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Development and characterization of *aloe vera* juice incorporated burfi

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Abstract
Khoa burfi is the most popular sweet in India with high nutritive value and *Aloe vera* has a long history as a medicinal plant with diverse therapeutic properties. The study was conducted with an objective to develop a novel and functional burfi with incorporation of *Aloe vera* juice at different levels (5, 10, 15, 20% levels) in burfi. The product was selected on the basis of sensory evaluation and analysed for moisture, pH, instrumental colour and textural profile properties. However, *Aloe vera* juice incorporation up to 20 per cent did not affect the colour and appearance, texture and sweetness scores but flavour and over all acceptability scores were significantly declined after 15 % percent *Aloe vera* juice addition in burfi. Percent moisture content of developed product increased significantly with incorporation levels of *Aloe vera* juice and ranged from 8.72 (control) to 17.02 (with 20% *Aloe vera* juice). As the levels of *Aloe vera* juice increased, the pH value was significantly decreased from 6.69 (control) to 6.46 (with 20 % of *Aloe vera* juice). However, *Aloe vera* juice addition decreased the hardness but increased the adhesiveness of the developed burfi. The cohesiveness of the burfi samples decreased proportionally with increased levels of *Aloe vera* juice incorporation. It is concluded that burfi can be prepared with *Aloe vera* juice incorporation at 15% level with improved physicochemical, textural and desirable sensory characteristics.

Keywords: *aloe vera* juice, burfi, characterization

1. Introduction
Against skin damage from x-rays, lung cancer, intestinal problems, increasing High Density Lipoprotein (HDL), reducing Low Density Lipoprotein (LDL), reducing blood sugar in diabetics, fighting Acquired Immuno Deficiency Syndrome (AIDS), allergies and improving immune system (Pandey and Singh, 2016) [20].

Ice cream was prepared by Manoharan and Ramasamy (2013) [17] with various levels of *Aloe vera* pulp, beetroot for natural colour, strawberry flavour and different artificial sweeteners. They concluded that ice cream incorporated with 20% aloe vera pulp, 4% beetroot juice and 50% sucralose scored 95.15 percent pursued by aspartame and levulose. One more study by Govindammal *et al.,* 2017 [6], concluded that the use of naturally occurring source of vitamin C Aloe vera in yogurt was superior as compared to other experimental samples found in good probiotics drinks with good taste that could essentially be transferred to the consumer. Srikanth *et al.,* 2017 [12] study the effect of incorporation of *Aloe vera* juice on textural and sensory characteristics of fresh Peda. The incorporation of *Aloe vera* juice on peda samples with respect to springiness, cohesiveness and gumminess did not showed any statistical difference as compared to control. However *Aloe vera* juice incorporation level increased, sensory scores decreased as compared to control. Some researchers studied the effect of fortification of dahi and flavoured milk fortified with *Aloe vera* gel (Jothy-lingam & Pugazhenthi, 2013; Ramachandran & Srividya, 2014) [10, 23]. There are lot of research papers on fortification of dairy products (Verma *et al.,* 2018; Wijesundara & Adikari, 2017; Raju & Pal, 2014) [26, 27, 22], bakery products, processed foods, beverages etc., but research on fortification of cultured buttermilk still needs attention of food scientists and has a wide scope of research and commercialization.

Looking to the functional, therapeutic and its bland flavour in nature, *Aloe vera* was utilized for development of a novel and functional herbal khoa burfi.

2. Materials and Methods
2.1 Materials
Full cream milk with 6.0% fat and 9.0% SNF was procured from Experimental Dairy Plant,

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Department of Livestock Product Technology, LUVAS, Hissar, India. The milk was stored at 4˚C for further use. *Aloe vera* leaves were procured from Centre of Plant Biotechnology, Hissar. Cane sugar was purchased from local market, Hissar.

