



P-ISSN: 2349-8528

E-ISSN: 2321-4902

IJCS 2018; 6(5): 1562-1567

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Received: 14-07-2018

Accepted: 18-08-2018

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Suitability of type of herb and its form as flavoring in herbal ice cream

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Abstract

The suitability of two forms (i.e. distillate and powder) of curry leaf and lemongrass as a new, natural flavouring in 'herbal ice cream' was studied. Herbal ice creams (11.0% fat, 11.0% MSNF, 15.35% other additives) were prepared incorporating lemon grass distillate (LGD) and curry leaf distillate (CLD) at levels of 3.50% and 2.50% respectively. Lemongrass powder (LGP) and curry leaf powder (CLP) were used at levels of 0.75% and 0.70% respectively. Use of herbal distillates led to slight decrease in nearly all the milk constituents. Use of herbal powders yielded ice creams having significantly higher fat, protein, carbohydrates, TS and pH compared to those containing herbal distillates. The ash content and overrun in ice cream was not affected markedly by type or form of herbal flavourings. Use of LGD at 3.5 % level is recommended for producing 'Lemongrass ice cream' having valued citral component since it had superior total sensory score.

Keywords: curry leaf, lemongrass, distillates, leaf powders, herbal ice cream, sensory quality

Introduction

Ice cream is a delicious, wholesome, nutritious dairy product liked by majority of the population world over. Ice cream is a frozen mixture comprising of milk components, sweeteners, stabilizers, emulsifiers, colourings and flavouring. The ice cream available commercially is generally poor in natural antioxidants and polyphenols. Nowadays people are health conscious and they wish to consume value added product as a part of their everyday meal over and above deriving pleasure, for instance from ice cream. Ice cream prepared incorporating herbal extracts can possibly be a new flavoured ice cream and might be therapeutic too. The growth of ice cream industry thrives on developing new novel flavours to lure the ever-inquisitive consumers. The herbal extracts are referred to as 'natural', since their source is of natural origin. Herbs are a potential source of natural antioxidants and hence promoted for being consumed in several foods. Herbs have been implicated in treating number of diseases and the herbal extracts can be used in pharmaceuticals, ayurvedic formulation, confectionery, nutritional foods, ready-to-drink mixes, instant foods, dairy products, seasoning blends, etc. Therefore, fortification of herbs in dairy products could enable producing value-added, functional dairy product [1]. The recent trend in developing new varieties of ice cream is based on flavouring with herbal extracts and spices. The ice-cream industry in India is estimated to be worth 4000 crores, and is growing at the rate of 20.0 % per year [2]. The market for foods that provide adequate nutrition and new eating experiences for consumers has grown rapidly in recent years [3, 4]. Curry leaves and lemongrass leaves have potential for use as flavouring ingredients and might exert therapeutic effects too.

Murraya koenigii, commonly known as curry leaf or *Kari patta* in Indian dialect, is a good source of vitamin A and calcium. Curry leaves (in fresh or dried form) are widely used in Indian cookery for flavouring foodstuffs, especially in South Indian curries, vegetables, pickles, chutneys, soups, butter milk, etc. They add to the smell and taste of food, in addition to contributing to the food value [5]. The major flavouring constituents of fresh curry leaves are the volatile oil containing pinene, sabinene, caryophyllene, cadinol and cadinene [6, 7].

Lemongrass (*Cymbopogon citratus*) is one of the cultivated medicinal plants for its essential oils [8, 9]. It contains 1.0-2.0 % of essential oil on dry basis [10]. Lemon grass extract is commonly used as an aromatic drink (e.g. tea), while the whole plant is incorporated into traditional food (alcoholic and non-alcoholic beverages, frozen dairy desserts, candy baked

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foods, gelatin and puddings, meat products) for its lemon flavour. The leaves of lemongrass present lemony characteristic flavour due to its citral content. The major flavouring constituents of fresh lemongrass leaves are neral, geranial, limonene, citronellal, caryophyllene, 6-methyl hept-5-en-3-one, linalool and β -myrcene^[11, 12]. The citral content in lemongrass oil is reported to exert anticancer and antimicrobial activities^[3]; anticancer activity is through antioxidative property of such extract.

