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Study on Chemical Composition of Fresh Mymensingh and Barishal Hog-plum (*Spondius mangifera*) and Developed Leather and Jelly and Sensory Evaluation

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Abstract

The study was concerned with the chemical composition of two varieties hog-plum Pulp collected from Mymensingh and Barishal and developed jelly and leather. Cabinet dryer, model OV-165 (Gallen Kamp Company) was used for dehydration of two types of hog-plum pulp and leather. The fresh and dried hog-plum and hog-plum products were analyzed for their moisture, ash, vitamin-C, pH, total soluble solids and sucrose contents. The moisture content, ash, vitamin C, pH, total soluble solid (TS), reducing sugar and non-reducing sugar of Barishal hog-plum's was 83.84% (wb), 0.81% , 33.00 mg/100g, 2.62, 8.5%, 5.02% and 1.6% respectively; Mymensingh hog-plum's was 86.69% (wb), 0.78%, 30.90 mg/100g, 2.7, 6.5%, 4.7% and 1.3% respectively. The chemical composition of Mymensingh and Braishal hog-plum showed that Barishal hog-plum contained higher solid content, ash, Vitamin C than Mymensingh hog-plum. It was found that Barishal hog-plum had higher flesh (67.59%) than Mymensingh hog-plum (62.60%). The chemical composition of hog-plum leather was analyzed for moisture, Ash, Vitamin C, TS, Titrable acidity, total sugar and protein content. The ash and sugar content of developed leathers from Barishal and Mymensingh hog-plum was very similar but the vitamin C content for developed products was very low. It was also found developed products contained higher amount and sugar and protein. It was found that the chemical compositions of developed jelly were more or less similar to the fresh hog-plum; only the vitamin C was decreased significantly. These studies indicate that, developed products viz. lather and jelly would contain significantly higher amount of nutrients and energy then the fresh fruits. Organoleptic taste testing using 1-9 hedonic scale showed that jelly made from mechanically dried Mymensingh hog-plum was the most acceptable product and was ranked as "like very much". Leather made from Mymensingh hog-plum (pulp+4.5% sugar+ 0.15% KMS) was the best among other samples and was ranked as "like very much".

Key word: Ash Composition, Hog plum, Jelly, Leather, Moisture, Spondius mangifera

Introduction

Hog-plum (*Amra*) is a minor fruit in Bangladesh. Botanically it belongs to the family of Anacardiaceae, and its scientific name is *Spondius mangifera*. It is an acid food, found in Bangladesh, Assam and Bombay. Hog-plum is a rich source of vitamin, specially vitamin C or ascorbic acid. Fruits are usually eaten raw and can be used for preparation of pickles, jam and other processed food. The quality of ripe and green hog-plum highly depends on the collection at suitable time and way. Due to poor keeping quality of hog-plum and difficulties of transportation, preservation and marketing facilities, a huge quantity of these valuable fruits are being damaged and spoiled. To reduce the wastage of this fruit and to get a reasonable price by the producer of this fruit, preservation is necessary. By processing products from it or preserving the fruit by adopting suitable means of food preservation can increase the utility of this fruit.(Ahmed, 1966) stated that hog-plum can be used to prepare good preserve (Morobba) and also jam, pickle and chutney. (Munmun, 2005) stated that chemical composition of the fresh and dried hog-plum showed that dried products contained substantially higher nutrient content than fresh one with the exception of vitamin C which was almost half of that present in fresh one. It was found that hog-plum contains various nutrients, vitamins and minerals such as protein, carbohydrate, calcium, iron, carotene, vitamin B_1, B2, C etc (Ali *et al.*, 1977; Islam, 2004; Munmun, 2005).

The goal of this paper was to study chemical composition of fresh Mymensingh & Barishal hog-plum and development of leather & jelly from them. Finally, comparison of chemical composition of fresh Mymensingh and Barishal hog-plum and dehydrated products viz. leather & jelly.

Srinivas *et al*-(1977) was used sun drying for preparing mango leather from the ripe fruit-pulp. Cabinet drying has been carried out for making mango leather resulting into a product with better colour and flavor (Heikal *et al.*, 1972; Mir and Nath, 1995).

