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RESEARCH ARTICLE

Process optimization for the development of grape pulp enriched Low- calorie ice cream made with sucralose and sorbitol

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Abstract: Grape pulp is a rich source of antioxidants whereas, ice cream is a poor source of these antioxidants; therefore, the present study was carried out on physico-chemical, nutritional quality and sensory evaluation of low-calorie ice cream fortified with different levels of grape pulp. The grape pulp was added to the low-calorie ice cream to improve the sensory and nutritional quality like antioxidant activity of the product. The low-calorie ice cream was prepared with sucralose 300 ppm along with 3% sorbitol was kept as control. Low-calorie ice cream is enriched with grape pulp by adding at three different levels i.e. 8%, 10% and 12%. Based on the physico-chemical and sensory evaluation, 10% grape pulp added low-calorie ice cream was found to be acceptable. The resulted low-calorie ice cream enriched with grape pulp had enhanced functional and nutritional attributes.The results of current study demonstrated that the addition of fruits to the Yogurt significantly improved the quality of Yogurt.

Keywords: Ice cream, Low-calorie, Grape pulp, Physico-chemical quality, Antioxidant activity

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Introduction

The ice cream market in India reached a value of Rs. 165.2 billions in 2021 and exhibiting at a CAGR of 17.69 per cent during 2022-2027. Factors such as the rising demand for innovative flavors, types, and the rising demand for impulse ice creams such as cones, sandwiches, and pops in developing countries are expected to drive the market growth. The increasing health consciousness among consumers is also expected to fuel the demand for premium ice creams in the upcoming years. 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. Thus producers have to add functional ingredients to food products to attract the attention of health conscious consumers (Shaviklo et al. 2011). Increasing preference of consumers towards natural ingredients has tempted the ice cream manufactures to search for new innovations in components having favourable health effects. Sugar has many roles in foods and sugar not only makes dairy products more palatable but also a acts as bulking agent, adds viscosity, enhances flavor, provides texture, adds color, is a preservative, and inhibits protein coagulation (Davis, 1995; Silcock, 2017). When sugar is replaced or reduced, another bulking agent, such as insoluble fiber or polydextrose system, often must take its place (Silcock, 2017). However, when sucrose is replaced with a bulking agent, the bulking agents also contribute calories to the product and may negate the original purpose of removing the sugar (Cardoso and Bolini, 2008). Sugar can also add viscosity to dairy products and so, when it is removed, viscosity is reduced (Kappes et al. 2006; Saint-Eve et al. 2010; Cadena et al. 2012; Leksrisompong et al. 2012). Sugar reduces the water activity of diary products and beverages, which makes water unavailable for bacterial and fungal growth. Thus, when sugar is removed, it has to be replaced with another preservative, which is often less appealing to consumers. Sugar acts as an anticoagulant agent, in that it delays a liquid

from changing into a solid or semi-solid state (Mizukoshi et al. 1979).

Grapes contain a variety of phytochemicals, like phenolic acids, stilbenes, anthocyanins, and proanthocyanidins, all of which act as strong antioxidants (Yang et al. 2009). From a health perspective, grape phytochemicals has been shown active against HIV by inhibiting virus expression and replication (Nair et al. 2002), anticarcinogenic (Roy et al. 2002) and cardio-protective agent (Shafiee et al. 2003). Clinical data has shown that the antioxidant potential of grape phytochemicals is twenty and fifty fold greater than vitamins E and C respectively (Shi et al. 2003) 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 present study was undertaken to develop a grape pulp enriched low-calorie ice cream made with sucralose and sorbitol.

Materials and Methods

Fresh chilled raw cow milk and cream was procured from Experimental Section, Department of Dairy Technology, College of Dairy Technology, Tirupati, Andhra Pradesh. Sucralose was purchased from Shandong Kanbosweet Biochemical Technology Co., Ltd. China, whereas, sorbitol used as bulking agent was procured from Panchamrut chemicals, Mumbai. Other ingredients such as skim milk powder, sugar, 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, 300 ppm sucralose, 3% sorbitol, 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, sorbitol 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 sucralose was first dissolved in small quantity water and mixed with the mixture properly. This mixture was kept 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 polystyrene cups of 100 ml capacity and kept for hardening at -23°C.

