

Development of grape pulp enriched low calorie ice cream made with aspartame and maltodextrin

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Abstract: An attempt has been made to increase anti-oxidants presence at higher levels in grape pulp by incorporating in ice cream to enhance the functional properties and nutritional quality. Ice cream was prepared using grape pulp at 8 to 12 % levels in ice cream mix prior to freezing. Inclusion of grape pulp at augmented levels resulted in significant ($P<0.05$) changes in physico-chemical properties and antioxidant activity of ice cream. The percentage values of fat and protein in grape pulp enriched low calorie ice cream ranged from 9.73 ± 0.02 to 9.43 ± 0.04 and 3.54 ± 0.01 to 3.95 ± 0.04 respectively. The mean carbohydrate percentage of ice cream were ranged from 10.91 ± 0.07 to 9.75 ± 0.20 in treatments C_m to G_3 respectively, which was significantly higher ($P<0.05$) in C_m than in other treatments. The mean total solids percentage of grape pulp enriched low calorie ice cream was in the range from 25.75 ± 0.06 to 24.06 ± 0.21 . A significant ($P<0.05$) higher antioxidant activity and over run per cent were found in the G_3 samples (55.16 ± 0.98 % inhibition of DPPH) and 86.80 ± 0.37 respectively than remaining formulations. The samples with 10% grape pulp incorporated low calorie ice cream was found to have highest overall acceptability scores (8.46 ± 0.06) with enhanced functional properties and nutritional value.

Key words: Ice cream, Aspartame, Maltodextrin, Low calorie, Grape pulp, Antioxidant activity, Sensory Characteristics.

Introduction

Frozen dairy desserts can be used successfully to deliver unique additional and nutritional benefits to consumers beyond the basic nutrition. New varieties of ice cream are coming out targeting the health conscious consumers, and also new manufacturing processes giving more value for money spent by consumers (Sasikala et al. 2020). At present focus on nutritional enrichment has shifted from the provision of nutrient deficiency to the pursuit of optimal health and dietary intake. The consumers are now more interested in healthy foods and looking for foods that have added beneficial compounds such as antioxidants, phenolics and phytosterols. At present focus on nutritional enrichment has shifted from the provision of nutrient deficiency to the pursuit of optimal health and dietary intake. The consumers are now more interested in healthy foods and looking for foods that have added beneficial compounds such as antioxidants, phenolics and phytosterols. Consumers can only be expected to consider consuming functional foods if they are perceived as healthier than their conventional counterparts (Urala and Lahteenmaki, 2003). However, consumers' acceptance of functional foods does not depend only on their interest in health. In order to gain the health benefits derived from functional foods consumption, consumers need to include them as part of their usual diet for a relatively long period of time (Sarubin, 2000), and consequently the sensory properties of functional foods should not discourage sustained consumption. The addition of many functional ingredients results in the appearance of off-flavors that decreases the sensory quality of the product (Urala and Lahteenmaki, 2004). It has been reported that functional food consumers are committed to the health benefits of these products and might be willing to have a food product with an unpleasant taste since they consider it as a marker of the health benefit of the product (Reineccius, 2000 and Baixauli et al. 2008). However, several authors have stressed that consumers are hardly willing to compromise on the taste of functional foods for eventual health benefits (Tuorila and Cardelo, 2002; Cardello and Schutz, 2003; Verbeke, 2006; Ares et al. 2009). Thus producers have to add functional ingredients to food products to attract the attention of health conscious consumers (Shaviklo et al. 2011). Grapes contain a variety of phytochemicals, like phenolic acids, stilbenes, anthocyanins, and proanthocyanidins, all of which act as strong

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antioxidants (Yang et al. 2009). Increasing preference of consumers towards natural ingredients has tempted the ice cream manufactures to search for new innovations in components having favourable health effects. Therefore, during the development of functional foods, it is extremely important to rely on methodologies that enable the identification of consumers' sensory and hedonic perception of the products. Clinical data has shown that the antioxidant potential of grape phytochemicals is twenty and fifty fold greater than vitamins E and C respectively which is arising from increased levels of polyphenol proanthocyanidins and oligomers of flavan-3-ol units, especially catechin and epicatechin present in GSE (Yilmaz and Toledo, 2004). Mechanism of antioxidant action of grape phytochemicals includes oxygen radical scavenging activity (Bagchi et al. 2000), stimulation of the enzymatic production of nitric oxide and inhibition of nitrositive stress (Roychowdhury et al. 2001). Thus, the objective of this study was to develop grape pulp added low calorie functional ice cream to improve the nutritional and sensory characteristics.

