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STANDARDIZATION OF METHOD FOR PREPARATION OF PROCESSED FORMS OF "BOTTLE-GOURD" AND STANDARDIZING THE FORMULATION OF ICE-CREAM

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ABSTRACT
The present investigation was planned and conducted to develop a technology for the manufacture of a vegetable based "bottle gourd" ice cream. For manufacture of bottle gourd ice cream Pusa Naveen and Anand bottle gourd-1 varieties were significantly ($P<0.05$) preferred comparedPusa Summer variety. The standardized process for preparation of bottle gourd puree for use in bottle gourd ice cream was addition of sugar @50% by wt. of puree followed by concentration to a concentration ratio of 1.5. Whereas, for manufacture of bottle gourd cubes the standardized process consisted of addition of water (@70% by wt. of cubes) and sugar (@70% by wt.of cubes) and concentrating the blend till 70° brix was achieved.It was found that the most suitable form of bottle gourd for preparation of bottle gourd ice-cream was a combination of processed sugar treated cubes and puree in an ice-cream mix formulation consisting of 12.0 % milk fat, 11.0 % MSNF, 14.0 % sucrose, 0.17 % stabilizer and 0.2 %emulsifier. It was found that among all the combinations tried the acceptability of "bottle gourd ice cream" containing processed bottle gourd cubes @7% and processed bottle gourd puree @4% by weight of mix.

INTRODUCTION

In today's food industry, a global trend towards the manufacture of healthier and more natural fruit and vegetable food products, such as soups, smoothies and sauces, is ongoing, as well as the incorporation of puréed vegetables in other food products. Ice cream is one of the oldest fat rich delicious dairy products relished by all age groups of people throughout the world. The development of new varieties of ice cream is based on flavouring with fruit and vegetable extracts (Olenev, 1989).

Currently health is a major concern of customers. Few of the trends which top the list of healthy eating are incorporation of fruits and vegetables, low-calorie products, natural products and products with functional ingredients. Hence, there is a need to develop new functional dairy products to reflect consumer interest in health (e.g. utilizing vegetable source with phytochemicals) and naturalness (Anon., 2007). The production of ice cream using bottle gourd as functional ingredient may make it economical and maybe a health promoting product.

In literature, various research workers have suggested novel ingredients such as Bottle gourd for use in Ice-cream. i.e. Tulsi extract (Kumar *et al*., 2013); Ripe fruits (Ulemale and Tambe, 2015); Ginger juice (Agrawal *et al*., 2016); Carrot juice and pumpkin paste (Khongjeamsiri *et al*., 2011); Carrot (Dias *et al*., 2015); Tomato juice (Jhansi and Sucharitha, 2013); Concentrated cactus pear pulp (El-Samahy *et al*., 2009); Dragon fruit pulp (Mufas and Perera, 2012); Green coconut pulp (Santana *et al*., 2011); Pitaya pulp (Mufas and Perera, 2013); Acai pulp (Lin, 2012); Aloe Vera pulp (Manoharan and Ramasamy, 2013).

The production of ice cream using bottle gourd as functional ingredient may make it economical and a health promoting product. It is well known that bottle gourd is helpful in constipation, premature graying hair, urinary disorders and insomnia which reflect significant health-promoting properties (Parle *et al.,* 2011). Its consumption is advocated by traditional healers for controlling diabetes mellitus, hypertension, liver diseases, weight loss and other associated benefits (Dhiman *et al.,* 2012). Additionally, owing to the inherent virtues of bottle gourd, such flavoured ice cream may exert functional role, improving the health of the consumers.

Barot *et al*. (2016) has developed a technology for use of bottle gourd in ice cream. In their study various bottle gourd forms which were prepared using method standardized by Babar (1996) with certain modifications. However, the sensory and compositional aspects of the processed bottle gourd forms were not reported. Therefore, in this study, the process for manufacture of the two bottle gourd forms has been standardized to improve the quality of processed bottle gourd forms for use in bottle gourd in ice cream. No work has been reported in this respect. Therefore, the present study was conducted to standardize a method for preparation of processed forms of Bottle-gourd i.e. bottle gourd puree and bottle gourd cubes suitable for use in bottle gourd ice cream.