Preparation of grape pulp

Good quality well ripened black grapes were purchased from local market of Tirupati, Andhra Pradesh, India. The grapes were washed thoroughly and 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 about 30 minutes) later 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 preparation by incorporating grape pulp is presented in Fig 1. The mixes were homogenized at 150 kg/cm^2 and ice cream mix was kept for ageing at 4°C for 4 hours and for freezing at -4°C. After packing of the ice cream was kept for hardening and storage at -23°C.

Analysis of ice cream

The ice cream was evaluated for compositional, physico-chemical and sensory characteristics. The fat content of the ice cream was determined by the standard method as suggested in ISI Hand Book (1989) for ice cream mixes using 5g 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

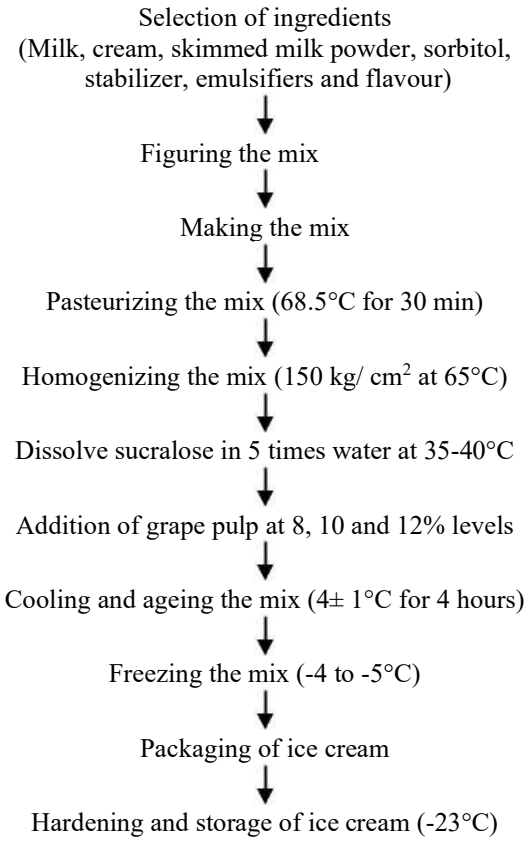

Fig 1. Flow chart for preparation of grape pulp enriched low-calorie ice cream

samples was determined by difference i.e. the sum of moisture, protein, fat and total ash percent was subtracted from 100. The 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 Loweenstein 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 ice cream by substituting with low-calorie sweetener was added at different levels were studied by conducting sensory evaluation with the help of 5 member panel of trained judges were assessed by using a 9- point hedonic scale.

DPPH radical scavenging activity

The ability to scavenge 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical by ice cream enriched with grape pulp was determined by the method of Singh et al. (2002). 100 µl ice cream enriched with grape pulp extracts were diluted with 0.1 M Tris–HCl buffer (pH 7.4) and mixed with 1 ml of DPPH (250 µM) with vigorous shaking. The reaction mixture was stored in the dark at room temperature for 20 min and then absorbance was measured at 517 nm using a UV–VIS spectrophotometer (UV-VIS spectrophotometer; Model: UV-1700 PharmaSpec, SHIMADZU, Japan). The scavenging activity was calculated by the following equation:

Scavenging activity % = (Absorbance of Blank –Absorbance of Sample/Absorbance of Blank) X 100

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. Now a day's 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.

Optimization of different levels of grape pulp for low-calorie ice cream prepared with sucralose and sorbitol

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_4) 8, (G_5) 10 and (G_6) 12 percent level with control low-calorie ice cream without grape pulp (Cs).

Compositional and physico-chemical analysis for low-calorie ice cream enriched with different levels of grape pulp

On perusal of the data presented in Table 1 pertaining to the compositional and physico-chemical analysis reveals that the mean values of fat, protein, carbohydrate, ash, total solids, pH and acidity for different levels of grape pulp enriched low-calorie ice cream and Cs cream are discussed below.

