER

# An Approach to Quality Assessment and Detection of Adulterants in Selected Commercial Brands of Jelly in Bangladesh

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***Summary***

*The study was conducted to determine the adulteration and assessment the quality of jelly commercially available in local market of Mymensingh, Bangladesh. A comprehensive baseline survey was completed to know consumers attitude towards jelly covering the people of different sections of society. It was found that most of the consumers did not want to consume this product as they believed that all commercial jellies were adulterated. Analytical works were done in laboratories of Bangladesh Agricultural University, Bangladesh Standard Testing Institute, Bangladesh Council of Scientific and Industrial Resesarch, and SGS, Bangladesh. Physico-chemical characteristics of jelly samples were tested in BAU laboratory. Total soluble solid content, pH, acidity, ash content of commercial brand samples were tested. Jelly samples were also analyzed in Bangladesh Standard Testing Institute laboratory to determine acidity as citric acid (% m/m), sodium benzoate (mg/Kg), arsenic (mg/Kg), lead (mg/Kg), copper (mg/Kg), zinc (mg/Kg), and tin (mg/Kg). From the analysis it was also clear that every commercial brand sample contained preservative to extant shelf life of the product. But it is injurious to human health to consume this type of product for long time. Increased dose of preservative was used in jellies to inhibit the growth of microorganisms particularly for yeasts and molds. According to the microbial evaluation, the samples of jelly were safe to consume. A sensory panel test was performed to judge the sensory attributes of the commercial jelly. All the samples obtained good scores. However, the jelly samples are adulterated with artificial sweetener and preservatives.*

***Keywords:*** *Adulteration, preservative, jelly, mango, pineapple, Bangladesh*

## Introduction

Food quality is the quality characteristics of food that makes food acceptable to consumers. It denotes the degree of excellence of a product. Major categories of food product quality attributes include food safety, nutritional value, package, and process attributes (Caswell *et al.,* 1992). On the other hand food safety is an important global public health issue to ensure sound health, refers to addressing "all those hazards, whether chronic or acute, that may make food injurious to the health of the consumer" (FAO, 2003). Food safety can be defined in a broad or in a more narrow way (Ritson and Mai, 1998). In the narrow sense, food safety can be defined as the opposite of food risk, i.e. as the probability of not contracting a disease as a consequence of consuming a certain food. In the broad sense, food safety can be viewed as also encompassing nutritional qualities of food (Grunert, 2005). Food safety is an alarming issue in Bangladesh. It has become an important topic as consumers in Bangladesh have become victim of serious adulteration in food. Now a days, consumers have knowledge about the safety, nutritional value, aesthetic value, proper use and also cost of preparation of foods which they buy but these are not sufficient for judgment. They have a right to know what is in a processed product.

Fruits are processed in many forms of value added products like juices, squashes, jams, jelly, chutneys, pickle, nectars, and frozen slices etc. These products have long storage life and delicious to eat. Fruit jellies are very invigorating and delicious products that are very popular throughout the world. The process of making jelly is a method of preserving ripe fruit, adding value to the final product (Gava *et al.,* 2008). Jelly is defined as a semisolid food made from not less than 45% (by weight) fruit juice and 55% (by weight) sugar (Smith, 2006). Various types of preservatives are used presently in fruit products. There is no preservative that is completely effective against all microorganisms present in a given foodstuff. In theory, one should be able to combine various preservatives to achieve a broader spectrum and increased antimicrobial action (Lueck, 1980).

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. However,

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this present study was undertaken to know the public opinion about the quality of processed jelly, to analyze important parameters of jelly required to assess the quality, to compare the parameters assessed with standards of Bangladesh Standard and Testing Institution (BSTI) as well as to assess the adulterants present jelly.

## Materials and Methods

### Baseline Survey

Before starting laboratory experiment a comprehensive Baseline Survey had been conducted to know the public response about the adulteration in different jelly available in the local market. In the survey, people of different areas of society such as scientists, doctors, researchers, food processors, food factory managers, traders and consumers were participated. Total 1054 questionnaires were distributed among the respondents. Quantitative and Qualitative data were converted into scoring wherever necessary. Data obtained from the respondents were first transferred to a master sheet, then compiled, coded, tabulated, and analyzed in accordance with the objectives of the study. Statistical measures such as number and percentage distribution, range, mean, and standard deviation were used in describing different variables. The data were entered into computer by using Microsoft Excel spread sheet and SPSS (Statistical Package for Social Sciences) package program.

