Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(4): 913-916
Received: 10-05-2019
Accepted: 12-06-2019

Ankita Dobhal
Ph.D. Scholar, Department of Foods and Nutrition, College of Home Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India

Pratima Awasthi
Professor, Department of Foods and Nutrition, College of Home Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India

Correspondence
Ankita Dobhal
Ph.D. Scholar, Department of Foods and Nutrition, College of Home Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India

Formulation of beetroot candy using simple processing techniques and quality evaluation

Ankita Dobhal and Pratima Awasthi

Abstract
Beetroot is a cool season crop having high nutritive value and great potential in processed forms. Still beetroot consumption is very low as compared to other root crops. It has got great potential in processed forms but scanty information is available regarding development of candy from beetroot. Beetroot candy was prepared by giving two types of preliminary treatments to beetroot, viz., steam-blanching (B1) and boiling (B2). Both types of candies were analyzed for differences in chemical composition, storage stability and sensory attributes. To establish the best acceptable product, sensory evaluation was done using Nine-point Hedonic Scale and Score card method. B1 was found to be the most preferred candy on the basis of sensory evaluation and chemical composition. Microbial analysis revealed that B1 and B2 candies can be stored safely for three months at ambient temperature.

Keywords: Beetroot candy, boiling, sensory evaluation, steam-blanching, storage stability

Introduction
Beetroot (*Beta vulgaris*) has been acclaimed for its health benefits, in particular for its disease fighting antioxidant potential, significant amount of vitamin C and vitamins B1, B2, niacin, B6, B12 whereas the leaves are an excellent source of vitamin A. In spite of its high nutritive value, beetroot consumption is very low as compared to other root crops. Therefore, there is a need of proper processing and preservation techniques to formulate beetroot enriched products so as to get maximum benefits from beetroot. Also, there is need for a simple and inexpensive preservation process, which has low capital investment and offers a way to save perishable products like beetroot and make them available for the regions away from production zones. Osmotic dehydration is one of these methods (Shi and Le-Maguer 2002) [1].
Osmotic Dehydration (OD) is an important technique of food preservation and processing in which foods especially fruits and vegetables are immersed in the osmotic solution containing concentrated salt, sugar, alcohol or starch. The osmotic agent may be fructose, corn syrup, glucose, sodium chloride or sucrose. Cell membrane of fruits and vegetables works as semi-permeable membrane which permits water to move from low concentrated fruits and vegetables to high concentrated osmotic solution (Khan 2012) [2].
Candy is an osmotically dehydrated sweet food prepared from fruits or vegetables by impregnating them with sugar syrup followed by draining of excessive syrup and then drying the product to a shelf stable state. Fruits and vegetables like apples, ginger, mangoes, guava, carrots and citrus peels have been used to prepare candies (Mehta and Bajaj 1984) [3], (Sharma *et al*., 1998) [4], (Chandu and Prasad 2006) [5]. Caronda, ber and Aonla candies have also been developed (Kaikadi *et al.*, 2006) [6]. White sugar is the usual sweetening agent used in preparation of candies. Sugar provides energy and enhances taste and texture of the food (Benitez *et al*., 2009) [7].
Concerning its availability throughout the year, beetroot can be processed into beetroot candies. In the present scenario, when food habits of the people are changing due to urbanization and popularization of processed, ready-to-eat food products, candies are becoming popular because of their high acceptability, minimum volume, higher nutritional value, convenience and relatively longer shelf life. Beetroot candy would be more attractive to consumers because it is more practical to eat. Singh and Hathan (2013) [8] optimized osmotic dehydration of candy by response surface methodology (RSM) and determined its organoleptic quality using Nine-point Hedonic Scale.
The present paper describes efforts made to optimize process to develop beetroot candy using two simple processing techniques, viz., steam-blanching and boiling and its quality evaluation.

Materials and Methods

Fresh, mature and good quality beetroots were procured from local market of Pantnagar Uttarakhand. Two types of processing treatments, viz steam-blanching and boiling were used for pre-preparation of beetroot candy.

Preparation

Steam-blanch treatment (Beetroot Candy B1) - Beetroots were washed and peeled, inedible portion was removed. Then beetroots were sliced into cube like pieces (1.5 cm^3), pricked by stainless steel fork and then steam-blanched for 7 minutes.
Boiling treatment (Beetroot Candy B2) - Washed beetroots were pressure cooked for five minutes and then peeled, inedible portion was removed and then sliced into cube like pieces (1.5 cm^3), pricked by stainless steel fork.

