Preparation and Quality Evaluation of Underutilized Unripe Papaya Candy

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Abstract:
In nature, papaya is fast-growing, high-yielding, and has a variety of varieties that can produce economically important products on a commercial scale, which can also be blended with other fruits. So, for the utilization of unripe papaya wastage, this study presents candies prepared from unripe papaya using different sweeteners. It helps in the improvement of digestion, due to rich in enzyme papain and composed of several nutritional compositions like Vitamin C and Vitamin A. Sugar-based candy (A) and Honey based candy (B) was prepared with 1.15 kg each of edible portion. Each candy was prepared using similar initial concentrations i.e., 30°Bx and final concentrations of 70°Bx. On alternate days, the syrup's strength was increased by 10 °Brix TSS, reaching a maximum strength of 70 °Brix TSS. 0.1% of citric acid was added on the basis of sugar syrup initially present when TSS reached to 60°Brix. They were then dried at 60°C for 12 h in a hot air oven. From sensory analysis, honey-based candy was found to be the best product. The result shows that the moisture content, total ash, crude fat, crude fiber, Vitamin C, reducing sugar, Total sugar, crude protein, acidity, pH, and carbohydrate of A and B was found to be 12.35±1.44%, 0.25±0.02%, 0.28±0.06%, 0.46±0.05%, 21.71±7.13 mg/100g, 6.45±0.09%, 29.45±0.95%, 5.94±0.81%, 0.19±0.06%, 6.35±0.11 and 80.38±1.71% respectively. Similarly, 16.03±1.11%, 0.37±0.05%, 0.31±0.07%, 0.56±0.10%, 15.11±4.33mg/100g, 29.64±0.09%, 76.81±0.58%, 6.29±1.21%, 0.14±0.04%, 6.66±0.06 and 76.87±1.04% respectively were found for honey-based candies.

Keywords: Drying, Honey, Papaya Wastage, Total Sugar, Unripe Papaya

1.0. Introduction

The papaya, also known as pawpaw or papaw, is the fruit of the plant Carica papaya L. and genus (Carica). It was first domesticated in Mexico several millennia before the traditional Mesoamerican cultures emerged. It is a native of the tropics of America [1]. The papaya fruit has melon-like characteristics and reaches up to 9 kg in weight. It is oval to almost spherical, somewhat pyriform, or elongated club-shaped [2]. Jain et al. found that papayas are excellent sources of Vitamin A and other vitamins, such as nicotinic acid, thiamine, and riboflavin [3]. Additionally, the fruit contains proteolytic enzymes (papain and chymopapain) that aid in the digestion of proteins and are used as meat tenderizers and digestive medicines in the pharmaceutical, brewing, and tanning industries [4]. Although unripe green papaya may not contain carotene, it contains a lot of nutrients which is used for vegetable along with products like puree, candy, syrup, concentrate, jam, pickle, fruit bar, and jellies. The skin, pulp, and seeds of both mature and unripe C. papayas demonstrated potential antibacterial activity against the different microorganisms [5].

The Food and Agriculture Organization (FAO) of the United Nations (FAO) estimates that 13.1 million tons of papaya were produced worldwide in 2016. Colombia produced 188,305 tons, while India and Brazil each produced 5.7 and 1.4 million tons [6]. Due to the perishable characteristics of papaya, which include an easy tendency to rot and weight loss [7], the world produces an estimated three million tons of agro-industrial papaya waste each year, of which 70% are seeds. One of the classic methods for preserving fruits is the preservation of fruit in the form of candy or the use of high concentrations of sugar in the form of sugar [8]. Candy is a sweet food made from fruits or vegetables impregnated with sugar syrup, which is drained, and then dried to ensure shelf stability [9]. The primary goal of food preservation is to remove water, which lowers the moisture content to a level that permits secure storage for a long time because moisture can cause degradation [10]. Therefore, this study suggests that turning unripe papaya into sweets as a substitute for composting papaya trash could be another way to use fruit.

2.0. Materials and Methods

Sample was collected from the local area of Pokhara, Chhorepatan. In this study, fresh and unripe papaya was used for the preparation of candies.

