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RESEARCH ARTICLE

Preparation of *Basundi* using *Ashwagandha* for value addition

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Abstract: The objective of the present study was to develop an acceptable quality *Basundi* incorporated with *Ashwagandha* powder**.** Four batches of *Basundi* were prepared using three different levels of *Ashwagandha* powder viz. 0 (P1), 0.20 (P2), 0.25 (P3) and 0.30 (P4) % (w/w of milk). Addition of ashwagandha powder up to 0.25% i.e. P3 was found to be acceptable. In order to evaluate the effect of level of sucrose on its acceptability, P3 *Basundi* was incorporated with three level of sugar viz. 5, 6 and 7 % (w/w of milk) and it was found that *Basundi* prepared using 6 % sugar was most acceptable. Cardamom was found most suitable background flavour on basis of sensory score among three different flavors viz. cardamom, saffron and nutmeg when added at the rate of 0.25 % w/w of *Basundi*. Based on the results obtained in this study a method for preparing *Basundi* using *Ashwagandha* powder was developed. The standardized method involved use of mixed milk (fat: SNF ratio of 0.5), addition of 0.25 % *Ashwagandha powder and* 6 % sugar (w/w of milk) and using cardamom flavour @ 0.02% w/w of *Basundi*. The total score of the developed product was 90.13 indicating that the product could be graded as excellent quality based on the 100 point score card suggest by BIS for sensory evaluation of milk.

Keywords: *Basundi*, *Ashwagandha*, Cardamom, Herbal

Introduction

Basundi is a heat-desiccated, thickened milk dessert, having white to light caramel colour, creamy consistency with soft textured flakes uniformly suspended throughout the matrix of product (Aneja 2002a). This product is well known in western and southern part of India, particularly in Andhra Pradesh, Gujarat, Karnataka, Kerala, Maharashtra and Tamil Nadu. It is analogous to *Rabri* and *Khurchan*, which are popular in the northern and central parts of India (Pandya, 2006; Patange et al. 2006). It has a sweetish caramel aroma, consumed directly as a dessert; it contains all the solids of milk in an approximate two-fold concentration plus additional sugar, with food and nutritive value. Additives (sugar, flavours and nuts) increase the calorific value of the product (Pal, 1997; Aneja et al. 2002b).

Ashwagandha (*Withania somnifera*), is one of the prime medicinal plants which is highly valued for its medicinal and nutraceutical properties (Sangwan et al. 2004; Misra et al. 2005; Hussain et al. 2011). This plant is known to synthesize withasteroids which have shown antioxidant, anti-tumour, adaptogenic, anti-stress, anti-convulsant, immuno-modulatory and neurological effects (Misra et al. 2005). It improves learning ability and memory capacity (Pawar et al. 2014). Numerous phytochemical studies have established *Ashwagandha* as a source of steroidal lactones known collectively as Withanolides (Jayaprakasam et al. 2004) of which withaferin-A has been recognized as the most important bioactive constituent (Xu et al. 2011). It finds extensive use in Ayurvedic system of medicine as a rasayana and medhyarasayana. The roots are extensively used in most of the Indian herbal pharmaceuticals and

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nutraceuticals and are well described in Ayurveda, the ancient Indian system of plant medicine for immuno-modulation and anti-ageing (Bhattacharya et al. 2001; Chaurasiya et al. 2008). Aureli et al. (1992) reported about the antimicrobial property of some essential oils against *Listeria monocytogens*. According to Kumar et al. (2009) antibacterial activity of aqueous and ethanolic extracts of *Ashwagandha* was determined against Staphylococcus aureus and Escherichia coli in terms of minimum lethal concentration. The *Ashwagandha* is capable of improving immune function. It increases haemoglobin concentration, red blood cell count, white blood cell count, platelet count, and body weight, in addition to providing immune-stimulatory activity (Ghosal et al. 1989).

With rapid expansion of urban and semi-urban areas, the demand for traditional dairy products is increasing and nowadays the popularity and demand of *Basundi* is increasing due to its delicacy. Moreover, addition of *Ashwagandha* powder in *Basundi* would result in a safe, physical and mental health promoting, value added traditional Indian dairy product, since natural substances are generally preferred over chemical ones and are generally seen as healthy (Gruenwald, 2009). Therefore, keeping in view the above medicinal and health benefits of *Ashwagandha*, the present research work was planned to develop a sensorily acceptable product by incorporating *Ashwagandha* powder in *Basundi* for its value addition.

Materials and Methods

Fresh mixed milk (cow: buffalo) used for manufacturing *Basundi* was procured from Vidya Dairy, Anand. The milk was standardised to desired Fat: SNF ratio 0.5±0.01. Good quality cane sugar, nutmeg, saffron and cardamom were procured from the local market. The *Ashwagandha* powder (root) was collected from Medicinal and Aromatic Plant, Processing Centre, AAU Anand, India. Cardamom, saffron and nutmeg were procured from local market.