Fat

The mean fat percentage in ice cream for Cs, G_4, G_5 and G_6 were 9.64, 9.51, 9.43 and 9.36 respectively, which was significantly higher (Pd 0.05) in Cs than in other treatments. The present findings illustrated that control sample (Cs), had the highest (9.64%) fat than remaining three ice cream mixes added with grape

Table 1 Average compositional and physico–chemical analysis for low-calorie ice cream enriched with different levels of grape pulp

Treatments	Fat (%)	Protein (%)	CHO* (%)	Ash (%)	Total solids (%)	pH	Acidity (% LA)	Antioxidant activity (% inhibition of DPPH)
Cs	$9.64^{a}\pm0.01$	$3.73^{a}\pm0.07$	$12.46^{a}\pm0.03$	$0.85^{a}\pm0.01$	$26.69^{a}\pm0.36$	6.582 ± 0.02	$0.21^{c}\pm0.01$	$29.36^{d}\pm0.05$
G_4	$9.51^{b}\pm0.01$	$3.59^{ab}\pm0.07$	$12.18^{a}\pm0.05$	$0.80^{b}\pm0.01$	$26.09^{b}\pm0.03$	$6.39^{b}\pm0.03$	$0.31^{b}\pm0.01$	$34.79^{c}\pm0.04$
G_5	$9.43^{c}\pm0.01$	$3.50^{b}\pm0.04$	$11.93^{ab}\pm0.09$	$0.76^{c}\pm0.01$	$25.64^{b}\pm0.03$	$6.34^{bc}\pm0.06$	$0.34^{a}\pm0.01$	$41.93^{b}\pm0.05$
G_6	$9.36^{d}\pm0.01$	$3.45^{b}\pm0.03$	$11.51^{b}\pm0.02$	$0.701^{d}\pm0.01$	$25.03^{c}\pm0.03$	$6.20^{c}\pm0.05$	$0.36^{a}\pm0.01$	$54.07^{a}\pm0.03$
CD (P≤0.05)	0.03	0.17	0.57	0.04	0.57	0.14	0.04	0.63

CHO*-Carbohydrate**;** Values mentioned above are mean ± SE; (n=5);
abcd: Means in the same column with different superscripts differ significantly (P≤0.05)

pulp. Irrespective of treatments grape pulp 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. Similar observations were recorded by Shelke et al. (2020) who reported a gradual decrease in fat content with increase in the level of jamun pomance in ice cream.

Protein

The mean protein percentage of ice cream prepared using grape pulp for different treatments was ranged from 3.73 to 3.45. The protein content of grape pulp ice cream in all treatments grape pulp enriched was significantly lower than Cs (3.73 percent). The observations revealed that as the pulp level in the ice cream increased, the protein content of ice cream decreased. The observations revealed that as the pulp level in the 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) also reported similar findings in ice cream incorporated with 0, 10, 15, 20 and 25% strawberry pulp and Murtaza et al. (2004) observed significant effect on protein content in ice cream manufactured with guar gum and xanthan gum and distilled monoglyceride.

Carbohydrate

The mean carbohydrate percentage of ice cream were ranged from 12.46 to 11.51 in treatments Cs to G_6 respectively, which was significantly higher in Cs than in other treatments. It was observed that the decrease in the carbohydrate content of ice cream with increase levels of grape pulp. The results corroborates the earlier observations made by Bajwa et al. (2003) and Murtaza et al. (2004), who also observed a decreasing trend of carbohydrate content with increasing addition of strawberry pulp and fig pulp respectively into the ice cream.

Ash

The mean ash percentage of grape pulp ice cream in all treatments with Cs was higher than G_4, G_5 and G_6. 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 results in accordance with Goraya and Bajwa, (2015) and Shelke et al. (2020) who observed a decreasing trend of total ash content with increasing addition of jamun pomace into the ice cream

Total solids

The mean total solids percentage of ice cream was range from 26.69 and 25.03. The total solids percentage of ice cream in all treatments with Cs was higher than 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 Shelke et al. (2020) who reported that the decrease in total solids content of ice cream with an increase in level of jamun pomace, orange and pineapple juice, respectively.

Acidity

The acidity of Cs ice cream was found to be lower and pH to be higher than ice cream prepared with grape pulp. The pH decreased from 6.58 to 6.20 with addition of grape pulp from 8 to 12 percent, while acidity of ice cream increased from 0.21 to 0.36 percent. Grape pulp addition at increased levels caused a significant increment in acidity and decrease in the pH of ice cream samples, this was due to higher acidity of grape pulp than Cs sample and pulp had good content of acidic phenolic substances which increased the acidity. The results are in accordance with Pinto et al. (2004) who observed that acidity increased with addition of ginger juice. The results are in correlation with Poul et al. (2009) reported that decrease in pH values in custard apple pulp ice cream and custard apple milk shake.

