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PHYSICO-CHEMICAL, MICROBIAL AND SENSORY ANALYSIS OF ALOE VERA (PULP) ICE CREAM WITH NATURAL IDENTICAL VANILLA FLAVOUR IN DIFFERENT ARTIFICIAL SWEETENERS

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ABSTRACT

In India type -2 diabetic is increasing every year and make the people to go for alternative sugar. Ice cream is fat rich product enjoyed by all age groups. The demand for ice cream production is increasing 12 to 15 per cent every year in India and vanilla is the second largest flavour wished in the world. Natural vanilla flavour being most expensive hence using natural identical flavour much advantage to meet the demand. Natural identical flavours are substances that are chemically identical to natural substances, but which are obtained by chemical processes or by chemical modification of other natural substances like plants. The present investigation was undertaken to prepare herbal (*Aloe Vera*) ice cream with artificial sweeteners and natural identical vanilla flavour to assess its acceptable level of the resultant product. *Aloe vera* pulp, artificial sweeteners and natural identical vanilla flavour are added different level in ice cream and prepared ice cream was subjected to sensory analysis to found out the optimum level of inclusion in the ice cream preparation. Then sample were stored at -29°C and studied for their sensory scores.

Key Words: Ice cream – Aloe vera – Artificial sweeteners – Aspartame – Levulose – Sucralose – Flavour – Natural identical flavour – Vanilla – Sensory analysis.

INTRODUCTION

Ice cream is one of the oldest fat rich delicious dairy products relished by all age groups of people throughout the world. In India annual growth rate of ice cream pro 12 – 15% with market value of 2500 cores per year. India, as elsewhere in the world, incidence of diabetes and coronary diseases are on the rise, and hence people have become conscious about their diet. Hence, producing an ice cream with reduced sugar and medicinal herbs is deemed to fill a gap in the market and fulfill consumer demand. Hence this study on herbal ice cream with artificial sweeteners was carried out.

Aloe vera is one of the oldest known medicinal plants gifted by nature; *Aloe vera*, often called miracle plant is known by many names. There are over 200 types of *Aloe vera* and of these only 4 or 5 are commonly used in medicines. The most widely used variety of *Aloe vera* is *Barbadensismillar*. It is perennial, succulent plant with stiff fleshy leaves. *Aloe vera* is a clear thin gelatinous material that comes from inside the *Aloe vera* leaves. *Aloe Vera* juice also improves blood circulation due to its ability to detoxify. It is also a natural healer, and hence any internal ulcers or lesions will be soothed and healing will be enhanced. *Aloe vera* leaves have vital ingredients such as vitamins, minerals, amino acids, polysaccharides, enzymes, plant steroids, saponins, lignin, anthraquinones, salicylic acid, which are necessary for the human body. *Aloe vera* works as anti-septic, antibacterial, antiviral, anti-carcinogenic and anti-inflammatory. It has been reported to cure eczema, diabetes, arthritis and is said to prevent infection. It also improves human immune system and digestive system.

Independent WHO observers have estimated the total number of diabetics in the world as 177 million. India tops the list of 10 countries, followed by China. In south India, Prof. Lefebvre said, the incidence of diabetes and impaired glucose tolerance had been increasing since 1984. The risk factors for the increase in prevalence of diabetes among Asian Indians included high racial susceptibility, general obesity and insulin resistance even with a low Body Mass Index. "There are a number of people dying of diabetes, as

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insulin is either not available or unaffordable." Following a healthy lifestyle, exercising and following precautions are extremely important to prevent the onset of the disease.

One of the most important factors that influence the consumers' perception of foods is flavor. Flavor is defined as the experience of the combined perception of compounds responsible for taste, aroma, and mouth-feel (Preininger 2006). Although vanilla is the second most expensive spice, next to saffron, it is still the most widely used (Ranadive 2005). Vanilla has a very versatile flavor that is acceptable at almost any concentration (Korthou and Verpoorte 2007). In the United States alone 1350 metric tons of cured vanilla beans are imported yearly and over 2100 metric tons are imported globally per year (Ranadive 2005). The inclusion of natural flavour increases the cost of production hence natural identical flavours have been recommended. Natural identical flavours are substances those are chemically identical to natural substances, but which are obtained by chemical processes or by chemical modification of other natural substances. An example is vanillin, which is identical to the vanillin in vanilla, but not obtained from vanilla pods (Robert L.Smith *et.al.* 2005).

