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Studies on textural profile, nutritional profile and microbial studies of ashwagandha root powder added ice cream

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Abstract
Present research was carried out to formulate phytochemical enriched functional ice cream by utilizing ashwagandha root powder. Prepared ice cream was analyzed for textural, nutritional and microbial characteristics. From the obtained results it was noted that hardness of ice cream increased from 1.63 to 4.202 kg. Highest hardness was recorded for sample T_4 (4.202 kg.). Moreover, adhesiveness was observed highest for the sample T_4 (0.156 kg. sec.) and lowest for T_0 (0.037 kg. sec.). Furthermore prepared ice creams analyzed for its nutritional profile viz., moisture, fat, protein, ash, carbohydrates. The results reported for fat content were 10.89 (T_0), 10.88 (T_1), 10.89 (T_2), 10.90 (T_3) and 10.91 (T_4) per cent respectively. Sample T_4 contained highest carbohydrates (25.51 per cent) followed by sample T_3 (25.01 per cent), sample T_2 (24.61 per cent), and sample T_1 (24.11%) respectively. The mean value for protein content were 4.03 per cent (control) 4.06 (T_1), 4.09 (T_2), 4.1 (T_3) and 4.14 (T_4). Total plate count of formulated samples with different levels of ashwagandha root powder was shown to increased compared to control sample were 1.3×10^2, 1.4×10^2, 1.7×10^2 and 1.8×10^2 for T_1, T_2, T_3 and T_4 respectively.

Keywords: ice cream, ashwagandha root powder, textural profile, nutritional profile and microbial studies

1. Introduction

Traditional use of herbal medicines implies substantial historical use and this is certainly true for many products that are available as 'traditional herbal medicines'. In many developing countries, a large proportion of the population relies on traditional practitioners and their armamentarium of medicinal plants in order to meet health care needs (Shaw, 1998) [17] Ashwagandha is one of the most revered plants in traditional Ayurvedic medicine in India. It is an erect, greyish, subshrub with inconspicuous yellow or greenish flowers followed by small, spherical, orangish-red berries containing yellow, kidney shaped seeds. It grows three to five feet tall, mainly on waste land, but is cultivated widely as the whole plant. Most commonly the root and leaf are used medicinally (Engels and Brinckmann, 2013) [2]. Ice cream, and most all of the other frozen desserts described above, generally contains seven categories of ingredients: fat, milk solids-not-fat (the principal source of protein), sweeteners, stabilizers, emulsifiers, water, and flavors. For the wide range of frozen desserts, production is similar. Ice cream is a complex food product, in which the removal of one ingredient may affect not only its physical structure but also the sensory characteristics that make it acceptable to consumers (Marshell*et al.*, 2003) [11]. The nutritive value of ice cream varies with its composition; however, all the constituents of milk are present in a concentrated (Eckles and Macy, 1951). The major constituents (ingredients) in the ice cream formula backbone are milk fat, milk solids not fat, sweetener, stabilizer and/or emulsifiers, water and air (Varnam and Sutherland, 1994) [19]. Protein interacts at the oil water interface during homogenization to stabilize the fat emulsion and during freezing, proteins function to control destabilization of fat (Goff, 1997 and Goff *et al*., 1989). Increased amount of whey protein at the oil water interface lowers surface tension and slightly increases mix viscosity that produces a drier ice cream and enhances partial coalescence in the freezer (Goff *et al.*, 1989). Goff (1997) found that properly controlling the physical properties of an ice cream mix by further processing can favorably alter the texture and physical appearance of ice cream. The manufacture of ice cream is a relatively complex operation, with a series of steps which, in both compositional and microbiological terms, contribute to the overall quality of the ice cream (Robinson, 1981) [15]. The UK Food Standard (ice cream) regulation cream must contain not less than 5% fat, and not less than 7.5% milk solids-not-fat (SNF) (Rothwell, 1983) [16].

