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Development of herbal milk beverage

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Abstract
The interest and use of *Aloe vera* as a valuable ingredient has increased dramatically. The present study investigated the possibility of developing a novel herbal milk beverage for commercialization to satisfy the needs of health-conscious consumers. The natural *Aloe verais barbadensismillar* extract used as a functional ingredient. The product was developed through trials with different levels of sugar (low, medium, high), pH (3.00– 4.50) levels and flavors (almond and ginger). The product was formulated and improved according to consumer preference based on sensory evaluation. The nutritional composition of the product was evaluated through standard analytical method. All the sensorial parameters which were tested in the formulated product scored above 7.0 in nine-point-hedonic scale which represented that the product was towards the "extremely-like" range. *Aloe vera* incorporated herbal milk beverage was acceptable to consumers. The nutritional composition matched with Food Act No. 26 of 1980. The product possessed good overall acceptability, physiochemical quality and the shelf life of 14 days. The product was acceptable for commercialization in terms of consumer preference.

Keywords: *aloe vera*, consumer, functional

1. Introduction
The food retailing industry has undergone massive consolidations in the last 25 years, with a huge change in food retailing centers where consumers are offering now with a vast diversity of foods which have never been seen before. When considering dairy display in a modern food shopping center, it provides a vast array of choices [6]. So the market for dairy products in most of the countries has been growing steadily; most of this growth can be attributed directly to the introduction of novel product options and increasing applications of milk constituents in other food formulations [4]. Nowadays, however, in all parts of the world, the production of various types of milk beverages is increasing rapidly, and they are becoming more popular day by day [9].

People all over the world are becoming more health conscious due to the increasing knowledge and awareness towards the advantages of herbal components. So large numbers of the population are moving towards herbal food products for their health benefits. Milk has always been a choice of innovation for food researchers to meet the ever changing consumer's preferences for newness in the products because it is a good medium to convey maximum medicinal benefits of herbs to human. The herbal milk characterizes a great in-between meal and medicine. Since Vedic times health benefits of milk have been enhanced through the use of herbal infusions and this is used for prevention against a list of diseases and to overcome nutritional deficiencies which is almost impossible to avoid in these modern times, thus natural supplements help in overall growth, development and enhanced immunity [8]. So it can be flavored with different herbal plants to change the medicinal properties.

The demand for functional foods with prolonged shelf life and without chemical preservatives have increased around the world. The inclusion of physiologically active natural components with beneficial effects on health by strengthening the nutritional value of milk beverages. Currently the interest and use of Aloe vera as a valuable ingredient for food and pharmaceutical industry has increased dramatically due to its biological activities and functional properties [12]. Various authors have suggested the use of Aloe vera juice in food commodities such as beverages, jams, candies, wines, and dairy products as a dietary supplement and functional ingredient [3]. There are as many as 200 different types of molecules in Aloe vera [1]. The Aloe vera leaf gel contains about 98% water, 0.66% total solids, 0.56% total soluble solids with some seasonal fluctuation. On dry matter basis Aloe gel consists of polysaccharides (55%), sugars (17%), minerals (16%), proteins (7%), lipids (4%) and phenolic compounds (1%) and contains many vitamins including the important antioxidants such as vitamins A, C and E. Vitamin B1 (thiamine), niacin, Vitamin B2 (riboflavin), choline and folic acid are also present [1]. Moreover, Food and Drug Administration (FDA), in the United States has approved the internal use of gel as a "dietary supplement" and also in the European Commission (EC) according to Annex I of Regulation No 1831/2003 [8]. Therefore, the addition of Aloe vera gel makes it possible to produce functional foods from milk by keeping their chemical, physical and sensory characteristics and fortifying their nutritional value by introducing biologically active components, in a controlled way by allowing fast compositional changes [11].

2. Materials and methods
2.1. Extraction and preservation of Aloe Vera juice
Extraction and preservation of pure Aloe vera juice were prepared by using freshly harvested leaves, through washing thoroughly with water containing Potassium metabisulfite at

500 ppm and the gel was extracted. For extraction of juice, the gel was passed through a high shear mixer, homogenized and treated with sugar at 1:1 ratio, pectin (0.5 %) at 60-70ºC for 30 minutes followed by filtration and pH adjustment (3.5) by adding citric acid. Further, it was cooled and stored at 4-6^{0}C for preparation of value-added products. The unit operations for extraction and preservation of pure Aloe vera juice for its further value addition are illustrated below through flow diagram (Figure 1).

