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Effect of different levels of *Piper betel* leaves on physico-chemical attributes of ice-cream

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Abstract
Ice-cream was prepared from standardized milk (6.00% fat) and the composition of basic mix was kept constant with 12.00% milk fat, 11.00% MSNF, 15.00% sugar, 0.20% sodium alginate and 0.20% glycerol monostearate. Ice-cream was prepared using the leaves of three varieties i.e. Maghai (V_1), Calcutta (V_2) and Banaras (V_3) at constant percentage in the juice form and the samples were judged for sensory parameters. The leaves of selected Calcutta variety were added to the ice-cream at constant percentage but in different combinations of forms i.e. juice + paste (LF_1), juice + pieces (LF_2) and paste + pieces (LF_3) and the samples were analysed for sensory parameters. The paste + pieces combination was found to score higher. During the optimization, the leaves of Calcutta variety with paste + pieces form were added to the ice-cream in three different levels i.e. 2% (T_1), 3% (T_2) and 4% (T_3) which were compared with control i.e. 0% (T_0) and were analysed for both sensory and chemical parameters. The 3% level scored maximum and the addition of *Piper betel* leaves to the ice-cream resulted in progressive decrease in fat percentage while the other parameters i.e. protein, total carbohydrates, ash, total solids and acidity were found increasing. Incorporation of *Piper betel* leaves of Calcutta variety in paste + pieces form @ 3% is recommended in manufacturing of ice-cream.

Keywords: *Piper betel,* Ice-cream, sodium alginate

Introduction
Ice-cream is a leading product in the global market among innovative dairy products (Soukoulis *et al.*, 2009) [15]. Ice cream is a frozen dairy product made by suitable blending and processing of cream and other milk products, together with sugar and flavor, with or without stabilizer or colour and with incorporation of air during the freezing process. As per *FSSAI* (2011), ice-cream, fruit ice-cream, nut ice-cream, chocolate ice-cream, mean the frozen food made from heat-treated mix made out of milk, cream and/or other milk products (derived from cow and buffalo milk) and with or without sweetening ingredients, eggs, water, fruits, nuts, chocolate, permitted stabilizer/permitted emulsifier, edible common salt, permissible flavoring and colorings matter. According to FSSAI (2011), ice-cream should contain not less than 10 per cent milk fat, 3.5 per cent protein and 36 per cent total solids.

Piper betel Linn (Piperaceae) is a natural herb which is valued for its medicinal and therapeutic properties. Its leaves are widely used as a post meal mouth freshener. Due to strong pungent aromatic flavor, betel leaves are used as masticatory by the Asian people. Leaves of betel vine are used with various condiments such as areca nut (Kattha), cloves, cardamom, candied rose and fennel for chewing purposes. Indian system of medicine and health has adopted the use of betel leaves in various ways. In India folkloric medicine, betel leaf is popular as an antiseptic and is commonly applied on wounds and lesions for its healing effects. (Datta *et al.*, 2011) [3].

The medicinal properties of pan were recognized during 600 A D when Ayurvedic system of medicine came into practice. Betel leaves are beneficial to the throat and remove viscidity in human beings. Leaves help in digestion and tend to remove the bad smell of the mouth. The juice of betel leaves is used as an adjunct to pills administered in the Ayurvedic medicines. It is also good for the respiratory system and is used in treatment of bronchitis, cough and cold (Chopra *et al.,* 1958) [2]. Pan chewing is considered as a good and cheap source of dietary calcium. It increases digestive capacity when used with lime. Besides, it neutralizes the acidity and acts as blood purifier. Main constituents of betel leaves are vitamin B and C, carotene and other elements. Its chlorophyll is beneficial in maintaining healthy teeth, clearing the mouth and helping in a digestion by encouraging salivation and neutralizing excess acid.

