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THE FUNCTIONAL, RHEOLOGICAL AND SENSORY ATTRIBUTES OF *TULSI* (HOLY BASIL, *OCIMUM SANCTUM*) EXTRACT BASED HERBAL ICE-CREAM

SWASHANKH KUMAR*, D. C. RAI AND DINKER SINGH
Department of Animal Husbandry and Dairying, Institute of Agricultural Sciences,
Banaras Hindu University, Varanasi - 221 005, U.P., INDIA
e-mail: shakyabhu68@gmail.com

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***Corresponding author**

ABSTRACT

Research was conducted to examine the effect of *Tulsi* as an herb on the functional, rheological and textural characteristics of ice-cream desserts in relation to their sensory attributes. The objective of the present research was to develop improved herbal based ice-cream with health benefits beyond those of traditionally formulated dairy products. The product was formulated with different levels of herbal extract at 2.0%, 3% and 4.0%. There was a proportionate decrease in the fat, protein, reducing sugars, non-reducing sugars and total solids (TS) in the experimental samples with increasing the levels of *Tulsi* extract compared to control. Addition of *Tulsi* extract to ice-cream was shown to decrease viscosity of the ice-cream mix and decrease melting rate of the resulting herbal ice-cream based on sensory evaluation, the order of preference was T_2 (3%) > T_1 (2.0%) > T_0 (0%) > T_3 (4.0%).

INTRODUCTION

Ice-cream is a delicious, wholesome and nutritious frozen dairy food. Its history goes back to the ancient period, but its future seems endless. It represents one of the most dynamic sectors of the dairy industry. It is the product liked invariably by one and all and is popular throughout the world (Pelan *et al*., 1997). The global market of ice-creams was pegged at US$61 billion in terms of retail value or 15 billion litres in terms of volume. The ice-cream industry in India is estimated to be worth Rs. 2000cr, in which the branded market is 100 million litres annually valued at Rs. 800cr. The per capita consumption of ice-cream in India is just 300mL/annum compared to 22L in the US or the world average of 2.3L/annum (Soni, 2009). There is considerable interest in extending the range of food by incorporating herbs in dairy foods for infant dairy food formulas, baby foods, fruits juice based products and pharmaceuticals (Singh, 2010).

Tulsi (Holy Basil, Ocimum sanctum) as an herb has been known from as early as the Vedic period. Its extract has numerous pharmacological activities like hypoglycaemic, immunomodulatory, anti-stress, analgesic, antipyretic, anti-inflammatory, antiulcerogenic, antihypertensive, CNS depressant, radioprotective, antitumour and antibacterial. The active constituents of the herb include volatile oil chiefly eugenol and beta -caryophyllene, flavonoids and a number of other components present in fixed oil (Das and Vasudevan, 2006).

Health conscious consumers are looking for natural remedies which are safe and effective. It is documented that 80% of the world's population has confidence in traditional medicine, particularly plant drugs for their primary healthcare. India is sitting on a gold mine of well recorded and traditionally well practiced knowledge of herbal medicines. Due to side effects of synthetic products, herbal products are gaining popularity in the world market. In spite of well practiced knowledge of herbal medicines and occurrence of a large number of medicinal plants, the share of India in the global market is not up to the mark (Rajkumar and Singh, 2009; Singh, 2010).

The objective of the present study was to develop improved herbal based Ice-cream with health benefits beyond those of traditionally formulated products and essentially be classified as neutraceuticals.

MATERIALS AND METHODS

Materials

The cow milk and cream used in this study were obtained from dairy farm, Banaras Hindu University, Varanasi. The ingredients skim milk powder (Gopal milk food, Gajroula, UP), stabilizer (Acasia Gum), emulsifier (soya Lecithin), cane sugar and herb were obtained from local market of Varanasi for ice-cream production.

Physico-chemical analysis

The ice-cream mix was analysed for fat, reducing sugars, non-

reducing sugars, total solids and titrable acidity as per the methods given in BIS for ice-cream (BIS, 1989). Overruns were measured according to the proportion of ice cream to the volume of mix (Cottrell *et al*., 1980). The protein content of ice-cream mix was determined by Kjeldal method (Menefee and Overman, 1940).