Antioxidant activity

The antioxidant activity ranged from 29.36 percent (Cs) to 54.07 percent (G_6). The antioxidant activity increased significantly ($P \leq 0.05$) and was greater at 12 percent level than 8 percent level. However, it is observed increasing level of grape pulp an increasing in antioxidant activity. Low- calorie ice cream samples prepared with different levels of grape pulp were found to have higher amount of antioxidant activity than control low-calorie ice cream (Cs). This remarkable increase in antioxidant activity was

Table 2 Physical properties of different levels of grape pulp for low-calorie ice cream prepared with sucralose and sorbitol

Treatments	Viscosity (before ageing at 37°C)	Viscosity (after ageing at 4°C)	Over run (%)	Penetration value (mm/5s)
Cs	132.80a± 2.93	280.40a± 11.69	79.34d± 0.25	70.46d± 1.09
G4	127.20ab± 2.76	234.38b± 11.91	82.44c± 0.50	76.62c± 0.99
G5	123.40bc± 3.05	223.56b± 3.77	86.14b±0.17	81.60b± 1.33
G6	116.80c± 2.63	211.04b± 4.00	88.10a±0.25	87.14a± 1.13
CD (P≤0.05)	8.55	36.33	0.96	3.43

Values mentioned above is mean ± SE, (n=5), abcd: means in the same column with different superscripts differ significantly (P≤0.05)

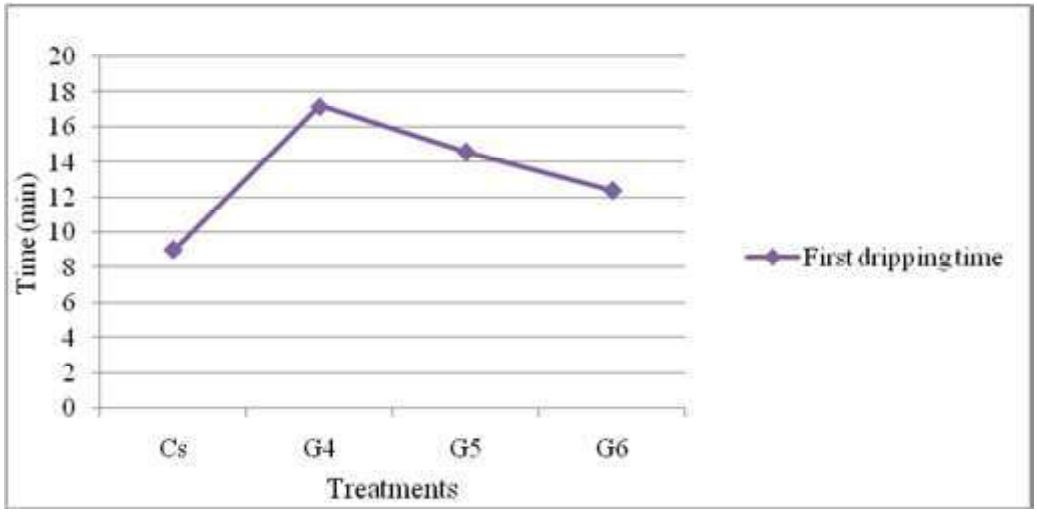

Fig 2. Effect of different levels grape pulp on first dripping for low-calorie ice cream prepared with sucralose and sorbitol