Materials and Methods

Fresh chilled raw cow milk and cream was procured from College Experimental Station, College of Dairy Technology, Tirupati. Aspartame was procured from Niantang Chemical Plant Co. Ltd., Niantang Town, China, whereas, maltodextrin used as bulking agent was procured from Vintop Products Pvt. Ltd., Mysore Road, Bangalore, and Karnataka. Other ingredients such as skim milk powder, stabilizer, black grapes and vanilla essence were purchased from the local market.

Preparation of low calorie ice cream

In the present study, low calorie ice cream (control) was prepared using 10% fat, 11% MSNF, 900 ppm aspartame, 2% maltodextrin, 0.3% stabilizer and emulsifier and 0.2% vanilla flavour used. Liquid ingredients (milk and cream) were mixed and heated to 49°C. Thereafter, dry ingredients (skim milk powder, maltodextrin and stabilizer) were added. The ice cream mix was then pasteurized at 68°C for 30 minutes, homogenized. The mixture was cooled to 30°C. Calculated quantity of aspartame was first dissolved in small quantity water and mixed with the mixture properly. This mixture was for ageing at 0 to 4°C for 4 hrs. After addition of vanilla essence, the mix was subjected to freezing at -4 to -5°C, filled in 100 ml polystyrene cups and kept for hardening at -23°C.

Preparation of grape pulp

Good quality well ripened black grapes were purchased from local market of Tirupati. The grapes were debauched and thoroughly rinsed in tap water followed by with distilled water. The whole fruits were pureed well using a fruit pulper and then filtered through a wire mesh to obtain pure pulp. The pulp was pasteurized (80 to 90°C) and then concentrated to maintain the

total soluble solids 15° brix and then cooled at 4°C for ice cream preparation.

Preparation of grape pulp enriched low calorie ice cream

Grape pulp enriched low calorie ice cream was prepared by incorporating grape pulp is presented in Fig 1. The mixes were homogenized at 2000/500 psi and ice cream mix were kept for ageing at 4°C for 4 hours and for freezing at -4°C. After packing of the ice cream were kept for hardening and storage at -23°C.

Analysis of ice cream

The ice cream was evaluated for physico-chemical and sensory characteristics. The fat content of the ice cream were determined by the standard method as suggested in ISI Hand Book (1989) for ice cream mixes using 5 g ice cream mix sample. The total nitrogen in the sample was determined by Macro-Kjeldahl method (AOAC, 2000). Ash content of ice cream samples was determined by procedure described in IS: 1547-1985. Total solids content of the ice cream mix was determined by gravimetric method (IS:2802-1964). The total carbohydrate content in the samples was determined by difference i.e. the sum of moisture, protein, fat and total ash percent was subtracted from 100. The

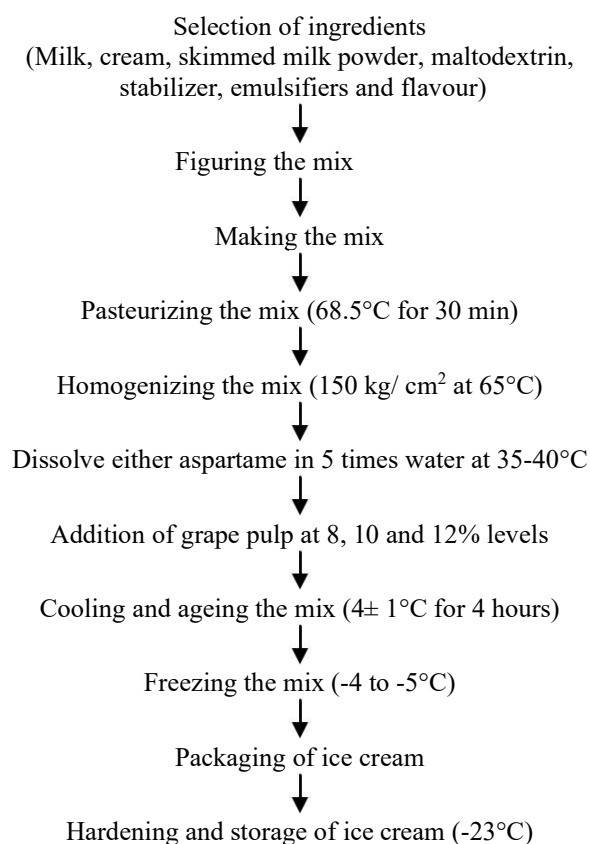


Fig 1. Flow chart for preparation of grape pulp enriched low calorie ice cream

titratable acidity of the ice cream was determined by the standard method suggested in ISI Hand Book (1989). The pH of ice cream mix was determined after ageing using a digital pH meter (Elico Pvt. Ltd., Hyderabad) (AOAC, 2000).