MATERIALS AND METHODS

The present study was conducted at the modern dairy plant, Institute of Food and Dairy Technology, Koduvalli, Alamathi (post), Chennai. The raw materials used for the preparation of ice cream are as follows: Buffalo milk (5.0 per cent fat and 9.5 per cent MSNF) purchased from the nearby village; Butter (80 per cent fat) purchased from the Tamil Nadu Co-operative Milk Producers Federation Ltd., Aavin and was used to standardize the fat content of the ice cream. Skimmed milk powder (95 per cent MSNF) obtained from Tamil Nadu Co-operative Milk Producers Federation Ltd. Aavin was used to standardize the milk solids not fat (MSNF) content of ice cream. High quality stabilizers (gelatin) and emulsifiers (Glycein-mono-strate) were used for this research. Vanilla natural identical flavor was purchased from the Chemical Engineering Corporation Pvt. Ltd., Ponpadi, R.S and PO – 631 213, Tamil Nadu was used flavouring ice cream. High quality cane sugar (sucrose) was used.

Ice cream mix was prepared with 10 percent fat, 36 percent total solids, 0.5 percent stabilizer and emulsifier in the ice cream, as per ISI (IS: 2802, 1964) specification (Sukumar De, 2008). The Artificial sweeteners like Levulose, Sucralose and Aspartame (along with dry mix) were added at the rate of 50 percent. In each treatment, mix ingredients were homogenized as described by Arbuckle, (1986) and then heated to 80°C for 30 sec as suggested by Rothwell, (1976). Mixes were cooled to 5°C and aged overnight at the same temperature. The natural identical vanilla flavour (0.05 percent) and *Aloe vera* pulp were added at the rate of 15 percent, 20 percent and 25 percent respectively before freezing. The different treatments carried out are shown in the following table. The freezing was done in a batch freezer. The ice cream was filled in 50 ml paper cups, covered with lid and stored at -29°C.

The sensory characteristics of the ice cream samples were assessed using the ADSA IC score card. The sensory panel belongs to staffs and students of Institute of Food and Dairy Technology, Koduvalli, Chennai.

Items	Perfect score	Score obtained
Flavor	45	
Body and Texture	30	
Color	5	
Melting quality	5	
Bacterial count	15	
Total score	100	

ADSA IC Score card

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The titrable acidity and pH of the ice cream were determined as per the procedure described in IS: 2802-1964. The standard plate count and coliform counts of the ice cream samples were determined as per the procedure described in IS: 2802-1964. The data collected were analyzed by analysis of variance (one way ANOVA) as described by Snedecor and Cochran (1989). And Duncan's multiple range tests were used as post hoc technique to study the significant difference among the means.