The various types of herbs that has been used as flavouring in ice cream include ginger^[14, 15, 16, 17], basil^[18, 19, 20], Aloe vera^[21], teas^[22], lemongrass^[15, 23], *Asparagus racemosus* Willd^[24] and *Phyllanthus niruri*^[25]. Curry leaves and lemongrass herbs has potential to be used as flavouring and they may exert pharmacological effects. So far, there is no reported literature on the use of curry leaves or its extract in ice cream and frozen desserts; however, only one isolated report is available on the use of lemongrass as flavouring in ice cream. The objective of the present study was to evaluate the suitability of two forms of 'curry leaf' and 'lemongrass' as a natural, novel flavouring in developing 'herbal ice cream'.

Materials and Method

Fresh, raw mixed (cow and buffalo milk) milk (5.8% fat, 8.5% SNF) was procured from Vidya Dairy, Anand and cream (45.0% fat, 50.3% TS) was obtained by separation of such milk at Anubhav Dairy, Anand Agricultural University (AAU), Anand. Skim milk powder (SMP) of 'Sagar' brand marketed by Gujarat Cooperative Milk Marketing Federation (GCMMF) Ltd., Anand was used as SNF source in the preparation of ice cream mix. Cane sugar was procured from the local market of Anand. Sodium alginate (S4 Regular from M/s. S. Square and Co., Gwalior) and guar gum (M/s. Moon Star Quality Products, Ahmedabad) were used as stabilizers while Glycerol Mono Stearate (GMS) (M/s. Brion Fine Chem., Mumbai) was used as an emulsifier. 'Eagle' brand green colour (fast green FCF) was purchased from M/s. Vijay Industries Pvt. Ltd., Vadodara. Fresh curry (*Murraya koenigii*) and lemongrass (*Cymbopogon citratus*) leaves were obtained from the Department of Medicinal and Aromatic Herbs, AAU, Anand. Freeze dried leaf powder of curry and lemongrass was obtained from M/s. Aum Agrifresh Foods, Vadodara. The curry leaf powder and lemon grass powder were referred to as CLP and LGP respectively. The photograph of fresh and dried herbal leaves is provided in Figure I and II respectively.



Fig 1: Photograph of freshly procured curry leaves and lemongrass leaves



Fig 2: Photograph of freeze dried powders of curry leaves and lemongrass leaves



Note: LGD – Lemongrass distillate, CLD – Curry leaf distillate, LGLP – Lemongrass leaf powder, CLP – Curry leaf powder

Fig 3: Photograph of herbal ice creams prepared using two forms of curry leaf and lemongrass leaf extracts

Preparation of herbal leaf distillates

The curry and lemongrass leaves (200 g each) were washed with potable water, partially crushed using mortar and pestle and then subjected to steam distillation using Clevenger apparatus (M/s. Precision Scientific Equipments, Ambala) to obtain the herbal distillates. The initial 100 ml of each distillate was collected in volumetric flask, which required distillation time of 30 min. Such distillates were stored under refrigeration ($6\pm 2^\circ\text{C}$) till its usage. The curry leaf distillate and lemon grass distillate were referred to as CLD and LGD respectively.

Preparation of colour

A fixed quantity (i.e. 1.5 g) of fast green FCF powder was dissolved in 100 g of previously boiled and cooled potable water and then kept in a clean, tinted glass container at refrigerated condition ($6\pm 2^\circ\text{C}$) till its use.

Preparation of ice cream mix

The quantity of milk, cream, SMP, sucrose, sodium alginate, guar gum and GMS required for a batch of 5.0 kg ice cream mix was calculated by serum point method^[26]. Mixing of all the ingredients resulted in basic ice cream mix having 11.0% fat, 11.0% MSNF, 15.0% sucrose, 0.20% stabilizer and 0.15% emulsifier. The mix was heated to 75°C , homogenized in a two-stage (2000 and 500 psi in first and second stages respectively) homogenizer (M/s. Goma Engineering Pvt. Ltd., Mumbai) and subsequently pasteurized at 85°C for 5 min. The pasteurized mixes were cooled to 6°C and aged overnight at the same temperature.