### Laboratory Experiment

The experiment was conducted in the laboratory of Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh, Bangladesh; Bangladesh Standards and Testing Institution (BSTI), Dhaka, Bangladesh; Institute of Food Science & Technology (IFST), Bangladesh; Bangladesh Council of Scientific and Industrial research (BCSIR), Dhaka, Bangladesh, and SGS Bangladesh Ltd.

### Materials Required

Fresh, fully matured, and ripe pineapples were collected from local market. Sugar, acid (Citric acid), pectin, and other required materials were used from the laboratory stock. The glass jar was used in the filling of jelly. Jellies of two commercial brands were collected from local market, Ganginapar market, and Notun Bazar market of Mymensingh city. This experiment was conducted with a handmade and two samples of two commercial brands jelly. For analyzing the parameters, these products of jelly were coded with A, B, & C. Specification was done as,

A = Commercial brand of pineapple jelly, B = Commercial brand of mango jelly, and C = Non-brand pineapple jelly

*Preparation of Jelly*

Firstly, the frozen fruit juice was defrosted one day before cooking. On the following day sugar and juice were weighed according to the formulation and heated to boiling and allowed to boil for 5-10 minutes. Citric acid dissolved in water was added at this stage. Calculated amount of Pectin and sugar was mixed with each other and added to the cooking pot. The mixture was allowed to boil for further 5 minutes to ensure complete dissolution of pectin. Soluble solids were determined before pouring the hot jellies in to desired glass jars. The surface of the jelly was covered with melted wax (paraffin) that solidified on cooling thus sealing the surface. The processed products were then stored at ambient temperature (in cool and dry place). The jellies, which developed mold on surface or were infested with insects were excluded from testing. No preservatives were used in prepared the handmade jelly.

#### *Analysis of Handmade Jelly*

Prepared pineapple jelly were analyzed for its moisture content, total soluble solids (TSS), active acidity (pH), ash content, reducing sugar, non-reducing sugar, and total sugar. These tests were conducted in the laboratory of Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Bangladesh.

#### *Determination of Moisture Content*

Moisture content was determined by following the AOAC official method 934.06 (2005).

#### *Determination Total Soluble Solids (TSS) Content*

Two drops of prepared sample was taken in a refractometer (Model no. 8987, PujiKuki Ltd. Tokyo, Japan) plate and the total soluble solids of the samples were read directly from the refractometer.

#### *Determination of Active Acidity (pH)*

The pH of the juice was measured by using PERKINFLMER Metrion V pH meter at an ambient temperature.

#### *Determination of Ash Content*

AOAC method 14.006 (2005) was used to determine the total ash content.

#### *Estimation of Total Sugar, Reducing Sugar and Non-Reducing Sugar*

Total sugar, reducing and non reducing sugar content of the sample was determined by following the method of Rangana (1991)

### Analysis of Jelly from Selected Commercial Brand

#### *Determination of Moisture Content*

Moisture content was determined by following the AOAC official method 934.06 (2005).

#### *Determination Total Soluble Solids (TSS) Content*

Two drops of prepared sample was taken in a refractometer (Model no. 8987, PujiKuki Ltd. Tokyo, Japan) plate and the total soluble solids of the samples were read directly from the refractometer.

#### *Determination of Ash Content*

AOAC method 14.006 (2005) was used to determine the total ash content.

### *Estimation of Total Sugar, Reducing Sugar and Non-Reducing Sugar*

Total sugar, reducing and non reducing sugar content of the sample was determined by following the method of Rangana (1991)

### *Determination of Sodium Benzoate*

AOAC method 963.19 (2000) was used for the determination of sodium benzoate.

### *Determination of Sulfur Di Oxide*

AOAC method 975.32 (2000) was used for the determination of sulfur di oxide.

## Microbial Evaluation

*Yeast and mould count per gram*

Yeast and mould count of selected fruit jelly and squash was done according to the method as described in the "Recommended Method for the Microbiological Examination of Food" (APHA, 1967).

### *Fruit juice content determination*

Raw juice was diluted into six different concentrations and ash content for each concentration was determined. A standard curve; ash content versus pulp concentration was plotted in Microsoft Excel. Ash content of each commercial sample was determined. Ash content value of each commercial sample was put into standard curve and Correspond value for pulp content were determined.

### *Determination of Artificial Sweeteners, Salt (Other Soluble Solids)*

The determination of other soluble solids (artificial sweeteners, salt etc) was done by BCSIR test laboratory.

Artificial Sweeteners, Salt = Total Soluble Solid (%) - Total Sugar (%)

### *BSTI Analyses for Commercial Brand Jelly*

Chemical testing wing of Bangladesh standards and testing institution (BSTI) performed some chemical tests of jellies.