In this paper, processing and preservation of hog-plum was carried out by using locally available machineries and thus low level technology involving minimal capital investment. Finally, chemical composition of hog-plum and development of leather & jelly from fresh and dried Mymensingh and Barishal hog-plum was studied.

Materials and Methods

Meterials

Two varieties of hog-plum (*Spondius mangifera*), one grown in Barishal and another in Mymensingh were collected from the local market. The other materials such as sugar, citric acid, agar-agar, skim milk, KMS, packaging materials (low density polythene) and necessary equipments and machineries were provided from the Food Processing Laboratory, Bangladesh Agricultural University.

Drying of hog-plum

Dehydration of hog-plum pulp and leather were carried out by mechanical drying method. Cabinet dryer, model OV-165 (Gallen Kamp Company) was used for dehydration of two types of hog-plum pulp and leather. The dryer consists of chamber in which trays of products were placed. Air was blown by a fan over a heater and then across the trays of products being dried. The velocity of air was recorded (0.6 m/s) by an anemomenter.

Two types of hog-plum (Barishal and Mymensingh) were washed thoroughly and then peeled and cut into pieces by knife and boiled in pressure cooker for 30 minutes. Following cooling pulps were collected by squeezing the flesh of the hog-plum. The pulp was then blended in an electric blender and the samples were taken for determination of moisture content. Four samples of leather prepared by the following process and mixture was then placed in trays as sheet (6 mm thickness) and dried with constant temperature (60ºC) and drying commenced as mentioned previously.

Chemical analysis

The fresh and dried hog-plum and hog-plum products were analyzed for their moisture, ash, acidity, pH, vitamin-C, total soluble solids and sucrose contents by the method described by Rangana (2002). All the determinations were done in triplicate and the results were expressed as average value.

Moisture

First of all, weight of empty crucible with cover was taken and 5 gm of sample was placed on it. Then the crucible was placed in an air oven (thermostatically controlled) and dried at a temperature of 105ºC for 24 hours, till constant weight was obtained. After drying, the crucible was removed from the oven and cooled in desiccator. It was then weighed with cover glass. The crucible was again placed in the oven, dried for 30 minutes; took out of the dryer, cooled in a dessiccator and weighed. Drying, cooling and weighing were repeated until the two consecutive weights were same. From these weights the percentage of moisture in food samples was calculated as follows:

$$\% \text{ Moisture} = \frac{Loss\ in\ weight}{Weight\ of\ sample} \times 100$$

Ash

Two gm sample was taken in a dry, clean porcelain dishes and weighed accurately. Hot air oven method was applied to remove the moisture. Then the sample was burned on an electric burner. This was done to avoid the loss of sample in the muffle furnace under higher temperature. Then, sample was transferred into the muffle furnace and burned for 4 to 6 hrs at a temperature of 550ºC and ignited until light gray ash resulted (or to constant weight). The sample was then cooled in dessiccator and weighed. The ash content is expressed as:

$$\% \text{ Ash} = \frac{Weight\ of\ residue}{Weight\ of\ sample} \times 100$$

Vitamin C

The reagents used for the estimation of vitamin C were as follows:

i) Meta phosphoric acid (3%)
ii) Standard ascorbic acid solution
iii) Dye solution

For estimation of vitamin C, the following steps wire followed:

i) Standardization of Dye:

5ml of standard ascorbic acid solution was taken in a conical flask and 5 ml meta-phosphoric acid (HPO_3) was added to and shaken. A micro burette was filled with dye solution, and then the mixed solution was titrated, using phenolphthalene as indicator solution to a pink colored end point that persisted for at least 15 seconds. Dye factor was calculated using the following formula.

$$\text{Dye factor} = \frac{0.5}{titre}$$

ii) Preparation of sample and titration:

Ten-gram sample was blended and homogenized in a blender with 3% metaphosphoric acid solution. The homogenized liquid was transferred to a 100 ml volumetric flask and made to volume with metaphosphoric acid solution. Content of the flask was then thououghly mixed and filtered. Then 5 ml of the aliquot was taken into a flask and titrated with 2, 6 dichlorophenol indophenol dye. The dye had been standardized with vitamin C solution to find an equivalent dye factor. The ascorbic acid content of the sample was calculated from the following relationship.

mg of vitamin C per 100 gm sample = $\frac{T \times D \times V_1}{V_2 \times W} \times 100$

Where, T=Titer, D=Dye factor, V_1=Volume made up, V_2= Aliquot of extract taken for estimation, W= Weight of sample taken for estimation.

