

## Effect of Pectin on the processing and preservation of Strawberry (*Fragaria ananassa*) jam and jelly

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### ABSTRACT

This study was conducted to investigate the interaction of different concentration of pectin and its dissipation from processing to storage of strawberry (*Fragaria ananassa*) jam and jelly. The fruits were collected from local market of Sylhet, Bangladesh. The analysis showed juice contains acidity 1.14±0.01 %, total sugar 0.61±0.06 %, TSS 8.98±0.03 % and pulp restrain acidity 01.02±0.01 %, total sugar 5.04±0.06 %, and TSS 8.57±1.36 %. Jam and jelly were prepared with 0.5%, 1% and 1.5% pectin. Potassium metabisulphate (KMS) was added as preservative in a required quantity. Study showed pectin do not significantly interact with quality attributes of processed product. During six month of storage at ambient temperature (27 °C to 34 °C) no mentionable changes were found. But P<sup>H</sup> of the products (jam and jelly) was slightly increased. At six month red color of 0.5 % pectin containing jam slightly faded and cohesiveness of 1% and 0.5 % pectin containing jelly considerably changed. A taste panel consisting 10 panelists adjudged the acceptability of the samples. The consumer's preferences were measured by statistical analysis. Among the samples, both jam and jelly made with 1.5% pectin was commended as best product by the panelists at p<0.05.

**Key words:** Jam, Jelly, Pectin, Strawberry

### INTRODUCTION

Strawberry (*Fragaria ananassa*) is one of the economically important edible fruits throughout the world, especially in USA, Japan, Mexico, Italy and Lebanon. This is not really a berry but an achene or false fruits. They are widely used in food stuffs ice-creams, jams, jellies, squashes, syrups, confectionaries, bakeries, chocolates and even medicines for their extraordinarily rich flavor, taste and color. Strawberry is excellent source of vitamin C, good source of folate and potassium<sup>[1]</sup>. More than 50% of the sucrose in strawberries is glucose. The fruit contains mainly citric acid and some malic acid. The red color of the fruit is due to anthocyanin pigment. The flavor of the fruit present in it is due to present of many volatile esters<sup>[1]</sup>. Strawberries vary in level and types of acids they contain. For example, a study of "Camarosa" and "Selva" strawberries showed citric acid, malic acid and ascorbic acid contents as 0.76%, 0.13%, 0.04% and 0.5%, 0.0% and 0.04% respectively<sup>[2]</sup>. The health benefits of strawberry include eye care, proper brain function, and relief from high blood pressure, arthritis, gout and heart diseases etc.

It is a highly perishable fruits due to high respiration, weight loss and fungus attack. The shelf-life of fresh produce is limited to 1-2 days at room temperature<sup>[3]</sup>. To extend the shelf life, reduce the transportation loss, diversifying consumption form and magnifying the techno-economical prospect this fruits item is processed to jam and jelly. Jam and jelly are simple and rewarding ways to preserve strawberry.

Strawberries are low pectin fruits so jam and jelly usually call for added pectin<sup>[4]</sup>. Pectin is known as pectic polysaccharide which helps jellification in proper concentration of p<sup>H</sup> and sugar. Different concentrations of added pectin bring variability in organoleptic and physico-chemical properties of jam and jelly. As the p<sup>H</sup> of a jellifying mixture is raised the strength of the jelly it forms diminishes (other conditions, such as total solids concentration, remaining unaltered)<sup>[5]</sup>. If the p<sup>H</sup> is raised sufficiently, the mixture fails to form a jelly; on the other hand, if acid is added the jelly increases in strength down to a p<sup>H</sup> at which the strength reaches a maximum<sup>[5]</sup>.

As no much product diversification or preservation methods are undertaken for this fruit in Bangladesh therefore the present study was carried out to develop strawberry jam and jelly, and find out the effect of pectin on processing and preservation of strawberry jam and jelly.

### MATERIALS AND METHODS

The strawberry fruit (*Fragaria xananssa*) was collected from the local market. The major ingredients for the preparation of products were sugar, citric acid, pectin and other chemicals were used from the laboratory store.

#### Extraction of pulp

The fully ripe healthy and fresh strawberries were washed thoroughly with potable water and the skin was removed by a knife. The seeds were removed

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and then blended by a blending machine. The pulp thus obtained was preserved by freezing.