### *Determination Total Soluble Solids (TSS) Content*

Two drops of prepared sample was taken in a refractometer (Model no. 8987, PujiKuki Ltd. Tokyo, Japan) plate and the total soluble solids of the samples were read directly from the refractometer.

### *Determination of acidity as citric acid, % m/m*

AOAC method 942.15 (2000) was used to determine acidity.

### *Determination of Sodium Benzoate*

AOAC method 963.19 (2000) was used for the determination of sodium benzoate.

### *Determination of Sulfur Di Oxide*

AOAC method 975.32 (2000) was used for the determination of sulfur di oxide.

### *Yeast and Mould Count Per Gram*

Yeast and mould count of selected fruit jelly and squash was done according to the method as described in the "Recommended Method for the Microbiological Examination of Food" (APHA, 1967).

### *Determination of Lead, Zinc, and Copper*

Lead, Zinc, and Copper were determined by following AOAC method 999.11 (2000)

### *Determination of Arsenic in Products*

Arsenic was determined by following AOAC method 952.13 (1990)

### *Determination of Tin in Products*

Tin was determined according to the method of ICMR (1990)

### *Sensory Evaluation*

For awarding scores to jelly samples they were judged by a panel of five judges. All the judges constituting a panel were conversant with the factors governing the quality of the product. The containers were opened and the content poured separately into white porcelain bowls. Each judge independently examined the contents from each of the containers and indicated scores for different characteristics. The judges considered the characteristics of color and texture; taste and flavor, and absence of defects.

## Results and Discussion

## Baseline Survey Results

### *Status of adulteration in jelly*

This survey was performed to know the opinions of general people of our society. 1054 questionnaires were distributed among the respondents and 996 complete questionnaires were received from them and most of the respondent's opinion is shown in table 1.

### *Adulterants Used in Jelly*

Different types of adulterant may use in fruit jelly like; non-permitted artificial sweeteners, excessive amounts of

***Table 1.*** *Status of Adulteration in Selected Processed Products (fruit jelly)*

| Total respondent | Responses | | Valid % | |
|---|---|---|---|---|
| | Adulterated | Not-Adulterated | Yes | No |
| 996 | 960 | 36 | 96.40 | 3.60 |

*From table 1 it is clear that 96% people of our society think that jellies available in local market are adulterated*

permitted preservatives, harmful colors, artificial flavor, and harmful preservatives.

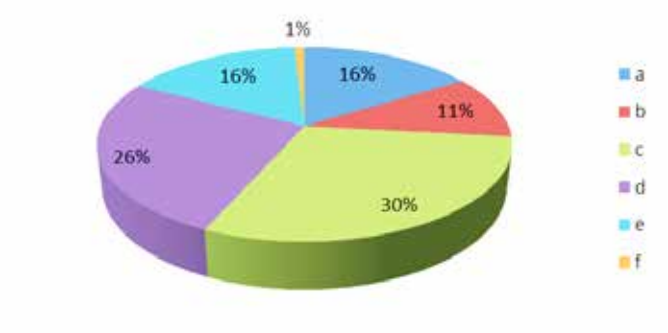


***Figure 1.*** *Level of Consumer Response About the Individual Adulterants Present in Jelly Samples*

*Here, a = Non-permitted artificial sweeteners; b = Excessive amounts of permitted preservatives; c = Harmful colors; d = Artificial flavor; e = Harmful preservatives and f = others.*

Consumers thinking about the type of adulterants usually used in jelly have been shown in figure 1. In all of jelly products, the use of harmful food colors is the highest (30%) which is followed by artificial flavor (26%). The use of non-permitted artificial sweeteners and harmful preservatives is in third position (16%) for all the selected processed fruit jelly.

### *Status of Quality and Safety of Processed Fruit Jelly*

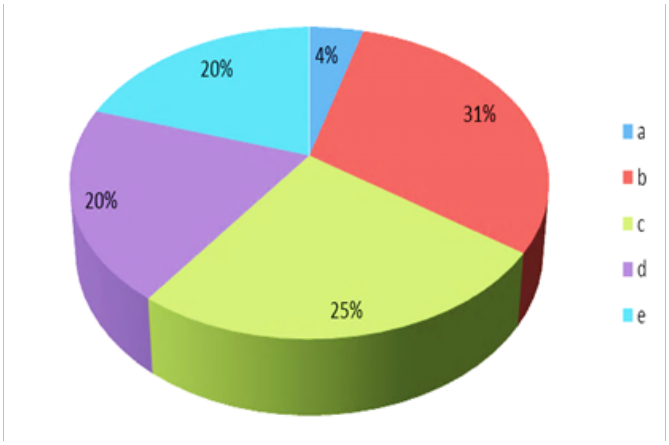


***Figure 2.*** *Status quality and safety of fruit jelly*

*Here, a = Healthful for the consumers; b = Harmful for the consumers; c = Don't contain fruit pulp; d = Contain little fruit pulp and e = Contain fruit flavor only*

Data collected from different respondent about quality and safety issue of fruit jelly is shown in fig. 2. Only 4% respondent said that fruit jellies are healthful for the children. On the other hand 31% people think it is harmful for consumers; 25% think that they don't content fruit juice and both case, 20% people think that they contain little fruit juice and flavor only.