The viscosity of ice cream mix was determined by the method of Lowenstein and Haddad (1972) using a Brookfield Viscometer, Model LTD2T, (Brookfield Engineering Laboratories, Chennai). The overrun in ice cream was determined as per the method of Marshall et al. (2003). The penetration value of the hardened frozen product was measured using cone penetrometer. The melting rate was determined as per the procedure given below by Specter and Setser, (1994).

Sensory evaluation

The acceptability of low calorie ice cream (aspartame) enriched with grape pulp was studied by conducting sensory evaluation with the help of panel of trained judges were assessed by using 9 point hedonic scale.

Statistical analysis

The results obtained during the course of investigation were subjected to statistical analysis using the software OPSTAT, as proposed by Sheoran et al. (1998).

Results and Discussion

Utilization of fruits in milk products for value addition is great challenge to dairy processing industry. Nowadays consumers prefer value added milk products. There is a large scope in dairy processing industry for conversion of milk into innovative fruit based milk products. Ice cream is rich in macronutrients i.e. carbohydrates, fats, proteins, and some micronutrients i.e. vitamin A, E and calcium. However, commercially available ice creams are generally poor in natural antioxidants like vitamin C, colours and phenols. Grape is a rich source of antioxidants including phenolic, flavonoid, and anthocyanin. To improve the functional and nutritional attributes of low calorie ice cream a trail has been conducted by addition of grape pulp levels (G_1) 8, (G_2) 10 and (G_3) 12 percent level with control low calorie ice cream without grape pulp (Cm).

Compositional and physico-chemical analysis of different levels of grape pulp addition in low calorie ice cream

Perusal of the Table 1 reveals that fat content of ice cream greatly influences the compositional, physico-chemical and sensory properties of ice cream. Fat imparts rich flavour, soft body and smooth texture and also important in acceptance of ice cream in terms of consumer's sensory perception. The percentage values of fat in grape pulp enriched low calorie ice cream ranged from 9.73 ± 0.02 to 9.43 ± 0.04 . Grape pulp ice cream prepared by using 8 % pulp addition was having highest percent fat (9.73 ± 0.02)

content. The present findings illustrated that control sample (Cm) had the highest (10.19 ± 0.03) fat per cent than remaining three low calorie ice cream samples added with grape pulp. Irrespective of treatments grape pulp enriched low calorie ice cream had low fat percent. The decrease in the fat content of ice cream with increasing levels of grape pulp is ascribed due to low fat content of grape pulp. The results are in agreement to Bajwa et al. (2003), Murtaza et al. (2004) and Goraya and Bajwa (2015) who incorporated strawberry pulp, fig pulp and amla products respectively. The mean protein percentage of low calorie ice cream prepared using grape pulp for different treatments were 3.63 ± 0.01 , 3.58 ± 0.03 and 3.54 ± 0.01 , while control low calorie ice cream had a protein percentage of 3.95 ± 0.04 . The protein content of ice cream in all treatments with grape pulp was significantly ($P < 0.05$) lower than control (3.95 ± 0.04 per cent). The observations revealed that as the pulp level in the low calorie ice cream increased, the protein content was decreased; the reason might be due to low protein content of grape pulp. Similarly, Bajwa et al. (2003) and Murtaza et al. (2004) observed significant effect on protein content in different treatments of ice cream.

The mean carbohydrate percentage of ice cream were ranged from 10.91 ± 0.01 to 9.75 ± 0.20 in treatments Cm to G_3 respectively, which was significantly higher ($P < 0.05$) in Cm than in other treatments. It was observed that the decrease in the carbohydrate content of ice cream with increase in levels of grape pulp.

