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Study and quality evaluation of candy prepared by using bottle gourd

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Abstract. Bottle Gourd (*Lagenaria siceraria*) is having a variety of uses throughout world. Recently the interest in bottle gourd has been growing amongst consumers because it contains several nutritive and medicinal constituents which are required for good health and wellbeing. The nutritive value of bottle gourd makes it a popular diet ingredient in making sweet curries, soups, jams, juices, beverages, cakes, for value addition. Keeping in view its nutritional and therapeutic values, bottle gourd candy was prepared by incorporating (65, 70 and 75 °Brix) of sugar syrup into them. Product quality was evaluated based on physicochemical (moisture, ash, pH, TSS, browning index), characteristics of the samples. It was studied that the physicochemical attributes of the bottle gourd candy samples were improved by adding the sugar syrup as compared to with control which is 2% CaCl₂ treatment. There was increased ash content, reduction in moisture content and browning index due to the sugar syrup incorporation. On 28th day the moisture content of the of the bottle gourd candy sample with (65, 70 and 75 °Brix) concentration was 7.49, 7.19 and 7.07 % respectively. The ash contents of the bottle gourd candy samples were found 0.385, 0.506, and 0.590 % respectively on 28th day and pH were 3.82, 3.89 and 3.49 respectively at the end of storage. The products were found to be safe for consumption and was in pristine state even after 28 days. Hence the study suggests the uses of bottle gourd candy for taste and health benefits.

1. Introduction

1.1. Background

The Bottle Gourd belongs to the genus *Lagenaria* which is obtained from the Latin word *lagena*, meaning “bottle”. Bottle gourd (*lagenaria siceraria*), belongs to the cucurbit family and also known with different names like Calabash, Doodhi, and Lauki in various parts of India [1]. India, Sri Lanka, South Africa, Indonesia, and Malaysia are the largest producers of bottle gourd around the globe. It is a fence creeper, and it can also grow on the ground like other cucurbit family members. The fruit is light green at first but in ripening stage its colour becomes pale brown, and it will dry at senescence.



The shape and size of the bottle gourd varies with their classification, it can small and round to large and narrow necked. Generally, fruit length varies between 150 to 1000 mm, depending on its variety. The shape of bottle gourd seeds are flat, or may be rectangular to trapezoidal [2]. Botanically bottle gourd can be classified into two categories wild variety as well as sweet or edible variety. Since the wild variety is difficult to procure the researcher are now using sweet and edible variety even for the production of medicines [3]. Food processors and researchers are working together to develop some special types of drinks by fortification of beneficial bioactive compounds which helps in enriching the beverage and improve its effectiveness and quality [4]. De-oiled bottle guard seed powder can be used as an alternative to wheat flour for the enhancement of quality of biscuits [5]. Polysaccharides obtained from vegetables and other parts of plants shows a significant anti-tumour, immuno-modulatory, anti-inflammatory and antioxidant properties [6]. Bottle gourd pulp powder can be helpful in lowering the plasma glucose level [7]. Furthermore, it can be classified into fruit, flower, leaf and they are shown in the figure 1.