### Chemical analysis

At first analysis carried out for raw fruits and subsequently for processed products. Vacuum oven drying method described by Endel Karmas was used for determining moisture content where the temperature was maintained at 70°C and pressure 50-100 mg of Hg<sup>6</sup>. The acidity was determined by titration using standard sodium hydroxide solution and expressed as anhydrous citric acid. p<sup>H</sup> was measured by a p<sup>H</sup> meter and the ascorbic acid content in the products was estimated by titrimetric method estimated by Rangana<sup>7</sup>. AOAC method was used to determine the ash content and sugar by Lane and Eynon method<sup>6,8</sup>. Total soluble solids (TSS) also estimated by the method described by Rangana<sup>7</sup>.

### Processing of jam:

Selected fresh mature strawberries were weighted and washed them thoroughly with cold water. Cut the washed fruits with a stainless steel knife into small pieces. Pulp was extracted from strawberry fruit and adjusted the pH by addition of citric acid or sodium hydroxide. Then the pulp was filtered, strained and mixed. Keep the mixed contract in deep container. Carefully decant the extract. For jam 450g of strawberry pulp, 550g sugar was taken in a container. Then pectin was mixed in 3 proportions 1.5%, 1.0%, and 0.5% with sugar thoroughly. Then cooking the pulp and sugar mix. When it was reached 55% TSS then pectin with sugar mix was added. Cooked the mixer until its TSS 65% tested by Refractometer. The cooking temperature maintained at 104-105°C. Then Citric acid 5g and KMS 300ppm were added for each of the product. Pour the finished products into clear dry sterilized glass jars.

### Processing of jelly

Selected fresh mature Strawberry was weighted and washed them thoroughly with cold water. Cut the washed fruits with a stainless steel knife into small pieces. Pulp was extracted from strawberry fruit and adjusted the p<sup>H</sup> by addition of citric acid or sodium hydroxide. Then the pulp was filtered, strained and mixed. Keep the mixed contract in deep container. Carefully decant the extract. For jam 450g of strawberry juice, 550g sugar was taken in a container. Then pectin was mixed in 3 proportions 1.5%, 1.0%, and 0.5% with sugar thoroughly. Then cooking the pulp and sugar mix. When it was reached 55% TSS then pectin with sugar mix was added. Cooked the mixer until its TSS 65% tested by Refractometer. The cooking temperature maintained at 104-105°C. Then Citric acid 5g and KMS 300ppm were added for each of the product. Pour the finished products into clear dry sterilized glass jars.

### Storage studies

Processed jam and jelly was stored at ambient temperature (27 °C to 34 °C) for a period of 6 months and quality parameters like the changes in TSS, p<sup>H</sup>,

color, flavor and texture were observed. The analyses of the parameters were done according to standard analytical methods summarized by AOAC<sup>6</sup> and Rangana<sup>7</sup>.

### Sensory analysis

Jellies were analyzed for sensory characteristics. Sensory quality characteristics were evaluated by a panel of 10 semi-trained members using a 9-point Hedonic scale. The strawberry fruit jellies were evaluated for their color, flavor, texture and overall acceptability.

### Statistical analysis

The experimental data were statistically analyzed by Randomized Complete Block Design (RCBD) using MSTAT statistical software (Version 5.4.1) in a microcomputer. The mean values adjusted by Duncan's Multiple Range Test (DMRT) Duncan,<sup>9</sup>.

## RESULTS AND DISCUSSION

The results of various experiments conducted during the study period are summarized below.

### Composition of juice and pulp

The composition of fresh juice and pulps changes depending on climate, soil, region and degree of ripeness etc. The present study shows that the strawberry juice and pulp contained percentage of moisture 91.04±0.02, 82.90±2.69; ash 0.31±0.01, 0.67±0.01; reducing sugar 03.64±0.04, 03.15±0.04; non-reducing sugar 02.56±0.02, 01.89±0.02; total sugar 06.10±0.06, 05.04±0.06; TSS 8.98±0.03, 8.57±1.36; P<sup>H</sup> 02.80±0.03, 02.87±0.03; acidity 01.14±0.01, 01.02±0.01 and Vitamin-C (mg/100g), 50.60±0.0, 47.16±0.90 respectively. The value of ash, reducing sugar, non reducing sugar, total sugar, acidity and pH coincides with result of Sharma which are 0.36, 3.50, 2.50, 6.00, 1.12 and p<sup>H</sup> 2.80 respectively<sup>10</sup>. The moisture content 91.04±0.02 is more or less similar with Hoque *et al.* findings 89%<sup>11</sup>. TSS content is closely related to the reported range 8-11.5 by Ayub<sup>12</sup>. Beside this TSS, total sugar and non-reducing sugar of strawberry pulp in line with Sonawane reported value 8.33, 6.51 and 1.69 respectively<sup>13</sup>.