2.2 Preparation of Aloe vera juice
Fresh *Aloe vera* leaves were washed with distilled water 3 times and the lower one inch leaf base was removed. The pulp was separated using spatula and cut into small pieces and blended in a blender to obtain a homogenous juice.

2.3 Preparation of Aloe vera juice incorporated Burfi
Burfi was prepared using the procedure described by Chetana *et al*. (2010) [5] with slight modifications (Fig 1). 10 litre of whole milk was heat desiccated till the pat khoa formation stage. Different levels (5, 10, 15 and 20%) of *Aloe vera* juice was incorporated maximum up to 20% on khoa weight basis along with 30% sugar by weight of khoa (Table 1). The hot mass was transferred to a stainless steel plates, cooled, spread evenly and cut into pieces of equal size.
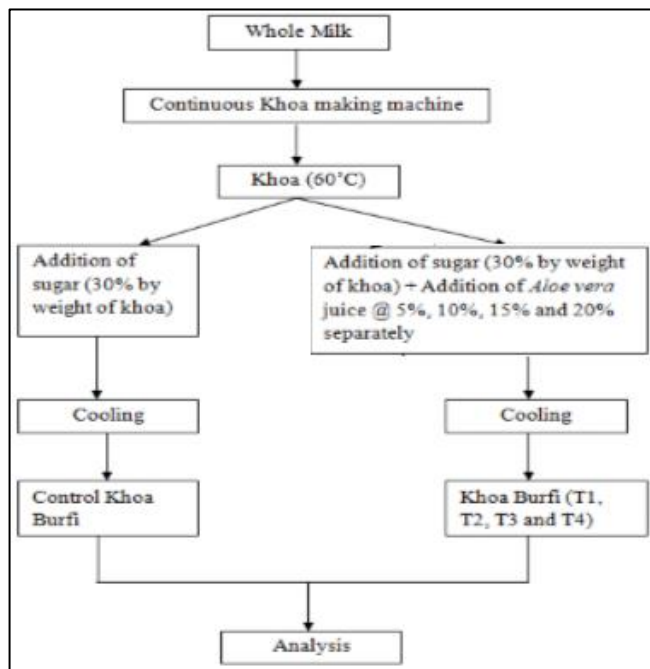

Fig 1: Flow chart for the preparation of *Aloe vera* fortified khoa burfi

Table 1: Different formulations of *Aloe vera* incorporated burfi

Burfi Sample	Khoa (In gms.)	*Aloe vera* (in ml on khoa weight basis)
T_1	500	0
T_2	500	25
T_3	500	50
T_4	500	75
T_5	500	100

2.4 Sensory analysis
Sensory evaluation (colour and appearance, body and mouthfeel, flavour and overall acceptability scores) of control and *Aloe vera* juice incorporated burfi samples were carried out using 9-point hedonic scale. Twelve experienced panellists were selected and served with 20–30 g of the product each labelled with a 3-digit code. The samples were presented in randomised order. Water and expectorant cups were also presented to each panellist for rinsing of their mouths between samples evaluation.

2.5 Moisture and pH
Control and fortified burfi samples were analysed for percent moisture content according to standard AACC (2000) [1] method and pH value was determined according to the procedure prescribed by.

2.6 Instrumental Colour measurement
The colour values were measured by Shimadzu Colour Measuring system (10˚ angle, illuminant C, Model-Labscan XE, Hunter Associates Laboratory, USA (Arora *et al*., 2010). The values were expressed as L*, a* and b*, where L*=lightness (or brightness), a* (+) =redness, a* (− =greenness, b* (+) = yellowness and b* (−) =blueness.

2.7 Instrumental texture profile analysis
Textural properties of control and *Aloe vera* added burfi were studied using texture profile analysis (TPA using a TA-XT2i Texture Analyzer (Stable Microsystems, Godalming, UK) by a uniaxial compression test of two cycles. A plate-plate sensor system with a stainless probe SMSP/75 was used at a constant rate of 0.5 mm/sec. Parameters such as hardness, adhesiveness, cohesiveness and consistency were analysed. Hardness is the maximum force obtained during the first compression cycle. Adhesiveness is the negative area obtained during the first cycle. Cohesiveness was obtained as the ratio between the positive areas of the second cycle and the first cycle. All tests were performed in triplicate.