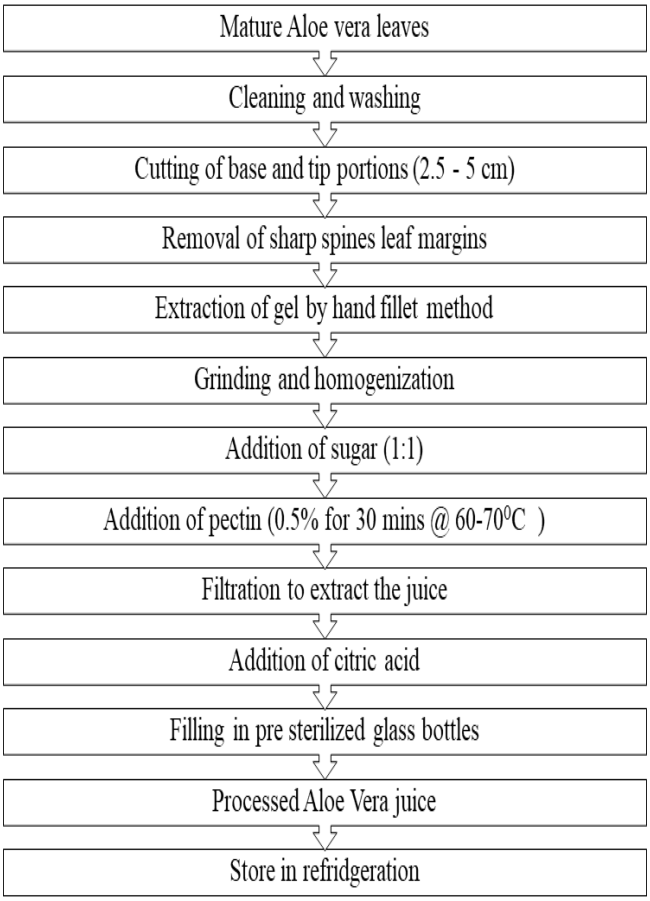

Fig 1: Procedure of extraction and preservation of Aloe vera juice

Fresh juice was analyzed for different physicochemical characteristics as per the standard methods. Total soluble solids, pH, titratable acidity, total sugars, reducing sugars, ascorbic acids and total phenols were measured according to standard procedures. The microbial load was recorded using the standard plate count method.

Fresh cow milk was standardized and pasteurized. The milk was cooled and stabilizer were and mixed well. Aloe vera pulp was added into the milk. First trial was conducted at neutral pH with 3 levels of sugar and the second trial was conducted in acidified pH with 3 different levels of sugar. The mixture was added with flavors (almond and ginger). Each trial was tested through sensory evaluation and the formulation selected according to the results obtained. The mixture was pasteurized, stained and bottle. The preparation procedure of Aloe vera incorporated herbal milk beverage is illustrated below through flow diagram (Figure 2).

Fig 2: Preparation of herbal milk beverage

The freshly prepared Aloe vera incorporated herbal milk beverage was analyzed for pH, total soluble solids, total solids during storage to find the effect of storage on its chemical composition. pH was determined with the help of the pH meter. The total soluble solids were determined by using a hand refractometer at room temperature and total solids were analyzed by using moisture analyzer.

Proximate composition such as crude protein, crude fat and ash content of the product were evaluated through standard procedure according to AOAC approved standard method (AOAC, 2006) and all experiments were carried out in triplicate.

Microbiological studies were conducted at every five days of storage. Aerobic plate count, and *E.Coli* were undertaken. Standard procedure according to AS 1766:1991; Section 2.1 used for Aerobic plate count and Standard procedure according to IDF Standard 73 A: 1985 (Method A) used for coliform detection.

Sensory evaluation was done with 30 semi-trained panelists along with ballot paper prepared as nine-point hedonic scale. Sensory qualities such as appearance, taste, odor, color, and overall acceptance were evaluated. The samples were given three-digit random numbers and placed in plastic cartons and served in random order to panelists.