Preparation of herbal ice cream

After aging of the basic ice cream mix, the mix was divided into four batches, each of 5.0 kg. Two separate herbal distillates (i.e. CLD @ 2.50 % and LGD @ 3.50 % by weight of ice cream mix) were used as herbal flavouring. Green colour was added to the first two herbal ice cream mixes at level of 3.0 ml/kg mix. The freeze dried powders (CLP and LGP @ 0.70 and 0.75 % by weight of ice cream mix respectively) were incorporated in the third and fourth batches of ice cream mixes. In the latter two ice cream mixes, green colour was added at level of 5.0 ml/kg mix.

The aged ice cream mixes, added with flavour and colour were frozen in a previously cleaned and sanitized batch ice cream freezer (M/s. Pal Engineering Pvt. Ltd., Ahmedabad; cylinder capacity of 10 L). The freezer cylinder, beater assembly and other parts were sanitized with cold (7°C) sodium hypochlorite solution (250 ppm). The overrun

targeted in ice cream was around 90.0 %, which required about 3-4 min. of whipping. Ice cream was drawn from the freezer at a temperature of -5°C and then subjected to hardening by transferring the packaged (100 ml cups made of polystyrene) ice cream in a hardening room maintained at $-25^{\circ}\text{C}\pm 2^{\circ}\text{C}$ for 12 h. Storage of ice cream was done in a deep freezer (Voltas, Model No. SLF-500L, Anand) maintained at $-18\pm 1^{\circ}\text{C}$. The photograph of four herbal ice creams is shown in Figure III.

Analysis of herbal distillates and powders

The herbal distillates were analysed for total soluble solids and pH. CLP was analyzed for moisture, β -carotene and calcium content. LGP was analyzed for moisture and citral content. The moisture content of leaf powder was analyzed using Mojonnier method, while TSS of distillates was measured using hand Refractometer (M/s. Erma, Japan; range 0-28%). The analysis for calcium, citral and β -carotene were analyzed at external laboratory (Centre of Analysis and learning in Livestock and Food [CALF] laboratory, National Dairy Development Board, Anand).

Analyses of ice cream

The ice cream was analyzed for fat, protein, total solids (TS), and ash as per standard method [27]. The pH of herbal ice cream was determined using a digital pH meter (Model 335, M/s. Systronic Ltd., Ahmedabad) at sample temperature of 25°C . The overrun of ice cream was calculated as per the method of Marshall *et al.* (2003) [28]. The sensory evaluation of tempered ($-15\pm 1^{\circ}\text{C}$) ice cream was carried out by a panel of 8 judges using American Dairy Science Association score card [29]. The experiment was replicated five times. The data obtained were subjected to statistical analysis using Completely Randomized Design (CRD) [30].

Results and Discussion

The particulars of herbal distillates and herbal powders are collated in Table I. The results tabulated in Table 1 indicate that CLP is a rich source of β -carotene and calcium, while LGD is a good source of citral content. Both the herbal distillates had total soluble solids (TSS) of $< 1^{\circ}\text{Brix}$ and a pH of 7.0. The moisture content of leaf powder ranged from 5.68 to 7.54% (Table 1). Based on the result of preliminary trials, it

was decided to use CLD and LGD as herbal distillate flavourings at the rate of 2.50 % and 3.50 % by weight of ice cream mix respectively. Green colour was added to both these herbal ice cream mixes at 3.0 ml/kg mix. Likewise, the herbal leaf powders CLP and LGP were added at the rate of 0.70 and 0.75 % by weight of ice cream mix respectively. Since the color imparted by the leaf powder was dull green, it was necessary to add green colour at higher level (i.e. 5.0 ml/kg mix) to obtain acceptable appearance of ice cream.