2. Materials and Methods

2.1 Texture profile analysis of Ice cream

Stable Micro System *TAXT2 plus* Texture Analyzer was used for texture profile analysis (TPA) of Ice cream. TPA is "two-bite" test, which includes the first and second compression cycles. The first and second compression cycles indicate the force vs. time data during the first and second compression of the product by the instrument probe. A representative graph of texture analysis is shown below. The parameters recorded were hardness, fracturability, springiness, cohesiveness and gumminess. Texture analysis was carried out as per method of Akalin *et al*., (2008) [3] with some modifications. TPA was conducted at room temperature using a Texture Analyser (*TAXT*, SDS) equipped with a P/36R stainless steel cylindrical probe. Ice cream samples stored at -18 °C for 5 days were tempered to -10 °C for 24 h before analysis. The conditions for analysis were as follows: penetration distance = 15 mm, force = 5.0 g, probe speed during penetration = 3.3 mm s^{-1}, probe speed pre and post penetration = 3.0 mm s^{-1}. Hardness was measured as the peak compression force (kg) during the penetration of the sample

The test is configured so that the TPA parameters, hardness, Adhesiveness, cohesiveness and gumminess, were calculated at the time of the test by determining the load and displacement at predetermined points on the TPA curve. Hardness (F1) was the maximum load, expressed in kg, applied to the samples during the first compression. Cohesiveness (A2/A1) was the ratio of the area under the curve for the second compression (A2) to that under the curve for the first compression (A1). Adhesiveness (A3) was the area under negative peak and expressed as kg. second. Gumminess (F1x A2/A1) was the product of hardness and cohesiveness. It was expressed as kg.

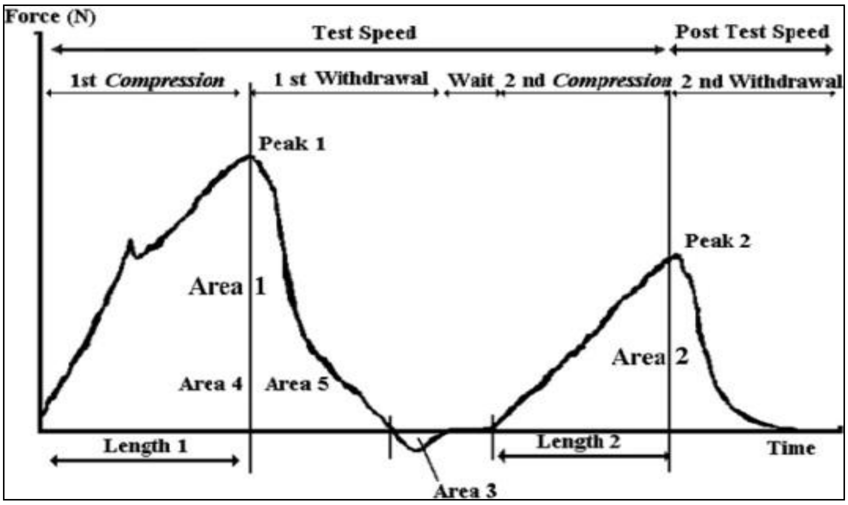

Fig 1

Representative graph of texture profile analysis (TPA)

Hardness (kg) = F1

Cohesiveness = A2/A1

Adhesiveness (kg-sec) = A3

Gumminess (kg) = Hardness X Cohesiveness

Springiness = L2 / L1

Where, F1- Positive Peak Force (Cycle 1)

F2- Peak Force (Cycle 2)

A1- Positive Area (Cycle 1)

A2- Positive Area (Cycle 2)

A3- Peak Negative Force

L1 – Length of Cycle 1

L2 – Length of Cycle 2

2.2 Microbial quality of ice cream

Microbial examination is the perfect quality assessment protocol performed in food products quality analysis. The microbial quality of prepared ice cream was determined. In the present study different microbial parameters such as Total Plate Count (TPC), Yeast and Mold, and pathogens viz. *E. Coli*and were examined, also the samples were examined as per the methods given by APHA, (1992) [2].

2.2.1 Total plate count (TPC)

The total plate counts of ice cream samples were determined by using nutrient agar media by pour plate technique. The serial dilutions were made up to 10^{-2} and the 1 ml of aliquot was used for the isolation. All process was carried out in a strictly sterile area with the help of laminar air flow. Plates were incubated at 37°C± 2°C for 48 hrs, and results noted in cfu/ml.