2.1. Preparation of Candy

Papaya candy is prepared as per the suggestion of [11]. The syrups of sugar with a strength of 30° Brix, honey with a strength of 30°Brix, were prepared separately. The blanched papaya pieces were dipped into sugar and honey for 24 h. It was heated for 6-7 min. To eliminate fermentation, the syrup was steeped continuously for 24 hours at a strength of 70° Brix TSS on alternate days. If impregnated with sugar too quickly, the fruit will shrivel and become unsuitable for glazing and crystallizing [10]. 0.1% citric acid was added on the basis of sugar syrup initially present when TSS reached 60° Brix which impart tart flavor and balance sugar: acid ratio and also improve color by retarding browning [12]. After draining the syrup, the candy pieces were rapidly rinsed with hot water to remove any syrup that had adhered to the surface and then dried in a hot air oven at 60°C for 12 hours [13].

Unripe papaya fruits cleaning and washing

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Removing latex by streaking on Peel (Peeling and prickling

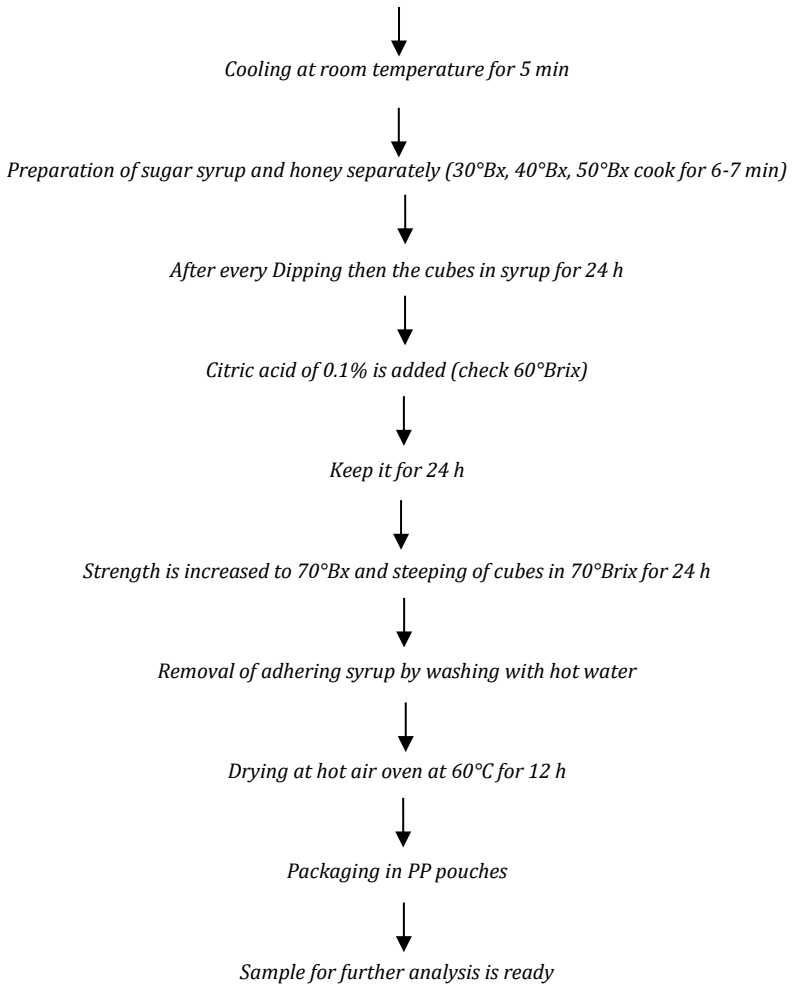
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Cutting into uniform sizes then wash

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Blanching at 80°C for 20 min

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Flow chart 1. Preparation of Unripe Papaya candy

2.2. Formulation of papaya candies

For the formulation of papaya candy, preliminary operations were done. Different types of syrups will be used for the preparation of papaya candy. Sugar syrup and honey syrup will be made at the strength of 30°Brix initially whereas the final strength will be 70°Brix by adding 10°Brix each day. Recipe for the formulation of papaya candy.

