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Studies on technology development, organoleptic evaluation and proximate composition of beetroot candy by using different sweeteners

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Abstract
In the present investigation, the technology is developed to standardize the process for preparation of beetroot candy. The fresh beetroot and prepared candy were analyzed for chemical and organoleptic properties. The raw fresh beetroot were peeled, cut into cubes, the cubes were steam blanched and syruping is carried out by using sugar, sucralose and sorbitol in different proportions. The raw beetroot found to contained moisture (85.56) percent, protein (1.41) percent, fat (0.21) percent, carbohydrate (9.05) per cent, ash (1.18) percent, fiber (2.2) percent and betalain content (291 mg/100g) respectively. The sample $T_{0, T4 \text{ and}}$ T_6 was found to be organoleptically significant over other candies.

Keywords: Beetroot, beetroot candy, sucralose, sorbitol, oragnoleptic properties

Introduction
Beet root, scientifically known as *Beta vulgaris* is one of the well known plants belonging to Chenopodiaceae family includes approximately 1400 species divided into 105 genera. It makes an excellent dietary supplement being not only rich in minerals, nutrients and vitamins but also has unique phytoconstituents, which have several medicinal properties Several parts of this plant are used in medicinal system such as anti-oxidant, anti-depressant anti-microbial, anti-fungal, anti-inflammatory, diuretic, expectorant and carminative. It is one of the natural food which boosts the energy in athletes as it has one of the highest nitrates and sugar contents plant (Lee C.H. 2005) [8].

The intense red color of beetroots derives from high concentrations of betalains, a group of phenolic secondary plant metabolites. Betalains are used as natural colorants by the food industry, but have also received increasing attention due to possible health benefits in humans, especially their antioxidant and anti-inflammatory activities (Georgiev *et al*., 2010; Zielinska-Przyjemska *et al*., 2009) [3, 18]. Other benefits include increased resistance to the oxidation of low-density lipoproteins (Tesoriere *et al*., 2003) [15], and chemo-preventive effects (Zhang *et al*., 2013) [17]. The betalains that are mainly found in beetroot are betacyanins and betaxanthins (Gandia-Herrero *et al*., 2010) [2]. Apart from betalains, small amounts of hydroxycinnamic acids such as gallic, syringic, and caffeic acids and flavonoids have been identified (Kazimierczak *et al*., 2014) [6].

Beetroot has excellent physiological properties. Its macro- and micronutrient content is remarkable and its vitamin content is high. Its vitamin A and C content is substantial and its vitamin B is outstanding. Vitamin B1 (thiamine), vitamin B2 (riboavin), and vitamin B3 (niacin) can be found in most root vegetables with dark green leaf, such as in beetroot. Beetroots play a vital role due to their remarkable folate content. Folic acid helps to prevent cancer and in cooperation with vitamin B contributes to the proper functioning of the nervous system (Tak_acsn_e, 2002) [9].

Candies are becoming more and more popular because of high acceptability, minimum volume, higher nutritional value and longer storage life. These have additional advantage of being least thirst provoking and ready-to-eat snacks. Among the unique products of aonla, the candy has much demand in domestic as well as export point of view. Its dietary intake can prevent atmospheric pollution related toxicity and the incidence of lung cancer (Sahu and Paul 1998) [13]. Consumers are increasingly conscious about health and have begun to look at the nutritional benefits of food, disease prevention and health promoting compounds in many foods. In view of the nutritional and neutraceutical significance of beetroot, the present research investigation has been planned to utilize the different types of sweeteners for preparation of beetroot candy to explore its neutraceutical based health benefits.

Materials and Methods

The present investigation was carried out in Department of Food Engineering with collaboration of Department of Food Science and Technology and Department of Food Chemistry and Nutrition, College of Food Technology, VNMKV, Parbhani during year 2017-18.

Chemicals and glasswares

The chemicals of analytical grade and glasswares required during investigation were used in the department of Food Engineering.

Process of preparation of beetroot candy

The beetroot candy was prepared by standard method (jayaraman, 1993) [5].