Sugar

Sugar content was estimated by determining the volume of unknown sugar solution of fruit juice required for complete reducing of standard Fehling's solution. The following procedures were followed in determining sugar content. The following procedures were followed in determining sugar Content.

i) Standardization of Fehling's solution:

Ten ml of both Fehling's Solution A and Fehling's Solution B were mixed together in' a beaker. Ten ml of mixed solution was pipette into a 250 ml conical flask and 25 ml distilled water was added to it. Standard sugar solution was taken in burette. The conical flask containing mixed solution was heated on a hot plate. When the solution began to boil, three drops of methylene blue indicator solution was added to it without removing the flask from 1 kg hot plate. Mixed solution was titrated by standard sugar solution. The end point was indicated by decolorization of the indicator. Fehling's factor was calculated by using the following formula.

Fehling's Factor (gm of inverts sugar) $= \frac{Titer \times 2.5}{1000}$

ii) Preparation of sample:

50ml of fruit juice was mixed with 100ml of distilled water and 5ml of neutral lead acetate solution and kept it for 10 minute and homogenized. Then the blended material was transferred to a 250ml volumetric flask. The volume was made up to the mark with distilled water. The solution was filtered.

iii) Titration for reducing sugar:

10 ml of mixed Fehling's solution was taken in a 250ml conical flask and made up to 250ml with distilled water. Purified juice solution (filtrate) was taken in a burette. Conical flask containing mixed Feliling's solution was heated on a hot plate. Three to five drops of methylene blue indicator were added to the flask when boiling started and then titrated with solution taken in the burette. The end point was indicated by the decolorization of indictor. percent reducing sugar was calculated according to the following foumula:

% Reducing sugar = $\frac{FD100}{TW100}$

Where, F= Fehling's Factor, D= Dilution, T=Titer, and W= Weight of sample.

iv) Titration procedure for total sugar:

Fifty ml of purified solution (filtrate) was taken in a 250ml flask. Five gm citric acid and 50ml distilled water were added to it. The conical flask containing sugar solution was boiled and finally cooled. Then the solution was transferred to a 250ml volumetric flask and neutralized by 0.IN NaOH using phenolphthalein as indicator. The volume was made up *to the mark with* distilled water. Then the mixed Fehling's solution was titrated using similar procedure followed as in case of invert sugar (reducing sugar) mentioned earlier. Percent total sugar as invert sugar was calculated by using the formula used in case of reducing sugar.

v) Estimation of non-reducing sugar

% non-reducing sugar = % total invert sugar-% reducing sugar

v) Estimation of total sugar

% total sugar = % reducing sugar + % non-reducing sugar

Titrable acidity

Twenty gram of sample was blended and homogenized in a blender with distlled water and carefully transferred to a 250 ml beaker. The mixture was boiled for 1 hr periodically adding water to replace the loss by evaporation and was cooled and transferred to a 100 ml volumetric flask. Then volume was made to 100 ml and was filtered. 30 ml of the filtered liquid was titrated against 0.1 N NaOH using phenolphthalent as an indicator. The titration was done in triplicate and titrable acidity was calculated from the following relationship.

% Titrable acidity= $\frac{T \times V_1 \times N \times E}{V_2 \times W \times 1000} \times 100$

Where, T =Titer, N = Normality of NaOH, V_1=Volume made up, V2 = Volume of sample taken for estimation, E = Equivalent weight of citric acid (64) and W = Weight of sample taken for estimation.

Protein

Protein content was determined using AOAC (1984).