The mean ash percentage of ice cream in all treatments with Cm was significantly higher than G_1 , G_2 and G_3 . Addition of grape pulp significantly affected the ash percentage of ice cream. It was observed that the decrease in the ash content of ice cream with increasing levels of grape pulp due to the high moisture content of grape pulp.

The mean total solids percentage of grape pulp enriched low calorie ice cream was in the range from 25.75 ± 0.06 to 24.06 ± 0.21 . It showed that there was significantly higher ($P < 0.05$) in Cm than in other treatments. However, the variation in total solids content due to different treatments was significant, although decrease in total solids content with an increase in grape pulp was noticed. Similar observations were recorded by Goraya and Bajwa (2015) who reported that the decrease in total solids content of ice cream with an increase in level of jamun juice, orange and pineapple juice, respectively.

The data on the pH and acidity of the ice cream samples as influenced by different levels of grape pulp are presented in Table 1. The mean pH of ice cream was ranged from 6.49 ± 0.01 to 6.31 ± 0.01 and acidity values from 0.25 ± 0.01 to 0.33 ± 0.00 in treatments Cm to G_3 respectively. However, grape pulp affects the titratable acidity of low calorie ice cream, as the acidity values of Cm ice cream is lower than the low calorie ice cream prepared with different levels grape pulp. Grape pulp addition at increased levels caused a significant increased in acidity and decrease in

the pH of ice cream samples, due to the presence of tartaric acid and phenolic substances in the grape pulp. The addition of phenolic rich substances, like elagic acid and gallic acid, enhanced acidity due to the acidic nature of these components. The results are in accordance with Pinto et al. (2004) who observed that acidity increased with addition of ginger juice.

The mean antioxidant activity values were 32.03 ± 0.04 , 36.73 ± 0.04 , 43.52 ± 0.05 and 55.16 ± 0.98 in treatments Cm to G₃ respectively, which is significantly ($P < 0.05$) different between the treatments. The antioxidant activity of low calorie ice cream enriched with grape pulp showed an excellent ability in antioxidant activity (36.73 ± 0.04 to 55.16 ± 0.98 percent), while it was 32.03 ± 0.04 percent in the case of Cm ice cream. The antioxidant activity increased significantly ($P < 0.05$) and was greater at 12 percent level than 8 percent level. However, it increased progressively with increased amount of grape pulp was due to more phenols and tannins infusing into the ice cream matrix. Thus, the enrichment with grape pulp increases health benefits by increasing antioxidant activity. Therefore, grape pulp used as good source of antioxidants for making ice cream with good nutritional and functional properties. The results are similar with (Goraya and Bajwa, 2015) reported that the processed amla (Indian gooseberry) incorporated ice cream samples were also found to have higher antioxidant activity, total phenols and tannins than control due to more total phenols and tannins infusing from the amla into the ice cream matrix.

Physical properties of different levels of grape pulp addition in low calorie ice cream

Perusal of the data presented in Table 2 reveals that the mean viscosity (Cp) values of control (Cm) and grape pulp enriched samples G₁ (8%), G₂ (10%), G₃ (12%) mixes before ageing were 154.40 ± 3.76 , 145.00 ± 2.98 , 143.70 ± 2.23 and 134.70 ± 4.02 respectively. The corresponding mean viscosity (Cp) of mix after ageing at 4°C values were 291.00 ± 4.95 , 240.06 ± 4.28 , 229.00 ± 3.92 and 214.80 ± 3.29 respectively. It may be seen from the Table that the viscosity of the control mix (Cp) was significantly higher ($P < 0.05$) in comparison to the other treatments for both the viscosities. Viscosities in low calorie ice cream prepared with different levels of grape pulp were observed to be decreasing with increasing levels of grape pulp and are significantly different from one another. The above observations indicated that, as the grape level decreases the viscosity of ice cream mix this might be due to grape pulp contain high moisture content contributing a low level of viscosity in grape pulp enriched low calorie ice cream mix.