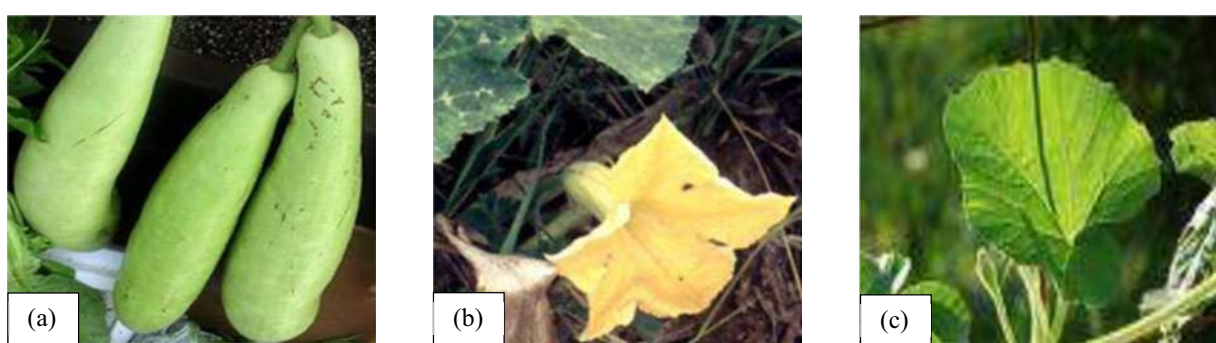


Figure 1. Bottle gourd:(a) Fruit (b) Flower and (c) Leaf

1.2. Medicinal and health benefits of bottle gourd

Bottle Gourd have been the main component for natural herbal medicines, especially in Asia. The bottle gourd juice has been used to treat acidity, indigestion, and ulcers. It cures pain, fever and is used for pectoral-cough, asthma, and other bronchial disorders and has anti-hyperlipidemic activity [8]. A glass of bottle gourd juice taken daily is also considered to prevent premature greying of hair [9]. Bottle Gourd is a vegetable for good health and is used as curative for mental health disorders. Among cucurbits, the bottle gourd is the only plant which contains the highest choline level along with required metabolites/metabolic precursors for brain function. It was emphasized that it has high therapeutic values and must be consumed as daily nutrition. The bottle gourd is a rich source of bioactive molecules which are beneficial in providing chemical difference against [10]. The study incorporates the quality evaluation of candy prepared from bottle gourd through examining the physico chemical properties utilising different syrup concentrations. Besides providing calories bottle gourd also contains vitamin C and fibres aiding the digestion mechanism, while the presence of zinc benefits in regulating the blood sugar levels. Consumers find it difficult and disinteresting in preparing the vegetable and juice on daily basis, but the candies prepared in this study can serve this purpose very well.

2. Methodology and experimental setup for preparation of bottle gourd candy

The experiments were carried out to study and evaluate the quality and shelf-life stability of bottle gourd candy developed by incorporating 65, 70, 75 °Brix sugar syrup. Quality of bottle gourd candy was calculated on of the basis of Nutritional (sugar content and ash content) and physicochemical characteristics (moisture content, pH, browning index and TSS). Storage stability of the products were, determined after every 7 days up to 28 days under ambient condition. All the experiments was performed

in the Department of Post-Harvest Engineering and Technology (PHET), Faculty of Agricultural Sciences, A.M.U Aligarh.

Various tools, instruments and equipment used for the study were pricking tool, gas stove, stainless steel vessel, trays, electronic weighing balance, hot air oven, muffle furnace, digital pH meter, digital spectrophotometer, refractometer, and autoclave. Various steps such as selection, cleaning, washing, peeling, cutting, steeping in saltwater puncturing, dropping in sugar syrup and shade drying are used in preparation of bottle gourd candy. The mature light green bottle gourd are used and trimmed into small cubes of 3cm after peeling then wash cubes properly. After that cubes were steeped in 2 % salt solution for 8 hours. Wash again and treatment with calcium chloride (CaCl_2) for 4 hours. Lukewarm water is used to displace the adhering (CaCl_2). Now sugar syrup of (65, 70 and 75 °Brix) concentration was prepared and left them to cool. In next step dip 250 gram of these cubes sample into each concentration of sugar syrup for 3 days. After one day of dipping, check the syrup concentration because it is lowered due to bottle gourd loses moisture and thus syrup concentration was reduced. To maintain concentration syrup must be heated. Repeat this step for next two days and after 3 days syrup was drained from sample and sample were placed in trays of a tray dryer for drying at 45 °C for 24 hours. They were packed into small airtight PET jars and stored at room temperature.

3. Physiochemical analysis

3.1. Moisture content

The moisture content of the sample was estimated by Hot-air oven method. 5g of sample was placed in hot air oven and was maintained at $100 \pm 5^\circ\text{C}$ for 4 hours. It was then cooled in desiccators and reweighed. Loss in weight gives the measure of moisture content in the sample [11].

$$\text{Moisture content (\%)} = \frac{\text{Loss in weight}}{\text{Initial weight of sample}} \times 100 = \frac{W_1 - W_2}{W_1 - W} \times 100$$

W_1 = weight of the dish and sample in gram (g) before drying; W_2 = weight of the dish and sample in gram (g) after drying; W = weight of the empty dish in gram (g)

3.2. Ash content

For the determination of ash content, 5g of sample (candy) was weighed accurately and heated with a crucible in a muffle furnace at 560°C for 6 hours than it is cooled in desiccators and the sample is weighed after completion of ashing (color of ash should be greyish white) [12]. Ash content was calculated by employing the following formula.

$$\text{Ash Content (\%)} = \frac{\text{Loss in weight}}{\text{Initial weight of sample}} \times 100 = \frac{W_1 - W_2}{W_1 - W} \times 100$$

W_1 = weight of crucible + candy sample before drying, (g); W_2 = weight of crucible + candy sample after drying, (g); W = weight of crucible (g)

3.3. pH measurement

The pH measurement was done by using digital pH meter. 5 g of sample was taken and properly ground and pulped in 30 ml distilled water. It was then mixed thoroughly in homogeniser (Yorco micro tissue homogeniser) and finally filtered. The filtrate was taken into the beaker and the electrode of pH meter was then dipped into the filtrate and the reading was noted.