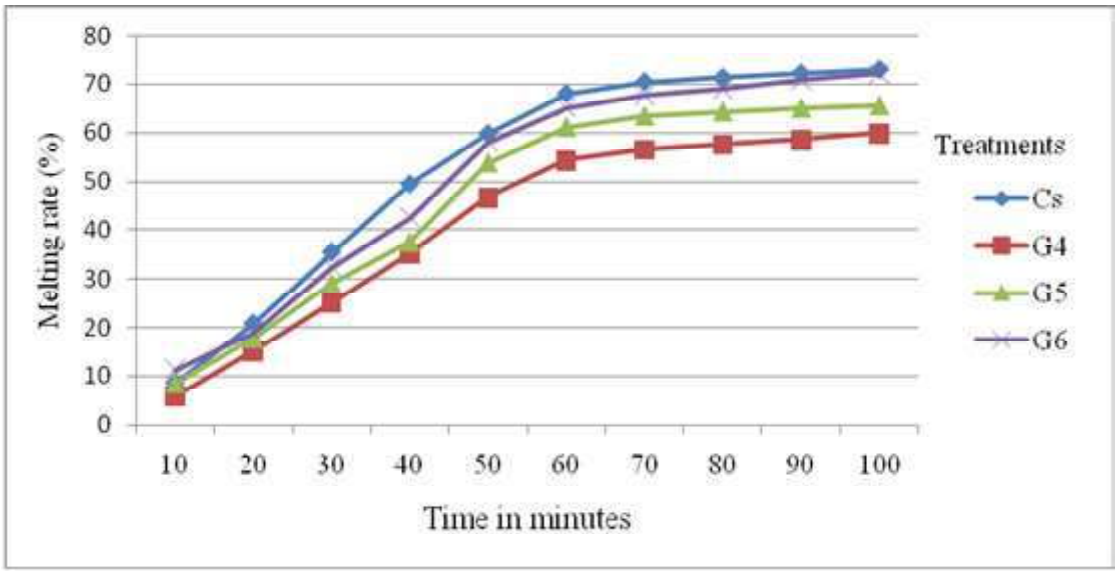

Fig 3. Effect of different levels of grape pulp addition in low-calorie ice cream prepared with sucralose and sorbitol on the first dripping time and melting rate

due to more phenols and tannins infusing from the grape pulp into the ice cream matrix. 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 for low-calorie ice cream prepared with sucralose and sorbitol

On perusal of the data presented in Table 2 pertaining to the physical properties reveal that the mean values of viscosity, overrun and penetration value for low-calorie ice cream (Cs) and ice cream prepared with different levels of grape pulp are discussed below.

Viscosity

The mean viscosity (Cp) of mix before ageing at 37°C the values are 132.80, 127.20, 123.40, 116.80 and after ageing the mix at 4°C the values are 280.40, 234.38, 223.56, 211.04 in treatments Cs to G_6 respectively. All the treatments are significantly different ($P \leq 0.05$) from each other. The above observations indicated that, increasing level grape pulp addition decreased the viscosity of ice-cream mix, this might be due to high moisture content of grape pulp contributing a low level of viscosity in low-calorie ice cream. These results are in agreement with Sasikala et al. (2020) in viscosity of various ice cream mixtures.

Overrun

It is evident from Table 2 the overrun of Cs was 79.34 percent. The overrun of G_6 was higher than Cs and that of G_4 and G_5 lower than G_6. Addition of grape pulp significantly affects the overrun of the ice cream. The reason might be due to a decrease in viscosity

with increasing level of grape pulp as contributing to the increment of overrun. Sasikala et al. (2020) reported that overrun of artificially sweetened frozen dessert increased when maltodextrin and sorbitol were used in combination.

Penetration value

The mean penetration value (mm/5s) indicated that there was increment in penetrometer reading revealing a decreasing hardness of sample with increasing levels of grape pulp (8 to 12% i.e. G_4 to G_6) respectively, which was significantly different (Pd"0.05) among the treatments. The penetration values were in the range 70.46 in Cm to 87.14 in G_6. However, the low-calorie containing 10% grape pulp was found to give a softer frozen dessert compared to Cm as well as G_1 and G_2, 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. Pawar et al. (2012) noted that use of ingredients added in ice cream affects the penetration value of ice cream.

Effect of different levels of grape pulp on the first dripping time and melting rate for low- calorie ice cream prepared with sucralose and sorbitol

The values given in the Table 3 (Fig 2 and 3) indicates that there was significantly lower in G_6 than in other treatments for first dripping time, in case of melting rate showed that there was significantly lower in G_4 than in other treatments. It was observed from the table that the first dripping time decreased and melting rate increased with increasing level of grape pulp because it contains high moisture content which caused decrease in viscosity and thus enhanced the melting resistance.