The mean overrun percentage values were 77.60 ± 0.44 , 81.20 ± 0.37 , 84.60 ± 0.40 and 86.80 ± 0.37 in treatments Cm to G₃ respectively, which differ significantly ($P < 0.05$) among the treatments. It was also observed from the table that overrun of G₃ was higher than Cm and that of G₁ and G₂ lower than G₃. Addition of grape pulp

significantly affected the overrun of the ice cream. The reason might be due to a decrease in viscosity with increase in the level of grape pulp as was observed in the increasing overrun. Table 2 shows mean penetration value (mm/5s) observed that there was increasing in penetrometer reading means decreasing the hardness of sample with increasing levels of grape pulp (8 to 12% i.e. G₁ to G₃) respectively, which was significantly different ($P < 0.05$) between the treatments. The penetration values were in the range from 71.60 ± 0.99 in Cm to 91.60 ± 1.05 in G₃. However, the low calorie ice cream containing 12% grape pulp was found to give a softer frozen dessert compared to Cm as well as G₁ and G₂, though very slightly. However, the hardness could depend on the overall structure of the product. It is observed a slight increase in penetrometer reading (that is decrease in hardness) by increased addition of grape pulp.

Effect of different levels of grape pulp addition in low calorie ice cream on the first dripping time and melting rate

The values given in the Table 3 (Fig 2 and 3) indicates that there was significantly lower in G₃ than in other treatments for first dripping time, in case of melting rate showed that there was significantly lower in Cm than in other treatments. It is observed from table that the first dripping time decreased and melting rate was increased with increasing level of grape pulp because of pulp contains high moisture content which caused decrease in viscosity and thus enhanced the melting resistance. Sakurai et al. (1996) found that ice creams with high overruns melted quickly whereas those with low overruns began to melt slowly and had a good melting resistance. As the ice cream melts, heat is transferred from the warm air surrounding the product into the ice cream to melt the ice crystals. They explained that initially the ice melts at the exterior of the ice cream and there is a local cooling effect (in the vicinity of the melting ice). The water from the melting ice diffuses into the viscous unfrozen serum phase and this diluted solution then flows downwards (due to gravity) through the structural elements that are destabilized fat globules, air cells and remaining ice crystals etc. to drip through the screen on which the ice cream rests. Meltdown is an important property of ice cream that affects its sensory quality. The melting resistance of ice cream increased progressively with increased levels of grape juice and thereby gradually decreased the melting rate. Maximum meltdown rate was observed for first 50 min after which it decreased progressively and followed a stationary curve for all samples of ice cream. The meltdown of ice cream is influenced by its composition, the amount of air incorporated, additives, the nature of ice crystals and by the network of fat globules formed during freezing (Koxholt et al. 2001). In a study by (Sakurai et al. 1996), it was found that ice creams with high overruns melted quickly whereas those with low overruns began to melt slowly and had a good melting resistance. As the ice cream melts, heat is transferred from the warm air surrounding the product into the ice cream to melt the ice crystals. Further, it was observed that initially the ice melts at the exterior of the ice

Table 1 Compositional and physico-chemical analysis of different levels of grape pulp addition in low calorie ice cream.

Treatments	Fat (%)	Protein (%)	Carbohydrate (%)	Ash (%)	Total solids (%)	pH	Acidity (%L.A)	Antioxidant activity (% inhibition of DPPH)
Gm	10.19 ^a ±0.03	3.95 ^a ±0.04	10.91 ^a ±0.07	0.72 ^a ±0.01	25.75 ^a ±0.06	6.49 ^a ±0.01	0.25 ^a ±0.01	32.03 ^a ±0.04
G ₁	9.73 ^b ±0.02	3.63 ^b ±0.01	10.60 ^{ab} ±0.01	0.69 ^a ±0.01	25.07 ^b ±0.14	6.44 ^b ±0.01	0.29 ^b ±0.01	36.73 ^b ±0.04
G ₂	9.57 ^c ±0.03	3.58 ^c ±0.03	10.18 ^{bc} ±0.09	0.65 ^b ±0.01	24.67 ^b ±0.19	6.39 ^b ±0.01	0.31 ^b ±0.01	43.52 ^b ±0.05
G ₃	9.43 ^d ±0.04	3.54 ^d ±0.01	9.75 ^c ±0.20	0.60 ^b ±0.01	24.06 ^c ±0.21	6.31 ^d ±0.01	0.33 ^c ±0.00	55.16 ^c ±0.98
CD (P≤0.05)	0.10	0.09	0.43	0.03	0.49	0.04	0.02	0.08

Gm (control): 900 ppm aspartame + 2% of maltodextrin added in ice-cream;

Values mentioned above are mean ± SE; (n=5);

abcd: Means in the same column with different superscripts differ significantly (Pd*0.05)

Table 2 Physical properties of different levels of grape pulp addition in low calorie ice Cream