Sensory Evaluation

Basundi prepared using *Ashwagandha* powder was evaluated for its sensory characteristics by a panel of 7 judges selected from Dairy Technology staff of the college**.** The selection criterion was that the subject had to be familiar with the product as well as show consistent results between sensory evaluation sessions. Each sample of product (~ 50 ml) was served in polypropylene (PP) cups for sensory evaluation.

Preparation of *Basundi*

Basundi was prepared in Dairy Technology department, AAU, Anand according to the method developed by Patel and Upadhyay (2003a). For selecting the rate of addition of *Ashwagandha* powder, it was incorporated in the product @ 0% (P1), 0.2% (P2), 0.25% (P3) and 0.3% (P4) (w/w of milk). Total four replications were taken for deciding the rate of addition of herb. *Ashwagandha* powder was incorporated during the addition of sugar i.e., at stage of 2X concentration of *Basundi*, on basis of preliminary trials. With a view to get optimum sweetness in the finished product, sugar was added into milk at three levels, viz., 5, 6 and 7 % (w/w of the milk).

Quality Analysis of *Basundi*

Representative samples of *Basundi* were analysed for total solids and fat content as per FSSAI (2012). The SNF content of *Basundi* was calculated by subtracting fat and sucrose from TS content. Total protein of *Basundi* was determined by Semi-Microkjeldahl method (IS: 1479 (Part-II), 1961), using Kjel-plus Digestion System (Model-KPS 006L, M/s. Pelican Instruments, Chennai) and Kjel-plus Semi-Automatic Distillation System (Model-Distil M, M/s. Pelican Instruments, Chennai). Lactose content of the milk, and *Basundi* samples was determined as per IS:10029 (1981) with slight change in quantity of sample taken. Sucrose content of *Basundi* samples was determined by the Colorimetric method suggested by Pantulu et al. (1976). The Ash content was estimated by using the standard method described for milk (IS: 10029, 1981). Withanolides content of *Ashwagandha* root powder was analysed by Colorimetric method, developed by Mishra (1994) and Mishra and Pocnori (1994). Microbiological analysis for total viable count, coliform, yeast & mold and spore count was carried out according to the standard methods described in FSSAI (2011).

Milk and *Basundi* was subjected to various physico-chemical analyses. Titratable acidity of all the samples was determined by using the method described in IS: 1479 (Part I), (1960). The pH of milk and *Basundi* was measured using digital pH meter (Mettler-Toledo AG, 8603 Schwerzenbach, Switzerland). The water activity of *Basundi* samples, tempered at 25°C temperature, was measured using Rotronic Hygroskop Model: Hygrolab-3 (M/s. Rotronic ag, Switzerland) connected to a sensing element (AW-DIO) with a measuring range of 0-100 % relative humidity. Free Fatty Acids (FFA) content (measured in terms of oleic acid) of milk/ *Basundi* samples was determined by the method suggested by Deeth and Fitz-Gerald (1975). The quantitative method presented by Keeney and Bassette (1959) for quantifying HMF by spectrophotometric measurement of the 2-thiobarbituric acid (TBA) reaction product was used to assess the extent of browning in milk and *Basundi* samples. The specific gravity of milk and *Basundi* samples was determined at 20°C using a specific gravity bottle according to the method described by Ling (1956). Viscosity of *Basundi* was determined by using "Brook field" viscometer (DV II + Pro viscometer, Model- LVDV-II + P, USA) at 20°C. Insolubility index of *Basundi* samples was determined using the procedure recommended by Haugaard et al. (1978) meant for finding solubility index of milk concentrates.

Statistical Analysis

The mean values obtained during the analyses of *Basundi* samples, were subjected to statistical analysis using completely randomized design (CRD) using software developed at Anand Agricultural University.

Results and Discussion

Effect of rate of addition of *Ashwagandha* powder on proximate composition

A comparative appraisal of proximate composition of *Ashwagandha* added *Basundi* (AAB) manufactured using different rate of addition of *Ashwagandha* in *Basundi* on proximate compositional attributes is collated in Table 1. In all the three experimental samples sugar was added into milk at 5% (w/w of the milk). The tabulated values showed that with the increased rate of addition of *Ashwagandha* powder viz. 0, 0.2, 0.25 and 0.30 % (w/w basis of milk) fat and lactose content decreased significantly whereas ash content of *Basundi* were increased significantly (P<0.05). Whereas in other compositional attributes the effect of *Ashwagandha* was found statistically non-significant on TS, protein, sucrose, and fat: SNF ratio. The significantly higher ash content could be due to result of *Ashwagandha* addition, as reported by Boone (1998) that *Ashwagandha* is rich in iron. Significant decrease of sucrose and fat content with increase in *Ashwagandha* could be due to slight lowered TS content of the *Basundi*. However, total solids content was non-significant affected, data indicates that TS content is slightly decreased when the increased rate of *Ashwagandha* was used. Addition of *Ashwagandha* with increased rate of addition was significantly (P<0.05) decreased the fat % of the *AAB*. This effect might be due to addition of *Ashwagandha*.