The forms of herbal flavourings used in the experiment exerted a significant ($P < 0.05$) influence on the fat, protein, carbohydrate and TS of the resultant ice creams. Only the ash content of ice creams made using two forms of herbs were rated at par with each other (Table 1). All the four herbal ice creams conformed to the Food Safety and Standards Act [31] specifications laid down for full-fat ice cream in India. The values of fat, protein, carbohydrates and TS of ice creams made using leaf powders (i.e. CLP and LGP) were at par with each other (Table 2). Similar observation was also noted with respect to protein and carbohydrates content of ice creams made using CLD and LGD (Table 2). However, the ice creams made using CLD had significantly ($P < 0.05$) higher fat and TS content as compared to ice creams made using LGD (Table 2).

The ice creams prepared using herbal powder (i.e. CLP, LGP) had significantly ($P < 0.05$) higher fat, protein, carbohydrates and TS content when compared to ice creams prepared using herbal distillates (i.e. CLD, LGD) (Table II). Since CLD was used at lower rate than LGD (i.e. 2.50 and 3.50 % of CLD and LGD by weight of ice cream mix respectively), ice cream prepared using CLD had higher values of fat and TS than its counterpart prepared using LGD. The higher moisture content present in the herbal distillates as compared to herbal powders led to such significant decrease in the values of chemical constituents in ice creams prepared using herbal distillates.

The lower values of chemical constituents has also been reported for herbal ice creams made using basil juice (@ 6.0 % by weight of mix) as compared to that prepared using freeze dried basil powder (@ 1.0 % by weight of mix) [20]. Herbal ice cream prepared using increasing level of basil leaf extract (i.e. 5.0 to 20.0 %) led to decrease in the fat, protein and TS of product. However, an increase in ash, fiber and acidity was noted [19].

Table 1: Particulars of herbal distillates and herbal powders

Herbal distillate	pH	Total soluble solids ($^{\circ}\text{Brix}$)	Citral content (mg/100 g)
LGD	7.0	< 1.00	25.20
CLD	7.0	< 1.00	NA
Herbal powder	Moisture (%)	Calcium (%)	β -carotene (mg/100 g)
LGP	5.68	0.42	NA
CLP	7.54	2.50	54.14

Note: LGD – Lemongrass distillate, CLD – Curry leaf distillate, LGP – Lemon grass powder, CLP – Curry leaf powder, NA – Not analyzed

Table 2: Influence of two forms of herb on the composition and physico-chemical properties of herbal ice cream

Form of herb	Chemical constituents (%)					Physico-chemical properties	
	Fat	Protein	Carbohydrate	Ash	Total solids	pH	Overrun (%)
LGD	10.66 ± 0.02^a	4.01 ± 0.02^a	20.94 ± 0.02^a	0.97 ± 0.01	36.58 ± 0.09^a	6.62 ± 0.03^b	91.10 ± 0.99
CLD	10.77 ± 0.03^b	4.04 ± 0.03^a	20.98 ± 0.01^a	0.98 ± 0.03	36.78 ± 0.01^b	6.60 ± 0.01^b	90.93 ± 0.88
LGP	10.96 ± 0.04^c	4.19 ± 0.05^b	21.39 ± 0.04^b	0.99 ± 0.01	37.54 ± 0.12^c	6.53 ± 0.05^a	89.67 ± 2.95
CLP	10.99 ± 0.02^c	4.19 ± 0.04^b	21.36 ± 0.05^b	0.99 ± 0.02	37.53 ± 0.05^c	6.50 ± 0.04^a	87.72 ± 3.55
C.D. (0.05)	0.05	0.07	0.36	NS	0.06	0.06	NS

Note: Mean values \pm SD with different superscripts in the same column indicate statistically significant difference ($P < 0.05$). Basic ice cream mix was formulated to contain 11.0 % fat, 11.0 % MSNF and 37.35 % T

Table 3: Influence of two forms of herb on the sensory score of herbal ice creams

