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Studies on extraction and utilization of chia seed gel in ice cream as a stabilizer

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Abstract
Chia is known as super food as it contains highly concentrated amounts of essential fatty acids, dietary fibers, vitamins and antioxidants. From the health point of view, omega-3 fatty acids (formerly expressed as n 3) are of interest because they are important constituents in the membranes of brain cells, heart muscle cells, and the rods and cones of the retina. Chia could also be a good source of gel. Chia gel is a polysaccharide based gel mainly consists of crude fiber and carbohydrate. Extracted chia seed gel has a great potential in food formulations as thickening agent, emulsifying agent and as a stabilizer. The extracted chia gel from chia seeds was analysed for proximate i.e. moisture, ash, protein, crude fiber, carbohydrate and oil. Chia gel was used to 0.1%, 0.2%, 0.3% and 0.4% as a stabilizer in ice cream formulation. Analysis of variance conducted on the chemical, physical and sensory characteristics indicated a statistically significant effect when utilizing chia seed gel as a stabilizer. We concluded that the use of 0.3% chia seed gel was organoleptically superior over other samples and technologically feasible in ice cream, with no significant alterations on their quality characteristics.

Keywords: Chia seed, Chia seed gel, Stabilizer, Ice cream.

Introduction
'Chia' is a name of Spanish origin, which is used for several species of genus *Salvia*, usually for *Salvia hispanica* L. The genus *Salvia* L. belongs to the *Lamiaceae* family and shows about 900 species distributed worldwide, mainly in the areas of the Mediterranean, Southeast Africa and Central and South America (Delamare *et al.,* 2007) [8]. Chia is known as super food as it contains highly concentrated amounts of essential fatty acids, dietary fibers, vitamins and antioxidants (Weber *et al.,* 1991) [18]. In one ounce (28 g) sample, chia seeds contain 9 per cent of daily value for protein, 13 per cent oil (57 per cent of which is ω -linolenic acid abbreviated as 3ALA) and 42 per cent dietary fiber, based on a daily intake of 2000 calories. The seeds also contain the essential minerals, phosphorus, manganese, calcium, potassium and sodium (Anonymous, 2010) [3]. The chia seed is a good source of protein (19-27 per cent) (Weber *et al*., 1991) [18]. The protein content is higher than that of other traditional crops such as wheat, corn, rice, oat, barley and amaranth (Ayerza and Coates, 2005) [4]. Although chia is not commercially grown as a protein source, its amino acid profile has no limiting factors in the adult diet (Bushway *et al*., 1981) [5]. The PER of *Salvia hispanica* L. protein has been shown to be 91 per cent (with casein as standard), which is higher than that of soy protein.
Chia seed is a good source of dietary fibers containing about 5 percent soluble fiber which appears as clear mucilage when it is placed in water. These remain tightly bound to the seed and have a very large molecular weight, averaging 1.5 x 106 Dalton (Lin *et al.,* 1994) [10]. The high viscosity of chia mucilage renders it more likely to produce desired metabolic effects than lower viscosity dietary fibers such as guar or β-glucan (Wood *et al.*, 1989) [20]. Hence chia is useful as a dietary fiber and possesses huge potential for application in food industry (Whistler, 1982; Weber *et al.*, 1991; Lin *et al.,* 1994) [19, 18, 10]. The most important antioxidants in chia are chlorogenic acid and caffeic acid, but it also contains myricetin, quercetin and kaempferol flavonols. These compounds are both primary and synergistic antioxidants, and make chia a very stable source of omega-3 fatty acids (Taga *et al.*, 1984; Castro *et al.*, 1986) [16, 7]. Hydrocolloids or food gums are key ingredients in food processing and the industry is always on the lookout for new ingredients with enhanced and/or different performance characteristics for use in novel food product development. Information on the chia gel functional properties/characteristics is essential in identifying potential food applications. The object of the present research was to extract chia seed gel and utilization in value added ice cream product.

Materials and methods

Materials

Milk, sugar, cream, skim milk powder and chia seed gel were obtained from local market.