2.2.2 Yeast and mold

The yeast and mold count of ice cream samples were determined by using potato dextrose agar (PDA), pour plate technique was used for the isolation. The media was sterilized and poured into plates. The serial dilutions of samples were made and then the 1 ml of aliquot was used. Plates were incubated at 25°C± 2°C for 72 hrs, and results noted in cfu/ml.

2.2.3 Coliform

The coliform and basically *E.Coli*is the indicator microbes of water contamination by feces and therefore it is mandatory to examine the contamination. The *Coliforms* gives red pink colonies on VRB agar so it was used for examination. Using the pour-plate technique, appropriately 1 ml aliquots was taken in duplicate plates and tempered VRB agar was added. The agar was allowed to solidify, and then overlay of about 5 ml of VRB agar was added. Plates were inverted and incubated at 35°C ± 2° C for 24 hrs. Red colonies surrounded by a zone of precipitate.

2.3 Nutritional profile of ice cream

Prepared ice cream were analyzed for nutritional composition Viz., moisture (AOAC, 2005) [1], fat (AACC, 2000) [2], protein (AACC, 2000) [2], carbohydrate (difference method) and ash (AOAC, 2005) [1].

2.4 Statistical analysis

The obtained data in the present investigation was statistically analysed. The analysis of variance of the data obtained was done by using completely randomized design (CRD) for different treatments as per the method given by Panse and Sukhatme (1967) [12].

3. Results and Discussion

3.1 Textural profile of prepared ice- cream

Prepared ice cream with varying concentration of powder subjected for textural analysis by using texture analyser (TA- XT, Stable Micro System, UK) and these was used to determine the hardness, adhesiveness and cohesiveness. The results obtained from analysis tabulated in table 17.

Table 1: Effects of ashwagandha root powder on textural properties of ice cream.

Sample code	Hardness (kg)	Adhesiveness (Kg.sec)	Cohesiveness
T_0	1.63	0.037	0.78
T_1	1.757	0.094	0.42
T_2	2.098	0.126	0.55
T_3	2.533	0.144	0.65
T_4	4.202	0.156	0.57
SE±	0.0021	0.00046	0.0045
CD @ 5	0.0064	0.00138	0.0138

T_0= Control
T_1= Ice cream with1 per cent Ashwagandha root powder (ARP)
T_2= Ice cream with 2 per cent Ashwagandha root powder
T_3= Ice cream with 3 per cent Ashwagandha root powder
T_4= Ice cream with 4 per cent Ashwagandha root powder

Ashwagandha root powder incorporated in different concentration in ice cream affectedthe hardness. This may be due to the micro-structure change, namely phase volume, ice crystal size, and fat stability in the ice cream. A larger force is required to be applied to the surface of the ice cream that is being categorized as hard.

Adhesiveness represents more energy that is required to overcome the attractive forces between the ice cream and mouth when they come into contact. Higher cohesiveness represents an improvement in sustainability of the ice cream as it is compressed in the mouth before it breaks (Radocaja *et al*., 2011) [14].

The hardness of ice cream was observed to be increased from 1.63 to 4.202. Highest hardness was recorded for sample T_4 (4.202 kg.) which was followed by T3 (2.533), T_2 (2.098), T_1 (1.757) and T_0 (1.63). It was clearly observed that hardness was increased with successive levels of ARP. This increase in hardness of ice cream attributed to increase in viscosity of ice cream mix was due to alteration in functional properties. Besides hardness of ice cream adhesiveness also increased. Adhesiveness is recognized as the work required to overcome the attractive forces between surface of the ice cream and surface of other materials with which the ice cream contact. Adhesiveness was observed highest for the sample T_4 (0.156 kg. sec.) and lowest for T_0 (0.037 kg. sec.).Similar results were obtained by Pon*et al*., (2015).

3.2 Nutritional profile of prepared ice cream

Ice cream prepared with various levels of ARP analyzed for nutritional composition in order to know the nutritional quality of product. Results related to various nutritional parameters of ice cream were evaluated and tabulated in Table 2. All samples of ice cream were analyzed for proximate composition viz., moisture, fat, protein, carbohydrate and ash. Data from table 2 revealed that moisture content of ice cream in case of all the samples were slightly decreased as level of ARP increased.