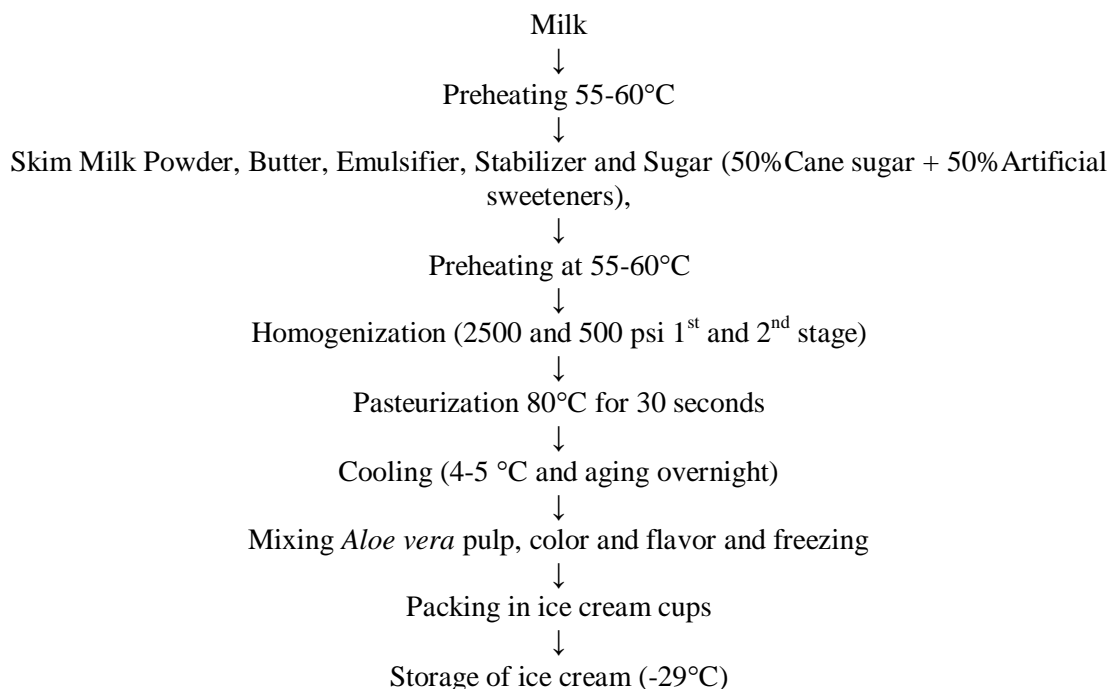


Figure 1: Process flow chart for the preparation of ice cream samples

RESULTS AND DISCUSSION

The average sensory scores presented in table 1 reveals that the incorporation of *Aloe vera* pulp in the ice cream significantly diminished the overall sensory scores compared to the control ice cream. The average scores for flavour, colour, body and texture and melting quality were significantly lower than the control samples. The aim of the study was to include maximum amount of *Aloe vera* pulp in the ice cream since it contains very low amount of total solids with all micronutrients essential for mankind, but is bitter in taste. Hence inclusion of *Aloe vera* pulp in ice cream reduces the sensory characters viz., colour, flavour, which can be overcome by using proper flavour and colour. The sensory evaluation scores revealed that acceptability was highest for the ice cream mix incorporated with 20 percent *Aloe vera* pulp. Hence, its next lower and higher level of incorporation viz., 15 percent and 25 percent along with 20 percent *Aloe vera* pulp were taken up for further studies.

Table 2 shows the sensory score for different characters and the overall scores for natural identical vanilla flavour. Vanilla is the most preferred flavor in ice cream preparations throughout the world. In the present study, natural identical vanilla flavor was added in the ice cream samples at three different levels viz., 0.03, 0.05 and 0.07 per cent. The overall average scores for the control, 0.03, 0.05 and 0.07 inclusion of vanilla were 96.52, 89.86, 97.26 and 92.16, respectively. Addition of flavour at lower concentration (0.03 per cent) the quantity was not sufficient enough to produce the required flavor while at higher concentration (0.07 per cent) it produced harsh flavour. From the table it may be noticed that the inclusion level of 0.05 per cent had the maximum overall score and was statistically similar to that of control samples for all the sensory characters.

Table 1: Sensory evaluation scores (Mean± SE)*for the ice cream prepared with different levels of *Aloe vera* pulp

Parameters	Control	<i>Aloe vera</i> pulp								
		5%	10%	15%	20%	25%	30%	35%	40%	45%
Flavour	41.32±0.314	42.12±0.431	41.85±0.409	41.26±0.428	39.50±0.212	38.02±0.302	38.61±0.144	38.76±0.150	38.56±0.176	38.21±0.209 ^a
Color	4.92±0.027	4.80±0.056	4.79±0.056	4.80±0.054	4.81±0.058	4.91±0.042	4.91±0.043	4.78±0.059	4.80±0.049	4.72±0.056
Body & texture	28.41±0.154	27.35±0.216	27.52±0.184	27.64±0.176	28.80±0.117	27.71±0.175	27.71±0.180	26.97±0.188	26.50±0.203	26.73±0.227
Melting quality	4.82±0.043	4.38±0.062	4.40±0.059	4.42±0.059	4.82±0.043	4.40±0.063	4.40±0.062	4.39±0.045	4.39±0.042	4.27±0.054
Microbial	15.00±0.000 ^a	15.00±0.000 ^a	15.00±0.000 ^a	15.00±0.000 ^a	15.00±0.000 ^a	15.00±0.000 ^a	15.00±0.000 ^a	15.00±0.000 ^a	15.00±0.000 ^a	15.00±0.000 ^a
Over all score	94.47±0.387	93.65±0.484	93.56±0.452	93.13±0.454	92.93±0.225	90.05±0.378	90.63±0.270	89.89±0.252	89.24±0.286	88.94±0.338