Form of herb	Sensory score of ice creams				
	Colour and appearance (Max. 5)	Flavour (Max. 45)	Body and texture (Max. 30)	Melting quality (Max. 5)	Total sensory score* (Max. 100)
LGD	4.79±0.08 ^b	41.45±1.30 ^c	26.74±0.13 ^b	4.45±0.12 ^b	92.43±2.71 ^b
CLD	4.71±0.12 ^b	39.43±0.39 ^b	26.53±0.48 ^b	4.40±0.13 ^b	90.07±1.68 ^b
LGP	3.55±0.47 ^a	37.83±0.85 ^a	24.90±0.90 ^a	4.05±0.10 ^a	85.43±0.98 ^a
CLP	3.28±0.45 ^a	37.04±1.19 ^a	24.32±1.02 ^a	3.91±0.10 ^a	83.55±0.73 ^a
C.D. (0.05)	0.52	1.56	1.12	0.18	2.66

Note: Mean values ± SD with different superscripts in the same column indicate statistically significant difference ($P < 0.05$),

* Full score of 15.0 has been considered for bacterial quality in total sensory score

pH and Overrun of ice cream

The pH of herbal ice creams prepared using two herbal distillates (CLD, LGD) or two herbal powders (CLP, LGP) were at par with each other (Table 2). However, the herbal ice creams prepared using herbal distillates (i.e. CLD, LGD) were associated with significantly ($P < 0.05$) higher pH as compared to those prepared using herbal powders. Use of basil juice as flavouring resulted in ice creams having relatively higher pH (i.e. 6.35) as compared to that made using basil powder (i.e. pH 6.28)^[20].

The overrun of herbal ice creams was rated at par with each other, irrespective of the form (i.e. distillate or powder) or the type of herbal flavourings (curry based or lemongrass based) used in the investigation (Table 2). This was especially since the air pressure (12 ± 3 psi) and whipping period (4-5 min) during freezing of ice cream mix in the batch freezer was kept nearly constant. The findings of this study are in conformity with the findings of Trivedi *et al.* (2014)^[20] and Kumar *et al.* (2012)^[18] who reported that incorporation of basil juice and basil powder did not have any marked influence on the overrun of resultant herbal ice creams. It has been reported that increasing the level of basil leaf extract from 5.0 to 20.0 % by weight of ice cream mix led to a decline in the overrun of herbal ice cream^[19]. Likewise, raising the level of basil powder from 0.5 to 2.0 % by weight of ice cream mix, led to a decline in the overrun of herbal ice creams.

Sensory score of herbal ice creams

Colour and appearance: The colour of ice cream, its intensity, visibility of herbal leaf particles (in case of leaf powder), patches of colour (in case of leaf powder), if any, were considered for scoring for colour and appearance of product. The colour of ice cream should be attractive, uniform, pleasing and should hint on the flavouring used^[32]. The two forms of herbs (distillate and powder) significantly ($P < 0.05$) affected the color and appearance (CA) scores of the resultant ice creams. The CA scores allotted to ice creams containing herbal powder was significantly ($P < 0.05$) lower than those prepared using herbal distillates (Table 3). The herbal powders imparted a dull green colour to resultant ice creams; rather green colour (@ 5 ml/kg mix) was added to ice cream mix in order to improve upon the appearance of herbal ice creams prepared using herbal powders. Even with incorporation of green colour, the ice creams containing herbal powders did not appear appealing. Both the herbal distillates used were colorless and the added green colour (@ 3 ml/kg mix) made the resultant ice creams look appealing. When ice creams made using herbal distillates alone or using herbal powders alone were compared with each other, the CA scores were found to be at par with each other (Table 3).

Flavour: Flavour is an important characteristic which determines the sensory acceptability of any food product. High quality ice cream should be pleasantly sweet, suggest a creamy background sensation, exhibit a delicate flavour and leave a most pleasant, but brief, rich aftertaste^[29]. The herbal distillates contributed a delicate, pleasing flavour of the concerned herb in such ice cream, while addition of herbal powders did not contribute such delicate flavour of herb. When comparing herbals ice creams prepared using herbal distillates only, the flavour score of lemongrass ice cream was significantly ($P < 0.05$) greater than the score of curry leaf ice cream. The average flavour scores of the herbal ice creams ranged from 37.03 to 41.45 (out of maximum score of 45.00). When using herbal powders, the judges did not report any specific preference out of the two herbal ice creams. However, the judges assigned significantly ($P < 0.05$) higher flavour score to herbal ice creams prepared using herbal distillates as compared to those prepared using herbal powders (Table 3).