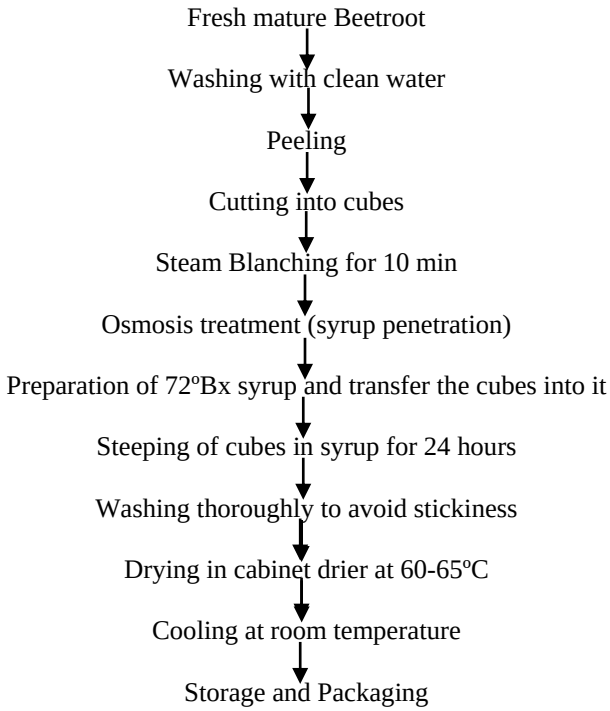

Fig 1: Flow sheet for preparation of beetroot candy

Table 1: Standardization of recipe for beetroot candy

Treatments	Sugar (%)	Sucralose (%)	Sorbitol (%)
T_0	100	00	00
T_1	90	10	-
T_2	80	20	-
T_3	70	30	-
T_4	60	40	-
T_5	90	-	10
T_6	80	-	20
T_7	70	-	30
T_8	60	-	40

Proximate composition of prepared beetroot candy

Proximate composition of prepared beetroot candy such as moisture, fat, protein, crude fiber, ash and carbohydrate were estimated according to the standards given by A.O.A.C. (1990) [1]. TSS was measured by using Erma hand refractometer and titratable acidity as per method given by Ranganna (1986) [12].

Sensory evaluation of prepared beetroot candy samples

Sensory evaluations of beetroot candy were carried out on the basis of 9 point hedonic scale.

Statistical analysis

The data obtained was analyzed statistically by Completely Randomized Design (CRD) as per the procedure given by Panse and Sukhatme (1967) [11]. The analysis of variance revealed at significance of $P< 0.05$ level, S.E. and C.D. at 5% level is mentioned wherever required.

Results and Discussions

Chemical composition of beetroot

The data pertaining to various chemical composition such as moisture, fat, carbohydrates, protein, ash and crude fiber were determined and results obtained are illustrated in Table. 2.

Table 2: Proximate composition of beetroot

Nutrients	Average Value
Moisture	85.56%
Fat	0.21±0.01%
Protein	1.04±0.02%
Carbohydrate	9.05±0.12%
Dietary fibre	2.2±0.21%
Ash	1.18±0.2%
Titrable acidity	0.89±0.031
Betalain content	291±140

Results given in the table. 2 indicated that the moisture content was 85.56%, fat 0.21%, protein 1.04%, carbohydrates 9.05%, crude fiber 2.2%, and ash 1.18%. The results found to be similar with (Odoh and Okoro 2013) [10].

Effect of sweetener syrup treatment on organoleptic evaluation of beetroot candy

The data pertaining the organoleptic evaluation of beetroot candy is presented in Table 3.

Table 3: Effect of sweetener treatment on organoleptic evaluation of beetroot candy

Treatments	Appearance	Colour	Taste	Flavour	Texture	Overall acceptability
T_0	7.0	8.5	8.2	8.5	8.5	8.5
T_1	7.0	8.0	8.0	8.0	7.9	7.9
T_2	7.0	8.0	8.0	8.0	8.0	7.9
T_3	6.9	8.0	8.2	8.2	7.9	7.5
T_4	7.5	8.5	8.5	8.5	8.5	8.4
T_5	7.0	8.0	8.0	8.0	7.9	7.5
T_6	7.5	8.5	8.2	8.2	8.2	8.2
T_7	6.9	7.9	7.9	7.5	7.5	7.0
T_8	6.8	7.5	7.5	7.5	7.5	7.0
SE	0.2	0.19	0.11	0.11	0.15	0.07
CD @5%	0.58	0.57	0.33	0.34	0.45	0.20

*Each value is average of three determinations
Treatment coding is as per given in table 1.