Ashwagandha with increased rate of addition was statistically not significantly affected the protein content but, it can be envisaged that *Ashwagandha* powder addition in *Basundi* decreased the protein % linearly. From tabulated data, it was noticed that, P4 is significantly differed from P1, P2 and P3 with respect to ash content. This effect might be due to addition of

Table 1: Effect of addition of *Ashwagandha* powder on the proximate composition and physico-chemical properties of experimental *Basundi*

Constituents (%)	Rate of addition of *Ashwagandha* powder (%)				CD (0.05)
	0 (P1)	0.20 (P2)	0.25 (P3)	0.30 (P4)	
Total Solids	47.38±0.05	47.36±0.08	47.32±0.04	47.30±0.06	NS
Fat	11.80±0.06	11.67±0.08	11.59±0.06	11.48±0.05	0.10
Protein	10.30±0.06	10.20±0.05	10.16±0.09	10.11±0.17	NS
Lactose	11.18±0.12	11.11±0.12	10.96±0.09	10.83±0.09	0.17
Sucrose	12.70±0.01	12.66±0.02	12.64±0.02	12.64±0.07	NS
Ash	1.85±0.07	1.93±0.05	2.04±0.05	2.14±0.05	0.09
Fat : SNF ratio	0.50±0.004	0.50±0.002	0.50±0.005	0.50±0.003	NS
Acidity (%LA)	0.42±0.01	0.43±0.01	0.45±0.02	0.45±0.02	NS
pH	6.59±0.04	6.53±0.04	6.52±0.08	6.45±0.05	0.08
FFA (µ eq/ml) (oleic acid)	1.40±0.05	1.36±0.02	1.34±0.04	1.32±0.05	NS
HMF (µ mol/litre)	15.54±0.02	15.56±0.08	15.69±0.09	15.71±0.11	0.13
Water activity (a_w)	0.98±0.001	0.97±0.002	0.97±0.002	0.97±0.006	NS
Specific gravity	1.13±0.01	1.13±0.01	1.14±0.01	1.15±0.01	NS
Viscosity (mPa.s)	52.90±0.04	54.23±0.52	54.55±0.40	54.19±0.50	0.72
Insolubility index (ml)	0.24±0.05	0.31±0.03	0.34±0.03	0.40±0.01	0.05

Figures placed after ± indicates standard deviation (n=3), NS – Non-significant, CD (0.05) – Critical difference at 5.0 % level of significance

Ashwagandha, as it contains various constituents like, alkaloids, phenolic compound and it is also high in iron level, which might be contributing the increased ash content. Using the same method, Patel and Upadhyay (2003b) had reported the average composition of *Basundi* i.e. fat 11.61 %, SNF 23.05 %, protein 9.86 %, lactose 10.79 %, sucrose 12.69 %, ash 1.72 %, total solids 47.35 %, and fat: SNF ratio 0.50; the values appear to be similar for all the attributes of control. Whereas with increasing the rate of addition of *Ashwagandha*, compositional attributes were tend to slightly change.

Effect of rate of addition *Ashwagandha* powder on Physico-chemical Properties

The effect of *Ashwagandha* powder addition on physico-chemical properties of the *Basundi* is presented in Table 1. On comparing the physico-chemical attributes of *Basundi* samples prepared using different rate of addition, it observed that the products manufactured, irrespective of the different levels had statistically similar values for acidity, free fatty acids, water activity and specific gravity, whereas pH, HMF, viscosity and insolubility index values differed significantly (P<0.05). The minimal inclination of acidity may be compositional effect of *Ashwagandha* or assigned by the slight lowering of TS level as observed in Table 1. Similarly, slightly depression of FFA content, might be either due to its antioxidative characteristics or due to decrease in fat content as observed in Table 1. It can be observed that with the increasing the rate of addition of *Ashwagandha* in the product HMF content tends to escalate significantly. This, significant rise of HMF value can be contributed by *Ashwagandha*, as it is having light brown color and also it contains starch, which possibly increase the HMF content of product. Patel and Upadhyay (2004b) reported that replacement of 25 % sweet cream buttermilk (SCBM) solids significantly increased the HMF content from 20.96 to 27.16 μ mol/litre. The viscosity of the *AAB* samples were significantly (P<0.05) higher at each incremental level of *Ashwagandha* addition. Control is significantly differed from all the *Ashwagandha* added products. P4 is statistically differed from P2 but it was at par with P3. This, effect of *Ashwagandha* in *Basundi* might be due to its water holding ability, as it has increased viscosity, with its increasing rate of addition. Similarly, significant increase in insolubility index exhibited when *Ashwagandha* level was increased. P4 is significantly differed from all the products. The higher level insolubility index with higher rate of addition of *Ashwagandha*, might be, due to addition of *Ashwagandha* powder as, it has lower solubility. However, the pH value remained statistically same up to addition of 0.25 % *Ashwagandha*. The slight decline of pH might be affected due to compositional effect of *Ashwagandha* or slight lowered TS level. The water activity of product remained statistically same for the *Basundi* added with different rate of addition of *Ashwagandha* powder in *Basundi*. This slight decrease in water activity (aw) can be due to its water holding property of *Ashwagandha*. Statistically, the effect of rate of addition of *Ashwagandha* on the specific gravity was not significant and slight transient may be due to it compositional attributes.

