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Influence of incorporation of honey on the sensory and physical qualities of traditional Petha sweet

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Abstract

This research study evaluates the impact of incorporating honey into traditional Petha sweet on its sensory and physio-chemical quality attributes. Honey, a natural sweetener, is renowned for its high nutritional content and myriad medicinal qualities, as compared to refined sugar. Considering, the nutritional and therapeutic properties of honey, a experimental petha sweet was developed by partial replacement of refined sugar by incorporating honey. Petha sweet was prepared with 5 different combinations of refined sugar and honey i.e. 50:10 (T_1), 40:20 (T_2), 30:30 (T_3), 20:40 (T_4), 10:50 (T_5). The control sample was prepared by using only ash gourd and refined sugar with ratio 40:60(T_0). The petha sweet prepared with a 30:30 (T_3) ratio of sugar and honey achieved the highest scores in sensory evaluations. Based on the overall acceptability scores, T_3 was favoured by the panel members. The nutritional analysis of all treatments indicated that moisture content ranged from 24.15% to 47.12%, protein content ranged from 1.19% to 1.85%, total soluble solid ranged from 44.25% to 46.51 0Brix, and sugar content ranged from 38.44 to 42.40%. All parameters were in increasing order synchronised with higher levels of honey incorporated treatments. Which is desirable from the point of view of amount of nutrient. Conversely, fat content ranged from 0.44% to 0.15%, total solids 75.85% to 52.88%, carbohydrate content ranged from 74.02% to 50.60%, pH levels ranged from 7.28 to 6.80, and energy ranged from 304.80 to 211.15 kcal. All these parameters were in decreasing order with the increased honey content. Which is desirable from the point of view of nutrition. Therefore, it can be concluded that honey can be effectively utilized in traditional petha sweet at a 30:30 ratio with sugar.

Keywords: Petha sweet, honey, natural sweetener, nutritional and therapeutic, refined sugar replacement

Introduction

Petha sweet, a traditional sweet delicacy originating from Agra, India. The city of Agra in Uttar Pradesh has become a notable centre for the production and processing of petha sweet, is primarily made from ash gourd (*Benincasa hispida*). This delicacy is cherished for its unique translucent appearance, chewy texture, and rich cultural heritage.

Ash gourd (*Benincasa hispida*), also known by several names such as white gourd, wax gourd, white pumpkin, winter melon, ash pumpkin, hairy melon, and Chinese preserving melon, is a significant cucurbit vegetable in India. The fruits of ash gourd have a long shelf life and offer great potential for value addition. They are composed of a high moisture content (96.4%), protein (467.67 mg/100 g), fat (102.63 mg/100 g), vitamin C (10.76 mg/100 g), dietary fiber (0.8 g/100 g), and carbohydrates (2.60%) as reported by (Pandey *et al*., 2009) [21]. Additionally, ash gourd possesses several medicinal properties, making it useful in treating conditions such as epilepsy (Ramesh *et al*. 1989) [24], peptic ulcer (Grover *et al*., 2001) [13], and urinary infections (Nayar and More, 1998) [20]. The fruit can be utilized in diverse culinary applications, including baking, frying, boiling, pickling, candying, and preserving, each method enhancing its unique properties and flavors (Robinson and Decker-Walters, 1999) [26].

A healthy alternative to sugar is honey, a functional food produced by bees (Apis mellifera). Honey contains a diverse array of bioactive substances and enzymes, which confer its antioxidant, antimicrobial, anti-inflammatory, and anticarcinogenic properties (Eteraf-Oskouei& Najafi, 2013; Samarghandian *et al*., 2017) [11, 28], despite its high sugar content (Karabagias *et al*., 2014) [16]. Honey is composed of carbohydrates (82%), water (17%), proteins (0.3%), minerals (0.7%), vitamins, organic acids, enzymes, phenolic acids, and flavonoids (Islam *et al*., 2012) [15]. The major carbohydrates in honey are fructose (38%), glucose (31%), and sucrose (less than 8%) (Ball, 2007; Hussein *et al*., 2014) [5, 14].