Means bearing different superscript in a row differ significantly ($P < 0.01$)

* Average of 8 trails

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Table 2: Sensory analysis score (Mean± SE)*for ice cream with natural identical flavour vanilla

Parameters	Control	Vanilla (natural identical flavour)		
		0.03%	0.05%	0.07%
Flavour	43.04±0.266 ^b	38.97±0.115 ^a	43.51±0.212 ^b	39.28±0.073 ^a
Color	4.89±0.035 ^a	4.92±0.032 ^a	4.86±0.070 ^a	4.85±0.029 ^a
Body& Texture	28.68±0.205 ^b	26.73±0.227 ^a	29.01±0.228 ^b	28.51±0.235 ^b
Melting quality	4.87±0.033 ^a	4.27±0.034 ^b	4.81±0.043 ^a	4.78±0.056 ^a
Microbial	15.00±0.00 ^a	15.00±0.00 ^a	15.00±0.00 ^a	15.00±0.00 ^a
Overall score	96.52±0.306 ^c	89.86±0.312 ^a	97.26±0.313 ^c	92.16±0.257 ^b

Means bearing different superscript in a row differ significantly ($P < 0.01$)

* Average of 8 trails

Table 3: Sensory analysis score(Mean± SE)*for ice cream with sucralose as artificial sweetener

Parameters	Control	Sucralose		
		50%	75%	100%
Flavour	43.24±0.206 ^c	43.07±0.189 ^c	38.52±0.242 ^b	37.77±0.193 ^a
Color	4.80±0.021 ^b	4.92±0.027 ^b	4.87±0.032 ^b	4.47±0.068 ^a
Body& texture	29.29±0.137 ^b	29.31±0.101 ^b	27.31±0.207 ^a	26.87±0.194 ^a
Melting quality	4.96±0.021 ^c	4.91±0.029 ^c	4.61±0.063 ^b	4.38±0.064 ^a
Microbial	15.00±0.00 ^a	15.00±0.00 ^a	15.00±0.00 ^a	15.00±0.00 ^a
Overall score	97.44±0.256 ^c	97.21±0.225 ^c	90.37±0.328 ^b	88.48±0.272 ^a

Means bearing different superscript in a row differ significantly ($P < 0.01$)

* Average of 8 trails

Table 4: Sensory analysis score(Mean± SE)*for ice cream with levulose as artificial sweetener

Parameters	Control	Levulose		
		50%	75%	100%
Flavour	42.96±0.250 ^c	42.65±0.258 ^c	38.97±0.101 ^b	37.63±0.212 ^a
Color	4.91±0.029 ^b	4.88±0.032 ^b	4.44±0.068 ^a	4.37±0.066 ^a
Body& texture	29.44±0.154 ^b	29.35±0.132 ^b	26.53±0.104 ^a	26.56±0.127 ^a
Melting quality	4.94±0.024 ^c	4.87±0.037 ^c	4.12±0.032 ^b	4.02±0.039 ^a
Microbial	15.00±0.00 ^a	15.00±0.00 ^a	15.00±0.00 ^a	15.00±0.00 ^a
Overall score	97.26±0.275 ^c	96.75±0.299 ^c	89.07±0.144 ^b	87.57±0.283 ^a

Means bearing different superscript in a row differ significantly ($P < 0.01$)

* Average of 8 trails

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Table 5: Sensory analysis score(Mean± SE)*for ice cream with aspartame as artificial sweetener