Formulation of Candy:

Beetroot pieces in each treatment were put into a bowl and sugar was added equal the amount of beetroot taken (1:1).Beetroot pieces were kept in alternate layers of sugar (1:1) for 24 hours at room temperature (25-30ºC). After 24 hours of steeping in each treatment, the syrups were drained and their concentrations were increased by heating. The syrup was cooled and added again with beetroots. The syrup concentration was increased by 10ºBrix daily until the syrup concentration reached 75ºBrix in both the candies. Two percent citric acid was added to both the syrups. The slices were kept in 75ºBrix sugar solution for 1 week until the equilibrium reached between the slices and syrup concentration. The slices in each treatment were drained free of syrup and dried in a tray drier at 60ºC for 10 hours until the desired moisture content was reached. The candies were packed in LDPE pouches (500-600µm) and were stored under ambient conditions for sensory evaluation and chemical analysis.

Sensory Evaluation

Sensory evaluation of both the beetroot candies (B1 and B2) was done by a semi-trained panel consisting of 15 members from the Department of Foods and Nutrition, G.B. Pant University of Agriculture and Technology, Pantnagar using Nine-point Hedonic Scale rating from liked extremely to disliked extremely and Score card method (Amerine *et al.*, 1965) [9] for their sensory characteristics namely color, flavor, texture, taste, appearance, after-taste and overall acceptability.

Chemical Composition

Moisture

Moisture content was determined as per Ranganna (1986) [10] procedure at 70±1ºC. Moisture content was expressed as percentage on the basis of fresh weight.

Protein

Crude protein content was determined by the micro-kjeldahl method of Ranganna (1986) [10]. Protein content was estimated as N×6.25 and percent Nitrogen was calculated using the formula:

$$\text{Per cent nitrogen} = \frac{(\text{sample titre volume} - \text{blank titre volume}) \times 0.0014}{\text{weight of sample}} \times \frac{\text{total volume of sample}}{\text{aliquot distilled}} \times 100$$

pH

pH was noted with the help of pH meter (Systronic make) after its calibration.

Total Soluble Solids (TSS)

Estimation of total soluble solids (TSS) was done using Hand Refractometer (Erma make) and expressed as degree Brix (°B).

Titrable Acidity

The percent acidity of beetroot candy samples was analyzed according to the method of Ranganna (1986) [10] and was calculated using the formula:

$$\% \text{ Total Acid} = \frac{\text{Titre} \times \text{Normality of Alkali} \times \text{Volume made up} \times \text{Equivalent wt.of acid} \times 100}{\text{Volume of sample for estimation} \times \text{Wt.or volume of sample taken} \times 1000}$$

Sugars: Total Sugars and Reducing Sugars

The quantification of sugars was carried out by Lane and Eynon method (Ranganna 1986) [10]. The percent reducing sugar was determined using the formula:

$$\text{Reducing Sugars (\%)} = \frac{\text{Fehling's Factor} \times \text{Dilution} \times 100}{\text{Titre (ml)} \times \text{Vol.of sample (ml)}}$$

% Total sugars as invert sugars = Calculated as (% reducing sugar) making use of the titre value obtained in the determination of total sugars after inversion.

Folic Acid

The folic acid in the samples was determined by the method as given in Ranganna (1986) [10]. Folic acid is extracted from samples using mild alkaline buffer, oxidized with potassium permanganate and the resulting amine is diazotized. The diazotized compound is coupled with N-(1-naphthol) ethylenediamine, and the colour developed is determined at 550 nm.

Storage Study

Beetroot candies were stored in LDPE bags under ambient temperature for a period of three months. They were evaluated for storage stability by estimating total bacterial count at regular intervals of one month over a period of three months.
Total bacterial count of the samples were determined using standard plate count (SPC) technique as given in compendium of methods for microbiological examination of foods (APHA 1984) [11]. This technique gives total number of viable cells of bacteria present in the sample, therefore also called as total viable count (TVC) technique or serial dilution technique. The samples were analyzed in three replicate.

$$\text{Cfu per g or ml of sample} = \frac{\text{Number of colonies} \times \text{Dilution}}{\text{amount of sample taken}}$$

Statistical Analysis

The data obtained on chemical composition and sensory evaluation was further analyzed statistically. One way ANOVA was used to find out significant difference between the two types of candies and CD value was calculated. Limit of probability fixed for the test of significance was P = 0.05. Mean ± SD was calculated for chemical composition as well as sensory evaluation of beetroot candy prepared by two different processing techniques.