White sugar is commonly used as the primary sweetening

agent in candy production, comprising about 99.7% sucrose. However, excessive consumption of sucrose is often linked to various health issues, including heart problems and coronary thrombosis (Alam, 1999) [2]. Given the health disadvantages associated with high sugar intake, there is significant interest in exploring alternative natural and artificial sweeteners. Recent developments by Srivastava *et al.* (2006) [30] have introduced a jaggery-based petha (ash gourd) candy, which can be stored for up to 45 days under refrigerated conditions.

This research aims to investigate the impact of incorporating honey into the traditional preparation of petha sweet. By replacing or supplementing traditional refined sugar with honey, the study explores potential health benefits alongside improvements in the physical and sensory qualities of petha.

Treatments Combinations

T_0: Control- Steeping of 40 g ash gourd pieces in 60 g sugar
T_1: Steeping of 40 g ash gourd pieces in 50 g sugar and 10 g honey
T_2: Steeping of 40 g ash gourd pieces in 40 g sugar and 20 g honey
T_3: Steeping of 40 g ash gourd pieces in 30 g sugar and 30 g honey
T_4: Steeping of 40 g ash gourd pieces in 20 g sugar and 40 g honey
T_5: Steeping of 40 g ash gourd pieces in 10 g sugar and 50 g honey

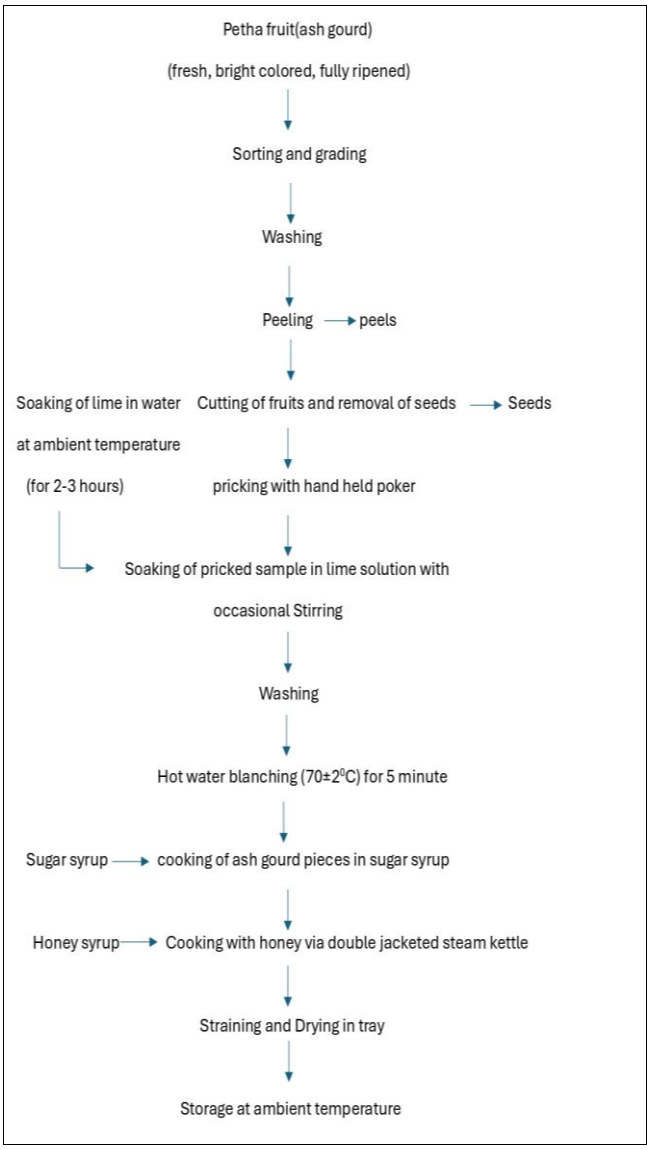
Material and methods

Method for preparation of Honey based Petha sweet

Ash gourd was selected by visual appearance of fresh and bright colored, fully ripened fruits obtained from local market of Prayagraj. Honey and sugar purchased from local market of Prayagraj. The entire experimental studies conducted in the Warner College of Dairy Technology, Department of Food science and Technology, SHUATS, PRAYAGRAJ.