Reagent required:

1. Concentrated H_2SO_4 (nitrogen free)
2. Digestion mixture:
   Potassium Sulphate = 100g
   Copper Sulphate =10g and
   Selenium di-oxid = 2.5g well mixed in a mortar and kept in a dry place.
3. Boric acid solution = 2% solution in water.
4. Alkali solution = 400g sodium hydroxide in water and diluted to 1 litre.
5. Mixed indicator solution = Bromocresol-0.1 g and Methy1 red- 0.2g dissolved in 250 ml ethyl alcohol.
6. Standard HCl = 0.1N

Procedure:

5 gm sample was taken in a 250 ml of Kjeldahl flask. 2 gm of digestion mixture was added with the sample. 25ml of concentrated sulfuric acid was added for oxidation. The flask was placed in an inclined position on the stand in digestion chamber, heated continuously until frothing ceased and then

simmered briskly. The solution became clean in 15-20 min., continued heating for 45 min. After cooling, 100 ml water was added and transferred quantitatively to a 1 liter round bottom flask; the final volume was about 500 ml. Added gently down the side enough NaOH solution to form a precipitate as cupric hydroxide and immediately connected the flask to stream-trap and condenser. To a 500 ml conical receiving flask 50 ml of boric acid solution, 50 ml distilled water and 5 drops of indicator solution were added. Positioning the condenser distillation was carried out for 40 to 45 minutes or until about 250 ml of distillate was obtained. The contents of the receiving was filtrated with hydrochloric acid, the end point was marked by a pink colour. A reagent blank was also determined and deducted from the titration.

1 ml of 0.1N hydrochloric acid contain = 0.0014 g of N_2. A protein conversion factor of 6.25 was used to calculate the percent protein from nitrogen determination. Percentage of nitrogen and protein were calculated by the following equation:

$$\% \text{ Nitrogen} = \frac{(T_s - T_b) \times N \text{ of acid} \times \text{meq. of } N_2}{\text{Weight of sample } (gm)} \times 100$$

Where, Ts =Titre volume of the sample (ml), Tb = Titre volume of the blank (ml), Meq. of N_2 = 0.014.

% Protein = Nitrogen ×6.25

pH

The pH meter was first standardized using buffer of pH 4.00 of Hog-plum and for hog-plum products. Again the pH meter was standardized using this buffer and checked the pH of sample.

Total soluble solids

Abbey Refractometer was used for determination of total soluble solids content. One drop hog-plum juice squeezed from the hog-plum was placed on the prism of the Refractometer (Atago Co. l Japan) and percent total soluble solid was obtained from Refractometer scale directly.

Development of hog-plum products

Leather

i) Extraction of hog-plum pulp

Fresh hog-plums (Barishal and Mymensingh variety) were used separately for extraction of pulp. After washing, they were peeled thoroughly. Then sliced into small pieces and boiled in pressure cooker for 30 minutes. Then cooled and pulp was collected by squeezing the flesh of hog-plums. The pulp was then blended in an electric blender. It was stored in a deep freeze at a temperature of -20^{0}C for future use.

ii) Preparation of hog-plum leather

At first hog-plum pulps (two variety) were cooled into room temperature. Sugar, skim milk, potassium metabisulphite (KMS) were weighed separately and mixed with pulp as per formulations [from Barishal hog-plum: sample 401 = pulp +0.15% KMS, sample 402 = pulp + 4.5% sugar +0.15% KMS, sample 402 = pulp + 4.5% milk + 0.15% KMS, sample 404 = pulp + 4.5% sugar + 4.5% milk + 0.15% KMS]. And [from Mymensingh hog-plum : sample 501 = pulp + 0.15% KMS, sample 502 = pulp + 4.5% sugar + 0.15% KMS, sample 503 = pulp + 4.5% milk + 0.15% KMS, sample 504 = pulp + 4.5% sugar + 4.5% milk +0.15% KMS]

All the above samples were heated individually for 30 minutes.