MATERIALS AND METHODS

Whole milk (5.5 ± 0.13 % fat; 8.5 ± 0.16 % MSNF; titratable acidity 0.16 ± 0.02 % LA) which was procured from Vidya Dairy, Anand and "Sagar" brand skim milk powder (SMP), marketed by Gujarat Cooperative Milk Marketing Federation Ltd., Anand were used as the base materials for ice cream manufacture. Commercial grade cane sugar (M grade) and salt (Sodium chloride – edible grade) was obtained from the local market of Anand. Sodium alginate (RM-7494), guar gum (RM-1233) and carrageenan (RM-1576) from Hi-media Laboratories Pvt. Ltd., Mumbai were used as a stabilizers and commercial grade Glycerol Mono Stearate (GMS) (Brion Fine Chem., Mumbai) was used as emulsifier. Vanilla essence No. 1 (M/s Bush Boake Allen (India) Ltd., Chennai) was used as the flavouring agents in bottle gourd ice cream.Bottle gourd (Pusa Naveen and Pusa Summer variety) were procured from local vegetable market of Anand and Anand Bottle Gourd – 1 variety was procured from the Anand Agricultural University farm located at Anand, Gujarat.

Preparation of ice cream mix

Whole milk, cream and SMP used in the manufacture of ice cream mix were analyzed for their composition. The quantity of milk, cream, SMP, sucrose, sodium alginate, guar gum, carrageenan and GMS required for a batch (i.e. 5.0 kg of ice cream mix to be frozen in a direct expansion type batch freezer) was calculated using serum point method (Marshall *et al*., 2003). Cream (40.0 ± 2 % milk fat separated from whole milk) was mixed with calculated quantity of whole milk and pre-heated to 45ºC. All the dry ingredients viz. SMP, sugar, stabilizers and emulsifiers were dry blended and added to the milk - cream mixture at a temperature of about 50ºC. The mix was further heated to 75ºC and subjected to homogenization (150 and 50 kg/ cm^2 pressure in the first and second stage respectively, M/s. Pal Engineering Ltd., Ahmedabad). The mix was then pasteurized at 80ºC for 5 min prior to cooling and aging overnight at 3 ± 1ºC. The flavouring ingredients were added just prior to freezing.

Preparation of ice cream

For preparing different batches of ice cream in direct expansion type batch freezer (cylinder capacity 10.0 lit), the aged mixes were frozen in a horizontal batch freezer (M/s. Pal Engineering Pvt. Ltd., Ahmedabad) having an arrangement for air incorporation under pressure. The temperature of the circulating refrigerant was -23.0 to -30.0ºC. After freezing the mix to a semi-solid consistency (10.0-15.0 min), as inferred from the load on the ammeter (initial beater load 2.1 amp; final load 2.6 amp), air was whipped in the freezer barrel at a pressure of 10 to 15 psi for about 2 min. Bottle gourd puree was incorporated in ice cream mix prior to freezing while the bottle gourd cubes were incorporated into the partially frozen ice cream before incorporation of air under pressure. The ice cream at the right stage of freezing, as ascertained from the consistency and overrun, was drawn directly into 100 ml High Impact Polystyrene (HIPS) ice cream cups and covered with wax coated paper board lids. The temperature of the ice cream at the drawing stage was recorded. Mixes were frozen to about -4.5 to -5.0ºC and the targeted overrun was set at 90%. The filled ice cream packs were then transferred immediately to a hardening tunnel maintained at -25 ± 2ºC and hardened for 3 h.The hardened ice creams were then subjected to compositional analysis and sensory evaluation.

Analysis

The fat, titratable acidity and total solids content of bottle gourd forms i.e. puree and cubes, ice cream mixes were determined by the standard method as suggested in ISI Handbook (1989). The protein content of ice cream mixes were determined by Semi – Micro kjeldahl method (ISO: 8968-1 2014), using Kjel-plus Digestion System (Model-KPS 006L, M/s.Pelican Instruments, Chennai) and Kjel-plus Semi-Automatic Distillation System (Model-Distil M, M/s.Pelican Instruments, Chennai). As per this method the total nitrogen was determined and the value so obtained was multiplied by a standard factor 6.24 to get the protein content. Ash content of processed bottle gourd forms were determined by procedure described in IS: 1547-1985. Total carbohydrate content was calculated on difference basis from total solid content.The viscosity of ice cream mix was determined using a Brooke field Viscometer, Model DV-II + Pro (Brooke field Engineering Laboratories, USA). The viscosity readings were taken at 4ºC after ageing mixes at 3-4ºC for about 24 h.