### *Preventive measures to control adulteration in processed food*

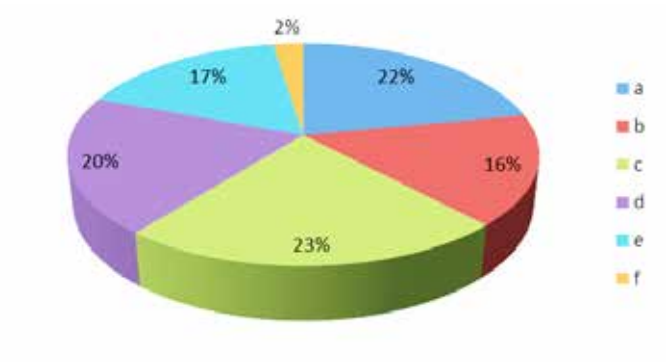


***Figure 3.*** *Status of preventive measures to control adulteration*

*Here, a = Enforcing law and imposing punishment; b = Social motivation of food processor; c = Adopting BSTI standards; d = Social motivation of food consumers and e = Strengthening supervision by legal authority*

The preventive measure needs to be undertaken to control adulteration in processed food indicated by a good number of respondents are shown in figure 3. According to the respondents, the first preventive measure should be "Adopting BSTI standard" (23%). The second and third preventive measures should be "Enforcing law and imposing punishment" (22%) and "Social motivation of food consumers" (20%) respectively.

## Physico-Chemical Analysis of Jelly in the Laboratory of Bangladesh Agricultural University, Bangladesh

### *%Moisture content*

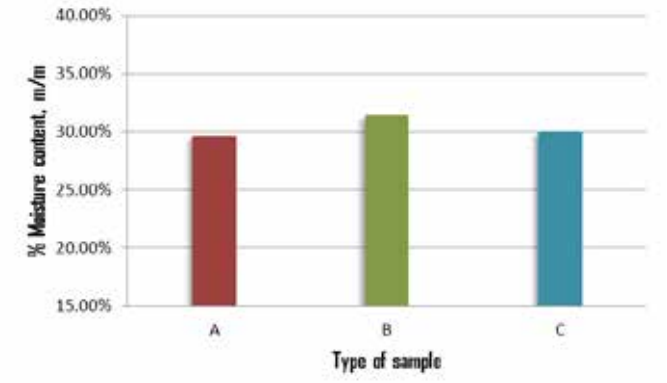


***Figure 4.*** *Moisture content (%) of coded jelly samples*

*Here, A = Commercial brand pineapple jelly, B = Commercial brand mango jelly, C = Non-brand pineapple jelly*

Figure 4 shows that, moisture content of commercial brand pineapple and mango jelly was 29.62% and 31.40% respectively. In handmade jelly moisture content was 30.00%. High moisture content is important factor affecting the flavor of product (Akubor, 1996). Product having high moisture content has minimum self-life (Ayub, 2005).

### *Total Soluble Solids (TSS) Content*

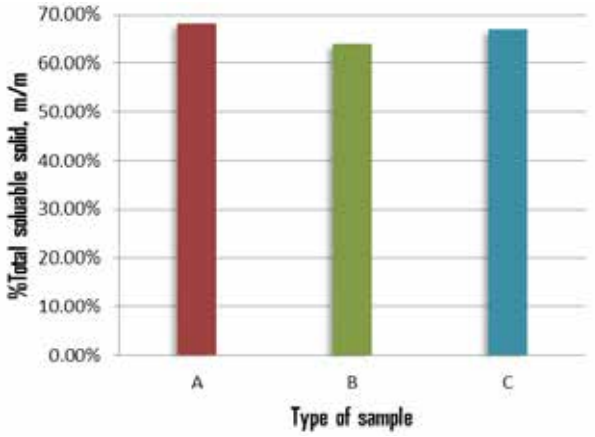


***Figure 5.*** *Total soluble solids, % m/m of coded jelly samples*

*Here, A = Commercial brand pineapple jelly, B = Commercial brand mango jelly, C = Non-brand pineapple jelly.*