The mixture was then placed in tray as sheet (6 mm thickness and dried with constant temperature (60^{0}C) and air velocity of 0.6 m/s using the cabinet dryer. The cabinet drier was adjusted to the selected temperature at least 0.5 hour before drying trays were weighted at 15 minutes intervals for the first 1 hour of drying and every one hour for the next 6 hours. As mentioned previouly, gravimetric measurements gave moisture content at each time interval as the initial moisture content was determined by oven drying. The developed products were dried to moisture content less than 25%. The steel trays were smeared with very thin layer of polythene to prevent hog-plum leather from sticking to tray surface after drying. The hog-plum leather was stored in a desiccators at room temperature.

Jelly

i) Extraction of hog-plum, juice

Both hog-plums (Barishal and Mymensingh variety) were selected separately. The hog-plums were then washed thoroughly with fresh water. Then the clean hog-plums were peeled and separated from the stone with the help of stainless steel knife. The fleshes from hog-plums were then boiled with water (1½ times the weight of fruit) for about 20-30 minutes. After boiling, strained of juice extract was collected.

ii) Preparation of hog-plum jelly

Four samples (Barishal hog-plum juice, Mymensingh hog-plum juice, mechanically dried Barishal hog-plum juice, mechanically dried Mymensingh hog-plum juice) were selected for making jelly for organoleptic evaluation.

Sugar, Pectin, were weighed separately and mixed with the hog-plum juices. The juice and sugar was in the ratio of 45:55. The mixture of 4 samples were cooked slowly with the occasional stirring till the cooking mass approached desired consistency (67% TSS) when the product was ready to filling in the container, citric acid, (2 g per kg juice) was added at the later stage of concentration. The hot product was filled into the clean dry glass jar and closed the filled jar immediately. The jars were

kept inverted for five minutes and then cooled and stored.

Sensory evaluation

The consumer acceptability of developed products was evaluated by a testing panel. The panelists were untrained and selected from the students, teachers and employees of the Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh. The panelists (10) were asked to assign appropriate score to each product tested on a 1 to 9 point hedonic scale for characteristic colour, flavour, texture and overall acceptability of four samples of jelly and leather of hog-plum.

The scale is arranged such that ; 9 = Like extremely, 8 = Like very uch, 7 = Like moderately, 6 = Like highly, 5 = Neither like nor dislike, 4 = Dislike slightly, 3 = Dislike moderately, 2 = Dislike very much, and 1 = Dislike extremely.

Results and Discussion

Chemical composition of Mymensingh and Barishal hog-plum

The initial compositions of Mymensingh and Barishal hog-plum were analyzed for their moisture content, ash, pH, titrable acidity, ascorbic acid, TSS, reducing sugar and non reducing sugar. The results are shown in Table-I.

The fresh Barishal hog-plum's moisture content is 83.84% (wb), whereas Mymensingh hog-plum contains 86.69% moisture. It is observed that Mymensingh hog-plum contains higher moisture content than Barishal hog-plum and the difference might be due to variation of soil, growing condition, harvesting period, maturity stage, climate etc. Ali *et al.* (1977) reported that in Bangladesh, moisture content of fresh hop-plum (per 100 g sample) is 83.2 g which was almost similar to this investigation. Munmun (2005) found that the fresh hog-plum contained 85.7% (wb) moisture whereas mechanically dried, osmotically dried by 60% sucrose and salt solution were 8.62%, 42.8% and 36.3% moisture content, respetively. Islam (2004) found that moisture content in green and ripe hog-plum 83.61% and 83.82% respectively.

The ash content of fresh Barishal and Mymensingh hog-plum was 0.81% and 0.78% respectively. this value is very close to that mentioned by Munmun (2005), who reported that ash content of fresh hog-plum was 0.79% and dried hog-plum contained 2.21% ash. Keramat Ali *et al.* (1992) reported that the ash content of Bangladesh fresh hog-plum was 1.2%. Islam (2004) found that ash content of green and ripe hog-plum were 0.473% and 0.476%, respectively.