Gathered data through ballot paper prepared as nine-point hedonic scale were analyzed by using Microsoft application package MS Excel 2010 and the data analyzed were interpreted through the Radar chart. Sensory evaluation data which obtained every seven days of storage period were analyzed by Kruskal–Wallis test by ranks non-parametric test in SPSS software package with 95% confidence interval. Statistical significance was declared at $P < 0.05$.

3. Results and discussion

The objective of the study was to extract Aloe vera pulp from Aloe vera to develop Aloe (*Aloe verais barbadensismillar*) incorporated herbal milk beverage and to evaluate its sensory, physio chemical, and microbial qualities.

3.1 Sensory analysis test results

Sensory scores mean values were used to choose the preferred formulation of the herbal milk beverage.

Table 1: Mean ranks of the sensory attributes tested through sensory evaluation to find the preferred sugar level at the pH 4.0

Sample	Color	Aroma	Texture/ Mouth feel	Overall taste	Overall acceptability
5% of sugar	6.70 ± 0.64	4.27 ± 0.98	4.61 ± 0.86	4.42 ± 0.79	4.42 ± 0.87
7% of sugar	6.67 ± 0.60	4.67 ± 0.69	4.67 ± 0.65	4.76 ± 0.75	4.88 ± 0.78
9% of sugar	6.82 ± 0.53	5.58 ± 0.61	5.48 ± 0.51	5.27 ± 0.57	5.12 ± 0.70

As in the table 3.1, 9% of sugar level showed highest mean ranks in all tested attributes such as color, aroma, texture/mouth feel, overall taste and overall acceptability.

Table 2: Mean ranks of the sensory attributes tested through sensory evaluation to find the preferred sugar level at the pH 4.5

Sample	Color	Aroma	Texture/ Mouth feel	Overall taste	Overall acceptability
5% of sugar	6.91 ± 0.68	6.94 ± 0.86	7.24 ± 0.56	6.97 ± 0.77	6.97 ± 0.73
7% of sugar	6.97 ± 0.73	7.06 ± 0.70	7.21 ± 0.74	6.97 ± 0.81	7.12 ± 0.78
9% of sugar	7.24 ± 0.71	7.33 ± 0.74	7.33 ± 0.74	7.03 ± 0.59	7.15 ± 0.76

As in the table 3.2, 9% of sugar level showed highest mean ranks in all tested attributes such as color, aroma, texture/mouth feel, overall taste and overall acceptability.

Table 3: Mean ranks of the sensory attributes tested through sensory evaluation to find the preferred pH level at the sugar level of 9%

Sample	Color	Aroma	Texture/ Mouth feel	Overall taste	Overall acceptability
pH 4.0	6.42 ± 0.90	6.67 ± 0.96	6.45 ± 0.90	6.39 ± 1.03	6.45 ± 0.83
pH 4.5	6.85 ± 0.76	6.82 ± 0.64	6.91 ± 0.63	6.94 ± 0.86	6.64 ± 0.70

As in the table 3.3, pH 4.5 with 9% of sugar level showed higher mean ranks in all tested attributes such as color, aroma, texture/mouth feel, overall taste and overall acceptability compared to the sample with pH 4.0 and 9% of sugar level.

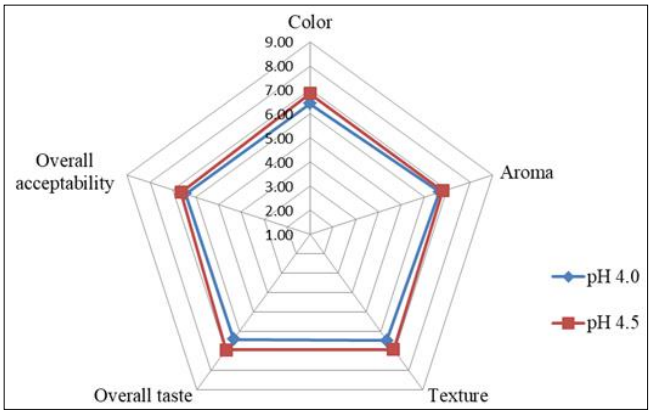

Fig 3: Radar graph for sensory mean scores of developed milk with pH 4.0 and 4.5

According to the figure 3.1 highest overall acceptability scores were received by pH 4.5 milk sample.