Sensory Analysis

The processed bottle gourd forms were tempered to refrigeration temperature for 1-2 h before judging. Ice cream samples were tempered to -12 + 2ºC for 1-2 h before judging. Sensory evaluation was conducted in isolated booths illuminated with incandescent light and maintained at 23 ± 2ºC. Products were subjected to sensory evaluation using 9 point scale based score card suggested by Arbuckle (1977).

Statistical analysis

Statistical analysis of the data was carried out as per Steel and Torrie (1980) using completely randomized design.

RESULTS AND DISCUSSION

Selecting a suitable variety and standardizing methods for processing of selected formsof bottle gourd

In the preliminary screening, amongst several varieties, 3 suitable varieties were selected viz. Pusa Summer, Pusa Naveen and Anand Bottle gourd-1. Processed bottle gourd cubes and shreds were prepared using the procedure described by Babar (1996) and processed bottle gourd puree was prepared using the procedure described by Agarwal and Prasad (2013). Processing of bottle gourd with peel resulted in bitter taste and off flavour in the final processed bottle gourd form than prepared from without peel bottle gourd. Therefore, peeled bottle gourd was used in the bottle gourd preparations in this study. Based on preliminary studies it was found that the products prepared using Pusa Naveen and Anand Bottle gourd-1 were preferred compared to products prepared using Pusa Summer variety. The products prepared using Pusa Naveen (and/ or Anand Bottle gourd-1) were dark green in colour, optimum chewiness and firmness and pleasing clean caramelized bottle gourd flavour. On the other hand, products prepared using Pusa Summer were light green in colour, hard body, more chewy texture and lacked optimum bottle gourd flavour and were generally criticized for being slightly bitter in

Table 1: Effect of addition of various forms of processed bottle gourd on sensory attributes of ice cream

Form of processed bottle gourd	Rate of addition (% w/w of basic ice-cream mix)	Sensory attributes			
		Flavour	Body and Texture	Colour and Appearance	Total score
Puree	4	+	+	+	+
	6	+	+	+ +	+
	8	+ +	+	+ + +	+ +
Cubes	2	-	+	+	+
	4	+	+ +	+ +	+
	6	+	+	+ + +	+ +
	8	+ +	+	+ + +	+ +
Shreds	2	-	-	-	-
	4	-	-	-	-
	6	-	+	+	+
	8	+	+	+ +	+
Cubes + Puree	2 + 10	-	+	+	+
	4 + 8	+	+ +	+ +	+ +
	6 + 6	+ +	+ +	+ + +	+ +
	8 + 4	+ + +	+ +	+ +	+ + +
Shreds + Puree	2 + 10	-	+	+	+
	4 + 8	+	+	+	+ +
	6 + 6	+ +	+	+	+ +
	8 + 4	+ +	+ +	+ +	+ +

Table 2: Effect of concentration ratio on acceptability of bottle gourd puree

Concentration Ratio	Observations
1.3	Predominant raw flavour, lacking desired consistency, lighter in color, lacking in sweetness.
1.5	Properly cooked, clean, pleasing, caramelized bottle gourd flavour; optimum sweetness, darker in color than above, highly acceptable optimum flavour
1.7	Cooked, highly caramelized flavour; very sweet, brown color. At higher rate of concentration occurrence of slight bitterness. Product became sticky therefore chances of browning and burning were more.

Table 3: Influence of varied concentration ratios on the 9-point hedonic scores of bottle gourd puree

Concentration ratio	Flavour	Colour and appearance	Body and texture	Overall acceptability
1.3	$6.75^{b} \pm 0.61$	$5.50^{b} \pm 0.46$	$6.00^{bc} \pm 0.46$	$6.50^{b} \pm 0.20$
1.4	$7.25^{ab} \pm 0.46$	$6.56^{a} \pm 0.24$	$7.00^{ab} \pm 0.46$	$7.13^{a} \pm 0.63$
1.5	$7.75^{a} \pm 0.41$	$7.00^{a} \pm 0.46$	$7.75^{a} \pm 0.41$	$7.56^{a} \pm 0.24$
1.6	$5.81^{c} \pm 0.43$	$5.50^{b} \pm 1.04$	$6.63^{b} \pm 0.92$	$5.75^{c} \pm 0.41$
CD(0.05)	0.744	0.961	0.924	0.627