The vitamin C content of Barishal and Mymensingh hog-plum was 33.00 mg/100g and 30.90 mg/100g, respectively. Munmun (2005), found that vitamin C content in fresh hog-plum was 31.2 mg/100g. Islam (2004) also found that for green and ripe hog-plum, vitamin C content were 29.68 mg/100g and 10.176mg/100g, respectively. The decrease in ascorbic acid in ripe hog-plum may be due to the physicochemical changes that occur with the degree of maturation. During these changes, other organic acid may also be degraded with the increase in pH as well as lowering of acidity. The reason behind this is the conversion of starch into simple sugar with the consequent increase in TSS (Wills *et al.,* 1981).

pH was 2.62 and 2.7 respectively for Barishal and Mymensingh hog-plum. Hog-plum is an acid food. Munmun (2005) found that pH for fresh hog-plum was 2.68 and titrable acidity 0.47%. Acidity for Barishal and Mymensingh hog-plum was 0.50% and 0.46%, respectively. Differences in pH and acidity for Barishal and Mymensingh hog-plum might be due to the variation of soil, growing condition, harvesting period, maturity stage, climate etc.

Total soluble solid for Barishal and Mymensingh hog-plum was 8.5% and 6.5% respectively. Barishal hog-plum contains more TSS than Mymensingh. So, Barishal hog-plum is very suitable for develoment of product, (specially jam, leather, jelly, pickles etc.). Munmun (2005) found that for fresh hog-plum, TSS was 7%.

Reducing sugar and non-reducing sugar for Barishal hog-plum was 5.02% and 1.6% and for Mymensingh hog-plum was 4.7% and 1.3% respectively. These variations might be due to the variation of physico-chemical changes occur in fruit.

Flesh obtained from hog-plum

An experiment is conducted to show the effect of cultivar on net flesh content and the results are shown in Table-II. It is observed that Barishal hog-plum was large in size compared to Mymensingh ho-plum. From the Table-II it is seen that hog-plum, (Barishal variety) gave higher flesh (67.59%) compared to local variety (62.60%). Barishal hog-plum is the best for its taste as well as processing.

Nutrient retention of the developed product

Composition of hog-plum leathers

The chemical composition of hog-plum leather was analyzed for moisture content, Ash, Vitamin C, TS, Titrable acidity, total sugar protection as per methods of Rangana (2002). The average moisture content of developed products was 25% mc bd (dried product become shelf stable). The ash and

sugar content of developed leathers (from Barishal and Mymensingh hog-plum) was very similar but differed with those fresh hog-plum due to removal of large quantity of water. The vitamin C content for developed products was very low due to fact that the concentration of vitamin C is readily oxidized and also heat labile (Von Loessecke, 1955). Moreover, reduction of vitamin C follows the first order kinetic reaction and the rate constant has an Arrhenious type relationship with absolute temperature (Heldman, 1971 and Islam, 1980). Developed products contained higher amount and sugar, protein etc. Thus developed products would contain significantly higher amount of nutrients and energy the fresh fruits. The chemical composition of Barisal and Mymensingh hog-plum leather results are presented in Table-III and Table-IV respectively.

Composition of hog-plum jelly

The developed products (jelly) were analyzed for their nutrient content as per methods of Rangana (2002). It was found that the composition of all the samples were more or less similar, with the exception of asscorbic acid content between fresh and developed hog-plum product. It is observed that mechanically dried hog-plum contain less moisture and more solid than fresh hog-plum because during drying most of the water in the hog-plum are vaporized and subsequent dehydration. So, the moisture content is so less and consequently solid content increased. The increased solid content results in increased protein, ash, etc. So, jelly prepared from mechanically dried hog-plum (Sample 201 and 150) contain less moisture (24.7% and 22.56%) and more ash (0.43% and 0.41%) than jelly prepared from fresh hog-plum (Sample 406 and 507). Moisture content (25.29% and 25.60%) and ash content (0.40% and 0.39%) respectively. From the proximate analysis of developed product, it was seen that ascorbic acid content is more or less similar (12.9 to 13.8 mg %).