The TSS of commercial jellies and handmade jelly was different from each other. Minimum TSS of 63% was recorded in sample B and A contained maximum 68% respectively. TSS content of handmade jelly was 67%. Several researchers have observed an increase in total soluble solids of fruit products during storage. This was obviously due to the loss of moisture. Tremazi (1967) reported that total soluble solids increased in canned Pakistani peaches on storage. Riaz *et. al*. (1999) observed an increase in total soluble solids of strawberry jam during storage. Anjum *et. al.* (2000) reported that soluble solids increased gradually during storage in dried apricot diet jam. The mean of TSS was 68.95% at 0 days which rose to 69.60% after 60 days of storage. Total soluble solids (TSS) contents are related directly to both the sugars and fruit acids as these are the main contributors. Pectins, glycosidic materials and the salts of metals (sodium, potassium, calcium etc.), when present, will also register a small but insignificant influence on the solids figure. Desrosier and Desrosier (1978) stated that the optimum solid range is slightly above 65%. It is possible to have gel formation at 60% solids, by increasing the pectin and acid levels.

### *Active Acidity (pH)*

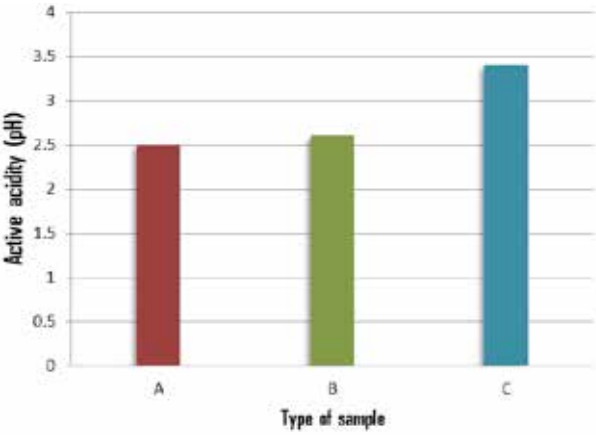


***Figure 6.*** *Active acidity (ph) of coded jelly samples*

*Here, A = Commercial brand pineapple jelly, B = Commercial brand mango jelly, C = Non-brand pineapple jelly*

Results regarding the effect of various preservatives on pH of jelly showed that the preservatives decrease pH of jelly. Commercial jellies were also slightly different from each other. On the other hand, the active acidity (pH) of handmade jelly was closed to the standard value 3.4. pH value of pineapple and mango jelly are 2.5 and 2.6 respectively. The overall range of pH was 2 to 5 for common fruits with the most frequent figures being between 3 and 4. Most of the bacteria grow at near neutral pH. The low pH value ranges from 2.5–3.8 inhibits most bacteria, but leaves yeasts unaffected. Yeasts in general, remain the key spoilage organisms because of their overall physiology and resistance to organic acid preservatives (Stratford *et al.*, 2000). Several researchers have reported different pH values for optimum jelling. Desrosier and Desrosier (1978) stated that gel formation occurs only within a narrow range of pH values. Optimum pH conditions were found near 3.2 for gel formation.

### *% Ash Content*

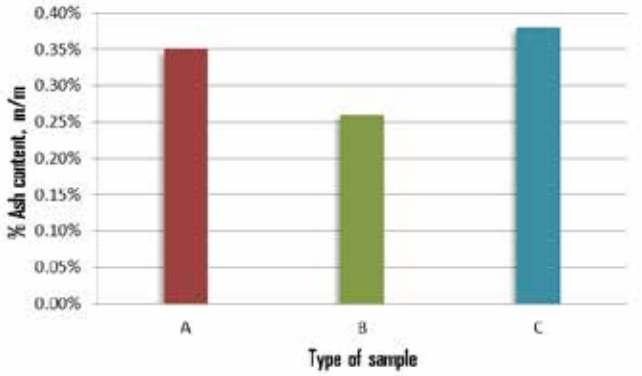


***Figure 7.*** *Ash content (% m/m) of coded jelly samples*

*Here, A = Commercial brand pineapple jelly, B = Commercial brand mango jelly, C = Non-brand pineapple jelly*

Ash content indicate cumulative amount of mineral present in food. The ash content of pineapple jelly was 0.35%. But in mango jelly ash content was 0.26%. In handmade made jelly, ash content was high (0.38%). Ash content may vary due to variation in fruit juice content. Ash content increased with the increase of fruit juice. Variation in ash content of the commercial brands may also due to presence of artificial sweeteners, salt, preservatives etc.