Table 4: Mean ranks of the sensory attributes tested through sensory evaluation to find preferred flavor

Sample	Color	Aroma	Flavor	Texture/ Mouthfeel	Overall taste	Overall acceptability
Almond	7.03± 0.77	6.94± 0.75	5.67± 0.54	6.97± 0.77	6.79± 0.82	7.12± 0.74
No flavors	7.21± 0.70	6.91± 0.68	5.79± 0.55	7.03± 0.77	7.00± 0.66	7.12± 0.70
Ginger	7.33± 0.69	7.36± 0.70	6.52± 0.87	7.18± 0.73	7.33± 0.74	7.27± 0.67

According to the figure 3.4 highest overall acceptability scores were received by ginger flavor added milk sample.

The product was made up of 5% Aloe pulp, 9% sugar, ginger flavor at the pH of 4.5. The amount of Aloe vera pulp used was 5% and it was the sensorial wise preferred amount included into milk. Along with-it Aloe vera has bitter taste due to aloin content which presence in the leaves, because of bitterness it was not tally with the neutral pH even with different flavors. To make it preferable by the consumers, the product was acidified using citric acid.

When comparing sugar level with dietetic herbal flavoured milk were prepared using Aloe vera pulp [7], they used artificial sweeteners like aspartame and sucralose and analysed for their physico-chemical properties and chemical composition. But here sugar was used as sweetner. Sugar amount added to formulate the product matched with the standards for milk added pasteurized drinks. According to SLS 917.1991 the amount of sugar level must be more than 5% and in this product it contained 9%.

3.2 Proximate composition

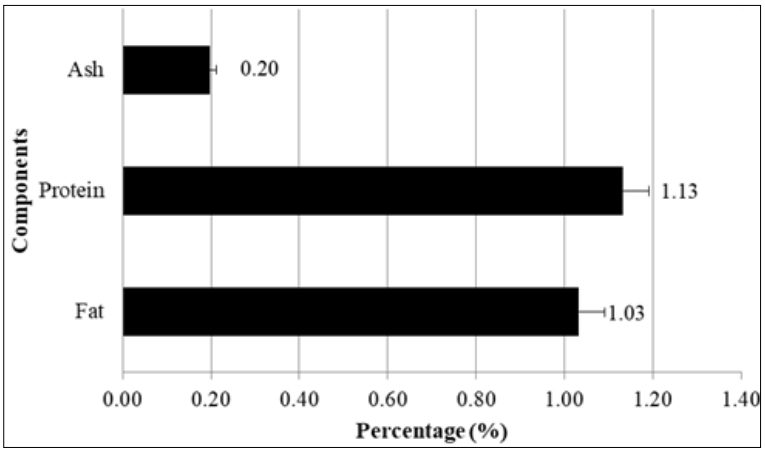

Fig 5: Proximate composition of herbal milk beverage incorporated with Aloe vera

Developed herbal milk beverage consisted of 0.2% of ash content, 1.13% of crude protein, and 1.03% crude fat. Ash content represents the mineral content in food products [2]. The ash content, crude protein and crude fat presented in the product was lesser than dietetic herbal flavored milk [7]. According to the Food Act No. 26 of 1980, maximum fat percentage for pasteurized/ sterilized/ UHT semi skimmed low fat milk was 2% and crude fat of this product was matched with this specification. According to Codex alimentarius CAC/RCP -57-2004 Code of hygienic practice for milk and milk products, there are no standards for herbal milk beverage but the ash, crude protein and crude fat content were lesser when compared to the specifications for chocolate flavored pasteurized milk, coffee flavored pasteurized milk, sweetened pasteurized whole milk, natural pasteurized milk and strawberry flavored pasteurized milk.

3.3 Physio- chemical evaluation of final product

Table 5: Physio-chemical evaluation of final product during the storage period

Parameters	1st day	5th day	10th day	15th day
pH	04.55 ± 0.01	04.58 ± 0.01	04.59 ± 0.01	04.58 ± 0.01
Total solids (%)	13.79 ± 0.00	13.80 ± 0.00	13.83 ± 0.00	13.52 ± 0.00
Total soluble solids (%)	13.50 ± 0.00	13.10 ± 0.00	13.20 ± 0.00	13.02 ± 0.00
Discoloration	No	No	No	No

Values are mean ± standard deviation of triplicate analysis.
The highest pH recorded was 04.59 ± 0.01 on the 10th day and the lowest pH was 04.55 ± 0.01 recorded on 1st day. Total solids and total soluble solids were found between the range of 13.52-13.83% and 13.90 – 15.20 % respectively. There was no discoloration during the storage period.