The pH of ice-cream mix was determined at 25ºC using a digital pH meter and viscosity determined by a Brookfield viscometer using spindle number 2 at 30rpm (Loewenstein and Haddad, 1972). The melting characteristics of ice-cream were evaluated by the method given by Upadhyay *et al*. (1978).

Sensory evaluation of herbal ice-cream was performed by a panel of five trained judges using hedonic rating (9-point scale; 1 = dislike extremely, 9 = like extremely) for body and texture, colour, flavour and overall acceptability of the herbal ice-cream. Considerations the variations expected in the sensory scores, the root-x scale was employed in statistical analysis of the data. Statistical analysis of the data was carried out as per Steel and Torrie (1980).

Statistical analysis

Data were analysed using the general linear model procedure of the SAS software package (SAS 9.1, 2006). Duncan's multiple range test (Montgomery, 1991) was used to detect differences between treatment means. Statistical significance was tested at the 5% level. All experiments were replicated three times.

RESULTS AND DISCUSSION

Effect of Different Levels of Tulsi extract on the Composition, pH and Acidity of Ice-cream

The average values of acidity and pH of freshly prepared herbal ice-cream are presented in Table 1. The compositional characteristics of herbal ice-cream are presented in Fig. 2.

There was a proportionate decrease in the fat, protein, reducing sugars, non-reducing sugars and total solids (TS) in the experimental samples with increasing level of incorporation of *Tulsi* Extract compared to control ($p < 0.05$).

The dilution effect of *Tulsi* extract in ice-cream was found to exercise significant ($p < 0.05$) influence in the Fat and TS content, both being slightly but significantly lower for experimental samples compared to control.

The protein content decreased slightly in experimental samples but was not significantly ($p < 0.05$) affected by the addition of *Tulsi* extract. Further, addition of *Tulsi* extract significantly decreased the reducing sugars and non- reducing sugars content of experimental ice-creams. The compositional attributes of all the samples are well above the minimum values specified for plain ice-cream by PFA (1955). The slightly lower pH of experimental ice-cream (non significant, ($p < 0.05$) did not have any adverse effect on the protein stability of the mix. However, care should be taken while formulating the basic ice-cream mix to take into account the decreases in fat and TS content which occurs when incorporating *Tulsi* extract.

Effect of Different Levels of *Tulsi* Extract on the Physical Properties of Ice-cream Mix and Ice-cream

Viscosity is an important property of ice-cream mix and up to a certain extent, it seems essential for proper whipping and retention of air cells. Table 2 portrays the average values of viscosities of the mix as influence by the level of addition of *Tulsi* extract. The increase in viscosity of the mixes containing *Tulsi* extract was statistically significant ($p<0.05$) and all the samples could be distinguished from each other on the basis of their viscosity. A lower viscosity seems to be desirable for Fast freezing and rapid whipping. Effect of various levels of

Table 1: The average values of acidity and pH of freshly prepared ice-cream

Ice-cream constituents (%)	Rate of addition of *Tulsi* extract (% wt of mix)			
	T_0 (0%)	T_1 (2.0%)	T_2 (3.0%)	T_3 (4.0%)
Titratable acidity	0.220	0.217	0.204	0.198
pH	6.30	6.38	6.46	6.52

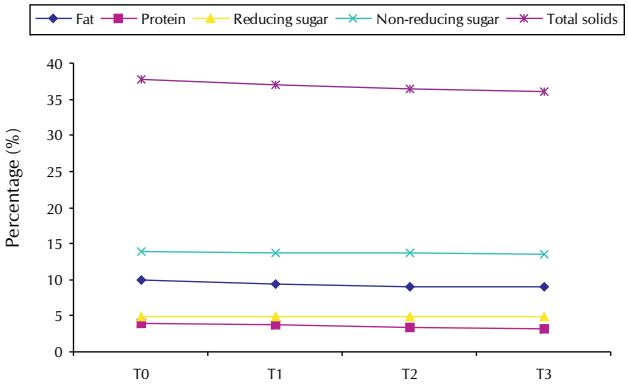

Figure 2: Composition of Ice-cream (%)