2.8 Statistical Analysis
The experiment was replicated thrice and data were analyzed using SPSS 16.0 software (SPSS Inc., Chicago, IL) and Microsoft Office Excel 2007 (Microsoft Incorporation). Means and standard error were derived with Microsoft Office Excel 2007.

3. Results and discussion
3.1 Effect of Aloe vera addition on sensory attributes
The sensory scores as influenced by the level of incorporation of *Aloe vera* juice is presented in Table 2. The statistical analysis of sensory attributes data revealed that flavor and overall acceptability scores decreased significantly after 15 % percent *Aloe vera* juice addition in khoa burfi.
Comparing treatment means, it was deduced that T_1, T_2, T_3 and T_4 were at par with each other; however T_5 varied significantly, indicating that *Aloe vera* juice addition had a non-significant effect on the color and appearance scores up to T_4. The difference in color and appearance scores might be due to the increased amount of *Aloe vera* juice which exhibits a slight greenish color. It was revealed from the results that T_3 had the highest flavor score of 8.15 while, T_5 had the lowest score of 6.20. The downtrend observed could be due to increased bland flavor of *Aloe vera* juice than that of khoa. Further addition of *Aloe vera* juice (at 20% level) significantly declined the flavor scores as compared to other treated product including control burfi. These results are in accordance with the findings of Wijesundara and Adikari (2017) [27] who reported that incorporation of *Aloe vera* juice at 15% level produce drinking yoghurt with the best sensory attributes. It was also observed that the sample T_5 (20% *Aloe vera* juice) secured the lowest sweetness score of 6.70 and T_3 secured the highest sweetness score of 8.20 followed by T_4

(8.10). This might be due to the breakdown of sugars by acids present in *Aloe vera* juice.

Panelists recorded that the overall sensory characteristics of burfi incorporated with *Aloe vera* juice up to 15 percent were comparable with control samples (Table 2). Difference exhibited in the overall acceptability scores of *Aloe vera* juice incorporated burfi may be due to the variations in color and appearance, texture, flavour and sweetness. The results obtained were in concordance with the findings of Manoharan *et al* (2012) [16] who reported that with the inclusion of *Aloe vera* pulp at different levels the sensory scores of *Aloe vera* ice cream reduced.

Table 2: Sensory analysis of *Aloe vera* incorporated burfi

Characteristics	Treatments				
	T_1	T_2	T_3	T_4	T_5
Colour and Appearance	8.10^b±0.57	8.10^b±0.35	8.10^b±0.11	8.00^b±0.09	7.15^a±0.16
Texture	7.70^b±0.23	7.90^b±0.16	8.06^b±0.10	7.70^b±0.05	7.20^a±0.13
Flavour	7.90^b±0.27	8.10^b±0.22	8.15^b±0.20	8.10^b±0.11	6.20^a±0.19
Sweetness	8.25^b±0.18	8.00^{ab}±0.10	8.20^b±0.09	8.10^{ab}±0.15	7.75^a±0.11
Overall acceptability	7.95^b±0.14	7.90^b±0.09	8.10^b±0.13	7.76^b±0.27	6.70^a±0.18

Means ±SE with different superscripts row wise differ significantly (p≤0.05).

T_1= control, T_2= 5% *Aloe vera* juice, T_3=10% *Aloe vera* juice, T_4=15% *Aloe vera* juice, T_5= 20% *Aloe vera* juice

3.2 Moisture and pH

There was a wide range of moisture content (8.72 to 17.02%) in control and *Aloe vera* incorporated burfi (Table 3). Moisture showed a significant uptrend with the increase in level of addition of *Aloe vera* juice. This increase in moisture content of *Aloe vera* juice incorporated burfi samples was expected, as *Aloe vera* contains 98.62 to 99.61 % water (Chandegara and Varshney, 2013) [4].

