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Organoleptic Evaluation of Beetroot Juice as Natural Color for Strawberry Flavor Ice Cream

[1]A. Manoharan, [1]D. Ramasamy, [2]C. Naresh Kumar, [2]B. Dhanalashmi and [2]V. Balakrishnan
[1]Institute of Food and Dairy Technology, Koduvalli, Alamathi (Post), 52 Chennai, India
[2]Department of Dairy Science, Madras Veterinary College, 7 Chennai, India

Abstract: The demand for natural food colorants is increasing because of public awareness of their health benefits. Betalains are nitrogen-containing plant pigments whose colors range from red-violet betacyanins to yellow betaxanthins. They are used for coloring dairy products, meat and frozen desserts. An investigation was carried out to find the acceptable level of beetroot juice as a natural coloring agent for ice cream and assess the sensory scored of the resultant product. Beetroot juice was incorporated at different level in strawberry flavor ice cream. Prepared ice cream was subjected to sensory analysis and found out the optimum level of inclusion of beetroot juice in the ice cream preparation. Then sample were stored at -29°C and studied for their sensory scores at weekly intervals.

Key words: Ice cream, natural colors, beetroot juice, strawberry flavor, food color, India

INTRODUCTION

Ice cream is one of the oldest fat rich delicious dairy products relished by all age groups of people throughout the world. Global production of ice cream is increasing constantly and the rate of growth in production is enormous. Color becomes the most sensitive part of any commodity not only for its appeal but also it enhances consumer acceptability. In addition, the color of a food substance is important to indicate its freshness and safety that are also indices of good aesthetic and sensorial values. For natural color and additives, adherence to the norms of bio-safety protocol are limited. The demand for natural source of such compounds is increasing day by day because of awareness of positive health benefit out of natural compounds. It therefore, necessitates looking into natural sources of food grade colorants and their use potentials. Red beet roots contain a large concentration of betanin, 300-600 mg kg^{-1} and lower concentrations of iso-betanin, betanidin and betaxanthins (Kanner *et al*., 2001). The prickly pear (*Opuntia ficus indica*) contains about 50 mg kg^{-1} of betanin and 26 mg kg^{-1} of indicaxanthin (Butera *et al*., 2002). The bioavailability of betalains is at least as high as flavonoids which are well-accepted natural antioxidants. Betalains, as natural antioxidants, may provide protection against oxidative stress-related disorders (Tesoriere *et al*., 2005; Kanner *et al*., 2001).

Betalains have several applications in foods such as desserts, confectioneries, dry mixes, dairy and meat products. The concentration of pure pigment required to obtain the desired hue is relatively small, rarely exceeding (50 mg) 1 kg calculated as betanin (Delgado-Vargas *et al*., 2000).

According to the Codex Alimentarius Commission, betalain use is limited only by Good Manufacturing Practice. The food colorant known as beetroot red, extracted from beetroots is commercialized in European Union and USA as food colorant. Betanin ($C_{24}H_{27}N_2O_{13}$) makes up 75-95% of the total coloring matter found in the beet root, therefore it is used as a natural food coloring agent (Azeredo *et al*., 2007). This pigment, like other betacyanins is highly susceptible to changes induced by both pH and temperature. As a powerful antioxidant pigment, betanin may provide protection and reduce risk of cardiovascular disease and cancer (Rakin *et al*., 2007). Betalains are nitrogen-containing plant pigments whose colors range from red-violet betacyanins to yellow betaxanthins. They are used for coloring dairy products, meat and frozen desserts. Betalains have attracted additional interest because of their antioxidative, anti-inflammatory and anticarcinogenic properties. The main source of commercially produced betalains is red beet root but alternative sources are found in plants from the Amaranthaceae and Cactaceae families (Pavokovic and Krsnik-Rasol, 2011).

Corresponding Author: A. Manoharan, Institute of Food and Dairy Technology, Koduvalli, Alamathi (Post), 600 052 Chennai, Tamil Nadu, India

MATERIALS AND METHODS

The present study was conducted at the modern dairy plant, Institute of Food and Dairy Technology, Koduvalli, Alamathi (Post), Chennai. The raw materials used for the preparation of ice cream are as follows: Buffalo milk (5% fat and 9.5% MSNF) purchased from the nearby village; butter (80% fat) purchased from the Tamil Nadu Co-operative Milk Producers Federation Ltd., Aavin and was used to standardize the fat content of the ice cream. Skimmed milk powder (95% MSNF) obtained from Tamil Nadu Co-operative Milk Producers Federation Ltd. Aavin was used to standardize the Milk Solids Not Fat (MSNF) content of ice cream. High quality stabilizers (gelatin) and emulsifiers (Glycein-mono-strate) were used for this research. Beetroot was purchased from local market and juice was extracted and good quality cane sugar (sucarose) was used.

Ice cream mix was prepared to contain a final composition of, 10% fat, 36% total solids, 15% sugar, 0.5% stabilizer and emulsifier as per ISI (IS: 2802, 1964) specification (Sukumar, 2008). Natural color like beetroot juice was added for strawberry flavor (3-5%) just before freezing. Ice creams with the different levels of beetroot juices were subjected to sensory evaluation and compared with the control sample to assess its acceptable level.

In each treatment, mix ingredients were homogenized as described by Arbuckle (1977) and then heated to 80°C for 30 sec as suggested by Rothwell. Mixes were cooled to 5°C and aged overnight at the same temperature. The freezing was done in a batch freezer. The ice cream was filled in 50 mL paper cups, covered with lid and stored at -29°C for 10 weeks in deep freezer.