### *Sodium Benzoate, mg/kg*

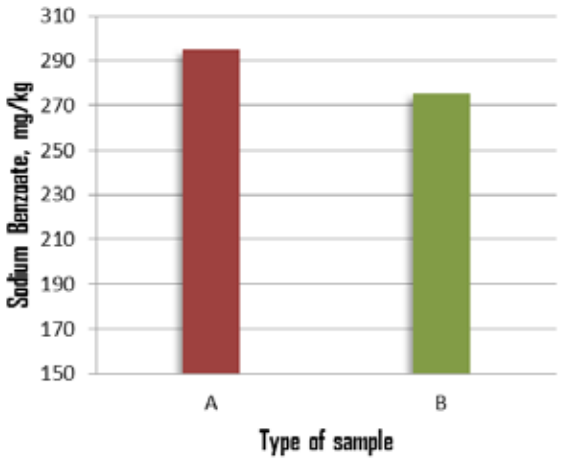


***Figure 8.*** *Sodium benzoate, mg/kg of coded jelly samples*

*Here, A = Commercial brand pineapple jelly, B = Commercial brand mango jelly*

From the result it is clear that preservative increases the acidity of sample during storage. It is important to control spoilage of jelly like products as sodium benzoate is an antimicrobial agent. It is more effective against yeasts than molds. Moreover it does not stop acetic acid and lactic acid fermentation. The quantity of sodium benzoate required depends on the nature of the product to be preserved, particularly its acidity. According to BSTI, the reference value for adding sodium benzoate is found 100mg/kg to be sufficient. Jelly samples with lower acidity require higher concentration of sodium benzoate. Figure 8 represented that a fair amount of sodium benzoate was used in different commercial brand for improving and increasing their self-life and in some cases it was very much excess in amount. Sodium benzoate in excess of 0.1 percent may produce disagreeable burning taste and it may cause adverse effect on health. So care must be taken before adding sodium benzoate.

## Microbial Evaluation

***Table 2.*** *Total plate count, yeast and mould count of coded jelly samples per gm*

| Samples | Total plate count per gram | Yeast and mould count per gram |
|---|---|---|
| A | 13 cfu | 11 cfu |
| B | 12 cfu | 10 cfu |
| C | 10 cfu | 10 cfu |

*Here, A = Commercial brand pineapple jelly, B = Commercial brand mango jelly, C = Non-brand pineapple jelly*

The colony counts of fungi are presented in Table 2. Plate count of mango jelly was 12cfu/gm but in pineapple jelly it was 13cfu/gm. Yeast and mould count was 11cfu/gm for pineapple jelly and 10cfu/gm for mango jelly. According to microbial standards mold count should not exceed 100cfu/gm.Visible mold was not seen on any sample. Different preservatives and their doses were similarly effective against mold during 90 days of storage. A minimum dose of 0.05% of sodium benzoate, potassium sorbet or combined is enough to preserve for 3 months. Felco *et al.,* (1993) reported that sodium benzoate and potassium sorbet reduced microbial count in samples of the jam; potassium sorbet was more effective than sodium benzoate. Periodic counts of mesophiles, molds and yeasts in jam treated with 500 ppm potassium sorbet confirmed its effectiveness.

## Juice Content

Figure 9 shows the fruit juice content of different coded jelly samples. The juice content of pineapple and mango jelly was 33.00% and 13.50% respectively. The standard value of juice content in jelly was 45%. In handmade jelly the juice content was equal to the standard value.

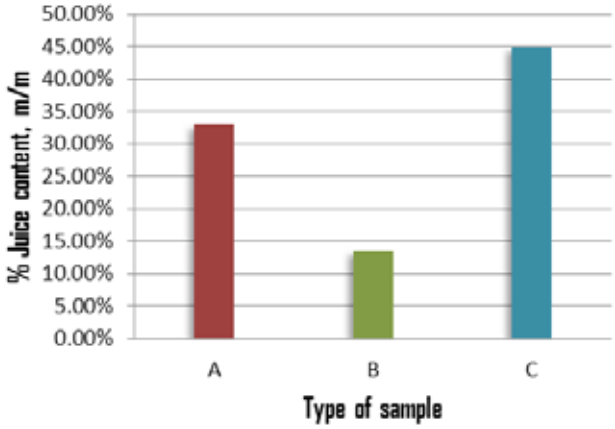


***Figure 9.*** *Juice content (%) of coded jelly samples*

*Here, A = Commercial brand pineapple jelly, B = Commercial brand mango jelly, C = Non-brand pineapple jelly*

## Reducing Sugars, Non-Reducing Sugars and Total Sugars

***Table 3.*** *Amount of reducing, non-reducing and total sugars in jelly samples*

| Parameters | Type of sample | | |
|---|---|---|---|
| | A | B | C |
| Reducing sugar | 28.53% | 24.65% | 28.64% |
| Non- reducing sugar | 34.97% | 33.55% | 34.80% |
| Total sugar | 63.50% | 58.20% | 63.44% |