Each observation is mean ± SD of 4 replications; [a–c]Superscript letters following numbers in the same column denote significant difference ($P < 0.05$)

Table 4: Influence of varied concentration ratios on the composition of bottle gourd puree

Concentration ratio	TS	Fat	Protein	Total carbohydrate	Ash	Acidity
1.3	$55.08^{d} \pm 0.46$	$0.74^{d} \pm 0.02$	$4.78^{d} \pm 0.10$	$47.55^{d} \pm 0.30$	$1.59^{d} \pm 0.03$	$0.0598^{c} \pm 0.01$
1.4	$57.20^{c} \pm 0.42$	$0.81^{c} \pm 0.01$	$5.25^{c} \pm 0.09$	$48.94^{c} \pm 0.28$	$1.74^{c} \pm 0.03$	$0.0740^{b} \pm 0.01$
1.5	$59.08^{b} \pm 0.78$	$0.88^{b} \pm 0.03$	$5.66^{b} \pm 0.17$	$50.17^{b} \pm 0.51$	$1.88^{b} \pm 0.06$	$0.0799^{b} \pm 0.01$
1.6	$61.83^{a} \pm 1.04$	$0.97^{a} \pm 0.04$	$6.27^{a} \pm 0.23$	$51.97^{a} \pm 0.68$	$2.08^{a} \pm 0.08$	$0.0913^{a} \pm 0.01$
CD(0.05)	1.11	0.04	0.24	0.73	0.08	0.01

Each observation is mean ± SD of 4 replications; [a–c]Superscript letters following numbers in the same column denote significant difference ($P < 0.05$).

taste. Because Pusa Naveen is available in the market throughout the year, Pusa Naveen variety was selected.

Selecting the most suitable form/s of bottle gourd and development of a formulation for bottle gourd ice cream

In this phase preliminary trial were conducted for selecting the most suitable form of bottle gourd from amongst three forms prepared using the method standardized in Phase I viz. cubes, shreds, puree and their combinations for manufacture of acceptable quality bottle gourd ice cream. Preliminary trails were also conducted for selecting the level of milk fat, MSNF, sucrose, stabilizer and emulsifier in a formulation of bottle gourd ice cream. The products for this phase were made employing a direct expansion type batch freezer.

Selection of bottle gourd form/s for bottle gourd ice cream

Preliminary trials were carried out in this part of the experiment to select the most suitable forms of processed bottle gourd for

Table 5: Effect of different sugar syrup and time-temperature on quality of processed bottle gourd cubes

Batch/Time (200 gm shreds) (Syrup 500ml)	A (80 % syrup)	B (70% syrup normal procedure)	C (70% syrup & boiling 5 min & then store at refrigeration temperature)	D (70% syrup & boiling 10-15 min)
Observation	Good taste, hard texture	Good acceptable taste but texture is smooth & soft body	Taste is better than A, B & texture is good firm enough than A, B	Caramel flavor, Jelly like texture & good firmness similar to A

Table 6: Influence of varied concentration ratios on the 9-point hedonic (Sensory attributes) scores of bottle gourd cubes

Concentration OF SUGAR SYRUP	Flavour	Colour and appearance	Body and texture	Overall acceptability
60 %	$6.13^{bc} \pm 0.32$	$5.69^{c} \pm 0.31$	$6.00^{c} \pm 0.46$	$5.97^{c} \pm 0.48$
65 %	$6.63^{b} \pm 0.43$	$6.31^{b} \pm 0.43$	$6.69^{b} \pm 0.43$	$6.66^{b} \pm 0.62$
70 %	$7.53^{a} \pm 0.57$	$6.97^{a} \pm 0.22$	$7.75^{a} \pm 0.36$	$7.52^{a} \pm 0.14$
75 %	$6.43^{b} \pm 0.88$	$5.50^{c} \pm 0.34$	$6.50^{bc} \pm 0.24$	$5.94^{c} \pm 0.30$
80 %	$5.59^{c} \pm 0.37$	$5.38^{c} \pm 0.72$	$6.44^{bc} \pm 0.75$	$5.19^{d} \pm 0.66$
CD(0.05)	0.746	0.593	0.642	0.650

Each observation is mean ± SD of 4 replications; [a–c]Superscript letters following numbers in the same column denote significant difference ($p < 0.05$); processed cubes: puree (%w/w): L1 (5:6), L2 (6:5), L3(7:4), L4(8:3)