Chia seed gel extraction

Two different water to sample ratios (1:20 and 1:40) were used for gel extraction. The chia seeds mixed with deionized water using an overhead mixer at 1920 rpm for 3 h. The mixture was then centrifuged using an Eppendorf 5810R centrifuge at 3220 × *g* for 50 min at 20°C to separate the gel. The top layer (excess water) was removed and the gel (middle) layer was collected, the seeds settled at the bottom. The chia seed gel then freeze-dried for 46 h at 1 mbar and stored in air tight containers at 20 °C and at a humidity of 40%. (Ranil *et al.,* 2014) [14].

Ice cream preparation

Preparation of ice cream with incorporation of chia seed gel (Sukumar De, 2008) [15]

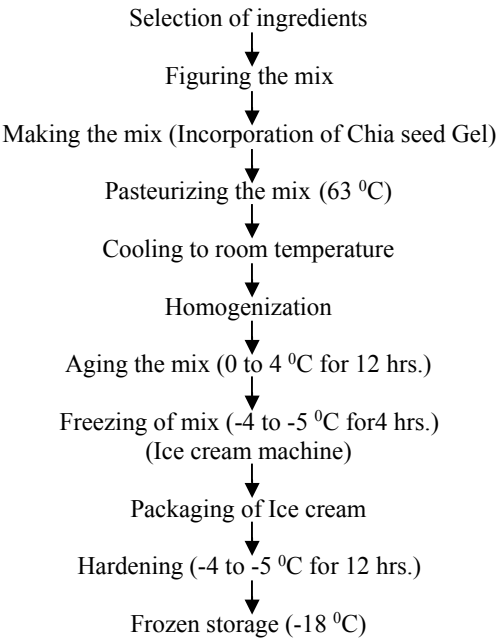

Fig 1: Flow sheet for preparation of ice cream with incorporation of chia seed gel

Table1: Formulation for preparation of Ice Cream with Chia seed Gel

Sr. No.	Ingredients	Quantity / kg
1	Milk	670 ml
2	Sugar	145 g
3	Cream (contains 25% Fat)	134 g
4	Skim milk powder (SMP)	38 g
6	Chia seed gel	0.1-0.4 % (1-4 g)

Table 2: Different treatments prepared with incorporation of Chia seed Gel at varying concentrations

Sr. No	Sample Code	Chia seed Gel Conc. (%)	Ice Cream Mix Qty. in Litres
1.	C (Control)	Nil	1 Lit.
2.	T_1	0.1%	1 Lit.
3	T_2	0.2%	1 Lit.
4.	T_3	0.3%	1 Lit.
5.	T_4	0.4%	1 Lit.

Physicochemical composition of chia seed gel and ice cream

Proximate composition of extracted chia seed gel and ice cream prepared with different incorporation levels of chia seed gel was examined according to Official Methods of Analysis of A.A.C.C. (2000) [1].

Sensory evaluation of prepared Ice cream

Samples were evaluated for sensory characteristics like color, flavor, mouth-feel and overall acceptability by 10 semi-trained panel members comprised of academic staff members of the Department of Food Science and Technology, CFT, Parbhani. Judgments were made through rating products on a 9 point Hedonic Scale with corresponding descriptive terms ranging from 9 'like extremely' to 1 'dislike extremely'(Meilgaard *et al.,* 1999) [12].

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) [13]. The analysis of variance revealed at significant of $P<0.05$ level, S.E. and C.D. at 5% level were mentioned whenever required.

Result and Discussion

Chemical composition of chia seed gel

Chemical compositions of chia seed gels are presented in Table 3. The chemical composition of chia seed was determined on dry basis.

Table 3: Chemical composition of chia seed gel

Chemical constituent (%)	Results (%)
Moisture	5.74
Protein	11.62
Lipids	3.20
Ash	5.09
Crude fiber	57.84
Carbohydrates	12.49

* Each value represents the average of three determinations

The data presented in Table 3 describes composition of major constituents of chia seed gel. The moisture content of sample was observed to be 5.74 per cent, while the ash value was found to be 5.09 per cent. The protein, fat and carbohydrate content chia seed gel was found to be 11.62, 3.20 and 12.49 per cent, respectively. Crude fibre content was observed to be 57.84 per cent, Similar results of chia seed gel for protein and lipid contents were obtained by Capitani *et al.,* (2012) [6], but the ash content obtained was higher, probably caused by the extraction conditions, due to the force applied by the mixing blade's on the seeds, causing the removal of the seed outer layers and increasing the impurities of the gel.