3.4. Total soluble solids (TSS)

TSS of the candy sample was determined by using handheld Refractometer (ERMA, ATC). A bit of the sample was evenly spread over the prism and scale is viewed through eyepiece facing bright sunlight. The

adjusting ring of dioptré was adjusted until the scale can be seen clearly. The calibrated scale shows a transparent portion giving the direct reading in degree Brix (°Brix) [13].

4. Results and Discussion

4.1. Physico-chemical characteristics of the bottle gourd candy incorporated with different syrup concentrations

4.1.1 Effect on moisture content

The results of the moisture content during storage of the bottle gourd candy are given in Table 4.1. The moisture content of the sample which was dipped in 65 °Brix syrup concentration was found to be the highest, while the lowest moisture content was observed in sample dipped in 75 °Brix. Since at the lower value of syrup concentration (i.e 65 °Brix) the osmotic dehydration is low therefore the moisture content is high.

Table 1. Moisture content of bottle gourd candy sample during storage period.

Variance / Storage	Moisture content (%)				
	0 day	7 day	14 day	21 day	28 day
CC	10.21	9.53	8.61	8.04	7.47
65 °Brix	10.23	9.54	8.97	8.20	7.49
70 °Brix	10.42	9.65	8.60	7.81	7.19
75 °Brix	10.62	10.16	9.26	8.63	7.07

CC= 2% CaCl₂ treatment, ± S.D

The overall moisture content was decreased significantly with the increase in storage time for all the four samples. The fresh samples having the values of moisture content as 10.21, 10.23, 10.42 and 10.62% respectively were decreased to 7.47, 7.49, 7.19 and 7.07 % during 28 days of storage period for bottle gourd candy incorporated with 2% CaCl₂ treatment, 65, 70, and 75 °Brix concentration for sugar syrup, respectively. Moisture content decrease with storage period of candy samples as similar trend was observed in the candies prepared from Indian gooseberry (*phyllanthus emblica*) [14]. The decrease of moisture content from the prepared samples is due to the evaporation taking place in the given atmospheric conditions that were present during the study. The trend of moisture content variation is shown in Fig 4.1.

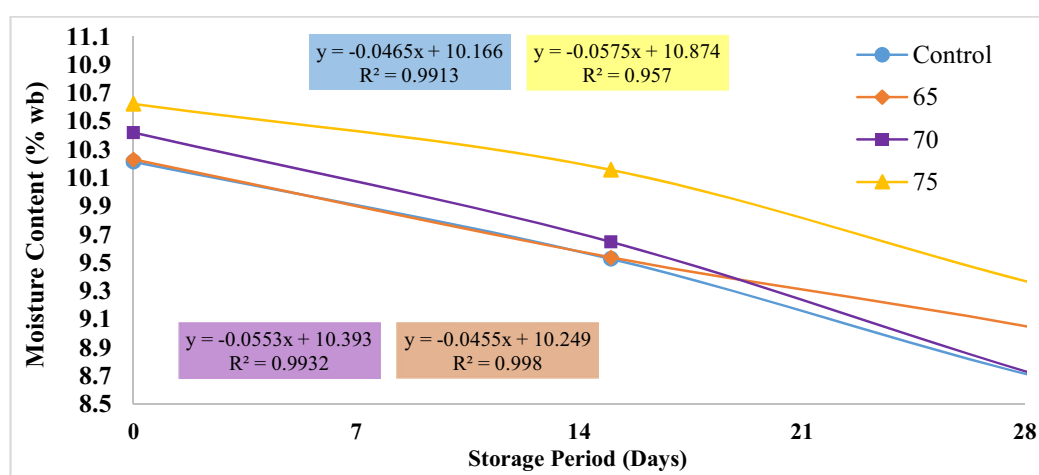


Figure 2. Change in moisture content of bottle gourd candy samples during storage.

4.1.2. Effect on ash content

Average values of ash content in bottle gourd candy samples were found to be ranging from 0.35-0.59 % (Table 2). High ash content was found in candy sample which contains higher concentration of syrup of bottle gourd candy.