Table 1. Formulation of recipe [14,15]

Sample No.	Day 1	Day 2	Day 3	Day 4	Day 5
A	30°Bx	40°Bx	50°Bx	60°Bx	70°Bx
B	30°Bx	40°Bx	50°Bx	60°Bx	70°Bx

A*; Sucrose syrup, B*; Honey syrup

2.3. Proximate and Physiochemical analysis

Papaya and candy were analyzed for various quality attributes including physical attributes and proximate chemical composition. The color and shape of the papaya were recorded by visual observation. Acidity and ash content was determined as per AOAC [16]. Reducing sugar, non-reducing sugar, and total sugar were determined by the methods given by Lane and Enyon as per using Fehling's A and Fehling's B. Vitamin C was determined by iodometric titration as given by [17]. Three samples of A and B candy were provided to 17 panelists, which evaluated color, flavor, texture, taste, and overall acceptability based on a 9-point hedonic scale.

2.4. Sensory analysis

Sensory score data were analysed using triplicate data of samples and the results were presented as (mean ± SD). The sensory variance was tested by one-way (ANOVA) by using the IBM SPSS statistics software program, version 20. The significant difference was studied by the least significant difference (LSD) at a 5% level of significance.

3.0. Results and Discussion

The total weight of unripe papaya 4.240kg was used. Among that, the weight of the seed was 24 grams, the peel was 418 grams, and the edible part was 3.456 kg. The final weight of sugar and honey-based papaya candies was found to be 892 g, 908 g, and 900 g respectively.

Table 1. *Nutrition composition of Fresh unripe papaya*

Parameters	***Value***
Moisture content (%)	*93.72±1.89*
Total ash (%)	*0.51±0.09*
Crude fat (%)	*0.55±0.34*
Crude fiber (%)	*0.36±0.13*
Acidity (%)	*0.16±0.03*
Vitamin C (mg/100g)	*48.33±4.80*
Crude protein (%)	*0.67±0.09*
Carbohydrate (%)	*4.20±2.93*
TSS	*7.00±0.20*

**Values are the means of triplicate standard deviations. All the parameters are on a dry basis except moisture.*

Table 2*. Chemical composition of the sample*

Parameters	***Sugar based candy***	***Honey based candy***
Moisture (%)	*12.35±1.44*	*16.03±1.11*
Total ash (%)	*0.25±0.02*	*0.37±0.05*
Crude Fat (%)	*0.28±0.06*	*0.31±0.27*
Crude Fiber (%)	*0.46±0.05*	*0.56±0.10*
Vitamin C(mg/100g)	*21.71±7.13*	*15.11±4.33*
Reducing sugar (%)	*6.45±0.09*	*29.64±0.99*
Total sugar (%)	*29.25±0.95*	*76.81±0.58*
Crude protein (%)	*5.94±0.81*	*6.29±1.21*
Acidity (%)	*0.19±0.06*	*0.14±0.04*
pH	*6.53±0.11*	*6.66±0.06*
Carbohydrate (%)	*80.38±1.71*	*76.87±1.04*

*Values are the means ± S.D. of triplicate determination. All the parameters are on a dry basis except moisture.

Compared to sugar-based candy, honey-based candy contains more moisture. The mean scores of moisture content in samples A and B were found to be 12.35±1.44% and 16.03±1.11% respectively. A similar result was found by in ginger candy after drying for 12 h [18]. But moisture content of sugar-based candy was found higher as compared to which might be due to different times and temperatures of hot air ovens [13]. The total ash of honey was found higher than sugar-based candy was found to be 0.25±0.02% and 0.37±0.05% for samples A and B respectively. The reason for the difference might be due to the high amount of ash content compared to honey [19]. The total ash was found to be a bit lower as compared to pumpkin candy given by [20]. The reason might be due to the high amount of ash content present in pumpkin as compared to unripe papaya [21].

The crude fat of honey-based candy was found to be higher than sugar-based candy. The mean scores of crude fats were found to be 0.27±0.06% and 0.31±0.27% for samples A and B respectively. This might be due to the high amount of fat content present in honey than in sugar [22]. The fat content of candies falls in the range of amla candy [29]. The crude fiber content of sugar-based candy was found lower than honey-based candy. The mean score was found to be 0.46±0.05 and 0.56±0.10 for samples A and B respectively. The crude fiber content was found similar to that of papaya candy [14]. The mean score for vitamin C content of sample A was found to be 21.71±7.13 which was higher than sample B i.e., 15.11±4.33 mg/100g. Vitamin C of sample A was found similar to papaya candy and sample B result was found similar to ginger honey-based candy [11,18].