Patel and Upadhyay (2004b) reported that use of SCBM solids for substitution of BM solids in manufacture of *Basundi* had an adverse effect on FFA and HMF contents. The *Ashwagandha* can contribute in the variation in physico-chemical properties of *Basundi* when, added at different rate of addition, as it is characterised by the presence of steroidal lactones, alkaloids and flavonoids. According to Purohit (2011) *Ashwagandha* roots contain alkaloids, starch, reducing sugar, glycosides, dulcitol, withaniol acid and a neutral compound.

Effect of rate of addition *Ashwagandha* powder on sensory attributes

Table 2: Effect of addition of *Ashwagandha* powder on sensory quality of the experimental *Basundi*

Rate of addition of *Ashwagandha* (%)	Sensory score of *Basundi*			
	Flavor (Max. 45)	Body and texture (Max. 35)	Color and appearance (Max 15)	Total score* (Max. 100)
0.0 (P1)	39.96±0.29	28.25±0.45	11.96±0.61	85.43±0.98
0.20 (P2)	37.86±0.57	28.68±0.57	11.75±0.21	83.54±0.97
0.25 (P3)	37.96±0.75	30.31±0.78	12.71±0.44	86.29±0.96
0.30 (P4)	36.50±0.63	29.11±0.59	11.36±0.47	81.25±0.58
CD (0.05)	0.86	0.94	0.71	2.48

* Including full packaging score (5). Figures placed after ± indicates standard deviation (n=3), NS – Non-significant, CD (0.05) – Critical difference at 5.0 % level of significance

The data obtained for changes in sensory attributes of *Basundi* with increasing rate of *Ashwagandha* presented in Table 2. It was noticed that, flavor score of *Basundi* were significantly (P<0.05) differed when *Ashwagandha* added at escalating rates. The flavor score of P3 was statistically, at par with P2. Although, addition of *Ashwagandha* in *Basundi* resulted in decline in the flavor score, slight nutty and caramelized flavor was perceived in the product due to addition of *Ashwagandha* powder. The body and texture score of *Basundi* increased by addition of *Ashwagandha* powder up to 0.25 %. However, further addition resulted into slightly reduction in the body and texture score. This might be due to very thick consistency attributed by *Ashwagandha* powder. The changes in color and appearance score indicates that there was a slight improvement in the color and appearance score of *Basundi* on addition of *Ashwagandha* up to 0.25 % i.e., P3 and it had highest score, might be this imparted slight desired caramelised color to the product. However, further addition resulted into decline in the color and appearance score. There was a significant difference between total score of the *Basundi*, when *Ashwagandha* powder was added at different levels. P3 had the highest total score and it was statistically at par (P<0.05) with P1 (control). Often, the addition of *Ashwagandha* resulted in some medicinal flavor and bitter aftertaste, it imparted desired body and texture and color and appearance at 0.25 % level of addition (P3). But, further addition to 0.30 % *Ashwagandha* in the product (P4) results declination in the total score of the *Basundi*.

Dubey et al. (2013) incorporated *Ashwagandha* roots powder in beverages namely banana milkshake, mango lassi and pineapple drink. The prepared beverages were accepted with regard to sensory characteristics. 3 % *Ashwagandha* scored the best in overall acceptability in Pineapple drink, whereas 1 % *Ashwagandha* scored the best in both, Banana Milk Shake and Mango lassi. They concluded that the medicinal value of the beverages increased with addition of this herb.

Ashwagandha powder, at rate of 0.0 % (T0), 0.3% (T1), 0.5% (T2) and 0.7% (T3) with 40 % cane sugar (by weight of chakka), was mixed for manufacture of Shrikhand. Product prepared by addition of 0.5 % was superior in organoleptic parameter followed by T3, T1 and T0, respectively (Landge et al. 2011).