The process begins with selecting and preparing the ash gourd. Fresh, mature, and disease-free gourds are peeled, deseeded, and cut into uniform cubes to ensure consistent cooking. The pieces are then soaked in a 1-2% calcium hydroxide solution for 2-3 hours to enhance firmness and rinsed thoroughly with potable water to remove residual lime. Blanching involves boiling the ash gourd pieces in potable water (70 ± 2 °C) for 5-10 minutes to deactivate enzymes and partially cook the gourd. The pieces are then drained and immersed in cold water to halt the cooking process. For the sweetening syrup, sugar is dissolved in water according to treatments and brought to a boil. The blanched ash gourd pieces are then added to the boiling syrup and cooked on medium heat 40 ± 5 °C in sugar syrup for 50 to 55 min until the syrup reaches a one-thread consistency and the ash gourd pieces become translucent, indicating thorough absorption of the syrup. Stirring should be done gently to avoid breaking the pieces. For honey based petha sweet, honey was mixed according to treatments ratio, brought to a double jacketed steam kettle pot and gently warmed without boiling to preserve honey's bioactive properties. Once cooked, the petha pieces are removed from the syrup, placed on a strainer or wire rack to drain excess syrup, and cooled to room temperature. For a firmer texture, the petha pieces can be air-dried or dehydrated at low temperature until they achieve the desired consistency.

Flow chart for experimental honey petha sweet



Physico-chemical analysis of experimental honey petha sweet

The petha sweet's moisture content were determined using the AOAC (2000) [4] method, which involves drying the sample at 105 °C until a constant weight is achieved. Fat contentwere measured by the Soxhlet Extraction Method as per AOAC (2000) [4], involving solvent extraction and gravimetric analysis. Protein contentswere determined using the Kjeldahl method (AOAC, 2000) [4], converting nitrogen to protein after acid digestion, distillation, and titration. The total ash content was measured by incinerating the sample in a muffle furnace at 550 °C (AOAC, 2000) [4]. Fiber contentwere estimated following AOAC (2000) [4] by treating the sample with acid and alkali, filtering, drying, and weighing the residue. Total solids were calculated by evaporating the water content (Ranganna, 2009) [25]. Carbohydrates were determined by difference, subtracting the sum percentage of protein, fat, ash, and moisture from

100% (AOAC, 2000) [4]. Total soluble solids (TSS) were estimated using a hand refractometer (Model RG701, Officine Galileo), while titratable acidity were determined by titration with a standard alkali solution (Ranganna, 2009) [25], pH were measured using a digital pH meter (Ranganna, 2009) [25]. Finally, the energy content were calculated by the factorial method, summing the energy contributions of protein, fat, and carbohydrates using their respective caloric values. The Lane-Eynon method (Ranganna, 2009) [25] were titrimetric procedure used to determine the concentration of reducing sugars in developed petha.

Sensory Evaluation

The sensory evaluation of the developed petha was conducted to assess its flavor, body and texture, color and appearance, and overall acceptability (OA). The samples, coded and presented on white plates, were evaluated by a test panel. Ten semi-trained panelists, comprising different genders and age groups (18-60 years), rated each sensory attribute using a 9-point hedonic scale (Baniwal & Hathan, 2015; Lawless & Haymann, 1998) [6, 18].