The sensory characteristics of the ice cream samples were assessed using the ADSA IC score card. The sensory panel belongs to students of Institute of Food and Dairy Technology, Koduvalli, Chennai (Table 1). The data collected were analyzed by analysis of variance (one way ANOVA) as described by Snedecor and Cochran. And Duncan's multiple range tests were used as post hoc technique to study the significant difference among the means.

Table 1: ADSA IC score card

Items	Perfect score	Score obtained
Flavor	45	-
Body and texture	30	-
Color	5	-
Melting quality	5	-
Bacterial count	15	-
Total score	100	-

RESULTS AND DISCUSSION

The average overall sensory score card for ice cream samples prepared with different levels of beetroot juice as natural color for strawberry flavor ice cream is shown in Table 2. The overall average score for control was 93.22. The ice cream prepared with 3% beetroot juice had an overall average of 88.88 and ranged from 85.10-92.40 while the samples with 5% beetroot juice ranged from 86.10-93.40 with an overall average of 90.85. The samples with 4% juice had an average score of 93.55 and ranged from 91-98.50. The sensory scores for different characters of the ice cream samples prepared with 4% beetroot juice were not significantly different from the control sample and consistently higher when compared to the other two inclusion levels indicating that the optimum level of inclusion of beetroot juice in the ice cream mix was 4%. This is mainly because lower the beetroot juice level shows lighter the color of the ice cream and higher the concentration shows the darker the color of the ice cream.

Table 2: Sensory analysis score (Mean±SE)* card for ice cream with beetroot juice as natural color

		Beetroot juice (%)		
Parameters	Control	3	4	5
Flavor	40.18±0.208^{c}	38.35±0.258^{a}	40.27±0.216^{c}	39.14±0.193^{b}
Color	4.86±0.034^{b}	3.80±0.060^{a}	4.91±0.029^{b}	4.78±0.052^{b}
Body and texture	28.39±0.131^{b}	27.31±0.207^{a}	28.56±0.125^{b}	27.39±0.203^{a}
Melting quality	4.80±0.037^{b}	4.41±0.058^{a}	4.81±0.037^{b}	4.54±0.059^{a}
Microbial	15.00±0.000^{a}	15.00±0.000^{a}	15.00±0.000^{a}	15.00±0.000^{a}
Overall score	93.22±0.269^{c}	88.88±0.351^{a}	93.55±0.281^{c}	90.85±0.361^{b}

Means bearing different superscript in a row differ significantly ($p<0.01$); *Average of 8 trails

Table 3: Mean organoleptic values of ice cream (Mean± SE)* beetroot color (4%) for strawberry ice cream on storage at -29°C

Flavor	0 day	1st week	2nd week	3rd week	4th week	5th week
Control	89.27±1.1.153^{a}	87.77±1.259^{a}	86.55±1.243^{a}	85.95±1.232^{a}	85.59±1.232^{a}	84.82±1.282^{a}
Strawberry	86.91±1.319^{a}	86.32±1.242^{a}	85.41±1.230^{a}	84.32±1.121^{a}	83.86±1.168^{a}	83.05±1.178^{a}
Flavor	6th week	7th week	8th week	9th week	10th week	
Control	82.73±1.249^{a}	82.12±1.225^{a}	82.28±1.214^{a}	81.64±1.170^{b}	81.18±1.163^{bc}	
Strawberry	82.18±1.143^{a}	81.77±0.193^{a}	80.73±1.121^{a}	80.41±1.202^{ab}	79.45±1.154^{abc}	

Means bearing different superscripts in a column differ significantly ($p<0.01$); *Average of 8 trails

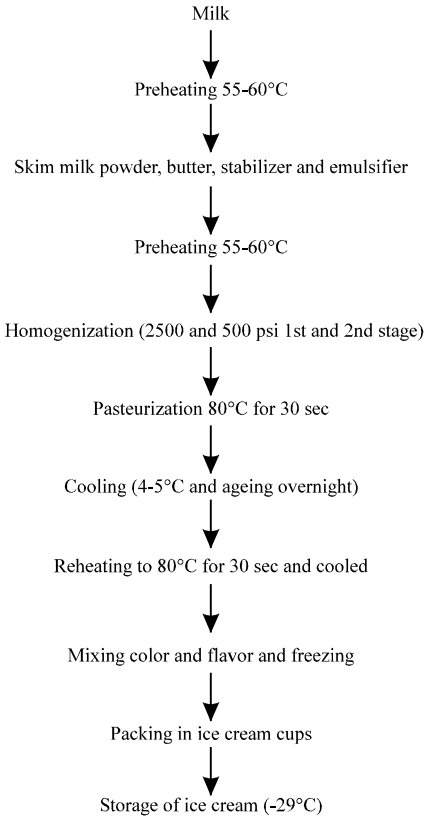

Fig. 1: Process flow chart for the preparation of ice cream samples

Hence, the four level of beetroot juice is scores higher value. This 4% level was included in the preparation of the strawberry flavored ice cream and samples were stored in the deep freezer for 10 weeks at -29°C (Table 3). The samples were subjected to sensory evaluation at weekly interval and reveals that sensory sores of natural colored ice cream was not significantly differ from the synthetic colored ice cream at 4% level inclusion of beetroot juice for the strawberry flavored ice cream (Fig. 1).

CONCLUSION

The results of the present study revealed that the inclusion of beetroot juice in the ice cream significantly altered the organoleptic scores of the ice cream samples. Among the different inclusion levels of beetroot juice, 4% had the maximum scores.

Hence, it was recommended that the beetroot juice can be added for strawberry flavor at the maximum of 4% in the preparation of herbal ice cream without much affecting its acceptability.

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