Effect of level of addition of sugar in *AAB* on the proximate composition

Three different rate of addition of sugar levels viz. 5, 6 and 7 % (w/w of milk) were selected so that sucrose content in the final product would be in vicinity of average value of sugar reported in literature. The effect of addition of different level of sugar in *AAB* on composition is as influenced by the sugar levels is portrayed in Table 3. It can be seen that, different level of addition of sugar in *Basundi* had significantly (P<0.05) increased the TS content. It could be observed that TS content was being increased proportionately with incremental level of sugar in product, and all the three products were significantly different from each other. Patel and Upadhyay (2004a) reported that addition of 5, 6 and 7 % of sugar had resulted in increased TS content up to 47.95, 49.09 and 51.70 % respectively in buffalo milk *Basundi*. Incremental rate of sugar in pre-concentrated milk, progressively and significantly increased the TS content of *Basundi*. The different level of sugar in *Basundi* making had non-significant effect on the fat content of the product. Tabulated value indicated that the increased rate of sugar addition increased the fat content of the product. However, the effect was found statistically non-significant. Patel and Upadhyay (2004a) also noticed that sugar addition had non-significant effect on fat content of buffalo milk *Basundi*. Present data were slightly differ from reported values by Patel and Upadhyay (2004a), might be due to addition of *Ashwagandha* in *Basundi*. It can be noticed that increasing the rate of addition of sugar significantly declined the protein content of product. However, the protein content of *AAB* at the addition of 5 % and 6 % sugar were statistically found unaffected. Patel and Upadhyay (2004a) reported significant effect of different level of sugar on protein content in *Basundi*.

It can be seen that sucrose content of the product was affected significantly with the increased level of sugar addition. It was revealed that increased rate of sugar addition had significantly (P<0.05) increased the sucrose content. In present study, sucrose level is quite lower than sugar content found in *Basundi* made by Patel and Upadhyay (2004a). This is might be due to addition of *Ashwagandha* and maintaining the TS level in the final product. It can be seen that sugar level had statistically not affected the lactose and ash content. So, sugar level had slightly increased the lactose and ash content of resultant product, but they were statistically non-significant. It is evident that fat: SNF ratio was decreased from 0.50 at 5 % sugar addition to 0.49 at 7 % sugar addition in *AAB*. However, the difference was found statistically non-significant. This decrease may be occurred might be due to increase in sucrose % in the product.

It was evident from the aforesaid that the increasing the extent of addition of sugar in pre-concentrated milk during manufacture of *Basundi* led to progressively significant increase in sucrose, and thus, TS content of experimental *Basundi*. The ratio of concentration maintained at the end of *Basundi* making being the same (i.e. 2.5 X the total milk solids including sugar), the contribution by sucrose to the TS of *AAB* increased proportionately.

Effect of sugar levels on the physico-chemical properties

The physico-chemical properties of the *Basundi* influenced by addition of sugar are collated in Table 3. It is evident that rate of sugar addition had non-significant (P<0.05) influence on the acidity (% LA) of product. From table values, it was noticed that the pH was not affected significantly with the addition of sugar

in *AAB*. However, statistically the pH was observed same for different rate of added sugar in *AAB.* Patel and Upadhyay (2004a) were reported that influence on pH of *Basundi* prepared using buffalo milk, was not affected significantly by sugar addition. The FFA content was decreased with increasing the sugar level of *AAB*, but the reduction in FFA was found non-significant. The HMF content was found increased non-significantly (P<0.05) with the increased rate of addition of sugar in *AAB*. But it could be noticed that HMF was slightly increased with the increased sugar level in product. The similar trend was observed by Patel and Upadhyay (2004a). According to them, the addition of sugar from 5-7% in *Basundi* resulted in non-significant increase in HMF content. Slight variation in the HMF values of the *AAB* might be affected due to addition of *Ashwagandha* powder. Comparison of data indicated that the initial HMF content is slightly more in present data, might be due to additional color imparted by *Ashwagandha* powder itself, as it was slight yellow-brown colored substance. As expected water activity (aw) decreased with increasing sugar level from 5 to 7 %. It can be seen that *AAB* had showed statistically similar water activity at different rate of sugar addition in product. Such effect of sugar addition on water activity (a_w) is an established phenomenon observed in other similar dairy and food products (Walstra and Jenness, 1984). Patel and Upadhyay (2004a) observed the significantly (P<0.05) decreased water activity of *Basundi* prepared from buffalo milk with addition of sugar. Slight variation in water activity values of the *AAB* might be influenced by addition of *Ashwagandha* powder. This could be possibly advantageous to use higher level of sugar for enhancing the shelf life of the *AAB*. The specific gravity of *Basundi* samples increased significantly (P<0.05) with increased in sugar level from 5 to 7 %. These tabulated values revealed that specific gravity of 5 and 6 % sugar added *Basundi* were statistically alike. Similarly, use of 6 and 7 % sugar level in product were observed significantly at par in their specific gravity. But specific gravity of 5 and 7 % rate of added sugar in *Basundi* were noticed significantly different. Patel and Upadhyay (2004a) also reported the similar influence of sugar levels on specific gravity of the buffalo milk *Basundi*.