Table 7: Influence of varied sugar syrup concentration on the composition of bottle gourd cubes

Concentration OF Sugar Syrup	TS	Fat	Protein	Total carbohydrate	Ash	Acidity
60 %	$70.47^{e} \pm 0.59$	$0.36^{e} \pm 0.02$	$2.30^{a} \pm 0.13$	$66.85^{e} \pm 0.39$	$0.77^{a} \pm 0.04$	$0.0273^{d} \pm 0.0022$
65 %	$74.09^{d} \pm 0.44$	$0.31^{d} \pm 0.01$	$2.00^{b} \pm 0.10$	$70.95^{d} \pm 0.29$	$0.66^{b} \pm 0.03$	$0.0298^{c} \pm 0.0018$
70 %	$78.02^{c} \pm 0.40$	$0.27^{c} \pm 0.01$	$1.76^{c} \pm 0.09$	$75.24^{c} \pm 0.26$	$0.59^{c} \pm 0.03$	$0.0315^{bc} \pm 0.0019$
75 %	$82.17^{b} \pm 0.47$	$0.24^{b} \pm 0.02$	$1.58^{d} \pm 0.10$	$79.69^{b} \pm 0.31$	$0.52^{d} \pm 0.03$	$0.0336^{ab} \pm 0.0013$
80 %	$86.03^{a} \pm 0.28$	$0.20^{a} \pm 0.01$	$1.33^{e} \pm 0.06$	$83.94^{a} \pm 0.19$	$0.44^{e} \pm 0.02$	$0.0354^{a} \pm 0.0006$
CD(0.05)	0.606	0.021	0.133	0.397	0.044	0.0023

Each observation is mean ± SD of 4 replications; [a–c]Superscript letters following numbers in the same column denote significant difference ($p < 0.05$); processed cubes: puree (%w/w): L1 (5:6), L2 (6:5), L3(7:4), L4(8:3)

Table 8: Influence of different combinations of processed bottle gourds on composition, acidity and pH of bottle gourd ice cream mixes

Type of Ice cream	Constituents (%) Fat	Protein	Total solids	Acidity(%L.A)	Physico-chemical properties pH	Viscosity (in cp at 4 °C)
L1	11.00 ± 0.06	4.36 ± 0.04	38.65 ± 0.01	0.23 ± 0.01	6.23 ± 0.03	$277.00^{b} \pm 5.72$
L2	10.95 ± 0.04	4.36 ± 0.03	37.95 ± 0.03	0.24 ± 0.01	6.21 ± 0.02	$272.54^{b} \pm 21.78$
L3	11.00 ± 0.03	4.35 ± 0.08	38.12 ± 0.04	0.25 ± 0.01	6.20 ± 0.04	$255.49^{a} \pm 13.77$
L4	10.9 ± 0.02	4.34 ± 0.02	38.74 ± 0.14	0.23 ± 0.00	6.29 ± 0.04	$250.26^{a} \pm 12.28$
CD(0.05)	NS	NS	NS	NS	0.08	12.44

Each observation is mean ± SD of 4 replications; [a–c]Superscript letters following numbers in the same column denote significant difference ($P < 0.05$)

Table 9: Influence of various levels of combinations of processed bottle gourd on the 9 point hedonic scale scores of bottle gourd ice cream

Type of Ice cream	Sensory attributes Flavour score	Body and texture score	Melting quality score	Colour and appearance score	Overall acceptability score
L1	$7.8^{c} \pm 0.1$	$8.0^{b} \pm 0.1$	$8.1^{b} \pm 0.2$	$8.1^{b} \pm 0.0$	$8.0^{c} \pm 0.1$
L2	$7.9^{c} \pm 0.0$	$8.0^{b} \pm 0.1$	$8.2^{b} \pm 0.1$	$8.1^{b} \pm 0.1$	$8.0^{c} \pm 0.0$
L3	$8.7^{a} \pm 0.1$	$8.3^{a} \pm 0.1$	$8.6^{a} \pm 0.3$	$8.6^{a} \pm 0.1$	$8.6^{a} \pm 0.1$
L4	$8.3^{b} \pm 0.0$	$8.3^{a} \pm 0.0$	$8.5^{a} \pm 0.1$	$8.1^{b} \pm 0.1$	$8.4^{b} \pm 0.0$
CD(0.05)	0.09	0.12	0.21	0.14	0.08

Each observation is mean ± SD of 4 replications; [a–c]Superscript letters following numbers in the same column denote significant difference ($P < 0.05$)

preparing acceptable quality bottle gourd ice-cream. Ice cream was prepared in a commercial batch freezer using the various prepared forms viz. puree, shreds, cubes and combination of the two forms of bottle gourd viz. shreds + puree and cubes + puree. The composition of ice-cream mix was 12 % fat, 11 % SNF, 15 % sugar, 0.15 % sodium alginate and 0.20 % GMS. The various forms of bottle gourd at selected levels were added after aging.