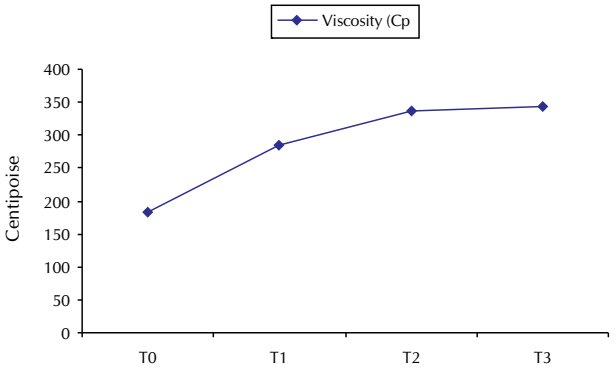

Figure 3: The average values of Viscosity (Cp)

Tulsi extract on Viscosity, Overrun and Melting Rate of Ice-cream are represented in Fig. 3, Fig. 4 and Fig. 5 respectively.

Overrun: The overrun in ice-cream affects the body, texture and palatability of the final product. It is also related to the yield and profit. This was calculated by comparing the weight of a known volume of ice-cream (M_2) to the weight of the same volume of unfrozen ice-cream mix (M_1) as follows (Marshall and Arbuckle, 1996):

$$\text{Overrun}\% = \frac{M_1 - M_2}{M_2} \times 100$$

The average overrun was maximum in Control (T_0) and least in T_3 (2.0%). The addition of *Tulsi* extract tended to decrease the overrun significantly. All the samples could be statistically differentiated from each other. The lower overrun encountered

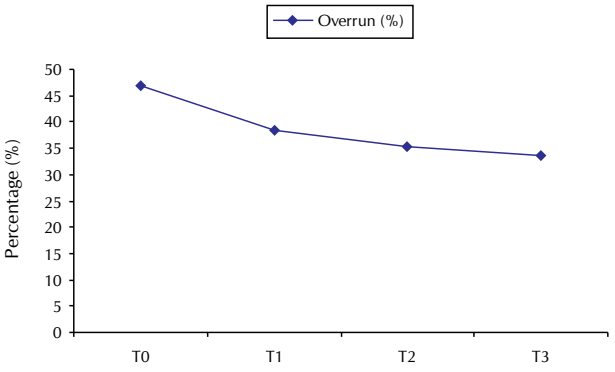

Figure 4: The average values of over run (%)

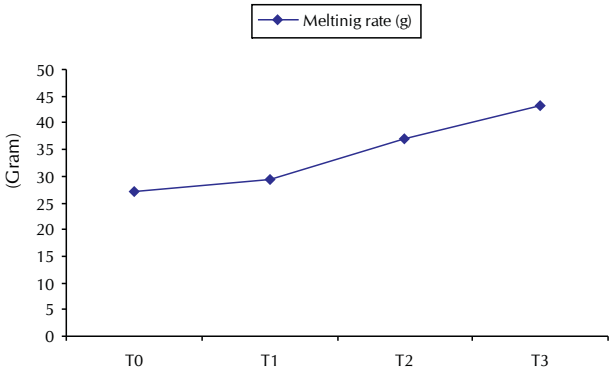

Figure 5: The average values of melting rate (g)

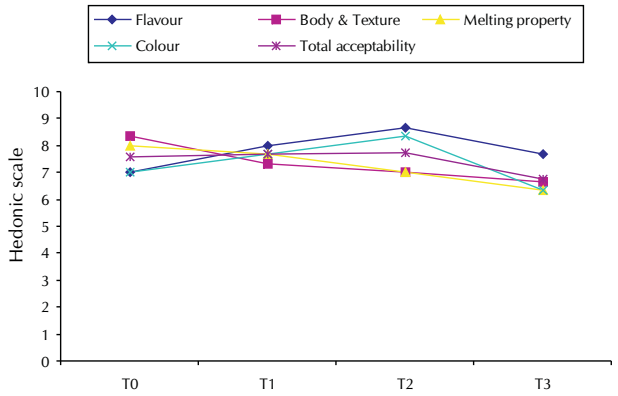

Figure 6: Effect of levels of *Tulsi* extract on sensory attributes of ice-cream.

in the experimental samples may be ascribed to the relatively higher viscosity associated with such samples. The results of the present study corroborates with that of Das *et al*. (1989) who observed similar effect in ice-cream mixes containing potato pulp.