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It is composed of essential oils (0.72.6 per cent), and other constituents viz., carbohydrate (0.5-6.1 per cent), fat (0.4 -1.0 per cent) protein (3.0 -3.5 per cent), fiber (2.3 per cent), minerals (2.3-3.3 per cent), water (80-90 per cent) with good source of water and oil soluble vitamins (Guha, 2006) [7]. The betel leaves have starch, sugars, diastases and an essential oil composing of terpinen-4-ol, safrole, allyl pyrocatechol monoacetate, eugenol, eugenyl acetate, hydroxylchavicol, Piper betol and the betle oil contains cadinene carvacrol, allyl catechol, chavicol, p-cymene, caryophyllene, chavibetol, cineole, estragol, etc. as the key components. The leaves contain important phenolic compound hydroxychavicol which reported to possesses anticarcinogenic, antinitrosation and antimutagenic effects. The chief component of the leaves is a volatile oil, called betel oil and contains 2 phenols, betel phenol like chavibetol and chavicol (Dwivedi and Tripathi, 2014). Essential oil of Piper betel leaves is used for manufacturing medicines, perfumes, mouth fresheners, tonics and food additives, also the juice is used for reducing the tumor growth in the animals (Sripradha, 2014) [16]. Considering the increasing demand of ice-cream and nutritional, therapeutic and post meal mouth freshener property of *Piper betel* leaves, the investigation was conducted on "Preparation of ice-cream with Piper betel vine leaves".

Materials and Methods
Fresh buffalo milk received from Dairy farm, College of agriculture, Kolhapur was used for preparing ice-cream mix. Skim milk powder was procured from Kolhapur District Milk Product Union Ltd. (Gokul). Cream of Amul brand, sugar, sodium alginate and glycerol mono stearate (GMS) were obtained from local market of Kolhapur city. Fresh PBL of three different varieties were procured from local market of Kolhapur city.

Formulation and preparation of ice-cream mix
The quantity of milk, cream, skim milk powder, sugar, sodium alginate and GMS required for a batch (1 kg of ice-cream mix) was calculated by serum point method (Goff and Hartel, 2013) [6]. The composition of basic mix was kept constant with 12 per cent fat, 11 per cent MSNF, 15 per cent sugar, 0.2 per cent sodium alginate and 0.2 per cent GMS.

Preparation of forms and form combinations of PBL
Fresh PBL were washed under running tap water, weighed and crushed with water (1:10) in grinder for 1 min., which was filtered through muslin cloth to get juice (10 per cent). The paste was prepared by taking fresh PBL, washed under running tap water, weighed and crushed in grinder with water (1:0.1) for 30 sec at medium speed. Fresh PBL were washed under running tap water, weighed and cut into fine pieces (2 mm^2) with the help of sharp knife. The combinations of forms of PBL were prepared by mixing the prepared forms as per above procedures in the proportion ratio of 1:1.
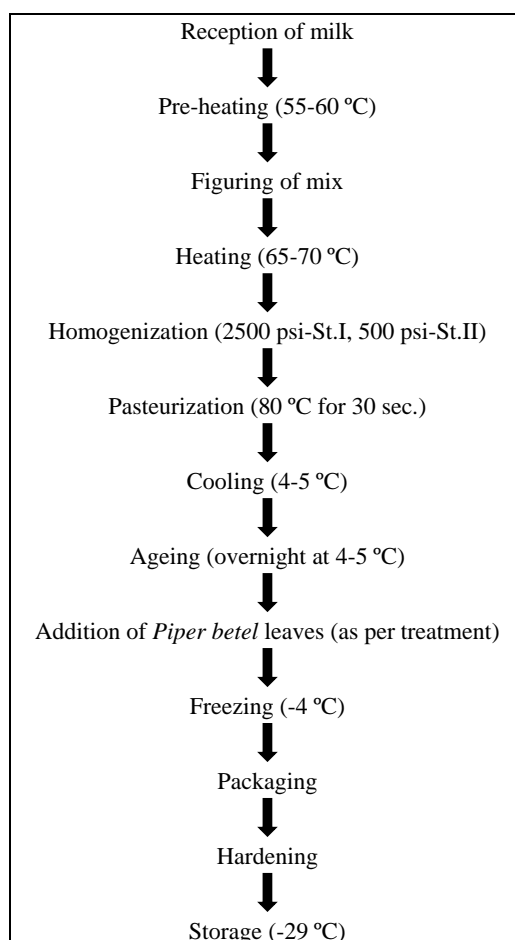
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Reception of milk
        ↓
Pre-heating (55-60 ℃)
        ↓
Figuring of mix
        ↓
Heating (65-70 ℃)
        ↓
Homogenization (2500 psi-St.I, 500 psi-St.II)
        ↓
Pasteurization (80 ℃ for 30 sec.)
        ↓
Cooling (4-5 ℃)
        ↓
Ageing (overnight at 4-5 ℃)
        ↓
Addition of Piper betel leaves (as per treatment)
        ↓
Freezing (-4 ℃)
        ↓
Packaging
        ↓
Hardening
        ↓
Storage (-29 ℃)
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Fig 1: Flow diagram of manufacture of ice-cream using PBL