Treatments	Viscosity(before ageing at 37°C)	Viscosity(after ageing at 4°C)	Over run (%)	Penetration
Gm	154.40 ^a ±3.76	291.0 ^a ±4.95	77.60 ^a ±0.44	71.60 ^a ±0.99
G ₁	145.00 ^{ab} ±2.983	240.06 ^b ±4.28	81.20 ^b ±0.37	77.24 ^b ±0.62
G ₂	143.70 ^{bc} ±2.23	229.00 ^b ±3.92	84.60 ^b ±0.40	84.20 ^b ±1.03
G ₃	134.70 ^c ±4.02	214.80 ^b ±3.29	86.80 ^b ±0.37	91.60 ^b ±1.05
CD (P≤0.05)	9.900	32.99	1.195	2.83

Values mentioned above are mean ± SE; (n=5);

abcd: Means in the same column with different superscripts differ significantly (Pd*0.05)

Table 3 Effect of different levels of grape pulp addition in low calorie ice cream on the first dripping time and melting rate

Treatments	Melting rate % (Time in minutes)										
	10	20	30	40	50	60	70	80	90	100	
Gm	10.600 ^a ±0.509	8.139 ^a ±0.42	19.375 ^a ±0.273	29.065 ^a ±0.564	37.12 ^b ±0.773	43.59 ^c ±0.567	47.631 ^c ±0.423	53.901 ^d ±0.567	57.404 ^b ±0.284	58.518 ^c ±0.380	59.886 ^b ±0.218
G1	9.800 ^a ±0.489	5.449 ^b ±0.16	15.07 ^b ±0.433	26.014 ^b ±0.377	35.104 ^b ±1.005	47.608 ^b ±0.657	55.502 ^b ±0.375	58.336 ^c ±0.406	59.324 ^b ±0.412	60.471 ^c ±0.400	62.295 ^b ±0.663
G2	5.800 ^b ±0.663	5.985 ^b ±0.09	15.60 ^b ±0.436	27.098 ^b ±0.515	37.479 ^b ±1.271	49.538 ^b ±0.91	57.40 ^b ±0.676	66.067 ^b ±1.543	68.869 ^a ±1.637	70.957 ^b ±1.679	71.514 ^b ±1.424
G3	5.400 ^b ±0.509	7.320 ^a ±0.43	18.564 ^a ±0.681	30.606 ^a ±0.716	42.501 ^a ±0.702	55.164 ^a ±2.010	66.620 ^a ±1.728	70.455 ^a ±1.755	71.723 ^a ±1.503	74.541 ^a ±0.777	76.464 ^a ±0.837
CD (P≤0.05)	2.426	0.957	1.435	1.669	3.684	2.909	3.657	3.416	2.900	2.690	

Values mentioned above is mean ± SE, (n=5)

abcd: means in the same column with different superscripts differ significantly (P≤0.05).

Fig. 2 Effect of different levels grape pulp on first dripping for low calorie ice cream prepared with aspartame and maltodextrin.

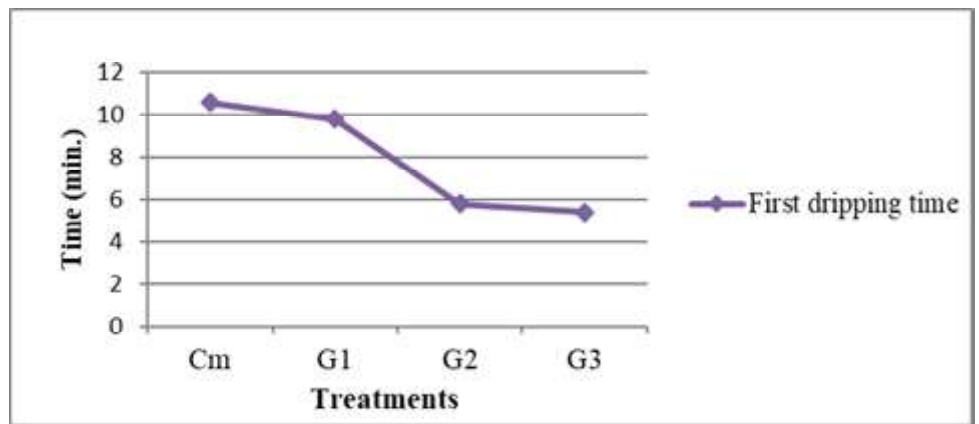


Fig. 3 Effect of different levels of grape pulp addition in low calorie ice cream on the first dripping time and melting rate