Physical properties of Ice cream prepared with different levels of chia seed gel

Overrun and Meltdown

The Overrun in the product was measured by using the method prescribed in Outlines of Dairy Technology by Sukumar De (2008) [15]. The obtained results were shown in the following Table 4.

Table 4: Physical properties of Ice Cream prepared with different levels of chia seed gel

Sr. No.	Samples	Overrun (%)	Meltdown(ml/min)
1.	C	48.37	1.50
2.	T_1	48.38	1.72
3.	T_2	48.54	1.68
4.	T_3	49.70	1.54
5.	T_4	49.82	1.49

* Each value represents the average of three determinations

The above Table revealed that the as the incorporation level increased the over run of the product increased. As the percentage of chia seed gel increased in ice cream samples, rate of whipping get increased. Thus the over run of the product also increased. The control sample had given over run of 48.37%. The highest over run obtained for sample T_4 that is 49.92%. The above obtained results were more or less comparative to the results obtained by Bruno *et al.,* (2016).

The ice creams containing chia seed gel should melt more slowly than the control ice creams because the chia seed gel slows the rate of heat transfer through the ice creams. However, the melting properties of the ice cream samples used in the study (Table 4) indicate that the ice creams supplemented with low concentrations of chia seed gel (0.1 and 0.2 %) had lower resistance values than that of the control ice cream, and that there were no significant differences ($p \leq 0.05$) between the ice creams with 0.3 % chia seed gel and the control ice cream. The above obtained results were more or less comparative to the results obtained by Tainara *et al.,* (2014) [17].

Chemical characteristics of prepared ice-cream

Table 5: Chemical characteristics of ice cream prepared with different levels of chia seed gel

Sample	Moisture (%)	Fat (%)	Protein (%)	Total carbohydrate (%)	Total ash (%)	Titrable acidity (%)	TSS (%)	pH
C	63.47	10.19	4.03	20.78	0.50	0.16	34.93	6.09
T_1	64.23	10.31	4.06	21.15	0.54	0.18	35.28	6.14
T_2	63.19	10.74	4.09	21.46	0.65	0.19	36.58	6.15
T_3	63.75	10.82	4.04	21.59	0.73	0.21	36.76	6.17
T_4	63.91	10.96	4.07	21.68	0.85	0.24	36.68	6.20
S.E±	1.13	0.44	0.06	0.71	0.02	0.01	0.26	0.09
C.D at 5%	3.57	1.39	0.21	2.25	0.05	0.03	0.62	0.31

* Each value represents the average of three determinations.

The data presented in above Table 5 represents the chemical composition of ice-cream prepared with different concentration of chia seed gel. All the four treatments and control sample were analysed. The Moisture content was found maximum in T_1 (treatment 1). The moisture content of different treatments was as follows. T_1 had 64.23%, T_2 had 63.19%, T_3 had 63.75% and T_4 had 63.91%. The highest fat content was found in T_4 (10.96%) follows T_3 (10.82%), T_2 (10.74%), T_1 (10.31). For control sample it was 10.19%. The values of protein content in the chia seed incorporated Ice cream indicating that maximum content of protein was found in T_2 (4.09%) than the control sample (4.03).The sample T_4 got the highest Carbohydrates percentage that was 21.68% following sample T_3 (21.59%), sample T_2 (21.46%) and sample T_1 (21.15%). The control sample had 20.74%.