So, it was obvious that a large percentage of vitamin C is lost from the developed products. The reason behind this huge loss has been attributed to oxidation, heat and discussed in the previous section. TSS and pH is fixed (67% and 3.2) for jelly. This proximate composition of jelly indicated the nutritive as well as calorific value of the jelly from with dehydrated and fresh hog-plum will be very high and such preserved product would go a long way in fighting malnourishment, particularly among children in Bangladesh. The results are presented in Table-V.

Sensory evaluation of developed product

Sensory evaluation of jelly

The mean score for colour, flavour, texture and overall acceptability of developed jelly are given in Table-VI. In the case of colour, a two way analysis of variance showed that there is no significance difference ($P<0.01$) among the samples (201, 150 and 507) and such the samples were equally accepted. As shown Table-VI, sample 201, secured the highest score (7.50). It is also seen that sample 406 differs significantly from the other samples, securing the lowest score (5.80). It may be mentioned here that during processing of hog-plum no pretreatment was conducted for fixation of original colour and thus there is a scope to improve colour by using preservatives /additives.

In the case of flavour preference among the samples, a two way analysis of variance (ANOVA) showed that significant ($P<0.01$) difference exists within the samples. As shown in Table-VI, sample 201 secured the highest score (7.70) and was ranked “like moderately” while the lowest score secured by sample 406 (6.00) for flavour.

In case of texture preference among the samples from Table-VI, it is seen that there is no significant difference for texture preference between sample 201, 150 and 507. Sample 406 was significantly different from the other three samples, securing the lowest (5.50).

In the case of overall acceptability of jelly it is apparent from Table-VI that there is no significant difference ($P<0.01$) in overall acceptability among the three samples but sample 406 significantly differs from the other three samples, securing lowest score (5.80). From this sensory evaluation it is found that jelly from Mymensingh hog-plum secured the lowest for all attributes but is ranked as like slightly, while other samples including the mechanically could be ranked as “like moderately” or “like very much”.

Sensory evaluation of developed leather

The mean score for colour, flavour, texture and overall acceptability of developed leather are given in Table-VII. In the case of colour, a two way analysis of variance showed that there is significance difference ($P<0.01$) in the colour of all samples which indicates that the samples were not equally accepted. As shown in Table-VII, sample 502, secured the highest score (7.70) followed by 402, 401 and 501. This difference is due to the presence or absence or particular ingredient in the samples. It is observed that ingredients specially sugar change the colour of leather. In sample 501 and 401 as no sugar is added, so its colour significantly different from sample 502 and 402.

In the case of flavour preference a two way analysis of variance showed that there is significant ($P<0.01$) difference among the samples. As shown in Table-VII, the flavour of sample 502 secured the highest score (7.50) and ranked like moderately. The lowest score secured by sample 501 (5.60).

In case of texture preference among the sample and Table-VII, it is seen that there is significant

difference for texture preference between all samples. The lowest score secured by sample 501.
In the case of overall acceptability of leather it is apparent that there is significant difference ($P<0.01$) in overall acceptability among the samples. Sample 502 secured the highest score (7.70) and sample 501 secured the lowest score (6.10)

Table I: Composition of Local and Barishal hog-plum

Composition	Barishal hog-plum	Local hop-plum
Moisture (%) (wb)	83.84	86.69
Ash (%)	0.81	0.78
pH	2.62	2.70
Titrable acidity (%)	0.50	0.46
Vitamin C (mg/100g)	33.00	30.90
TSS (%)	8.50	6.50
Reducing sugar (%)	5.02	4.70
Non-reducing sugar (%)	1.60	1.30

Table II: Flesh obtained from hog-plum

Item	Variety	
	Barishal	Mymensingh
Hog-plum (Nos)	150	100
Hog-plum before peeling (g)	11673	7059
Hog-plum after peeling (g)	9258	5598
Stone (Ati) (g)	1496 (12.82%)	1289 (18.26%)
Hog-plum without stone (g)	7762	4309
Fibre (g)	128	110
Flesh (g)	7890	4419
% of flesh	67.59	62.60