In preparation of herbal distillates, there is concentration of the flavouring components, while in case of herbal powders all the chemical constituents of herb are simultaneously present in higher concentration along with the flavouring compounds. Such increased chemical constituents (fat, carbohydrates, protein, ash) in freeze-dried leaf powder must be masking some of the flavor components. Moreover, there can be some loss of flavour components during freeze drying of herbal leaves too.

Body and texture: The ice cream should be judged for its relative smoothness, coarseness, presence or absence of sandiness to know about its body and texture^[32]. The ice creams prepared using herbal distillates had superior body and texture (designated as BT) score as compared to those prepared using herbal powders (Table 3). When comparing the BT scores amongst herbal ice creams prepared using herbal distillates, and amongst those prepared using herbal powders, no specific preference was expressed by the judges (Table 3). The inferior BT scores associated with ice creams containing herbal powders could be ascribed to the perception of 'crumbly' texture and sometimes 'chewy' body in such ice creams. The presence of leaf powder particles (not completely soluble in ice cream mix) in the matrix of ice cream might be contributing to the 'crumbly' texture.

Melting quality: The relative time taken for the ice cream to melt in the petri dish and the appearance of the melted ice cream (uniform, consistency of melted ice cream, frothiness, whey separation at periphery of melted portion, etc.) was noted in giving the score for melting quality. High quality ice cream should exhibit some resistance toward melting when an ice cream dish is exposed to room temperature for at least 10

min. [29]. During the melting phase, the mix should flow from the center portion of the scooped ice cream toward the periphery. The melted ice cream is expected to form a smooth, uniform and homogeneous liquid in the dish.

The melting scores of ice creams prepared using herbal distillates were significantly ($P < 0.05$) superior over the melting scores of ice creams prepared using herbal powders (Table 3). When the melting scores of ice creams prepared using herbal distillates, or using herbal powders were compared with each other, the scores were found to be similar (Table 3). The melting resistance of herbal ice creams prepared using herbal distillates was somewhat lower than when using herbal powders. Since soluble solutes determine the freezing point of ice cream mix, use of herbal distillates exerted greater impact on melting resistance of ice cream than did herbal powders. The herbal distillates contain only soluble solutes, while herbal powders contain insoluble solutes in addition to soluble solutes. In addition, the appearance of melted herbal ice creams made using herbal powders was not as appealing as ice creams prepared using herbal distillates.

Total sensory score: Since ice cream containing herbal distillates (LGD, CLD) had superior scores for CA, flavour, BT and melting quality, they obviously had superior total sensory scores as compared to ice creams prepared using herbal powders. Hence, the two ice creams containing herbal distillates had significantly ($P < 0.05$) higher total sensory scores (92.43 and 90.07 for LGD and CLD respectively; out of 100.00) as compared to those prepared using herbal powders (85.43 and 83.55 for LGP and CLP respectively) (Table 3).

The cost of lemon grass ice cream was computed to be about ₹ 9.00 per 100 ml serving size, assumed to have 90% overrun. The raw materials cost was computed to be ₹ 77.02 per 100 kg mix, processing and allied cost was assumed to be 84.0% of raw materials cost and packaging cost was considered to be ₹ 8.00 per L of ice cream.

Conclusion

Out of the two forms of herbs (i.e. distillate and powder) used as flavouring matter, use of herbal distillate, especially of lemongrass is recommended for the preparation of 'herbal ice cream'. The herbal ice creams prepared using herbal distillates had superior total sensory score over those prepared using herbal powders. Use of LGD at level of 3.50 % by weight of ice cream mix is recommended as natural herbal flavouring matter for producing 'herbal lemongrass ice cream'. Such ice cream conformed to the standards prevailing for full-fat ice cream. It is desirable to formulate the basic ice cream mix to contain milk fat and protein content with some allowance so that the impact of water from the herbal distillate in diluting chemical constituents is taken care of. The citral component contributed by lemongrass can be of advantage to human health.

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