*Here, A = Commercial brand pineapple jelly, B = Commercial brand mango jelly, C = Non-brand pineapple jelly*

### *Reducing Sugars*

From Table 3 we can see that reducing sugar content of sample A (28.53%) was greater than sample B (24.65%). But in the preservative free handmade sample C contained 28.64% reducing sugar. This difference may be due to the effect of different processing techniques. Commercial jellies are processed in vacuum condition. During processing, different types of sweeteners are used to obtain proper texture. Reducing sugars showed increasing trend with storage period. da Silva Junior *et al.,* (2013) developed a jelly from cactus pear fruit which con-

tains 21.6% reducing sugar. Anjum *et. Al,.* (2000) while working on apricot diet jam observed increase in reducing sugars. Desrosier and Desrosier (1978) emphasized that a balance is required between the sucrose and invert sugar content of the jelly. Low inversion may result in crystallization, high inversion in granulation of dextrose. The amount of invert sugar present should be less than the amount of sucrose. Egan *et. al.,* (1981) 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. The modern use of glucose syrups in jams and jellies considerably reduces the tendency to crystallization.

### *Non- Reducing Sugars*

Between the commercial jellies, sample A had 34.97% and sample had 33.97% non-reducing sugar. The presence of low non-reducing sugar is contradictory to the claims of Desrosier *et. al.* (1978) and Egan *et. al.* (1981). This may be due to the addition of mixtures of sweeteners, still attaining acceptable texture without using conventional ratio 60% of sucrose.

### *Other Soluble Solids (Artificial Sweeteners, Salt etc.)*

Biochemical Analysis in the Laboratory of Bangladesh Council of Scientific & Industrial Research (BCSIR), Bangladesh

***Table 4.*** *Other soluble solids (artificial sweeteners, salt etc.). test results for jelly samples*

| Samples | Total Soluble Solid (%) | Total Sugar (%) | Other soluble solid (Artificial Sweeteners, Salt etc.) (%) |
|---|---|---|---|
| A | 69.20 | 64.19 | 5.01 |
| B | 63.94 | 58.58 | 5.36 |
| C | 66.84 | 62.96 | 3.88 |

*Here, A = Commercial brand pineapple jelly, B = Commercial brand mango jelly, C = Non-brand pineapple jelly*

The samples were sent to BCSRI for soluble solid test. Table 4 shows that total soluble solid (TSS) content of pineapple jelly was 69.20% and in mango jelly TSS was 63.94%. The total sugar content of the jellies was 64.19% and 58.58% respectively. In non-brand handmade sample total sugar level was 62.96%. The difference between TSS (Total Soluble Solid) and TS (Total Sugar) shows that there may present other soluble solids. It may include artificial sweeteners, salt etc. Other soluble solids may use for improving the texture quality, flavor and preservation purpose.

### Physico-Chemical Analysis of Jelly in the Laboratory of Bangladesh Standards and Testing Institution (BSTI)

In BSTI they found total soluble solid was greater in commercial brand pineapple jelly (68.72%) than in commercial brand mango sample (63.62%). But in BAU lab analysis these values were **68.00**% and **63.00**% respectively, which are quite similar to each other. From the data we can see that the TSS values of commercial mango jelly is below the range of Reference value of BSTI which is showed in table 5 (i.e. ≥65.00). Increase in TSS during storage has been reported by Mahajan (1994). It may be occurred due to storage duration difference among the samples. Acidity of both samples as citric acid was 0.59%. In non-brand handmade jelly acidity was low (0.31%). This value is below the reference value (0.90%) decleared by BSTI. It is a common preservative in jelly preservation. Sodium benzoate level of pineapple jelly was **269.72** mg/kg and in mango jelly it was **264.31**mg/kg. Maximum permitted limit for sodium benzoate is different, according to country law, like somewhere it is 250ppm. In Bangladesh, BSTI reference value for sodium benzoate is 100.0 mg/kg. By this sense, commercially, the use of sodium benzoate to some extent is excess in amount. 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 juice according to standard formulation. Care should be taken to prevent the use of excessive amount of pre-