Five combinations were tried out cubes, shreds, puree, puree + cubes and puree + shreds. The level of addition of various forms of bottle gourds was decided based on preliminary trials. Then products were subjected to rating test by a panel of 25.

Panelists were asked to rate the products using the following scale: + + + + = Highly acceptable; + + + = Acceptable; + + = Moderately acceptable; + = Slightly acceptable; - = Not acceptable. The effect of addition of various forms of processed bottle gourd on acceptability of ice-cream is presented in Table 2.

It can be seen from Table 1 that addition of cube as well as shreds alone resulted in a product which was not acceptable in sensory properties and was less palatable or preferred by sensory panel because alone shreds or cubes were resulted in crunchy texture, lacking in flavour and lacking in desired caramelized, pleasant flavour. Hence, they were not acceptable. Addition of puree alone was also not liked well by panelists as it gave unacceptable flavor and faster meltdown. The combination of shreds and puree also had poor acceptability as it gave a similar effect as in case of shreds alone but had a good appearance. Hence, they were not selected. Addition of cubes and puree in combination was best in terms of acceptance or liked the most by the panelists. It was found that puree contributed to viscosity, richness, ash, protein content in ice-cream and cubes contribute good flavour, appearance, texture and increase in palatability of ice cream. Hence, a combination of cubes and puree was selected and used in next part of study.

Preparation and processing of bottle gourd

Fresh, clean, optimum matured, uniform and good quality of bottle gourd (Pusa Naveen) was procured from the local vegetable market at Anand, Gujarat, India. Firm, tender, uniform, green, nearly straight and cylindrical bottle gourds, at a commercially marketable stage were obtained from a local market in Anand, Gujarat. The average weight of selected bottle gourds ranged from 0.85 kg to 1 kg. Over ripe, under ripe and defective bottle gourds were removed. Selected bottle gourds (Pusa Naveen) were approximately 30 to 40 cm in length and 4 to 8 cm in width. Bottle gourds were washed thoroughly using potable water and peeled (using clean, dry commercial sharp stainless steel peeler), de-cored (optional) and immediately dipped in pasteurized and warmed water (35 to 40 ^{o}C). The quantity of peels obtained was 13 to 15 % of the initial weight of bottle gourd. The approximate compositional analysis of raw, peeled bottle gourd was moisture (%): 94.2 ± 1.06; Total solids (%): 5.52 ± 1.21; protein: 0.65 ± 0.12; ash: 0.48 ± 0.08.

Pre-treatments

The bottle gourds were thoroughly cleaned to remove any dirt or insecticide residues. This cleaning process involved washing the bottle gourds under a faucet with running potable water. Bottle gourds were then soaked in water containing 25 to 50 ppm chlorine for 10 min.The bottle gourds were peeled; care was taken to use a sharp, clean, dry stainless steel peeler to prevent the discolouration of the plant tissues. The average thickness of peels was 0.2 mm. From the moment bottle gourds are peeled, the quality of the bottle gourd decreases due to the release of enzymes and nutrients for micro-organisms. A decrease in quality is also caused by the damage done to the plant tissues (James and Kuipers, 2003). For this reason, the interval between peeling and cutting was kept as short as possible. Bottle gourds were cut in uniform pieces (approximate length of 5cm). After cutting, the bottle gourds were de-cored to remove the core portion in preparation of bottle gourd cubes and shreds. Bottle gourd core contains seeds which would result in adverse effect on the body and texture of cubes and shreds.The pieces of bottle gourd were blanching in hot water at 90-95^{o}C for 2 min followed by immediate cooling by transferring the pieces in potable lukewarm water.