Parameters	Control	Aspartame		
		50%	75%	100%
Flavour	43.61±0.223 ^c	43.37±0.261 ^c	39.79±0.615 ^b	38.14±0.242 ^a
Color	4.78±0.067 ^c	4.66±0.071 ^{bc}	4.51±0.065 ^b	4.21±0.065 ^a
Body& texture	28.98±0.184 ^b	28.89±0.136 ^b	28.92±0.119 ^b	25.28±0.123 ^a
Melting quality	4.79±0.063 ^c	4.64±0.070 ^c	4.27±0.070 ^b	3.59±0.069 ^a
Microbial	15.00±0.00 ^a	15.00±0.00 ^a	15.00±0.00 ^a	15.00±0.00 ^a
Overall score	97.16±0.300 ^c	96.56±0.316 ^c	92.49±0.638 ^b	86.22±0.298 ^a

Means bearing different superscript in a row differ significantly ($P < 0.01$)

* Average of 8 trails

Table 6 Physico-chemical, microbial and sensory analysis of Aloe vera (pulp) ice cream (Mean ± SE)*at various concentrations with natural vanilla flavour in different artificial sweeteners

Parameters	Control	Aspartame			Levulose			Sucralose		
		15% Aloe	20% Aloe	25% Aloe	15% Aloe	20% Aloe	25% Aloe	15% Aloe	20% Aloe	25% Aloe
pH	6.53±0.040 ^c	6.54±0.030 ^c	6.52±0.023 ^c	6.03±0.077 ^a	6.55±0.034 ^c	6.51±0.029 ^c	6.37±0.054 ^b	6.61±0.014 ^c	6.55±0.032 ^c	6.29±0.081 ^b
Titration acidity	0.24±0.004	0.22±0.003 ^a	0.25±0.019 ^{ab}	0.30±0.022 ^c	0.21±0.005 ^a	0.22±0.005 ^a	0.28±0.012 ^{bc}	0.23±0.005 ^a	0.24±0.004 ^a	0.30±0.004 ^c
SPC (log₁₀ cfu/ml)	4.47±0.563 ^b	5.41±0.462 ^{bc}	4.65±0.270 ^b	4.35±0.320 ^b	5.47±0.394 ^{bc}	4.82±0.287 ^{bc}	4.53±0.311 ^b	6.06±0.406 ^c	3.94±0.552 ^a	3.47±0.07 ^a
Overall organoleptic quality	93.54±0.467 ^{de}	90.45±0.428 ^a	94.80±0.416 ^c	91.85±0.413 ^{bc}	90.12±0.476 ^a	93.78±0.571 ^{de}	92.50±0.420 ^{cd}	90.68±0.362 ^{ab}	94.21±0.442 ^c	91.24±0.384 ^{abc}

Means bearing different superscript in a row differ significantly ($P < 0.01$)

* Average of 8 trails

The inclusion of vanilla above 0.05 per cent level significantly altered the flavour even though it did not alter the colour and body and texture of the ice cream and hence the level of 0.05 per cent inclusion of vanilla was considered as optimum. This result was comparable with Ernst and Krish (1996). In this study, sucralose was substituted for cane sugar in the ice cream samples at three different levels viz., 100, 75 and 50 percent and the average sensory scores for different characters and the overall average scores are presented in table 3. It may be noticed that the inclusion level of 50 percent had the maximum overall score and was statistically similar to that of control samples for all the sensory characters. It was also found that sucralose when substituted for cane sugar at 75 and 100 percent level adversely affected the body and texture and melting quality apart from flavour which might be due to the reduction in the bulk volume of the ice cream. Sucralose has no calorific value, is not metabolized by the body, can be used in cooking and baking, and an average daily intake (ADI) of 15 mg per kg of bodyweight is permissible in human beings. (Marie Spano, 2002). Hence the optimum level of substitution (50 percent) as found in the present study is well within the ADI.

Table 4 shows the average sensory analysis scores of ice creams incorporated with levulose in place of cane sugar at different levels in the ice cream. The overall average sensory scores for 100, 75 and 50 percent inclusion levels were 87.57, 89.07 and 96.75, respectively; while the corresponding value for

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control samples were 97.26. All the sensory characters were significantly altered by the level of inclusion of levulose in the ice cream samples.

The inclusion of levulose at the level of 50 percent was statistically different from the remaining two levels of inclusion and was not significantly different from the control samples. The results of the study showed that levulose can be added with the ice cream mix at the rate of 50 percent. Aspartame was substituted for cane sugar in ice cream in three levels viz., 100, 75 and 50 percent. The overall average values scored by three levels of inclusion namely 100, 75 and 50 percent were 86.22, 92.49 and 96.56, respectively. The control samples had the maximum overall average score of 97.16 and all the sensory characters were not statistically different from the samples prepared with 50 percent aspartame as artificial sweetener (Table 5).