The sample T_4 got the highest ash percentage 0.85% followed by sample T_3 (0.73%), sample T_2 (0.65%), and sample T_1 (0.54%). The control sample had 0.50% ash content. The sample T_4 got the highest titratable acidity percentage that is 0.24% following sample T_3 (0.21%), sample T_2 (0.19%), and sample T_1 (0.18%). The control sample had 0.16%. The sample T_3 got the highest TSS percentage 36.76% followed by sample T_4 (36.68%), sample T_2 (36.58%), and sample T_1 (35.28%). The control sample had 34.93%. The sample T_4 got the highest p^Hthat is 6.20 following sample T_3 (6.17), sample T_2 (6.15), and sample T_1 (6.14). The control sample had 6.09 TSS. The results obtained by analysis were more or less similar to the results obtained by Bruno *et al.,* (2016), Ei. Owni (2009) [9] and Anjum Murtuza (2004) [2].

Sensory evaluation of prepared ice cream

The panel of semi- trained judges was given the chia seed gel incorporated ice cream samples for evaluation of organoleptic characteristics viz. appearance, colour, taste, flavor, texture and overall acceptability. It was served to judges on the day of preparation. The average score recorded by judges was considered, presented and discussed (Table 6) under suitable quality attributes.

Table 6: Sensory Evaluation of chia seed Incorporated Ice Cream

Treatment	Appearance	Texture	Flavour	Taste	Overall Acceptability
C	9	8.9	8.9	9	9
T_1	8.5	8.4	8.4	8.7	8.4
T_2	8.5	8.4	8.3	8.7	8.6
T_3	8.8	8.7	8.7	8.8	8.8
T_4	7.9	7.6	7.8	7.9	7.9
S.E.	0.039	0.046	0.039	0.045	0.077
C.D. at 5%	0.116	0.135	0.117	0.135	0.230

* Each value represents the average of three determinations.

There was much variation in the score given by the judges for appearance. Control treatment (C) received top score of 8.9 followed by treatment$T_3$and T_1, T_2, at 8.8, 8.5 and 8.5 respectively. Lowest score was received by treatment T_4 (7.9). It could be seen that as chia seed gel level increased, the scores for appearance of ice cream get increased up to 0.3 %.

It may be visualized from Table 6 that the ice cream combination exhibited wide differences with regard to texture characters of final product ranging from 7.6 to 8.9. Treatment C (control) scored highest at 9 followed by treatment $T_3$and T_1, T_2 at 8.7, 8.4 and 8.4 respectively. Lowest score was received by treatment T_4 (7.6). It was interesting to note that

the texture of ice cream prepared by chia seed gel (T_4) scored lowest (i.e. 7.6) compared to control. Results showed that in case of treatment T_4 higher levels of chia seed gel were not preferred by the judges.

From the results presented in Table, it is revealed that control treatment (C) received top score of 8.9 for flavor. It was followed by treatment T_3, T_1 and T_2 at 8.7, 8.4 and 8.3 respectively. Treatment T_4 with highest level of chia seed gel (i.e. 0.4%) was not found at acceptable level. From above Table, it is observed that chia seed gel had significant effect on the flavour of ice cream. Results showed that in case of treatment T_4 higher levels of chia seed gel were not preferred by the judges. The best taste was observed in case of control (C) ice cream samples valued at 9, it was followed by treatment $T_3$and T_1, T_2. Treatment T_4 with highest level of chia seed gel (i.e. 0.4%) was not found at acceptable level. It is important to note from the present findings that the taste characters were decisively governed by the level of chia seed gel. The taste may be taken as a sum total of combination of sugar, delicate taste of added cream, skim milk powder, and inherent characters of chia seed gel.

It may be seen from the results that much variation observed in overall acceptability score. The treatment C, T_3, T_1 and T_2 valued in between like very much to like extremely. Lowest score was observed in treatment T_4. The overall acceptability of ice cream could be attributed to the different characters of appearance, flavour, texture and taste of the final product. It is revealed from the scores of the overall acceptability that the chia seed gel can be successfully incorporated up to 0.3 per cent. These results are in agreement with those reported by Bruno *et al.,* (2016) and Mahdian and Karazhian (2013) [11] with the addition of different stabilizer, respectively.