Results and Discussion

Physicochemical characteristics of the developed honey petha

Physiochemical composition of experimental petha incorporated with honey by the partial replacement of refined sugar. The honey levels in pethais 10, 20, 30, 40 and 50 percent respectively in all experimental petha treatments. The moisture content of control sample was 23.29 percent. Similar results were observed in crystallized petha, with a moisture content of 25.79 percent as reported by Pandey *et al*., 2014 [22]. The moisture content in the developed honey petha sweet samples (T_1-T_5) increased, ranging from 24.15% to 47.12% shown in table-1. The moisture content of honey petha sweets was found to increase with the amount of honey added. The highest moisture content was observed in T_5 (50 grams of honey), and the lowest in T_1 (10 grams of honey). This trend is likely due to the higher moisture content in honey compared to sugar. This finding wassimilar tokhajoor burfi using honey as a sweetener and khoa burfi, the moisture content significantly increases with addition of honey 19.05 to 21.02 percent (Mete *et al*., 2017) [19] and 21.33 to 26.87 percent (Deshmukh *et al*., 2023) [12].

The fat content of control sample was 0.50 percent. The developed honey petha sweet samples (T_1-T_5) exhibited a reduction in fat content, ranging from 0.44 to 0.15 percent shown in table-1. It was observed that the fat content of the honey petha sweets decreased slightly as more honey was added.This notable decrease in fat content with increased honey addition can be attributed to the absence of fat in honey and the naturally low fat content of ash gourd. These results align with findings by Grover *et al*. (2001) [13] and Rahman *et al*. (2008) [23]. Additionally, Bhattarai *et al*. (2021) [8] noted that beetroot candy made with honey syrup had a slightly higher crude fat content compared to beetroot candy made with sugar syrup.

The protein content of the control sample was 0.67percent. The developed honey petha sweet samples (T_1-T_5) showed an increase in protein content, ranging from 1.19 to 1.85 percent shown in table-1. The protein content of the honey petha sweets increased slightly with the addition of honey. This significant increase in protein content is attributed to the presence of protein in raw honey (Schäfer *et al*., 2006; Subramanian *et al*., 2007) [29, 31]. An increasing trend in protein content was also reported by Shalan *et al*. (2019) in the formulation of hard candy containing pure honey as a functional food.

The total solid content of the control sample was 76.71 percent. The total solid content of the developed honey petha sweet samples (T_1-T_5) decreased, ranging from 75.85to 52.88 percent shown in table-1. It was observed that the total solid content of honey petha sweets decreased slightly with the incorporation of honey. This significant decrease in total solid content can be attributed to the high moisture content in both ash gourd and honey. These findings are consistent with those reported by Deshmukh *et al*. (2017) [10], who found that increasing the level of honey in honey burfi was inversely proportional to the total solid content in the burfi.

The carbohydrate content of the control sample was 75.34 percent. The carbohydrate content of the developed honey petha sweet samples (T_1-T_5) decreased, ranging from 74.02 to 50.60 percent shown in tabe-1. It was observed that the carbohydrate content of honey petha sweets decreased slightly with the addition of honey. This significant decrease in carbohydrate content is due to the higher carbohydrate content of sugar compared to honey. Similar findings were reported by Bhattarai *et al*. (2021) [7] in the preparation and quality evaluation of sugar and honey-based beetroot candies, where the higher carbohydrate content in sugar candy was attributed to the inherently higher carbohydrate composition of sugar relative to honey.

The TSS content of the control sample was 43.61. The TSS content of the developed honey petha sweet samples (T_1-T_5) increased, ranging from 44.25 to 46.51. It was observed that the TSS content of honey petha sweets increased slightly with the addition of honey. This significant increase in TSS content is due to the incorporation of honey. Similar findings were reported by Ahmad *et al*. (2015) [1] in the case of amla preserve.

The sugar content of the control sample T_0 was 36.43 percent. The sugar content of the developed honey petha sweet samples (T_1-T_5) increased, ranging from 38.44 to 42.40 percent shown in table 1. It was observed that the sugar content of honey petha sweets increased slightly with the incorporation of honey. Similar results were found by Cholera *et al*. (2020) [9] in the physico-chemical analysis of honey-based herbal gooseberry candies, which contained approximately 45.09 percent total sugar.