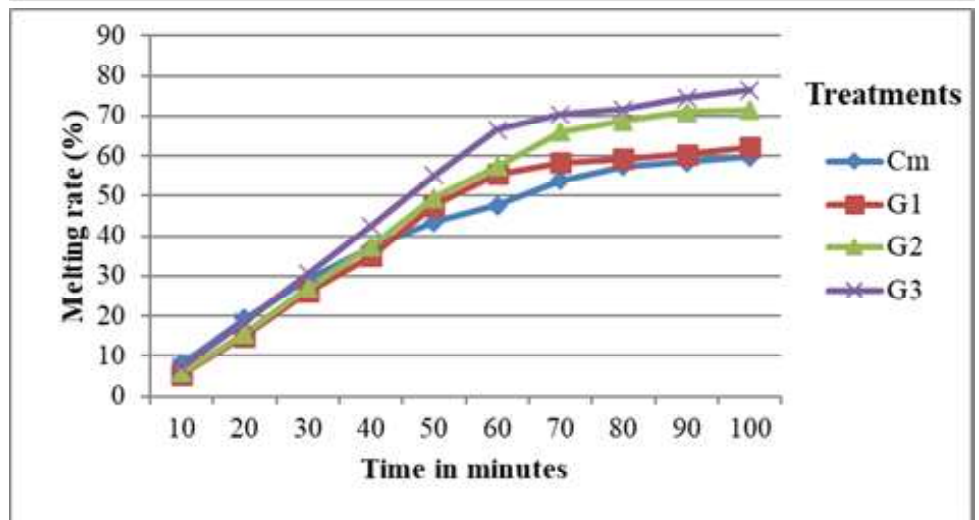
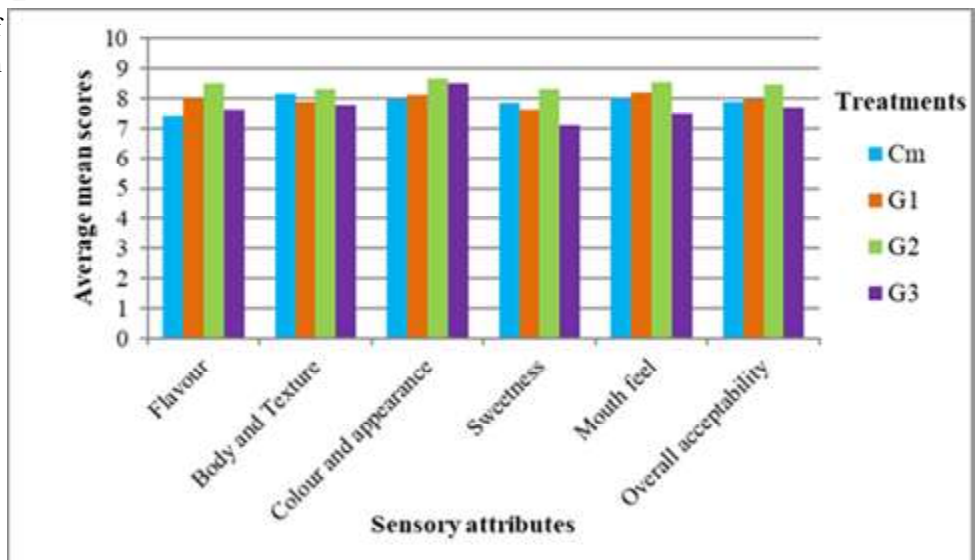


Fig. 4 Sensory scores for selection of grape pulp level for low calorie ice cream



cream and there is a local cooling effect (in the vicinity of the melting ice). The water from the melting ice diffuses into the viscous unfrozen serum phase and this diluted solution then flows downwards (due to gravity) through the structural elements that are destabilized fat globules, air cells, and

remaining ice crystals etc. to drip through the screen on which the ice cream rests. The use of Konjac flour alone or combined with κ -carrageenan as stabilizer retarded the meltdown of ice cream samples with respect to the control (Akesowan, 2008). Pinto et al. (2004) reported that 40-45% of ice cream melted during