Results and Discussion

Sensory Analysis

Data on sensory evaluation of candies (B1 and B2) are presented in Table 1. Data revealed that B1 was liked very much by 70 percent respondents and B2 was liked moderately by 40 percent respondents.

Table 1: Sensory Evaluation of Beetroot Candy using Nine-Point Hedonic Scale

Hedonic Scale	Beetroot Candy	
	Steam-blanched (B1)	Boiled (B2)
Liked extremely	10%	5%
Liked very much	70%	35%
Liked moderately	20%	40%
Liked slightly		20%
Neither liked nor disliked		
Disliked slightly		
Disliked moderately		
Disliked very much		
Disliked extremely		

*****Values are given in percentage of respondents

The mean sensory scores of the different attributes and overall acceptability of beetroot candy are presented in Table 2. Significant difference was found between B1 and B2 Candy on the basis of color, flavor and taste. The average scores of color, flavor, texture, taste, appearance, aftertaste and overall acceptability of B1 Candy were higher as compared to B2 Candy. Overall acceptability score for B1 candy was 8.1 which was higher than the score for B2 Candy (7.45).

Thus on the basis of sensory analysis steam-blanched (B1) was the most preferred candy over B2.

Table 2: Mean Sensory Scores of Beetroot Candy using Score Card Method

Attributes	Maximum Score	Score B1 (steam-blanched)	Score B2 (boiled)	CD at 5% level of significance	Significant Difference (S/NS)
Color	10	8.25 ±0.72	7.4 ±0.94	0.54	S
Flavor	10	8.25 ±0.85	7.4 ±1.43	0.75	S
Texture	10	8.1 ±0.72	7.55 ±1.28	0.66	NS
Taste	10	8.25 ±0.85	7.4 ±1.43	0.75	S
Appearance	10	8.3 ±0.92	7.65 ±1.04	0.63	NS
Aftertaste	10	8 ±1.03	7.5 ±1.28	0.74	NS
Overall Acceptability	10	8.1 ±0.85	7.45 ±1.19	0.66	NS

*Values are mean sensory scores ± S.D.

Chemical Composition

Data on chemical composition of candies (B1 and B2) prepared by steam blanching and boiling techniques have been depicted in Table 3.

B2 candy had 11.5% moisture content, which was higher than the moisture content of B1 (10.83%). Hasanuzzaman *et al.,* (2014) [12] reported 7.42% moisture in tomato candy. B1 Candy had 2.04% protein content, which was higher than that of B2. Hasanuzzaman *et al.,* (2014) [12] reported 2.97% protein in tomato candy. B1 and B2 candies had almost similar pH values (4.96). TSS of the syrup for both the candies B1 and B2 candies was 75ºBrix. Similar results (75.2ºBrix) were reported by Nayak *et al.,* (2001) [13] for aonla candy. Significant difference was found between B1 and B2 candies on the basis of titrable acidity. B2 had 0.68% titrable acidity, which was slightly higher than that of B1 candy. Nayak *et al.,* (2001) [13] have reported 0.48-0.56% titrable acidity in aonla candy. B1 candy had 48.11% total sugars, whereas B2 candy had 45.96% total sugars. Srivastava *et al*., (2011) [14] have reported 78% total sugars in carrot candy which is higher than that of B1 and B2 candies. Jayashree *et al.,* (2012) [15] have reported 22.7% total sugars in sapota candy which is lower than the beetroot candy B1 and B2 both. B1 candy had reducing sugar content of 28.74%, which was higher than that present in B2 candy. Srivastava *et al*., (2011) [14] have reported 30.5% reducing sugars in carrot candy. Jayashree *et al.,* (2012) [15] have reported 14.7% reducing sugar content in sapota candy which is quite lower than that present in beetroot candy (28.74 and 28.35%). B1 candy had 4.76 µg of folic acid per 100g, whereas B2 candy was found to have 4.65%.

Table 3: Chemical Composition of Beetroot Candy

Parameter	B1 (steam blanched)	B2 (boiled)	CD at 5% level of significance	S.Em±	Significant Difference (S/NS)
Moisture (%)	10.83 ±0.42	11.5 ±0.5	1.21	0.31	NS
Protein (%)	2.04 ±0.25	1.90 ±0.25	0.57	0.15	NS
pH	4.96 ±0.01	4.97 ±0.03	0.04	0.01	NS
TSS (ºBrix)	75	75	-	-	NS
Titrable Acidity (%)	0.56 ±0.01	0.68 ±0.02	0.04	0.009	S
Total Sugars (%)	48.11 ±2.24	45.96 ±2.05	4.84	1.24	NS
Reducing Sugars (%)	28.74 ±0.23	28.35 ±0.44	0.79	0.20	NS
Non-Reducing Sugars (%)	19.36 ±2.04	17.60 ±1.69	4.22	1.08	NS
Folic acid (µg/100g)	4.76 ±0.15	4.65 ±0.07	0.26	0.07	NS

*Values are mean of triplicate observations ± S.D.