### Composition of Strawberry products (jam and jelly)

Vitamin-C content in strawberry was found to be very low compared to other citrus fruits. It was further reduced in jams and jellies prepared from strawberry pulp because most of the Vitamin-C present in the pulp was destroyed during long heating at high temperature. The compositions of strawberry products (jam and jelly) were analyzed for moisture content, ash, Vitamin-C, acidity, TSS, pH and sugar. The average results are shown that the different concentrations of pectin were not significantly effect on quality characteristics in respect of chemical composition of strawberry jam and jelly. The

strawberry jam and jelly contained the average moisture  $29.22\pm 0.18$ ,  $31.13\pm 0.02$ ; ash  $0.69\pm 0.02$ ,  $0.35\pm 0.01$ ; reducing sugar  $26.05\pm 0.05$ ,  $28.13\pm 0.03$ ; non-reducing sugar  $37.42\pm 0.09$ ,  $39.10\pm 0.02$ ; total sugar  $63.47\pm 0.2$ ,  $67.23\pm 0.05$ ; TSS  $66.90\pm 0.57$ ,  $67.00\pm 0.0$ ;  $p^H$   $2.77\pm 0.05$ ,  $2.75\pm 0.10$  and acidity  $1.12\pm 0.01$ ,  $1.11\pm 0.01$  respectively.

### Storage studies of strawberry products

#### Jam:

The samples of jam (A, B and C) were stored at ambient temperature ( $30^\circ\text{C}$ ) for a period of 6 months of storage and quality parameters were assessed. During storage the changes in quality parameter i.e. color, flavor, texture, TSS and pH was observed.

**Table 1: Storage study of strawberry jam**

Period of storage(months)	Sample Code	Observations			TSS %	pH	Remarks
		Color	Flavor	Texture			
0	A	Red	Satisfactory	Firm	66.90	2.77	Good
	B	Red	Satisfactory	Firm	66.88	2.76	Good
	C	Red	Satisfactory	Firm	66.86	2.76	Good
1	A	Red	Satisfactory	Firm	66.90	2.84	Good
	B	Red	Satisfactory	Firm	66.88	2.84	Good
	C	Red	Satisfactory	Firm	66.86	2.85	Good
2	A	Red	Satisfactory	Firm	66.90	2.85	Good
	B	Red	Satisfactory	Firm	66.88	2.85	Good
	C	Red	Satisfactory	Firm	66.86	2.88	Good
3	A	Red	Satisfactory	Firm	66.90	2.90	Good
	B	Red	Satisfactory	Firm	66.88	2.90	Good
	C	Red	Satisfactory	Firm	66.86	2.90	Good
4	A	Red	Satisfactory	Firm	66.90	2.90	Good
	B	Red	Satisfactory	Firm	66.88	2.92	Good
	C	Red	Satisfactory	Firm	66.86	2.92	Good
5	A	Red	Satisfactory	Firm	66.90	2.95	Good
	B	Red	Satisfactory	Firm	66.88	2.95	Good
	C	Red	Satisfactory	Firm	66.86	2.98	Good
6	A	Red	Satisfactory	Firm	66.90	2.98	Good
	B	Red	Satisfactory	Firm	66.88	2.98	Good
	C	Red (fade)	Satisfactory	Firm	66.86	2.99	Good

Table 1 illustrates that there was no change in red color of strawberry jam from first to five months of storage. At six month jam containing 0.5% of pectin slightly faded. High anthocyanin content may be resulted in imperceptible pectin esterification and

consequential color degradation. Color and TSS was alike through entire period of storage and flavor was satisfactory. With increasing the storage time  $p^H$  gradually increased. This is may be due to declining the titratable acidity of jam [14]. Increased  $p^H$  decreases the firmness of texture though not mentionable cause contained allowable  $p^H$  that is 3.3. Additional citric acid should add to maintain firmness if the  $p^H$  is above 3.3 [14]. Cohesiveness of jam slightly changed after 5 month of storage. This is may be due lowering the functionality of pectin.

#### Jelly:

The samples of jelly (A, B and C) were stored at ambient temperature for a period of 6 months of storage and quality parameters were assessed. Table 2 coinciding that flavor and TSS was identical

in the course of storage. At six month of storage texture of B and C trends to moderately firm. At fifth and sixth month of storage 0.5 % pectin containing jelly slightly changed in color. From first to fourth month nevertheless pH increased but texture was firm.