Table III: Composition of Barishal hog-plum leathers

Parameter	Sample 401	Sample 402	Sample 403	Sample 404
Moisture (%)	25	25	25	25
Ash (%)	3.58	3.80	3.64	4.01
Vitamin C (mg/100g)	0.012	0.013	0.014	0.014
TS (%)	75	75	75	75
Titrable acidity	0.09	0.08	0.08	0.07
Total sugar	55.68	56.89	52.80	61
Protein	8.36	9.98	6.80	8.37

Sample 401 : Hog-plum pulp + 0.15% KMS
Sample 402 : Hog-plum pulp + 4.5% sugar+0.15% KMS
Sample 403 : Hog-plum pulp + 4.5% milk+0.15% KMS
Sample 404 : Hog-plum pulp + 4.5% sugar+4.5% milk+0.15% KMS

Table IV: Composition of Mymensingh hog-plum leathers

Parameter	Sample 401	Sample 402	Sample 403	Sample 404
Moisture (%)	25	25	25	25
Ash (%)	3.57	3.69	3.60	4.12
Vitamin C (mg/100g)	0.013	0.013	0.014	0.013
TS (%)	75	75	75	75
Titrable acidity	0.09	0.08	0.10	0.09
Total sugar	55.70	56.80	53.70	60
Protein	8.32	9.89	6.88	8.32

Sample 501 : Hog-plum pulp + 0.15% KMS
Sample 502 : Hog-plum pulp + 4.5% sugar+0.15% KMS
Sample 503 : Hog-plum pulp + 4.5% milk+0.15% KMS
Sample 504 : Hog-plum pulp + 4.5% sugar+4.5% milk+0.15% KMS

Table V: Composition of hog-plum jelly

Sample	Moisture (%)	TS (%)	TSS (%)	Ash (%)	pH	Ascorbic acid (mg/100g)
201	24.71	75.29	67	0.43	3.2	12.86
150	22.56	77.44	67	0.41	3.2	12.94
406	25.29	74.71	67	0.40	3.2	13.01
507	25.60	74.40	67	0.39	3.2	13.82

Sample 201 : Jelly form mechanically dried Mymensingh hog-plum
Sample 150 : Jelly from mechanically dried Barishal hog-plum
Sample 406 : Jelly from Mymensingh hog-plum
Sample 507 : Jelly from Barishal hog-plum

Table VI: Mean score for colour, flavour, texture and overall acceptability of developed jelly

Sample	Sensory attributes			
	Colour	Flavour	Texture	Overall acceptability
201	7.50^{a}	7.70^{a}	7.30^{a}	7.90^{a}
150	7.40^{a}	7.00^{ab}	7.30^{a}	7.30^{a}
406	5.80^{b}	6.00^{b}	5.50^{b}	5.80^{b}
507	7.10^{a}	6.50^{b}	7.10^{a}	7.50^{a}

Sample means having the same letter suffix do not differ at 1% (P<0.01) level of significance.
Sample 201 : Jelly from mechanically dried Mymensingh hog-plum
Sample 150 : Jelly from mechanically dried barishal hog-plum
Sample 406 : Jelly from Mymensingh hog-plum
Sample 507 : Jelly from Barishal hog-plum

Table VII: Mean score for colour, flavour, texture and overall acceptability of developed leather

Sample	Sensory attributes			
	Colour	Flavour	Texture	Overall acceptability
502	7.70^{a}	7.50^{a}	7.90^{a}	7.70^{a}
402	7.30^{ab}	6.20^{b}	6.40^{bc}	6.70^{bc}
501	5.60^{c}	5.60^{b}	6.00^{c}	6.10^{c}
401	6.60^{b}	6.60^{ab}	7.00^{b}	7.10^{ab}

Sample means having the same letter suffix do not differ at 1% (P<0.01) level of significance.
Sample 502 : Mymensingh hog-plum +4.5% sugar+0.15% KMS
Sample 402 : Barishal hog-plum pulp+4.5% sugar +0.15% KMS
Sample 501 : Mymensingh hog-plum pulp +0.15% KMS
Sample 401 : Barishal hog-plum pulp+0.15% KMS

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