The mean score for reducing sugar content of sample A was found to be 6.45±0.09 which was lower than sample B, 29.64±0.99. This might be due to the presence of a high amount of reducing sugar glucose and fructose in honey compared to sugar. The results of sugar-based candy were found lower than bael candy [18, 30]. The reducing sugar of honey candy was found similar to that of honey-based carrot candy [15].

The mean score for total sugar content of sample A was found to be 29.25±0.95 which was lower than sample B 76.77±2.55 % respectively. This might be due to the presence of both reducing sugar and non-reducing sugar present in honey.

The mean scores for the crude protein of samples A and B were found to be 5.94±0.81% and 6.29±0.62% respectively. This might be due to the high amount of protein is present in honey than in sugar [31]. The acidity of samples A and B were found to be 0.19±0.06% and 0.14±0.04% respectively. The reason might be due to the addition of citric acid in papaya candy [32]. The carbohydrate of sample A was found higher than sample B i.e., 80.38±1.71 % and 76.87±1.04%. The reason might be due to the high amount of carbohydrates present in sugar than in honey [33].

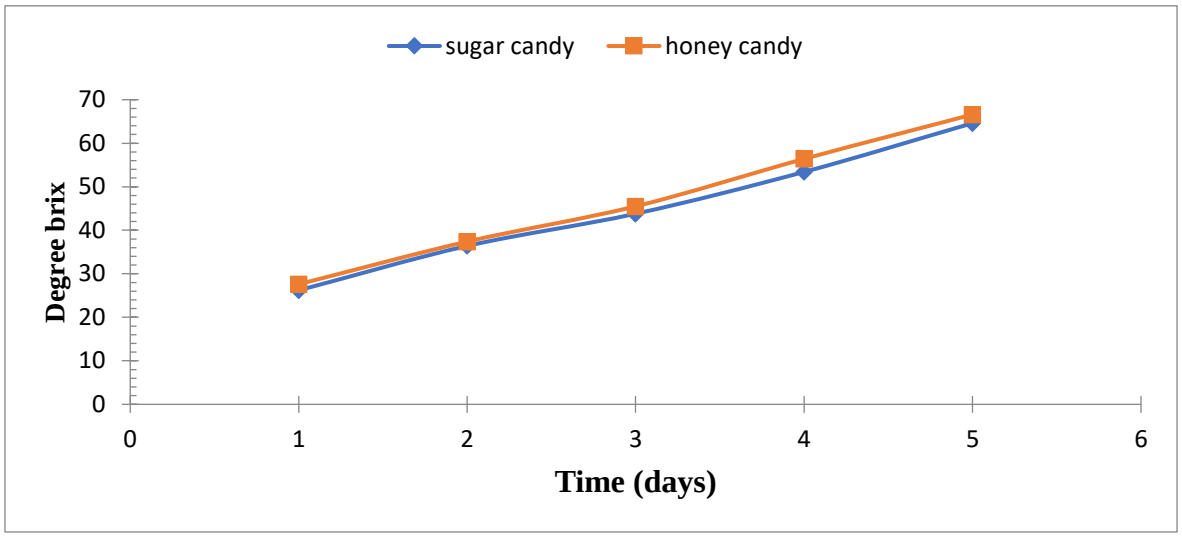


Figure 1. Changes in Total soluble solids in candies during syruping

The migration of sugar on the initial days of syruping was lower as compared to that of later days. On 1st and 2nd day, the TSS of sugar candy was found to be 26.2 °Bx and 36.4 °Bx respectively. This might be due to low osmotic inhibition of sugar. The migration of sugar on fruits was higher on later days i.e., the TSS of sugar candy was found to be 43.8 °Bx, 53.4 °Bx, and 64.6 °Bx on 3rd, 4th and 5th days respectively. A similar result was found in Beetroot candy [3]. On honey-based candy, a similar result was found i.e TSS of honey candy was higher on initial days than on later days. The TSS of honey candy was found to be 27.6 °Bx, 37.4° Bx, 45.5 °Bx, 56.4 °Bx, and 66.6 °Bx on the 1st, 2nd, 3rd, 4th and 5th days respectively. This might be due to high solid gain and sugar content with the loss of moisture from pieces as a solid gain of honey is higher than other solutions [21].