***Table 5.*** *Physico-chemical analysis of commercial jelly products in BSTI*

| Tested parameters | Test Results | | | |
|---|---|---|---|---|
| | Samples | | | |
| | A | B | C | Reference value |
| Total soluble solids, %m/m | **68.72** | **63.62** | 66.94 | ≥65.00 |
| Other soluble solid (artificial Sweeteners, Salt etc. (%) | 5.40 | 5.40 | 3.62 | - |
| Acidity as citric acid, % m/m | 0.59 | 0.59 | 0.31 | ≤0.90 |
| Sodium benzoate, mg/kg | **269.72** | **264.31** | - | 100 |
| Total plate count per ml | <10 cfu | <10 cfu | <10 cfu | - |
| Yeast count per ml | <10 cfu | <10 cfu | <10 cfu | - |
| Arsenic (as As), mg/kg | BDL* | BDL* | BDL* | - |
| Lead (as Pb), mg/kg | BDL* | BDL* | BDL* | 1.00 |
| Copper (as Cu), mg/kg | BDL* | BDL* | BDL* | - |
| Zinc (as Zn), mg/kg | BDL* | BDL* | BDL* | - |
| Tin (as Sn), mg/kg | BDL* | BDL* | BDL* | 250.00 |

**Below Detection Limit*

*Here, A = Commercial brand pineapple jelly, B = Commercial brand mango jelly, C = Non-brand pineapple jelly*

servatives, otherwise it obviously cause an adverse effect on health and our sufferings in the long run.

Some metals such as arsenic (As), lead (Pb), copper (Cu), zinc (Zn) and tin (Sn) are nutritionally important while lead is a non-nutritive toxic element. The presence of these elements above certain limits is normally an indication of contamination, although the reference value given by BSTI is only for lead and tin and their limit 1.0 mg/kg and 250 mg/kg respectively for jelly. In this study BSTI analysis result shows that concentration of As, Pb, Cu, Zn and Sn in all samples were below detection limit (BDL).

### *Sensory Evaluation of Fruit Jelly*

***Table 6.*** *Average score for color & texture, taste & flavor and absence of defects for different jelly samples*

| Factors | Average score for different Jelly Samples | | | BSTI Range |
|---|---|---|---|---|
| | A | B | C | |
| Color & Texture | 23.2 | 23 | 20.6 | 20-25 |
| Taste & flavor | 41.8 | 42.8 | 42.4 | 40-50 |
| Absence of defects | 23.2 | 22.8 | 21.2 | 20-25 |
| Total score | 88.2 | 88.6 | 84.2 | 80-85 |

*Here, A, B = Commercial brand jelly and C = Non-brand pineapple jelly*

### *Color & Texture*

The first judgment of any product is done by seeing. So, color is one of the most important sensory attributes which add to the aesthetic value of a product. From the average score obtained for color and texture all the samples obtained scores within the range set by BSTI. Among three products of jelly, sample A got highest score. But all jellies scored in the range of BSTI standard value. This indicates that all the samples have acceptable color quality.

### *Taste & Flavor*

All the jelly samples have pleasant aroma, taste, and characteristic flavor of the product, free from any objectionable smell or odor are desirable. Table 6 represents that, sample B obtained the maximum score. But all scores were within the range of BSTI. Several factors influence the taste and flavor of the jelly samples such as cooking period, fruit maturity and fruit content. The values from the table indicated pleasant aroma, taste and characteristic flavor of the product, free from any objectionable or off-taste smell or odor according to the score card given by BSTI.

### *Absence of Defects*

Jelly samples should be free from defects such as extraneous material and grit; free from visible fungal attack. From the table 6 it was observed that scores obtained by all the samples were satisfactory according to BSTI score card.

## Conclusions

The survey was conducted on the quality issue of commercial brand jelly. From the respondent 90-96% think that jelly available in local market is adulterated or harmful for health. Samples analyzed in the laboratory of BAU, BSTI, and BCSIR shows that, moisture content, total soluble solids, acidity as citric acid, pH, reducing sugars, non-reducing sugars, total sugar, plate count, yeast and mould count, heavy metals (as As, Pb, Cu, Zn and Sn) content in different jelly samples is in an acceptable level. In the case of preservative, squash had sulfur dioxide as preservative. Level of sulfur dioxide was in acceptable level (150 mg/kg is the standard value according to BSTI). But in the jelly level of sodium benzoate, as preservative, is comparatively high in the commercial brand jellies. Excessive amount of preservative can harm the consumer health. Jellies are prepared from fruit juice. Fruit juice content of commercial brand jellies were varied from 13% to 33%. But the standard value of juice content is 45%. To increase the total soluble solid proportion of additional sugar was increased. Other solids like artificial sweetener, salts etc. were also used to increase TSS. The jelly products were tasted to judge sensory quality by five semi trained panelists using particular score card provided by BSTI. According to the score given by the panelists, all the samples have satisfactory sensory attributes. They suggested that the samples are safe and fit for human consumption. According to the chemical and sensory analysis of the selected commercial jellies, 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.

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