The viscosity of the *AAB* samples were significantly (P<0.05) higher at each incremental level of sugar addition. Thus, it can be clear that viscosity of each level of sugar addition was significantly differed from each other. According to Patel and Upadhyay (2004a) the viscosity of the *Basundi* samples was significantly higher at each incremental level of sugar addition, mainly on account of increased solids content, mainly on account of increased solids content. This implies that a nominal rise in sugar level can be used to obtain adequate viscosity, without rendering the product too sweet. From Table 3 it is evident that, there was a significant decreased in the insolubility index of the *AAB* with the increased level of sugar. It was noticed that a significant decreased in insolubility index exhibited when the sugar level was raised from 5 to 6 % and beyond that level, the insolubility index remained unaffected i.e. at 6 and 7 % addition of sugar, the insolubility index was found statistically at par. Patel and Upadhyay (2004a) suggested that this implies beneficial effect of increased sugar level on the protein stability in buffalo milk *Basundi*. Data delineated by them are lower than the present data (Table 3) for *AAB.* The higher level of insolubility index is due to addition of *Ashwagandha* powder in the product. Gaikwad and Hembade (2011) reported that best Ujani *Basundi* product with optimum consistency and optimum sweet with characteristic brown colour can be prepared by using the standardized Buffalo milk with 6% fat and 9% SNF by adding the 8% sugar and

Table 3: Effect of levels of sugar on the proximate composition and physico chemical properties of *AAB*

Constituents (%)	Rate of addition of sugar (%)			CD (0.05)
	5	6	7	
Total Solids	47.21±0.03	47.78±0.08	49.06±0.11	0.11
Fat	11.71±0.17	11.70±0.06	11.44±0.06	NS
Protein	10.16±0.04	10.12±0.07	10.03±0.06	0.08
Lactose	10.94±0.03	10.83±0.16	10.74±0.11	NS
Sucrose	12.31±0.12	13.01±0.33	14.73±0.38	0.41
Ash	2.09±0.10	2.10±0.04	2.11±0.08	NS
Fat : SNF ratio	0.50±0.004	0.50±0.002	0.49±0.001	NS
Acidity (%LA)	0.45±0.01	0.44±0.01	0.44±0.01	NS
pH	6.51±0.01	6.53±0.01	6.54±0.04	NS
FFA (µ eq/ml)	1.34±0.01	1.29±0.03	1.25±0.08	NS
HMF (µ mol/litre)	15.65±0.05	16.22±0.18	16.72±0.19	NS
Water activity (a_w)	0.973±0.001	0.963±0.010	0.964±0.022	0.010
Specific gravity	1.14±0.01	1.15±0.01	1.16±0.01	0.01
Viscosity (mPa.s)	54.72±0.25	57.86±0.54	60.21±0.74	0.76
Insolubility index (ml)	0.34±0.01	0.32±0.01	0.31±0.01	0.01

Figures placed after ± indicates standard deviation (n=4), NS – Non-significant, CD (0.05) – Critical difference at 5.0 % level of significance

concentrating to 3.0X to its original total solids including sugar. Patel and Upadhyay (2003a) and Patel and Upadhyay (2004a) also reported the similar effect of sugar addition and found non-significant (P<0.05) effect on the acidity of *Basundi* prepared from buffalo milk. So reported values were appearing to be alike to the present acidity of *AAB.*

Therefore, it is evident that the level of sugar did not significantly influenced the acidity, pH, FFA, HMF whereas, water activity (a_w), specific gravity, viscosity and insolubility index were markedly influenced. Based on these physico-chemical properties, it seems that a level of 6 % sugar addition is beneficial with regard to protein stability, FFA development and viscosity.

Effect of sugar addition on the sensory attributes of *AAB*

The prepared samples of *Basundi* with 5, 6 and 7 % sugar (w/w of milk) were subjected to sensory evaluation by panel of seven judges using sensory score card for *Basundi*. Total five replications were conducted for the each rate of addition. The data obtained for changes in sensory attributes of *Aswagandha* added *Basundi* with increasing rate of sugar are presented in Table 4. It is evident that flavor score was significantly (P<0.05) influenced by the sugar addition at different rate in the *AAB.* Flavor and total scores in product were significantly higher at 6 % rate of sugar addition. Body and texture score of *AAB* prepared using different level of sugar were alike statistically. Therefore, it could be perceived that 6 % addition in product was most acceptable on account of body and texture of product. The body and texture score of the product diminished on further raising the sugar addition which had tendency to give thick consistency. Total score was significantly (P<0.05) influenced by the level of sugar addition in the *AAB.* The total score allotted to 6 % sugar level was highest (88.29) followed by 5 % (86.57) and 7 % (86.05) of sugar addition in the product.