The pH content of the control sample was 7.30. Similar findings were reported by Pandey *et al*. (2014) [22] for refrigerated petha sweet, with a pH range in kashipetha of 6.8 to 7.0. The pH of the developed honey petha sweet samples (T_1-T_5) decreased, ranging from 7.28 to 6.80. It was observed that the pH content of honey petha sweets decreased slightly with the incorporation of honey. This significant decrease in pH content can be attributed to the acidic nature of honey (Codex Alimentarius, 2001) [3].

The energy content of the control sample was 308.54 Kcal. The energy content of the developed honey petha sweet samples (T_1-T_5) decreased, ranging from 304.80 to 211.15 Kcal shown in table-1. It was observed that the energy content of honey petha sweets decreased slightly with the

incorporation of honey. This significant decrease in energy content is correlated with the increasing amount of honey added. Shah (2022) [17] reported that the energy values of honey ranged from 314.72 to 325.24 Kcal per 100 grams.

Table 1: Mean of physio-chemical attributes of experimental honey petha

Treatments / Attributes	T_0	T_1	T_2	T_3	T_4	T_5
Moisture	23.29	24.15	30.19	36.85	45.29	47.12
Fat	0.5	0.44	0.43	0.28	0.21	0.15
Protein	0.67	1.19	1.32	1.44	1.80	1.85
Total solids	76.71	75.85	69.80	63.15	54.71	52.88
Carbohydrates	75.34	74.02	67.84	61.20	52.47	50.60
TSS	43.61	44.25	44.52	45.35	46.08	46.51
Sugar	36.43	38.44	40.00	41.29	41.93	42.40
pH	7.29	7.28	7.26	7.15	6.96	6.80
Energy	308.5	304.8	280.5	253.1	219.00	211.1

Sensory evaluation of developed Petha

The score of color& appearance, body & texture, flavor& taste as well as the overall acceptability of different treatment combinations of peda with 2, 2.5 and 3 percent of flaxseed were compiled in Table 2. The highest sensory evaluation shown for color and appearance, body and texture, flavor and taste and overall acceptability is for control peda with the score 7.77, 7.00, 6.72 and 6.22 respectively.

Taste and flavour of experimental honey Petha sweet

The mean score of taste and flavour, color and appearance, body and texture as well as overall acceptability of different treatments of experimental honey petha sweet. The levels of honey in petha sweet were 10, 20, 30, 40 and 50 percent respectively in all petha samples. The mean score of all sensory attributes shown in table-2.

The mean score of taste and flavour, color and appearance, body and texture as well as overall acceptability of experimental honey petha of control sample was 6.09, 6.17, 6.10 and 6.12 respectively. The highest score obtained by a panel of judges in all sensory attributes in T_3 in which honey and sugar were mixed in a 30:30 ratiowere 8.57, 8.83, 7.69 and 7.85 respectively.

Table 2: Mean of sensory attributes of experimental honey petha

Treatments / Attributes	T_0	T_1	T_2	T_3	T_4	T_5
Taste and flavour	6.09	6.40	7.27	8.57	7.63	7.42
Colours and appearance	6.17	8.19	8.24	8.83	8.24	8.29
Body and texture	6.10	6.24	7.17	8.64	7.69	6.87
Overall acceptability	6.12	6.94	7.56	8.68	7.85	7.53

Conclusion

The study demonstrated that preparing honey petha with varying levels of honey and partial replacement of refined sugar significantly impacts its physico-chemical attributes, including moisture content, fat, protein, total solids, carbohydrates, TSS, pH, energy, and sugar content, as well as sensory attributes such as taste, flavor, color, appearance, body, texture, and overall acceptability. Nutritional analysis revealed that higher honey levels increased moisture content, protein content, TSS, and sugar content, while reducing fat content, total solids, carbohydrates, pH, and energy. Based on overall acceptability scores, sample T_3 was preferred by the panel members. Thus, it can be concluded that honey can be effectively incorporated into traditional petha sweet in a 30:30 ratio with sugar.

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