**Table 2: Storage study of strawberry jelly**

Period storage(months)	of Sample code	Observation			TSS %	pH	Remarks
		Color	Flavor	Texture			
0	A	Red	Satisfactory	Firm	67.5	2.75	Good
	B	Red	Satisfactory	Firm	67.5	2.75	Good
	C	Red	Satisfactory	Firm	67.5	2.75	Good
1	A	Red	Satisfactory	Firm	67.5	2.78	Good
	B	Red	Satisfactory	Firm	67.5	2.78	Good
	C	Red	Satisfactory	Firm	67.5	2.78	Good
2	A	Red	Satisfactory	Firm	67.5	2.80	Good
	B	Red	Satisfactory	Firm	67.5	2.80	Good
	C	Red	Satisfactory	Firm	67.5	2.80	Good
3	A	Red	Satisfactory	Firm	67.5	2.84	Good
	B	Red	Satisfactory	Firm	67.5	2.84	Good
	C	Red	Satisfactory	Firm	67.5	2.84	Good
4	A	Red	Satisfactory	Firm	67.5	2.90	Good
	B	Red	Satisfactory	Firm	67.5	2.90	Good
	C	Red	Satisfactory	Firm	67.5	2.90	Good
5	A	Red	Satisfactory	Firm	67.5	2.94	Good
	B	Red	Satisfactory	Firm	67.5	2.94	Good
	C	Red	↓ Satisfactory	Firm	67.5	2.94	Good
6	A	Red	Satisfactory	Firm	67.5	2.97	Good
	B	Red	Satisfactory	Moderately firm	67.5	2.97	Good
	C	Red	↓ Satisfactory	Moderately firm	67.5	2.97	Good

### Sensory evaluation of the strawberry products (jam and jelly)

By hedonic rating test the acceptability of the strawberry products was evaluated. The semi-trained panelists were selected to evaluate the samples. The panelists (10) were requested to assign appropriate score for general appearance and overall acceptability of the strawberry (jam and jelly).

#### Strawberry jam

The samples of strawberry jam were subjected to sensory evaluation, 10 judges evaluated the color, flavor, texture and overall acceptability of 3 samples. Retaining all the ingredients equal except the using of different percentage of pectin, 3 different samples were prepared.

A was processed by 1.5% pectin, B was processed by 1.0% pectin and C was processed by 0.5% pectin. The mean scores for color, flavor, texture and overall

acceptability of different samples are presented in table 3.

A two-way analysis of variance was carried out for color preferences and the results revealed that there were not significant ( $p < 0.05$ ) differences in color acceptability. It can also be noted that the sample A and B secured the highest score of 7.30 out of 9.

In case of flavor preference among the samples a two-way analysis of variance (ANOVA) was carried out and the results revealed that there were not significant ( $p < 0.05$ ) differences in flavor acceptability. The results showed in table 8 that samples A and B were secured the highest score for these two was 7.50 out of 9.

In case of texture preference among the samples, analysis of variance (ANOVA) showed that there was significant ( $p < 0.05$ ) difference in texture. The results showed in Table 3 that A was the most preferred sample than the other samples, which secured 7.80 out of 9.

**Table 3: Duncan's Multiple Range test (DMRT) for color, flavor, texture and overall acceptability of Strawberry jam**

Parameters	Product Type	Original Order of Mean	Product Type	Ranked Order of Mean	LSD value	P (at alpha)	Error Mean Square	Error	No of Judges
Color	A	7.30 <sup>a</sup>	A	7.30 <sup>a</sup>	0.569	0.05	0.367	18	10
	B	7.30 <sup>a</sup>	B	7.30 <sup>a</sup>					
	C	7.20 <sup>a</sup>	C	7.20 <sup>a</sup>					
Flavor	A	7.40 <sup>a</sup>	B	7.50 <sup>a</sup>	0.691	0.05	0.541	18	10
	B	7.50 <sup>a</sup>	C	7.50 <sup>a</sup>					
	C	7.50 <sup>a</sup>	A	7.40 <sup>a</sup>					
Texture	A	7.80 <sup>a</sup>	A	7.80 <sup>a</sup>	0.618	0.05	0.433	18	10
	B	7.70 <sup>a</sup>	B	7.70 <sup>a</sup>					
	C	6.70 <sup>b</sup>	C	6.70 <sup>b</sup>					
Overall Acceptability	A	7.20 <sup>a</sup>	A	7.20 <sup>a</sup>	0.646	0.05	0.474	18	10
	B	6.70 <sup>b</sup>	B	6.70 <sup>b</sup>					
	C	6.40 <sup>b</sup>	C	6.40 <sup>b</sup>					

- The means with same superscripts within a column are not significantly different at  $p < 0.05$ . A was processed by 1.5% pectin, B was processed by 1.0% pectin and C was processed by 0.5% pectin.