Processing of bottle gourd forms

Processed bottle gourd puree

Puree was made from the blanched and drained bottle gourd slices by grinding for 2 to 3 min food processor (Model-Boss Food Processor, Boss Electrical, Solan and Himachal Pradesh). The puree was then transferred in a clean, sanitized pre-weighed stainless steel vessel and sugar was added @50 % (by weight of puree) and blended. The contents in the vessel were then cooked on medium flame.In preliminary investigations it was found that addition of sugar at a higher rate resulted in excessive browning and pronounced caramelized flavor whereas addition of sugar at lower rate resulted in a product with decreased sweetness and unpleasant predominant raw bottle gourd flavour.

Selection of concentration ratio

In order to select the concentration ratio (CR) with a view to achieve optimum flavour, colour and acceptability of the final puree, three concentration ratios were employed viz. 1.3, 1.5 and 1.7. The prepared bottle gourd puree was bland in taste. Hence, Sugar and sodium chloride was added at the rate of 50 % and 0.1 % by weight of raw puree respectively to enhance its flavour. This rate was decided based in preliminary investigations. The composition of raw bottle puree was similar to the composition of raw peeled bottle gourd. The processed bottle gourd purees were subjected to observation, sensory analysis and physico-chemical analysis, the results obtained are presented in Table 2, 3 and 4 respectively. It can be seen that a highly acceptable puree was obtained when CR of 1.5 was used. Hence a CR of 1.5 was selected and used in preparation of bottle gourd puree. To prepare 1 kg processed bottle gourd puree 1.1 kg peeled bottle gourd was required.

Preparation method of processed bottle gourd puree

For preparation of processed bottle gourd puree, one kg of the selected bottle gourd variety (Pusa Naveen) was taken. The bottle gourds were then washed, peeled and blanched as described above. It was cut into piecesof average length 5.0 ± 1.0 cm, breadth 2.0 ± 0.5 cm and thickness 2.0 ± 0.5 cm. These pieces were again blanched in hot water at 90 ^{o}C for 2 min and drained. Raw bottle gourd puree was prepared by grinding the pieces in a food processor for 2 to 3 min. Addition of sugar and salt in puree was done @ 50 % and 0.1% by weight of puree (raw) respectively. The puree was concentrated by heating on medium flame till a concentration ratio of 1.5 was attained. The total time taken for concentration was about 25 min. It was cooled to room temperature (25-30 ^{o}C), packaged and stored at 7 ± 1^{o}C till in use.

Standardization of method for processing bottle gourd cubes

Bottle gourds were peeled (using commercial peeler), washed, de-cored, halved into two parts and cut in pieces (average

length 5.0 ± 1.0 cm slices, breath 2.0 ± 0.5 cm and thickness 2.0 ± 0.5 cm). From 1 kg bottle gourd ~ 15 to 20 % of its weight was peel and 20 to 25 % was core portion. Therefore, quantity of edible portion bottle gourd obtained after peeling and decoring was 40 to 45 % of weight of initial weight of bottle gourd. These raw pieces were blanched (90ºC for 2 min) to prevent enzymatic browning which affects the final quality of processed cubes in terms of color and other sensory aspects (Holds worth, 1983). After draining, the pieces were sliced into 0.8 ± 0.2 cm^3 size cubes using clean, dry knife. Then, blanched cubes were taken in pre-washed, sanitized, clean, pre-weighed stainless steel vessel.

Preparation of bottle gourd cubes

It has been reported in literature that treating bottle gourd cubes with calcium chloride solution for preparation of tutti fruity resulted in improved firmness of cubes (Babar, 1996). The effect of treating blanched cubes by addition of calcium chloride on body and texture of processed bottle gourd cubes were evaluated. Control was also prepared without $CaCl_2$ treatment. After blanching the cubes were dipped in 1 %lukewarm calcium chloride solution for 3 h. The cubes were then drained, mixed with equal quantity of 50º Brix sugar syrup and cooked by heating on a direct flame till the concentration of sugar syrup reached 70º Brix. It was observed that $CaCl_2$ treated cubes had slight off flavour with bitter aftertaste. However, the firmness and color of $CaCl_2$ treated cubes were acceptable. The control sample had good shape, flavour and color retention, uniform texture and firmness like tutti fruity. No perceptible difference was found in body and firmness of the samples. $CaCl_2$ treatment caused no improvement on texture or firmness of bottle gourd cubes.