Sensory characteristics for selection of grape pulp level for low-calorie ice cream prepared with sucralose and sorbitol

Flavour

From the results presented in Table 4 (Fig.4) revealed that the mean flavour score for Cs had significantly lower score (7.280)

Table 3 Effect of different levels of grape pulp on the first dripping time and melting rate for low-calorie ice cream made with sucralose and sorbitol

Treatments	Melting rate % (Time in minutes)										
	FDT	10	20	30	40	50	60	70	80	90	100
Cs	9.00^{c}± 0.447	8.58^{b}± 0.33	20.79 ^{a}±0.38	35.42^{a} ± 0.56	49.48^{a} ± 0.29	59.90^{a} ± 0.81	68.13^{a} ± 0.55	70.55^{a} ± 0.52	71.43^{a} ± 0.46	72.32^{a} ± 0.33	73.11^{a} ± 0.20
G_4	17.20^{a}±0.9 69	5.79^{c}± 0.56	15.00^{c} ± 0.88	25.04^{d} ± 1.46	35.10^{d} ± 2.03	46.59^{c} ± 1.61	54.30^{d} ± 1.09	56.61^{d} ± 0.69	57.5^{c}± 0.80	58.58^{c} ± 1.17	59.92^{c} ± 1.34
G_5	14.60^{b}± 0.678	8.48^{b}± 0.37	17.72^{b} ± 0.44	29.08^{c} ± 0.55	37.47^{c} ± 0.61	53.76^{b} ± 0.65	61.10^{c} ± 0.47	63.38^{c} ± 0.73	64.29^{b} ± 0.85	64.97^{b} ± 0.97	65.52^{b} ± 1.15
G_6	12.40^{b}± 0.812	11.24^{a} ± 0.54	18.83^{b} ± 0.56	32.39^{b} ± 0.68	42.50^{b} ± 0.85	58.05^{a} ± 0.47	65.10^{b} ± 0.98	67.66^{b} ± 1.37	68.93^{a} ± 1.70	70.74^{a} ± 1.62	72.19^{a} ± 1.79
CD (P=0.05)	2.254	1.31	1.80	2.70	3.46	2.97	2.45	2.67	3.41	3.38	3.78

Values mentioned above are mean ± SE; (n=5);
abcd: Means in the same column with different superscripts differ significantly (P≤0.05)

Table 4 Average sensory scores for selection of grape pulp level of low-calorie ice cream prepared with sucralose and sorbitol

Treatments	Flavour	Body and texture	Colour and appearance	Sweetness	Mouth feel	Overall acceptability	Remarks
Cs	7.28^{c} ± 0.02	8.01^{b} ± 0.05	7.90^{d} ± 0.05	8.38^{b} ± 0.01	8.03^{c} ± 0.03	7.92^{b} ± 0.17	Acceptable sweetness
G_4	8.36^{a} ± 0.01	7.88^{b} ± 0.05	8.12^{c} ± 0.05	7.87^{c} ± 0.04	8.23^{b} ± 0.01	8.09^{b} ± 0.09	Low level of sour taste
G_5	8.54^{a} ± 0.02	8.45^{a} ± 0.02	8.66^{a} ± 0.03	8.53^{a} ± 0.02	8.64^{a} ± 0.01	8.56^{a} ± 0.03	Acceptable level of sour taste
G_6	7.62^{b} ± 0.13	7.71^{c} ± 0.05	8.50^{b} ± 0.01	7.15^{d} ± 0.05	7.54^{d} ± 0.01	7.70^{b} ± 0.21	High level of sour taste
CD (P=0.05)	0.21	0.15	0.12	0.11	0.06	0.45	-

Values mentioned above are mean ± SE; (n=5);
abcd: Means in the same column with different superscripts differ significantly (P≤0.05)