Table 2. Ash content of bottle gourd candy sample during storage period.

Variance / Storage	Ash Content (%)				
	0 day	7 day	14 day	21 day	28 day
CC	0.350	0.353	0.356	0.357	0.360
65 °Brix	0.353	0.355	0.366	0.372	0.385
70 °Brix	0.431	0.438	0.447	0.450	0.506
75 °Brix	0.509	0.529	0.535	0.541	0.590

CC= 2% CaCl₂ treatment, ± S.D

Ash content slightly increases as storage period increases is seen in Fig 3. The initial value of ash content was 0.350 % in bottle gourd candy sample with 2% CaCl₂ treatment and increased to 0.360 % during the storage period of 28 days. Likewise, the ash was increased from 0.353 to 0.385%, 0.431 to 0.506 % and 0.509 to 0.590 % in samples incorporated with 65, 70 and 75 °Brix concentration of syrup respectively during the 28 days of storage. As it is revealed in the previous studies that when the moisture content is reduced than the mineral content increases which shows coherence in this study as the ash content is increasing.

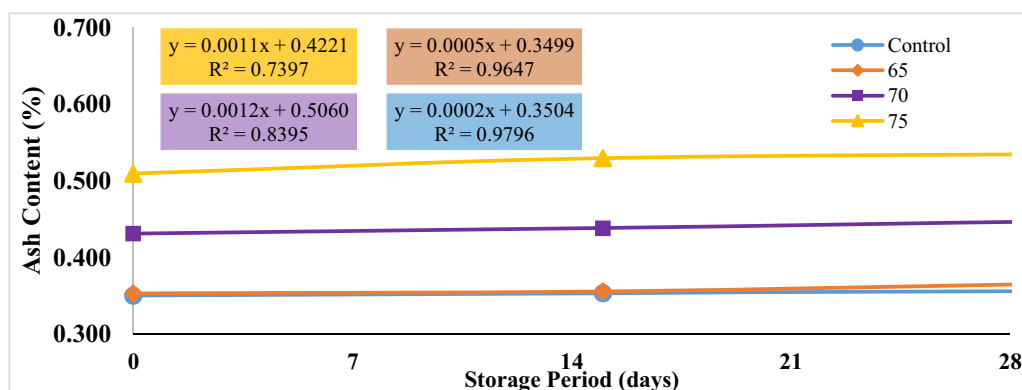


Figure 3. Change in ash content of bottle gourd candy samples during storage.

4.1.3. Effect on pH

Table 3 shows that the values of pH that are observed and are in the range of 3.39-3.98 for the bottle gourd candy samples. Throughout the study a lower pH was maintained in samples incorporated with sugar syrup steeping. When the syrup concentration is increases pH decreases.

Table 3. Effect on pH of bottle gourd candy sample during storage period.

Variance / Storage	pH				
	0	7	14	21	28
CC	3.98	3.96	3.95	3.95	3.92
65 °Brix	3.88	3.86	3.85	3.85	3.82
70 °Brix	3.60	3.54	3.52	3.51	3.49
75 °Brix	3.53	3.50	3.45	3.43	3.39

CC= 2% CaCl₂ treatment, ± S.D

The pH decreased in all the bottle gourd candy samples. The rise in acidity throughout storage period are due to pectic acid. The pH change was from 3.98 to 3.92 in bottle gourd candy with 2% CaCl₂

treatment during 28 days of storage period. The initial value of pH was 3.88 and reduced to 3.82 after 28 days storage of bottle gourd candy incorporated with 65 °Brix syrup and 3.60 to 3.49 in 70 °Brix syrup. The pH range for bottle gourd candy incorporated with 75 °Brix syrup concentration was 3.53 to 3.39 throughout the storage of 28 days. The tendency of lowering in the value of pH with the advancing of storage time is quite common in the items having moisture [15].