The pH value showed significantly downtrend with the augmentation of *Aloe vera* juice in burfi and it declined from 6.69 (control) to 6.46 (20% *Aloe vera* treatment). This was attributed due to the acidic nature (pH 3.5 to 4.7) of *Aloe vera* juice (Keerthi *et al.*, 2016) [13].

Table 3: Moisture content and pH of *Aloe vera* incorporated burfi

Treatments	Moisture (%)	pH Value	Ash (%)	Fat (%)
T1	8.72^a±0.54	6.69^d±0.02	1.60^a±0.14	23.2^d±0.24
T2	11.10^b±0.59	6.63^{cd}±0.03	1.52^a±0.21	22.6^d±0.15
T3	12.13^c±0.23	6.57^{bc}±0.02	1.46^a±0.19	21.1^c±0.19
T4	14.31^d±0.33	6.51^{ab}±0.01	1.33^a±0.27	19.7^b±0.11
T5	17.02^e±0.45	6.46^a±0.01	1.17^a±0.30	17.5^a±0.18

Means ±SE with different superscripts column wise differ significantly (p≤0.05).

T_1= control, T_2= 5% *Aloe vera* juice, T_3=10% *Aloe vera* juice, T_4=15% *Aloe vera* juice, T_5= 20% *Aloe vera* juice

Fat content of *Aloe vera* incorporated Burfi decreased as the level of *Aloe vera* juice was increased. The highest fat percentage 23.2% was reported in the control. Fat percentage gradually decreased as relative amount of moisture increased with the increasing level of *Aloe vera* incorporation in burfi. The lowest fat percentage (17.5%) was observed in burfi incorporated with 20% *Aloe vera*.

It was observed from the results that ash content decreased with increase in level of incorporation but the decrease was non-significant.

3.3 Instrumental colour

The values *L** was expressed as lightness (or brightness) of the products. A declining trend in the lightness values of the developed burfi with augmentation of *Aloe vera* juice levels was noticed (Table 4) and it ranged from 64.99 (T_1) to 63.64 (T_5). According to Barba *et al.* (2012) [3], values of colour can be classified analytically as not noticeable (0-0.5), slightly noticeable (0.5-1.5), noticeable (1.5-3.0), well visible (3.0-6.0), and great (6.0-12.0).

This slight colour darkness might be due to the greenish colour of *Aloe vera* juice i.e. as the *Aloe vera* content increased; it imparted a greenish tinge to the product.

The colour value (*a**) demonstrating an inverse relation between lightness and redness scores and expressed as *a** (+) = redness and *a** (−) = greenness. The differing proportions of *Aloe vera* juice resulted in distinguished effect on *a** values of the products. Supplementation of *Aloe vera* juice from 5% to 20% escalated the values of *a** from -2.96 to -4.06, respectively. These results reflect that the burfi which contains higher amount of *Aloe vera* juice exhibited slightly greenish colour.

Table 4: Effect of *Aloe vera* incorporation on instrumental colour of burfi

Treatments	*L**	*a**	*b**
T_1	64.99^b±0.25	-2.96±0.48	13.03±0.97
T_2	64.87^b±0.57	-3.36±0.02	11.70±0.63
T_3	64.55^a±0.20	-3.51±0.04	12.01±0.62
T_4	64.68^a±0.27	-3.98±0.22	12.15±0.33
T_5	63.64^a±0.21	-4.06±0.32	12.32±0.48

Means ±SE with different superscripts column wise differ significantly (p≤0.05).