The *AAB* prepared using 5 % level sugar was perceived to be some typical flavor, medicinal, bitter or groundnut flavor in the product, as mentioned by judges. On contrary, *Basundi* made using 7 % sugar perceived to be sweeter. The sensory quality of

Table 4: Effect of rate of addition of sugar on sensory score of *AAB*

Rate of sugar addition (%)	Sensory score of *Basundi*			
	Flavor (Max. 45)	Body and texture (Max. 35)	Color and appearance (Max 15)	Total score* (Max. 100)
5.0	39.10±0.57	30.21±0.40	12.27±0.25	86.57±0.93
6.0	40.61±0.11	30.53±0.31	12.14±0.43	88.29±0.59
7.0	38.92±0.38	30.09±0.48	12.05±0.40	86.05±0.88
CD(0.05)	0.55	NS	NS	1.17

* Including full package score (5); Figures placed after ± indicates standard deviation (n=4), NS – Non-significant, CD (0.05) – Critical difference at 5.0 % level of significance

Table 5 Effect of addition of flavoring on the sensory attributes of the *AAB*

Addition of Flavors	Sensory Score			
	Flavor (Max. 45)	Body and Texture (Max. 35)	Color and Appearance (Max 15)	Total Score* (Max. 100)
Control	38.89±0.37	30.56±0.88	12.32±0.29	86.77±0.99
Cardamom	42.23±0.49	31.16±0.47	12.57±0.31	90.97±0.82
Saffron	40.66±0.26	30.96±0.34	12.79±0.52	89.41±0.95
Nutmeg	39.57±0.76	30.97±0.65	12.14±0.51	87.68±0.99
CD (0.05)	0.78	NS	NS	1.52

* Including full package score (5); Figures placed after ± indicates standard deviation (n=3), NS – Non-significant, CD (0.05) – Critical difference at 5.0 % level of significance

the product diminished on further raising the sugar addition rate mainly on account to excessive sweetness and partly due to thick consistency. It can be inferred that the addition of sugar at 6 % by weight of milk yielded organoleptically superior quality *Basundi*. Thus, taking cognizance, sensory score and judge's preference, 6 % sugar addition was considered to be optimum.

Effect of addition of flavorings in the *AAB*

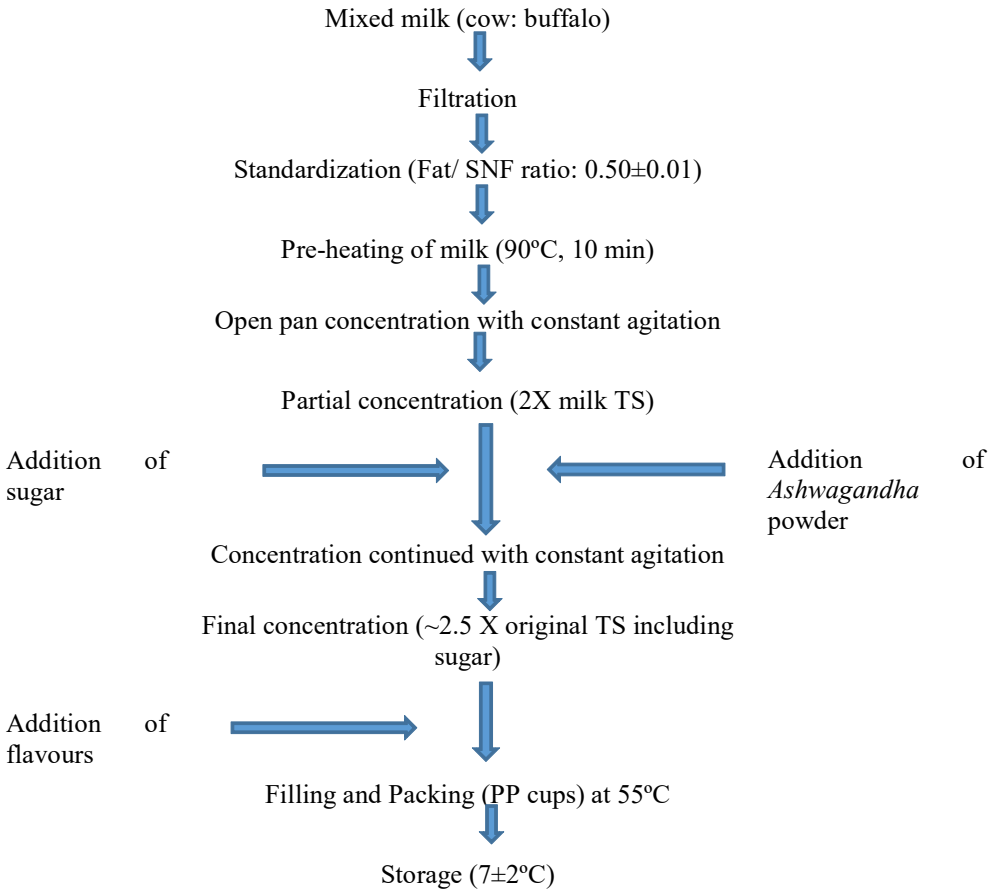

Fig.1 Flow Diagram for Preparation of *Basundi* using *Ashwagandha* powder

Table 6 Average Chemical Composition, Physicochemical Properties and Microbiological Quality of *AAB*