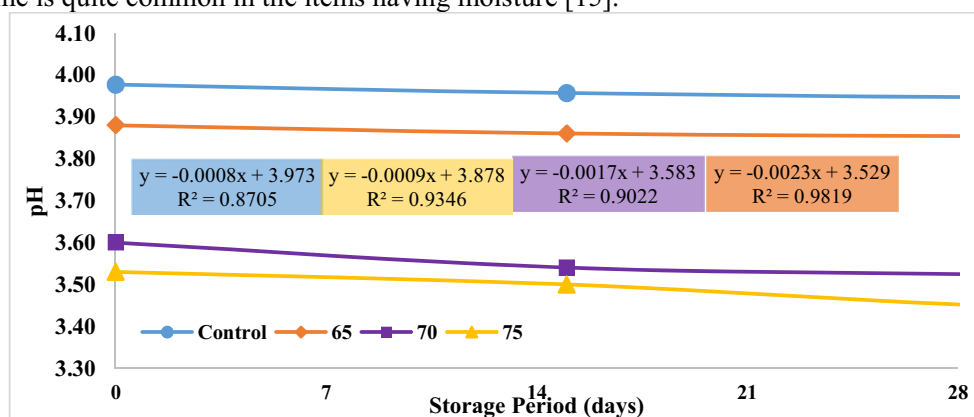


Figure 4. Change in pH content of bottle gourd samples during storage.

4.1.4. Effect on (total soluble solid) TSS

Table 4 shows that the result of TSS of bottle gourd candy samples for 28 days storage period and are ranging from 24.61-32.28 was highest for the sample with 75 °Brix syrup concentration incorporation and lowest for the sample with CaCl_2 treated. Previous studies revealed that during storage of candies (pear and pumpkin) the value of TSS increased due to the reduction of moisture content and osmotic inhibition of sugar.

Table 4. TSS of bottle gourd candy samples during the storage period

Variance / Storage	TSS				
	0	7	14	21	28
CC	12.50	13.53	14.37	16.46	18.37
65 °Brix	21.37	23.78	25.44	27.37	30.28
70 °Brix	22.37	24.42	26.41	28.54	31.27
75 °Brix	24.61	25.72	28.27	29.20	32.28

CC= 2% CaCl_2 treatment, \pm S.D

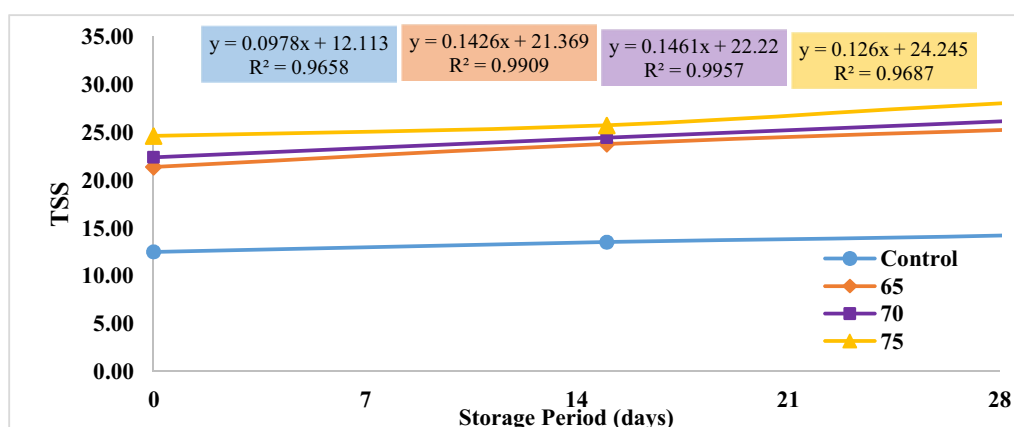


Figure 5. Change in TSS content of bottle gourd samples during storage.

The overall trend of change in TSS during the 28 days storage period is given in the Fig. 5. It can be seen an increase in the TSS as the storage days increased the reason for higher TSS is due to the reduction in moisture. TSS increases with increase in storage period was also reported in Indian gooseberry (aonla) candy by [16]. The fresh values of TSS in bottle gourd candies with different concentrations of syrup (75, 70 and 65 °Brix) were 24.61, 22.37 and 21.37. At 28 days period the TSS increased to 32.28, 31.27 and 30.28.

5. Conclusion

Bottle gourd is a rich source of nutrition thereby having numerous applications in dietary and medicinal products. Keeping in view its nutritional and therapeutic values, bottle gourd candy was prepared using different concentrations of sugar syrup. The physico chemical characteristics (pH, ash content, moisture content, TSS, and browning index) changed considerably by the incorporation of sugar syrup having concentrations as 65, 70 and 75 °Brix, respectively. The study suggest that the bottle gourd candy samples prepared with 75 °Brix concentration having superior quality product nutritionally as compared with other concentrations, having high mineral and better organoleptic properties (tenderness and taste). The levels of sugar syrup incorporated as sweetener described are cost effective and commercially viable. Sugar syrup incorporation provides improvement in quality of the products.

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