Preparation of ice-cream
In the first phase, for the selection of variety, freshly prepared juice of three different varieties of PBL was incorporated into the ice-cream in a constant level i.e. 2 per cent (v/w) of ice-cream mix and the treatments were Maghai variety (V_1), Calcutta variety (V_2) and Banaras variety (V_3). In the second

phase, the selected variety through first phase was used in three different form combinations at constant level i.e. 2 per cent (w/w) of ice-cream mix. The treatments were juice + paste (LF_1), juice + pieces (LF_2) and paste + pieces (LF_3). In the final phase, the variety and form combination screened out through first two phases were used at different levels in ice-cream preparation i.e. 2 per cent (T_1), 3 per cent (T_2) and 4 per cent (T_3) and were compared with control i.e. 0 per cent (T_0).

The ice-cream was prepared as per procedure described by Manoharan and Ramasamy (2013) [14] with certain modifications. The aged mixes were freeze using '4 Quart ice-cream freezer' which uses ice + rocksalt mixture as freezing media. The freezing and whipping process was continued for about 35-40 min as guided in the machine user manual. The frozen ice-cream at right stage of freezing, which was determined by checking the consistency, was drawn into 100 ml polystyrene ice-cream cups. The filled ice-cream cups were transferred immediately to the deep freezer for hardening which was maintained at -29 ℃±1 ℃.

Chemicals
The raw materials utilized for preparation of ice-cream mix were analysed according to their standard procedures. The fat content of ice-cream was determined by standard Gerber method as suggested by IS: 1224 part I (1977) [10, 11, 12] taking 5g of melted ice-cream sample. The protein content of ice-cream was determined by Pynes method as given in Handbook of analysis of milk (2010) [8] by Shrivastav. The total carbohydrates was determined as per Lane-Etymon's method given in IS: 1479 part II (1961) [8]. The ash content of ice-cream samples was determined by procedure described in IS: 1547 (1989) [13]. The total solids content of ice-cream was determined as per method given in IS: 2802 (1964). The treatable acidity in terms of per cent lactic acid (% LA) was determined by procedure described under IS: 2802 (1964).

Physical
The over-run was calculated by procedure given in IS: 2802 (1964) while the melting rate of ice-cream was determined using procedure described by Agrawal *et al.* (2015) [1].

Result and Discussion
Composition of milk and cream
The milk used was standardized to 6.00 per cent fat and contained 3.90, 4.72, 0.76 and 15.3 per cent protein, lactose, ash and total solids whereas acidity was found to be 0.15% LA. The cream used contained 25.1 per cent fat and 32.9 per cent total solids.

Effect of levels of PBL on physical qualities of ice-cream
The table 1 indicates that with the increase in level of addition of PBL, the percentage of overrun of experimental samples increased from 66.58 (T_0) to 74.03 (T_3). The results are in accordance with Dhivya *et al.* (2015) [5] who reported that as the level of potato and tapioca was increased, the total solids content of ice-cream also increased thus increasing the overrun.

All the experimental samples had lower melting rate values as compared to control. The melting rate of the samples was in range of 37.33% (T_1) to 35.23% (T_3) as against 38.35% for (T_0).