Results of chemical composition indicated that there was non-significant difference in moisture, protein, pH, TSS, total sugars, reducing sugars, non-reducing sugars and folic acid content of B1 and B2 candies. Significant difference was observed only in titrable acidity of both the candies.

Storage Study

Data on microbiological examination of both the candies are given in Table 4. As the storage period increased from 0 day to 90 days the TVC of B1 Candy increased from 0 to 1.23 X 10^3 CFU/g whereas for B2 Candy TVC increased from 0 to 1.34 X 10^3 CFU/g.

Microbial analysis revealed that B1 and B2 candies can be stored safely in LDPE bags for 3 months at ambient temperature. Hasanuzzaman *et al.,* (2014) [12] reported the bacterial load on tomato candy with 60% sugar solution after 15 days and 6 months of storage as $3X10^1$ cfu/g and $7X10^1$ cfu/g respectively which is lower than that present in beetroot candy.

Table 4: Total Viable Count of Candy (cfu/g) during Storage

Candy	0 days	30 days	60 days	90 days
B1	absent	$4.3X10^1$	$6.1x10^2$	$1.23X10^3$
B2	absent	$5.1X10^1$	$6.7X10^2$	$1.34X10^3$

*Values are mean of triplicate observations ± S.D.

Conclusion

Formulation of beetroot candy is a nutritious way to utilize the crop and preserve it. Steam-blanching treatment was found to be better than boiling treatment for making beetroot candy. Among ready-to-eat foods, beetroot candy can become popular because of minimum volume, higher nutritional value, more convenience and relatively longer shelf life.

References

1. Shi J, Le Maguer M. Osmotic dehydration of foods: Mass transfer modeling aspects. Food Reviews International. 2002; 18:305-35.
2. Khan MR. Osmotic Dehydration Technique for Fruits Preservation- A Review. Pakistan Journal of Food Science. 2012; 22:71-85.
3. Mehta U, Bajaj S. Changes in the chemical composition and organoleptic quality of citrus peel candy during preparation and storage. Journal of Food Science and Technology. 1984; 21:422-424.
4. Sharma S, Dhaliwal YS, Kalia M. Candied apple: a new perspective. Journal of Food Science and Technology. 1998; 35:79-82.
5. Chandu N, Prasad M. Development of guava candies. Journal of Food Science and Technology. 2006; 43:210-212.
6. Kaikadi MA, Chavan UD, Adsule RN. Studies on preparation and shelf-life of ber candy. Beverage and Food World. 2006; 33:49-50.
7. Benitez EI, Genovese DB, Lozano JE. Effect of typical sugars on the viscosity and colloidal stability of apple juice. *Food* Hydrocolloids. 2009; 23:519-525.
8. Singh B, Hathan BS. Optimization of osmotically dehydrated Beetroot candy using response surface methodology. International Journal of Food and Nutritional Sciences. 2013; 2(1):15-21.
9. Amerine NA, Pangborn RM, Roessler EB. Principles of sensory evaluation of food. Academic Press. New York, 1965.
10. Ranganna S. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Edn 3, Tata McGraw Hill Publishing Company, New Delhi, 1986.
11. APHA. Recommended Methods for the Microbiological Examinations of Food. New York, American Public Health Association Inc, 1984, 53-59.
12. Hasanuzzaman MD, Kamruzzaman M, Islam MD, Khanom S, Rahman MD, Lisa L *et al*. A Study on Tomato Candy Prepared by Dehydration Technique Using Different Sugar Solutions. Journal of Food and Nutrition Sciences. 2014; 5:1261-1271.
13. Nayak P, Tandon DK, Bhatt DK. Study on changes of nutritional and organoleptic quality of flavored candy prepared from aonla (*Emblica officinalis* G.) during storage. International Journal of Nutrition and Metabolism. 2001; 4(7):100-106.
14. Srivastava PK, Durrani, AM, Verma S. Development and quality evaluation of honey-based carrot candy. Journal of Food Science and Technology. 2011; 48(4):502-505.
15. Jayashree S, Divya AR, Bhogi B. Effect of storage methods on the nutritional quality of sapota candy. Asian Journal of Dairy and Food Research. 2012; 33(2):104-108.