Table 2: Nutritional composition of ice cream

Sample Code	Nutritional parameters (%)				
	Moisture	Fat	Protein	Carbohydrate	Ash
T_0	61.37	10.89	4.03	23.71	0.50
T_1	60.95	10.88	4.06	24.11	0.54
T_2	60.41	10.89	4.09	24.61	0.65
T_3	60.01	10.90	4.10	25.01	0.73
T_4	59.51	10.91	4.14	25.51	0.85
SE±	0.4253	0.00624	0.02095	0.2577	0.03217
CD@ 5	1.75687	0.02576	0.08654	1.04418	0.13288

The moisture content of control sample was found to be highest compared to other treatments. At par results was observed in moisture content of ice cream. The treatment T_0 and T_1 was statistically significant over T_4. The mean value recorded for moisture content were 60.95 (T_1), 60.41 (T_2), 60.01 (T_3) and 59.51 per cent respectively. The decrease in moisture content may be attributed due to addition of ashwagandha root powder in ice cream mix.

Fat content of ice cream was statistically at par with each other for the entire sample. It can be seen that there was least deviation in fat content of ice cream on addition of ARP ice cream. The results reported for fat content were 10.89 (T_0), 10.88 (T_1), 10.89 (T_2), 10.90 (T_3) and 10.91 (T_4) per cent respectively.

Results demonstrated for carbohydrate content of ice cream showed that there was least variation among the samples. The carbohydrate content of sample was statistically non-significant with each other. Sample T_4 contained highest carbohydrates (25.51 per cent) followed by sample T_3 (25.01 per cent), sample T_2 (24.61 per cent), and sample T_1 (24.11%) respectively. Although, lowest carbohydrate content was noted by control sample (23.71 per cent).

It was observed that there was minimal variation in protein content of ice cream. The mean value for protein content were 4.03 per cent (control) 4.06 (T_1), 4.09 (T_2), 4.1 (T_3) and 4.14 (T_4) respectively. Similarly, results found for ash content was 0.84, 0.73, 0.65, 0.54 and 0.50 per cent for T_4, T_3, T_2, T_1 and T_0 respectively.

3.3 Microbial studies of formulated ice creams

Formulated ice cream samples with different levels of ARP investigated for microbial studies viz., Total plate count, yeast and mold count and coliform count on 5 th day after its preparation. Results regarding this summarized in Table 3.

Table 3: Microbial analysis of prepared ice cream

Samples	Total Plate Count (cfu/ml) $\times 10^2$	Yeast and mold count (cfu/ml)$\times 10^2$	Coliform count MPN/ml
T_0	1.1	ND	ND
T_1	1.3	ND	ND
T_2	1.4	ND	ND
T_3	1.7	ND	ND
T_4	1.8	ND	ND

The pasteurization, freezing and hardening are the main steps to inhibit the growth of organisms and eliminate the microbial hazards of the products for food safety point of view (Anderson and Nielson, 1998). The ingredients of ice cream may contribute microorganisms and affects the quality of the product (El-Sharef*et al.* 2005) [7]. Inpresent experiment ice cream samples were assessed and checked for microbial qualities.

The results for total plate counts of formulated ice cream samples presented in table 19. The total plate count of controlled ice cream was 1.1×10^2. Total plate count of formulated samples with different levels of ashwagandha root powder was shown to increased compared to control sample were 1.3×10^2, 1.4×10^2, 1.7×10^2 and 1.8×10^2 for T_1, T_2, T_3 and T_4 respectively.

According to FSSAI microbial standards of ice cream the limit given for total plate count and coliform count is 2×10^5 and 1×10^2 per gram. From the results it was revealed that ice cream prepared with varying proportions of ARP was acceptable in case of microbial quality and was found to less contaminated. The results found in close agreements with the results reported by Trivedi (2014) [18].

Conclusion

Present research reveals the utilization of ashwagandha root powder in value added food product as carrier of functional ingredients in ice cream. Textural analysis of ice cream reveals the hardness, adhesiveness and cohesiveness. These textural properties found to increase with increase in levels of ashwagandha root powder. It was clearly observed that hardness was increased with successive levels of ARP. Overrun of the ice cream significantly affected by the various levels of ashwagandha root powder. Ice cream prepared with varying proportions of ARP was acceptable in case of microbial quality and was found to less contaminated.

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