The various sweetener treatments were given to beetroot as shown in table 1. Then the prepared candy were subjected for sensory evaluation based on 9-point hedonic scale to colour, appearance, flavour, taste and overall acceptability which was compared with control sample and results obtained are tabulated in Table 3.

The data shown that colour and appearance of sample $T_{0\ i.e}$ control sample recorded highest score i.e. 8.5 and 7.0 followed by T_4 sample scored 8.5 and 7.5, whereas T_6 sample recorded 8.5 and 7.5 respectively. Taste attribute of sample T_4 recorded highest score (8.5), where as sample T_0 and T_6 showed same score of (8.2).The flavor and texture of the sample T_0 showed highest score of (8.5) where as T_4 and T_6 showed score of (8.5) and (8.2) for both attributes respectively. The overall acceptability score for sample T_0, T4 and T_6 were 8.5, 8.4 and 8.2 respectively.

Hence from the data it can be concluded that the samples T_0, T4 and T_6 were oragnoleptically significant over other candies.

Effect of sweetener syrup treatment on chemical constituents of beetroot candy

The data regarding the chemical constituents of beetroot candy was presented in Table 4.

Table 4: Effect of syrup treatments on chemical constituents of beetroot candy

Treatments	Moisture (%)	P^H	TSS (^{0} Brix)	Acidity (%)
T_0	26.04	7.12	72	0.09
T_4	27.99	7.31	74	0.06
T_6	26.60	7.31	75	0.05
SE	0.008	0.0039	0.48	0.002
CD @ 5%	0.025	0.0114	1.42	0.005

*Each value is average of three determinations
T_0 –Sugar: 100
T_4 -Sugar: Sucralose: 60: 40
T_6 -Sugar: Sorbitol: 80: 20

The data obtained from the effect of sweetener on chemical constituents of selected beetroot candies showed that there were minimum changes with respect to moisture, TSS and P^H, statistically the values found to be at par with each other with respect to the moisture TSS and P^H. The highest score for acidity was shown by control sample T_0 (0.09) and minimum for T_6 (0.05).

Chemical composition of beetroot candy (T_0)

The data pertaining the chemical composition of the beetroot candy is given in table 5.

Table 5: Chemical composition of beetroot candy (T_0)

Chemical parameters	Observations
Moisture (%)	26.04
P^H	7.12
TSS (^{0} Brix)	72
Titrable acidity (%)	0.09
Fat (%)	0.13
Protein (%)	0.97
Crude fibre (%)	2.01
Carbohydrate (%)	66.50
Reducing sugar (%)	2.28
Non reducing sugar (%)	25.37
Total sugar (%)	27.65

The sample T_0 selected on the basis of organoleptic evaluation is the analyzed for the chemical composition which is shown in table 5. The beetroot candy can be categorized under the group of intermediate moisture foods (IMF) which contains moisture content of moderate level of 20 % to 50 percent (vora *et al*.) [16]. The IM foods have an acceptable eating quality and reasonable storage stability under ambient conditions (Iman *et al.*, 2011) [4]. The data showed that the moisture content, TSS, P^H, Titrable acidity observed to be 26.04 percent, 72^0 Brix, 7.12 and 0.09 percent. The fat, protein, carbohydrate, crude fibre content found to be 0.13 percent, 0.97 percent, 66.50 percent, 2.01 percent. The total sugar, reducing sugar and non reducing sugar of the candy found to be 27.65 percent, 2.28 percent and 25.37 percent. The variation in results might be due to absorption of sugars during osmosis. A significant increase in total sugar content of ber fruit (Singh, 1992) [14] and blueberries (Kim and Toledo, 1987) [7] was reported when the fruits were osmo air dried.

Conclusion

From the present investigation, it can be concluded that prepared beetroot candy was considered as Intermediate Moisture Food that it contained 26 per cent moisture. The use of sweetener for preparation make it feasible for the health conscious people as they give lower calories as compared to sugar at the same time provides the sweetness same as sugar. It can be safely presumed that, the food industry shall give due considerations to the use of sweeteners and processing of beetroot which not only add new dimension to our dietary habits but also retain its neutraceutical properties and quality parameters.

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