T_1= control, T_2= 5% *Aloe vera* juice, T_3=10% *Aloe vera* juice, T_4=15% *Aloe vera* juice, T_5= 20% *Aloe vera* juice

The colour values *b** (-) were expressed as blueness (blue-yellow component) of the products. With addition of *Aloe vera* juice *b** values showed a downtrend from 13.03 (T_1) to 11.70 (T_2) and then increased to 12.32 (T_5), but all the treated values were lower than control samples. Wijesundara and Adikari (2017) [27] also documented the similar results for colour profile using response surface methodology and reported that initially addition of *Aloe vera* juice (at 10 and 15% levels) decreased the *b** value and after that it was increased as the level of *Aloe vera* juice was increased in drinking yoghurt.

3.4 Instrumental texture profile analysis

Aloe vera addition in burfi affected the textural parameters of all the treatments having different levels of incorporation (Table 5). Supplementation of Aloe vera juice non-significantly increased the hardness of herbal Burfi from 1723 to 1736 g (T_1 to T_3).

However, the hardness values of T_2 and T_3 were slightly higher as compared to control (Table 4). This higher trend of hardness in T_2 and T_3 was due to slight increase in fibre content in T_2 and T_3 as compared to T_1 (Keerthi *et al*., 2016) [13]. Secondly, this might be due to lower pH of T_2 and T_3

(Table 3), leading to little grains formation in *Aloe vera* juice added samples. This grain could have resisted the texture probe during compression test. Also reported high acid/sour milk yielded with grainy/coarse leading to higher hardness in the finished product. Thereafter, as the levels of *Aloe vera* juice increased in T_4 and T_5, the hardness value decreased significantly because there was a negative correlation between moisture content and hardness. With increase in the level of *Aloe vera* juice, the moisture content in burfi was increased (Table 3) which lowered the hardness of the products.

Table 5: Effect of *Aloe vera* addition on textural properties of burfi

Treatments	Hardness (g)	Adhesiveness (g)	Springiness (mm)	Cohesiveness
T_1	1723^c±099.04	-18.16±1.33	0.169±0.01	0.206±0.012
T_2	1736^c±101.48	-24.66±2.15	0.176±0.04	0.199±0.009
T_3	1731^c±143.69	-27.97±1.74	0.161±0.02	0.187±0.016
T_4	1535^b±178.93	-35.18±0.96	-	0.143±0.005
T_5	1457^a±152.42	-39.29±2.03	-	0.134±0.013

Means ±SE with different superscripts column wise differ significantly ($p \leq 0.05$).

T_1= control, T_2= 5% *Aloe vera* juice, T_3=10% *Aloe vera* juice, T_4=15% *Aloe vera* juice, T_5= 20% *Aloe vera* juice

The T_5 treated samples had highest (-39.29 g) and control (T_1) had lowest (-18.16 g) adhesiveness. The higher adhesiveness in treated samples was due to more moisture and stickiness nature of *Aloe vera* juice, which affected the adhesiveness of herbal burfi samples.

Springiness is the rate and extent to which a deformed sample regains its original condition after the removal of deforming force. It was observed that springiness was not much affected by the incorporation of *Aloe vera* juice as evident by non-significant difference existed among control and treated samples. However, in T_4 and T_5 springiness was not detected by texture analyzer. This could be attributed to the fact that as the level of total solids content in the *Aloe vera* incorporated burfi decreased with increasing levels of *Aloe vera* juice, resulting in decrease in springiness values. Similar results have been reported earlier by Jha *et al*. (2014) [9] in lal peda with increase in the total solid content.

Cohesiveness was a measure of the difficulty in breaking down the internal structure of the burfi incorporated with *Aloe vera* juice. The control had the highest (0.206) and T_5 had the lowest (0.134) cohesiveness scores. The cohesiveness decreased with increasing levels of *Aloe vera* juice incorporation in burfi samples. It could be due to variation in the values of hardness and springiness among herbal burfi samples, because it is positively correlated with hardness and springiness value of the products. Also concluded similar results in khoa based products.

4. Conclusions

It is concluded that herbal burfi can be prepared with *Aloe vera* juice incorporation at up to 15% level with improved physicochemical, textural and desirable sensory characteristics.

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