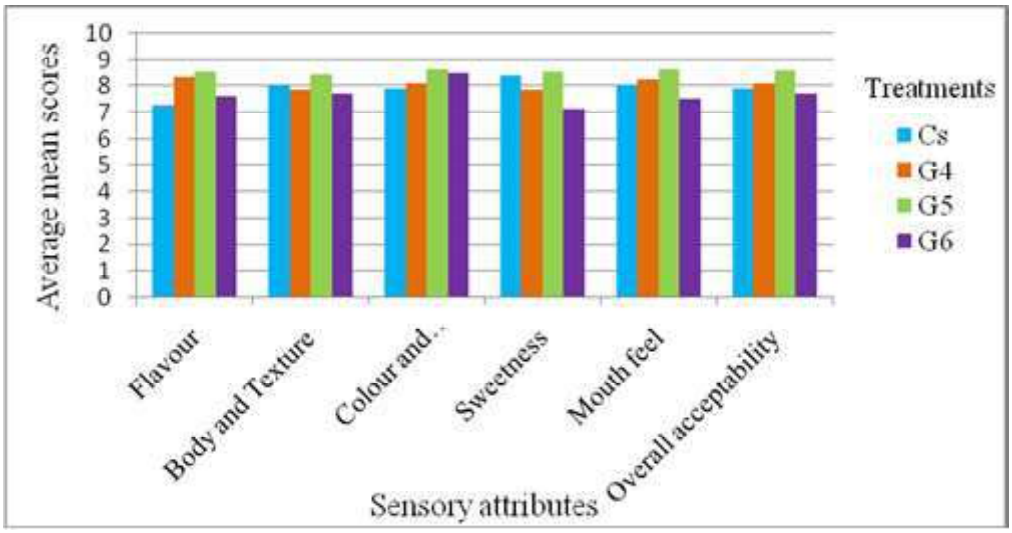

Fig 4. Sensory scores for selection of grape pulp level for low-calorie ice cream

than low-calorie ice cream made with grape pulp. Among the treated sample G_5 had significantly higher score (8.548) than G_4 and G_6 (8.362 and 7.628). A significant decrease in flavour scores observed as grape pulp level increases in ice-cream. Control had significant ($P<0.05$) lower flavor scores than grape pulp added ice cream samples. Addition of grape pulp increase flavour score up to 10 per cent level and thereon a significant ($P<0.05$) reduction of flavor scores of 12 % grape pulp added ice cream was recorded.

Body and texture

The mean body and texture scores of ice cream were 8.012, 7.884, 8.456 and 7.712 in treatments Cs to G_6 respectively, which was significantly higher (Pd"0.05) in G_5 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 with 12 percent grape pulp. Similar findings were noticed by Morley and Ashton (1982) suggested that 10.8% sorbitol is optimum to produce softness in soft scoop ice cream. On the other hand, Finney and Dea (1978) obtained the soft scoop ice cream with 3% sorbitol.

Colour and appearance

Colour and appearance score observed for sample Cs was significantly lower score (7.960) than low-calorie ice cream added with grape pulp. Among the treated sample G_5 had significantly higher score (8.662) than G_4 (8.120) and G_6 (8.500) respectively. It is observed that the colour has been changed from white to light purple colour as the level of grape pulp was increased and colour and appearance score decreased. From the results, it was concluded that increased level of grape pulp beyond 12 per cent decreased colour and appearance score of product.

Sweetness

The mean sweetness scores of ice cream were 8.384, 7.874, 8.530 and 7.156 respectively, which was significantly higher (Pd"0.05) in G_5 than in other treatments. A significant decrease in sweetness scores observed as grape pulp level increases in ice-cream.

Mouth feel

The mean mouth feel scores were 8.034, 8.236, 8.644 and 7.542 respectively, which was significantly (Pd"0.05) higher in G_5 than in other treatments. Ice cream containing 12% grape pulp obtained lower acceptance. This was because of sourness of samples at higher levels.

Overall acceptability

The overall acceptability scores were significantly (Pd"0.05) higher for ice cream prepared with 10 percent grape pulp than all others and similar findings were noticed by Goraya and Bajwa, (2015) that 10 percent amla candy was optimal for incorporation in ice cream. The overall acceptability scores for 10 percent grape pulp are significantly higher than the other levels of grape pulp.

Based on the sensory attributes of the above study confirming that addition 10% grape pulp enriched ice cream was better acceptable since it had optimum flavour and mouth feel as compared to other treatments. Therefore, 10% grape pulp enriched low-calorie ice cream was selected for storage studies.

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 (Cs) added at three different levels of grape pulp (8, 10 and 12 percent) compared with the control low-calorie ice cream. The composition, physico-chemical and sensory

attributes of the product have been studied. The overall acceptability scores were highest score (8.568) for 10 percent grape pulp with 300 ppm sucralose and 3 percent sorbitol added low-calorie ice cream (G_5). So, low-calorie ice cream can be prepared by addition of grape pulp with improved colour, flavour and enriched with antioxidants.

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