Melting resistance

Meltdown is also an important property of ice-cream affecting its sensory quality. It is important from at least two view points (a) eye appeal and (b) mouth feel (Flack, 1988). Deviation in the melting property from ideal condition can make the ice-cream defective. Melting time was dependent on the ice-cream formulation and especially on the nature of the emulsifier. Fat aggregation appeared to be the major contributor to the melting resistance of ice-cream (Pelan *et al*., 1997; Bolliger *et al*., 2000; Goff and Spagnuolo, 2001) through the existence of networks resulting from the presence of fat, proteins or other stabilizer. The melting of the ice was also controlled by the outside temperature and the rate of heat transfer.

A 30 g sample of ice-cream was placed in a Buchner funnel on the top of a flask and was allowed to melt at room temperature (24 ± 1ºC) for 15 min. After this time, the dipped volume was weighed and melting resistance was obtained using the following equation:

$$\text{Melting resistance} = \frac{A_1 - A_2}{A_1} \times 100$$

Where, A_1 and A_2 are the weight of initial sample (30g) and melted sample respectively (Marshall and Arbuckle, 1996).

In general, as the viscosity increases, the resistance to melting and smoothness increases (Arbuckle, 1986). Slow melting generally indicates over stabilization and such condition can be corrected by reducing the amount of stabilizer and/or emulsifier. *Tulsi* contains some hydrocolloids (viz., starch), which might be responsible for the increased viscosity and hence, the melting resistance. Sample T_3 (2.0%) was criticized for exhibiting "does not melt" defect. Such sample was frequently accompanied by body defects such as soggy, gummy, doughy and sticky. This indicates that if such high melting resistance is not required, the same could be corrected by reducing the amount of stabilizer, emulsifier or milk solids – not-fat with added cost benefits.

Effect on the sensory attributes of herbal ice-cream

Sensory evaluation of herbal ice-cream was performed by a panel of nine trained judges from the department of Animal Husbandry and Dairying, I. Ag. Sc, BHU, Varanasi. A special laboratory with necessary facilities, viz., separate booths, provisions for adequate diffused light and air-conditioned odour-free environment, was employed for product evaluation. Hedonic rating (9-point scale; 1 = dislike extremely, 9 = like extremely) was used for colour, texture, flavour and overall acceptability for herbal ice-cream (Fig. 6).

Flavour scores

Use of in herbal ice-cream as against plain ice-cream, increased its flavour preference when used up to 3 % level only; 4 % level led to decrease in flavour score due to presence of excessive amounts of *Tulsi* extract and intense flavour. The addition of treated *Tulsi* extract at the rate of 3% was found to improve the flavour score significantly ($p<0.05$) over that of control. The flavour preference decreased in the order: T_2 (3.0%) > T_1 (2.0%) > T_3 (4.0%) > T_0 (0%).

Body and texture scores

The average body and texture scores indicated superiority of T_0 ice-cream over all other samples due to improved smoothness and better body. The preference was in the order: T_0 (0%) > T_1 (2.0%) > T_2 (3.0%) > T_3 (4.0%). With higher levels of addition of *Tulsi* the samples were criticized for being heavy bodied (due to lower overrun) and especially T_3 was criticized for its cohesive gummy body.

Melting characteristics scores

The judges criticized the experimental samples for exhibiting

slow meltdown, especially in T_0, which also had body defects ike soggy and gummy. The preference was in the order: T_3 (4.0%) > T_2 (3.0%)> T_1 (2.0%) > T_0 (0%).

Colour scores

In the case of colour scores, very marginal decrease was observed in experimental samples. The preference was in the order: T_2 (3.0%) > T_1 (2.0%) > T_0 (0%) > T_3 (4.0%).

Total acceptability

In the case of overall scores, the preference was given in the order: T_2 (3.0%) > T_1 (2.0%) > T_0 (0%) > T_3 (4.0%).

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