Conclusion

The extracted gels from chia seed performed better in terms of proximate composition that increase nutrition value of the prepared product. Due to the better functional properties of the chia seed gel it has the potential to be used as stabilizing agent in food formulations. Chia seed gel was used effectively as stabilizing agent, as results indicate that formulations with up to 0.3 per cent presented technological characteristics similar to the reference. The great importance of this ingredient is that ice creams were obtained with no requirement of additives or other ingredients to change on structure and texture of ice cream. This is an important advantage for the use of a clean label claim when the product is marketed.

References

1. AACC. Official Methods of Analysis of AACC international, American association of cereal chemists, Washington D.C, 2000.
2. Anjum Murtuza, Mueenuddin M. Quality evaluation of ice cream prepared with different Stabilizers/emulsifier blends. International Journal of Agriculture and Biology. 2004; 15(20):65-67.
3. Anonymous. Nutrition Facts for Seeds: chia seeds, dried; Nutrition Data, USDA SR-21, 2010.
4. Ayerza R, Coates W. Chia: rediscovering a forgotten crop of the Aztecs. 1st edition Tucson, Arix. : The University of Arizona press, 2005, 135.
5. Bushway AA, Belyea PR, Bushway RJ. Chia seed as a source of oil, polysaccharide, and protein. Journal of Food Science. 1981; 46:1349-1350.
6. Capitani MI, Spotorno V, Nolasco SM, Tomas MC. Physicochemical and functional characterization of by-products from chia (*Salvia hispanica* L.) seeds of Argentina. Food Science and Technology. 2012; 45:94-102.
7. Castro MR, Pratt DE, Miller EE. Natural antioxidants of chia seeds. Proceedings of the World Conference on Emerging Technologies in the Fats and Oils Industry, edited by the American Oil Chemists' Society, Champaign, Illinois, USA, 1986, 392-396.
8. Delamare AL, Pistorello IM, Artico L, Serafini LA, Echeverrigaray S. Antibacterial activity of essential oils of *Salvia officinalis* L. and *Salvia triloba* L. cultivated in South Brazil. Food Chemistry. 2007; 100(2):603-608.
9. Ei Owni. Chemical Composition of Ice Cream Produced in Khartoum State, Sudan. Pakistan Journal of Nutrition. 2009; 8(2):158-160.
10. Lin KY, Daniel JR, Whistler RL. Structure of chia seed polysaccharide exudate. Carbohydrate Polymers. 1994; 23:13-18.
11. Mahdian E, Karazhian R. Effects of Fat Replacers and Stabilizers on Rheological, Physicochemical and Sensory Properties ofReduced-fat Ice Cream. J. Agr. Sci. Tech, 2013, 1163-1174.
12. Meilgaard M, Civille GV, Carr BT. Sensory Evaluation Techniques. 3rd ed. CRC Press Inc., Boca Raton, FL, 1999.
13. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. 2nd Edition, ICAR publication, New Delhi, 1967, 381.
14. Ranil C, Tjoe A, Jayasena V. Gelling properties of chia seed and flour. Journal of Food Science, 2014.
15. Sukumar De. Outlines of Dairy Technology, 26th edition. Oxford University Publisher, 2008.
16. Taga MS, Miller EE, Pratt DE. Chia seeds as a source of natural lipid antioxidants. Journal of American Oil Chemists' Society. 1984; 61:928-931.
17. Tainara de Moraescrizel, Rubileneramos de araujo, Alessandro de oliveirarios, Rosanerech and Simone Hickmannflores. Orange fiber as a novel fat replacer in lemon ice cream. Food Science and Technology, 2014.
18. Weber CW, Gentry HS, Kohlhepp EA, McCrohan PR. The nutritional and chemical evaluation of Chia seeds. Ecology of Food and Nutrition. 1991; 26:119-125.
19. Whistler RO. Industrial gums from plants: guar and chia. Economic Botany. 1982; 36:195-202.
20. Wood PJ, Anderson JW, Braaten JR, Cave NA, Scott FW, Vachon C. Physiological effects of beta D glucan rich fractions from oats. Cereals Food World. 1989; 34(10):878-882.