Attributes of Standardised *Basundi* Prepared Using *Ashwagandha* Powder			
a. Proximate Composition%		b. Physico-chemical Properties	
Total Solids	47.78	Acidity (%LA)	0.45
Fat	11.73	pH	6.52
Protein	10.12	FFA (µ eq/ml) (oleic acid)	1.34
Lactose	10.83	HMF (µ mol/ litre)	16.32
Sucrose	13.03	Water activity (a_w)	0.96
Ash	2.10	Specific gravity	1.15
Fat : SNF ratio	0.50	Viscosity (mPa.s)	56.41
Withanolides, on dry matter basis	0.29	Insolubility index (ml)	0.33
c. Sensory Attributes		d. Microbiological Quality	
Flavor	41.33	Standard Plate Count	$2.24x10^3$ cfu*/g
Body and Texture	31.28	Thermoduric Count	Nil
Color and Appearance	12.52	Yeast and Mould	Nil
Total score	90.13	E. coli Count	Nil

*Colony forming unit

One of the important aspects considered in the acceptability of dairy product is the enticing flavoring ingredients. The flavoring ingredients utilized in *Basundi* are cardamom (about 0.02 % of concentrated milk), saffron and borneol (edible camphor) etc. (Aneja et al. 2002a). Hence, to improve the flavor profile and to enhance the overall acceptability of *AAB*, suitable flavor could be added as background flavor. Therefore, three different flavorings viz., cardamom, saffron and nutmeg at rate of about 0.02 % of concentrated milk were used to assess their compatibility with *AAB*. *AAB* without a flavor addition was used as control. The data obtained for changes in sensory attributes of *Basundi* with addition of different flavor in *AAB* is presented in Table 5. From the tabulated values it was revealed that different flavoring had a significant ($P<0.05$) effect on the flavor, and total score of the product, whereas, body and texture and color and appearance score was almost unaffected with respect to addition of background flavors in product. Similarly, use of nutmeg flavor given the flavor score comparable to control. Incorporation of cardamom to the *AAB* as background flavor resulted masking effect as it reduced the bitter/ medicinal after taste in the prepared *AAB*. It can be seen that the *Ashwagandha Basundi* prepared with addition of cardamom, saffron and nutmeg as flavors ingredients; the total score found were 90.97, 89.41 and 87.68 respectively. Owing the highest sensory acceptance and its masking property, cardamom was selected for the final product.

Standardized method for preparation of *AAB*

For manufacture of sensorily acceptable, value added *Basundi*, the standardized method of manufacture is developed from the above study. For this purpose, fresh mixed milk, skim milk, cream, *Ashwagandha* powder, sugar and flavoring were used.

For preparation of *AAB* the standardized process was comprised of standardization of mixed milk (0.50±0.01, fat: SNF ratio), fore-warming of milk (90ºC for 10 min), partial concentration to approx. 2X the original milk TS, addition of sugar (6 %, w/w of milk) and *Ashwagandha* powder (0.25 %, w/w of milk), final concentration to approx. 2.5X the original milk TS inclusive of sugar, filling and packing in polypropylene (PP) cups at 55ºC, cooling and storage (7±2ºC). For preparation of *Basundi* using *Ashwagandha* for value addition the standardized method is given in Fig. 1. The Average Chemical Composition, Physicochemical Properties and Microbiological Quality of standardized *AAB* is depicted in Table 6. The proximate composition of standardized *Basundi* added with Ashwagandha at 0.25 %, sugar 6 % and Cardamom flavor had the proximate composition having total solids 47.78 %, fat 11.73 %, protein 10.12 %, lactose 10.83 %, sucrose 13.03 %, ash 2.10 % and fat: SNF ratio 0.5. Withanolides content of the product was 0.29 % (on dry matter basis). The proximate physico-chemical properties were having acidity 0.45 % lactic acid, pH 6.52, FFA 1.34 µ eq/ml, HMF 16.32 µ mol/litre, water activity 0.97, specific gravity 1.15, viscosity 56.41 mPa.s and insolubility index 0.33 ml. Sensory score for the standardized *Basundi* prepared using *Ashwagandha* powder were 41.33, 31.28, 12.52 and 90.13 for flavor, body and texture, color and appearance and total score, respectively. Microbiological quality assessed in standardized *Basundi* (fresh) was found to be standard plate count (SPC) $2.24x10^3$ cfu/g, whereas thermoduric count, yeast and mould and E. coli count were nil.

Conclusion

Hence, it can be concluded that a sensorily acceptable, delectable, novel and value added *Basundi* can be prepared using 0.25 % *Ashwagandha* powder, 6 % sugar and cardamom flavor. Commercialization of such *Basundi* will promote the production and utilization of the Indian traditional dairy product *Basundi* and the therapeutic herb *Ashwagandha*.

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