Table 4 Average sensory scores of grape pulp added low calorie ice cream

Treatments	Flavour	Body and texture	Colour and appearance	Sweetness	Mouth feel	Overall acceptability	Comments
Cm	7.41c± 0.28	8.15± 0.04	7.96d± 0.05	7.85b± 0.03	8.01c± 0.04	7.87b± 0.12	Acceptable sweetness
G1	8.02ab± 0.08	7.91b± 0.08	8.12c± 0.05	7.61c± 0.06	8.20b± 0.02	7.97b± 0.10	Low level of sour taste
G2	8.49a± 0.03	8.31a± 0.03	8.63a± 0.01	8.32a± 0.03	8.53a± 0.02	8.46a± 0.06	Acceptable level of sour taste
G3	7.64bc± 0.19	7.77b± 0.07	8.50b± 0.03	7.09d± 0.04	7.48d± 0.07	7.69b± 0.23	High level of sour taste
CD(P≤0.05)	0.53	0.18	0.12	0.14	0.13	0.43	-

Values mentioned above are mean ± SE; (n=5)

abcd: Means in the same column with different superscripts differ significantly (P≤0.05).

first 40 min and also found that addition of ginger shreds at higher levels decreased the meltdown rate. Meltdown rate was also significantly affected by strawberry inclusion at different levels (Bajwa et al. 2003). Melting resistance of ice cream was significantly affected by 10 and 15% addition of pumpkin, black mulberry and red grape pulp (Gafour et al. 2007).

Sensory evaluation of grape pulp added low calorie ice cream

The ice cream prepared from the addition of grape pulp were analyzed for sensory quality parameters like flavour, body and texture, colour and appearance, sweetness mouth feel and overall acceptability on nine point hedonic scales. The sensory scores presented in Table 4 (Fig.4) indicated that flavour of control sample and ice cream with 10% addition were good compared to other samples. Flavour parameter tells about the presence of grape flavour, an increase in addition of grape pulp the flavour score decreased significantly the reason might be due to sourness increases causing ice cream unacceptable at 12 % addition. A 12 % addition makes texture unacceptable. The mean body and texture scores of ice cream were 8.15±0.04, 7.91±0.08, 8.31±0.03 and 7.77±0.07 in treatments Cm to G₃ respectively, which was significantly higher (P≤0.05) in G₂ than in other treatments. It was observed from above finding that 10 % grape pulp ice cream developed a superior body and texture whereas the lowest noticed for ice cream prepared 12 percent grape pulp. The mean colour and appearance scores of ice cream were 7.96±0.05, 8.12±0.05, 8.63±0.01 and 8.50±0.03 in treatments Cm to G₃ respectively, which was significantly higher (Pd*0.05) in G₂ than in other treatments. It is observed that the colour has been changed from white to light purple colour as the level of grape pulp was increased the colour and appearance score decreased. Appearance parameters tell about the looks of the ice cream physically, it becomes light purple on addition of grape pulp.

The mean sweetness scores of ice cream were 7.85±0.03, 7.61±0.06, 8.32±0.03 and 7.09±0.04 respectively, which was significantly higher (P≤0.05) in G₂ than in other treatments. A significant decrease in sweetness scores observed as grape pulp level increases in ice-cream. The mean mouth feel scores were 8.01±0.04, 8.20±0.02, 8.53±0.02 and 7.48±0.07 respectively, which was significantly (P≤0.05) higher in G₂ than in other treatments. Ice cream containing 12 % grape pulp obtained lower acceptance. This was because of

sourness of samples at higher levels. The overall acceptability scores were significantly (Pd≤0.05) higher in G₂ ice cream than in other treatments and similar findings were noticed by Goraya and Bajwa (2015) that 10 percent amla candy was optimal for incorporation in ice cream. Based on the sensory attributes of the above study confirming that addition 10% grape pulp enriched low calorie ice cream was better acceptable since it has optimum flavour and mouth feel as compare to other treatments

Conclusions

The addition of grape pulp to low calorie ice cream improved the appearance and flavour of low calorie ice cream, giving it a good natural colour and flavour. To improve the functional property of low calorie ice cream (Cm) added at three different levels of grape pulp (8, 10 and 12 percent) compared with the control low calorie ice cream. The compositional, physico-chemical and sensory attributes of the product have been studied. The overall acceptability scores were highest (8.46) for 10 percent grape pulp with 900 ppm aspartame and 2 percent maltodextrin added low calorie ice cream (G₂). So, low calorie ice cream can be prepared and enriched by addition of grape pulp with improved colour, flavour and enriched with antioxidants.

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