However the other two levels of inclusion viz., 100 and 75 percent significantly altered the sensory scores of the all the characters and hence the 50 percent level of inclusion of aspartame in the ice cream was considered as optimum. Aspartame is a dipeptide (L-aspartyl-L-phenylalanyl-methyl ester) with a sweetening power of 180 to 200 times that of sucrose (Mazur RH, 1969). The Joint Expert Committee on Food Additives (JECFA) estimated the level causing no effect in the rat to be 4 g/kg body wt/day and proposed an ADI (safety factor 100) of 40 mg/kg body wt/day for humans (JECFA, 1980). Hence, it was found that aspartame can be substituted for cane sugar at 50 percent level without affecting the sensory characters of ice cream which was also well within the ADI.

Table 6 presents the results of the physico-chemical and microbial quality of ice cream samples prepared with 15, 20 and 25 percent of *Aloe vera* pulp with natural vanilla flavour and three different artificial sweeteners viz. aspartame, levulose and sucralose. The average pH value, titrable acidity and total plate count of the control sample was 6.53, 0.24 and 4.47, respectively. The ice cream was prepared in the department dairy plant under strict hygienic precautions and thus coliforms were not found in the sample. This may be also due to the presence of *Aloe vera* which has anti-microbial properties. The pH value of samples with 15, 20 and 25 percent *Aloe vera* pulp and aspartame as artificial sweetener were 6.54, 6.52 and 6.03 respectively. The corresponding values for levulose sweeteners were 6.55, 6.51 and 6.37, respectively; while for sucralose the values were 6.61, 6.55 and 6.29, respectively. The average titrable acidity of the ice cream samples prepared with 15, 20 and 25 percent *Aloe vera* pulp with aspartame, levulose and sucralose sweeteners were 0.22, 0.25, 0.30, 0.21, 0.22, 0.28, 0.23, 0.24 and 0.30, respectively. The corresponding values for total plate counts were 5.41, 4.65, 4.35, 5.47, 4.82, 4.53, 6.06, 3.94 and 3.47, respectively. The results of the present study revealed that the increased level of inclusion of *Aloe vera* in the ice cream reduced the pH value and standard plate count and simultaneously increased the titrable acidity. *Aloe vera* contains uronic acid, salicylic acid and phenolic compounds which are causally responsible for the increase in the acidity and there by decrease the pH of the ice cream. In addition to the above *Aloe vera* also contains many anti-bacterial, anti-viral and anti-fungal agents namely saponins, fatty acids etc. which might have caused the reduction of standard plate count (Klien and Penneys, 1988; Marshall, 1990; Ahmad *et al.*, 1993).

Conclusion

The results of the present study of one way analysis of variance revealed that the incorporation of *Aloe vera* pulp in the ice cream significantly diminished the sensory scores. The average scores of flavour, colour, body and texture and melting quality were significantly ($P < 0.01$) lower than the control samples. The sensory evaluation scores revealed that acceptability was highest for the ice cream mix incorporated with 20 percent *Aloe vera* pulp. Hence, its next lower and higher level of incorporation viz., 15 percent and 25 percent along with 20 percent *Aloe vera* pulp were taken up for further studies.

The addition of various levels of natural identical vanilla flavours in the ice cream significantly ($P < 0.01$) altered the sensory qualities and the optimum inclusion levels was found to be 0.05 per cent.

It was found that the increased level of inclusion of *Aloe vera* in the ice cream significantly ($P < 0.01$) reduced the pH value and standard plate count and simultaneously increased the titrable acidity. The ice cream was prepared in the department dairy plant under strict hygienic precautions and hence coliforms

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were not found in the sample. This may be also due to the presence of *Aloe vera* which was having anti-microbial properties. However, the amount of *Aloe vera* in the ice cream above 20 percent reduced the sensory scores significantly ($P < 0.01$) and hence it was concluded that the optimum level of inclusion of *Aloe vera* in the ice cream was 20 percent.

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