It was apparent from the results of the ANOVA that there were significant differences in overall acceptability of the samples, since the calculated F-value (7.87) was greater than tabulated F-value (3.55). This indicated that the samples are not equally acceptable as far as overall acceptability is concerned. It can be seen from Table 3 that A had the best overall acceptability as compared to the other samples A secured the highest score 7.20 out of 9.

#### Strawberry jelly

The samples of strawberry jelly were subjected to sensory evaluation. 10 judges evaluated the color, flavor, texture and overall acceptability of 3 samples. Retaining all the ingredients equal except the using of different percentage of pectin, 3 different samples were prepared. A was processed by 1.5% pectin, B was processed by 1.0% pectin and C was processed by 0.5% pectin. The mean scores for color, flavor, texture and overall acceptability of different samples are presented in table 4. A two-way analysis of variance was carried out for color preferences and the results revealed that there were no significant ( $p > 0.05$ ) differences in color acceptability since the calculated value F-value (0.87) was smaller than the

**Table 4: Duncan's Multiple Range test (DMRT) for color, flavor, texture and overall acceptability of Strawberry jelly**

Parameters	Product Type	Original Order of Mean	Product Type	Ranked Order of Mean	LSD value	P (at alpha)	Error Mean Square	Error	No of Judges
Color	A	6.20 <sup>a</sup>	A	6.20 <sup>a</sup>	0.732	0.05	0.607	18	10
	B	5.80 <sup>a</sup>	B	5.80 <sup>a</sup>					
	C	5.80 <sup>a</sup>	C	5.80 <sup>a</sup>					
Flavor	A	5.80 <sup>b</sup>	C	6.90 <sup>a</sup>	0.730	0.05	0.604	18	10
	B	5.10 <sup>b</sup>	A	5.80 <sup>b</sup>					
	C	6.90 <sup>a</sup>	B	5.10 <sup>b</sup>					
Texture	A	7.20 <sup>a</sup>	A	7.20 <sup>a</sup>	0.495	0.05	0.278	18	10
	B	5.70 <sup>b</sup>	C	7.20 <sup>a</sup>					
	C	7.20 <sup>a</sup>	B	5.70 <sup>b</sup>					
Overall Acceptability	A	7.10 <sup>a</sup>	A	7.10 <sup>a</sup>	0.782	0.05	0.693	18	10
	B	6.80 <sup>a</sup>	B	6.80 <sup>a</sup>					
	C	5.70 <sup>b</sup>	C	5.70 <sup>b</sup>					

The means with same superscripts within a column are not significantly different at  $p < 0.05$ . A was processed by 1.5% pectin, B was processed by 1.0% pectin and C was processed by 0.5% pectin

tabulated F-value (3.55). So the samples are equally accepted. The results showed in table 9 that A was the most preferred one followed by B and C in respect to color preferences. However, B and C were equally acceptable at 0.05% level of statistical significance. It can also be noted that A secured the highest score of 6.20 out of 9.

In case of flavor preference among the samples a two-way analysis of variance (ANOVA) was carried out and the results revealed that there was significant ( $p < 0.05$ ) differences in flavor acceptability since the calculated F-value (13.63) was greater than the tabulated F-value (3.55). The results showed in table 4 that C was the most preferred one with a score of 6.90 out of 9. In case of texture preference among the samples, analysis of variance (ANOVA) showed that there was significant ( $p < 0.05$ ) difference in texture. The results showed in Table 4 that there was no significant ( $p < 0.05$ ) difference for texture preferences between A and C and the highest score was 7.20 out of 9.

It was apparent from the results of the ANOVA that there were significant ( $p < 0.5$ ) differences in overall acceptability of the samples, since the calculated F-value (7.84) was greater than tabulated F-value (3.55). This indicated that the samples are not equally acceptable as far as overall acceptability is concerned. It can be seen from Table 4 that A had the best overall acceptability as compared to the other samples. A secured the highest score 7.10 out of 9.

## CONCLUSION

Increased global supply has intensified competition in all food commodities. Product quality and consistency is the key for long-term profitability. To make a good quality jam and jelly, the fruit must contain the proper amount of pectin and acid. Additional pectin is compensated in jam and jelly processing due low pectin content of strawberry fruits. This study claims quality properties do not significantly differed among 3 formulations of jam and jelly. In sensory evaluation 1.5 % pectin containing jams and jellies proved as preeminent product in terms of color, flavor, texture and overall acceptability. Therefore this formulation could be practiced for escalating the country's developing food industries.

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