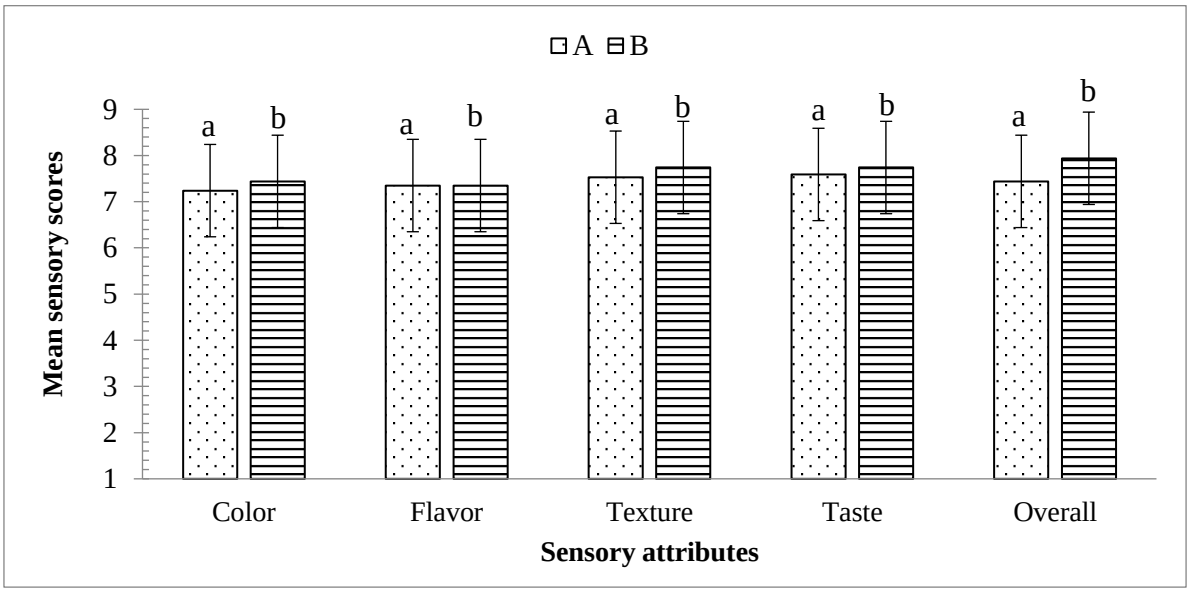


Figure 2. Sensory evaluation of unripe papaya candy in three different syrups *aa, *bb denotes significant difference A*; sugar-based candy and B*; honey-based candy

The mean score of sample A and B was found 7.24 ±0.92, 7.44 ±0.97, B has the highest means whereas A has the lowest means. Sensory scores for the color of all the samples were subjected to ANOVA at a 5% level of significance. Statistical analysis showed that samples A and B were not significantly different (P>0.05). According to the mean score for flavour, the mean scores of samples A and B are similar. Sensory scores for the flavor of all the samples were subjected to ANOVA at a 5% level of significance. Statistical analysis showed that samples A and B were not significantly different (P>0.05).

The mean score of samples A and B and for texture was found to be 7.59±1.14 and 7.74±1.06. According to the mean score, the mean score B has the highest mean score. Sensory scores for the taste of all the samples were subjected to ANOVA at a 5% level of significance. Statistical analysis showed that samples A and B found not significantly different (P>0.05). The mean scores of sample A and B for overall acceptability was found to be 7.44±0.97 and 7.94±0.77. According to the mean score, the sample B has the highest mean score. Sensory scores for the overall acceptability of all the samples were subjected to ANOVA at a 5% level of significance. Statistical analysis showed that samples A was found not significantly different from B (P>0.05).

4.0. Conclusion

According to the aforementioned study, unripe papaya can be easily turned into candy. The utilization of mature green papaya in candy is an alternative to minimize post-harvest losses and wastage minimization. Papaya candy with honey-based syrup was found to be best in overall sensory evaluation.

5.0. Future scope

Despite the fact that the unripe papaya is an underutilized product, it is nonetheless discarded as trash owing to a lack of awareness and poor application. Henceforth, converting unripe papaya into a sweet product is one of the alternative methods for the production of any confectionery product. Our future

aim is to prepare juices, jam, and other confectionery products



Dipped into syrup ***Lab analysis*** ***Final product***

6.0. Acknowledgement

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