Selection of concentration of sugar syrup

In this part of experiment, different treatments were employed to check the effect of sugar syrup concentration in combination with temperature on sensory profile of final processed bottle gourd cubes .Water and sugar (70 % by weight of bottle gourd cubes respectively) and salt (0.1 % by weight of cubes) were added to the bottle gourd cubes and concentration was done till different level of degree Brix of sugar syrup (using digital Refracto meter) was achieved.The effect of different sugar syrup treatments viz. 80 % syrup, 70% syrup, 70% syrup and boiling 5 min and 70% syrup & boiling 10 min on quality of cubes was evaluated. The influence of different sugar syrup and time-temperature on quality of processed bottle gourd cubes is presented in Table 5.

Different sugar syrup concentration was studied viz. 60, 65, 70 and 75º Brix by heating on medium flame. It was observed that cooking to final concentration up to 60 and 65º Brix resulted in final cubes having uncooked, unpleasant, predominant raw bottle gourd flavour, less sweet and less acceptable in terms of sensory characteristics. Cooking to concentration up to 70º Brix resulted in final quality cubes having very pleasant, clean, caramelized, sweet flavour and properly cooked firm texture was seen but above 75º Brix resulted in excessive increase in highly cooked, caramelized flavour, browning and chances of sticking or burning was more due to excessive concentration. So, 70º Brix was used in the final preparation of cubes (Babar, 1996). Hence, 70º Brix sugar syrup concentration was used in the final preparation of cubes. To prepare 1 kg processed bottle gourd cubes 1 kg peeled and decored bottle gourd was required.

The effect of varied sugar syrup concentration on the sensory attributes and composition of bottle gourd cubes is presented in Table 6 and 7 respectively.

Preparation method of processed bottle gourd cubes

For preparation of processed bottle gourd cube, one kg of the selected bottle gourd variety (Pusa Naveen) was taken

Pretreatments and processing of bottle gourd was done as described above (i.e. washing, peeling, decoring and blanching etc.). It was cut into pieces of average length 5.0 ± 1.0 cm, breadth 2.0 ± 0.5 cm and thickness 2.0 ± 0.5 cm. These pieces were blanched in hot water at 90 ºC for 3-4 min and drained. These bottle gourd cubes were cut and resized into 0.8 ± 0.2 cm^3. Addition of sugar and salt in cubes were done @70 % and 0.1% by weight of cubes respectively and mixed properly. The contents were then concentrated by heating on medium flame upto 75ºBrix at 105 ºC for 35-40 min. It was cooled to room temperature (25-30 ºC). It was packaged and stored at 7 ± 1 ºC till in use.

A basic ice cream mix adopting the procedure and having the composition as described abovewas prepared. Preliminary studies indicated that, incorporation of the processed bottle gourd puree up to 5 % in combination with cubes up to 7% in combination up was desirable and beyond that, the acceptability of the product decreased considerably. Accordingly based on preliminary investigations, 4 levels of incorporation of processed cubes: puree was selected viz. L1 (5:6), L2 (6:5), L3(7:4), L4(8:3). Vanilla was used as the flavouring ingredient in all the samples. The products prepared during this part of the investigation were also subjected to analyses as has been described above. The experiment was replicated four times. In each replication four batches of ice cream were prepared. It can be seen from Table 8 than there was no significant ($P > 0.05$) difference in compositional attributes viz. fat, protein, total solids content as well as acidity among all the samples. However, the viscosity of samples L3 and L4 were significantly ($P < 0.05$) lower than L1 and L2. This could be because of the higher levels of puree in these samples causing increase in viscosity of the mixes.

It can be seen from Table 9 that the overall acceptability score of L3 was the highest i.e. 8.6 followed very closely by L4 scoring 8.4. These were followed by L1 and L2 scoring minimum marks. From the relevant statistical analysis it can be noticed that the total score of L3 was significantly higher than all the other samples. It is evident that amongst all the levels tried in experimental samples, L3 was preferred the most with respect to flavour, body and texture, colour and appearance, melting quality as well as total scores.A standardized method of manufacture of bottle gourd ice cream is developed from this study. It is concluded that all the study parameters such as bottle gourd cubes and bottle gourd puree play a significant role in obtaining bottle gourd ice cream with high acceptability and consistent quality. The optimum level of addition of processed bottle gourd cubes was 7% and puree was 4%. The formulated "bottle gourd ice cream" was found to be highly acceptable.

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