Effect of levels of PBL on chemical qualities of ice-cream
The table 1 indicates the chemical qualities of experimental ice-cream samples. The fat content of ice-cream was found to decrease slightly as the level of PBL was increased. The lowest fat per cent was recorded for ice-cream containing 4 per cent (T_3) PBL. The protein content was found ranging from 4.20 to 5.34 per cent. As PBL is a good source of protein (Guha 2006) [7] there was a slight increase seen in protein content of experimental ice-creams when PBL level was increased. The total carbohydrates values in experimental ice-cream ranged from 19.70 to 20.70 per cent. The values were found directly proportional to the PBL levels and the maximum per cent was obtained for ice-cream having 4 per cent (T_3) PBL. The ash content ranged from 0.79 to 0.96 per cent. The ash content was found to increase with increase in the level of PBL addition s PBL contains a good variety of minerals (Guha 2006) [7]. The total solids content ranged from 36.80 to 38.30 per cent. The minimum per cent of total solids was shown by control (T_0) while maximum per cent was shown by ice-cream having 4 per cent (T_3) PBL. The acidity ranged from 0.213 to 0.280 per cent LA. The acidity was also found increasing slightly with increase in PBL level and the maximum acidity was recorded for ice-cream containing 4 per cent (T3) PBL.

Conclusion
On the basis of study of variety and form of PBL, it was found that the leaves of *Piper betel* of Calcutta variety used in the combination of form of paste + pieces @ 3 per cent level (w/w) of ice-cream mix was significantly superior than the other two varieties, forms and levels respectively under study. Also the results of consumer acceptance trial were found satisfactory (more than 50% rating excellent and very good). Hence, the ice-cream prepared using PBL of Calcutta variety, paste + pieces form and 3 per cent level is recommended for commercial production.

Table 1: Effect of levels of PBL on physical qualities of ice-cream

Level of Piper betel leaves	Physical attributes*	
	Over run (%)	Melting rate (%ice-cream melted in 40 min.)
T_0	66.58[a] ± 0.12	38.35[d] ± 0.11
T_1	68.95[b] ± 0.10	37.33[c] ± 0.09
T_2	72.10[c] ± 0.15	36.40[b] ± 0.18
T_3	74.03[d] ± 0.20	35.23[a] ± 0.14
SE m	0.14	0.12
CD (0.05)	0.45	0.42
CV	0.88	1.88

Mean ± SE of four replications within column followed by same letter are non-significantly different at $p<0.05$

Table 2: Effect of levels of PBL on chemical qualities of ice-cream

Level of *Piper betel* leaves	Chemical attributes *					
	Fat (%)	Protein (%)	Total carbohydrates (%)	Ash (%)	Total solids (%)	Acidity (%)
T_0	$12.80^d \pm 0.06$	$4.20^a \pm 0.03$	$19.70^a \pm 0.03$	$0.79^a \pm 0.01$	$36.80^a \pm 0.05$	$0.213^a \pm 0.003$
T_1	$12.10^c \pm 0.09$	$4.43^b \pm 0.04$	$20.10^b \pm 0.08$	$0.83^b \pm 0.02$	$37.45^b \pm 0.07$	$0.230^b \pm 0.004$
T_2	$11.60^b \pm 0.05$	$4.91^c \pm 0.03$	$20.55^c \pm 0.06$	$0.87^c \pm 0.01$	$37.88^c \pm 0.10$	$0.248^c \pm 0.005$
T_3	$11.31^a \pm 0.10$	$5.34^d \pm 0.02$	$20.70^c \pm 0.05$	$0.90^c \pm 0.02$	$38.30^d \pm 0.09$	$0.280^d \pm 0.004$
SE m	0.11	0.03	0.05	0.01	0.08	0.004
CD ($p<0.05$)	0.25	0.10	0.19	0.04	0.28	0.013
CV	1.84	1.35	0.76	3.76	0.57	3.430

Mean $\pm$ SE of four replications within column followed by same letter are non-significantly different at $p<0.05$

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