3.4 Microbial evaluation of final product

Table 6: Microbial evaluation of final product during the storage period

Parameters	1st day	5th day	10th day	15th day
Aerobic plate count (cfu/ml)	18	106	230	116
Coliform count (cfu/ml)	Absent	Absent	Absent	Absent

According to table 3.6 highest aerobic plate count was observed in 10th day with the count of 230. The coliform count was zero throughout the storage period.
Microbial evaluation of this product was analyzed by calculating aerobic plate count and coliform count. According to SLS 181. 1983 the Aerobic Plate Count should be less than 30000 cfu/ml and coliform count should be less than 1. This product consisted with the Aerobic Plate Count ranged from 18 – 230 cfu/ml. The counts were much lesser than the standard levels. The reasons for this may due hygineic processing of Aloe vera and preparation procedures, and because of its antimicrobial property. There was no coliform found in the product up to 14 days of storage. So it was matched with the microbial specification for milk added pasteurized drinks. Thus, it was coincided with the concept that aloe gel could be utilized for bio-fortification of various foods as a source of antioxidant rich ingredient, nutraceuticals or as a natural preservative[5].

3.5 Shelf life sensory evaluation results of final product

Table 7: Mean ranks of the sensory attributes tested through sensory evaluation to find the shelf life of the final product

Attributes	1st day	7th day	14th day
Appearance	7.47 ± 0.82	7.48 ± 1.00	7.28 ± 1.29
Flavor	7.30 ± 1.06	7.48 ± 1.00	7.10 ± 1.16
Aroma	7.33 ± 0.71	7.43 ± 1.01	6.86 ± 1.22
Overall taste	7.17 ± 1.21	7.60 ± 0.81	6.86 ± 1.26
Mouth feel/Texture	7.40 ± 0.89	7.57 ± 0.89	7.00 ± 1.21
Overall acceptability	7.13 ± 1.07	7.53 ± 0.81	7.28 ± 1.05

According to the table 3.7 all the sensorial attributes were above 7.0 up to seven days and after that on fourteenth day of evaluation sensorial attribute aroma and overall taste drop below 7.0 but above 6.5. There was no significance difference between all the sensorial attributes when compared to the first day.

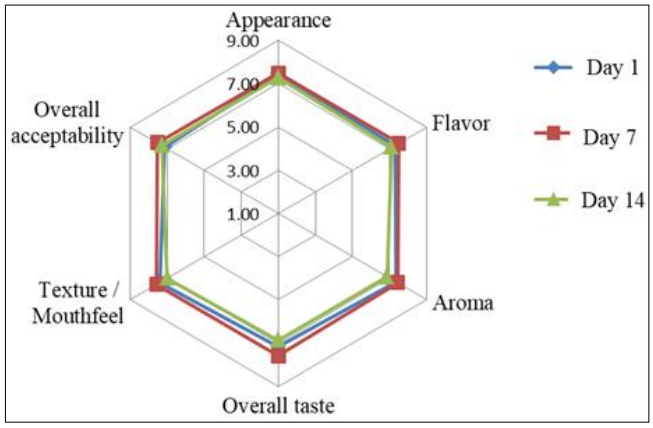

Fig 6: Radar graph for sensory mean scores of final products during the storage period

All the sensorial attributes which gathered during first, seventh and fourteenth day are evenly distributed in a regular pattern and it completed hexagon shape.

In product development, sensory evaluation plays a vital role for evaluation of products. When quality of a food product is assessed by means of human sensory organs, the evaluation is said to be sensory or subjective [2]. Sensory attributes are the most significant quality parameters for determining consumer acceptance. Sensory evaluation is the only method for getting correct opinion of the target population and consumer acceptance of the product and there are different rating scales used for testing the product acceptance, out of these the hedonic scale is mostly used [5]. Sensory evaluation of the product was conducted initially and weekly which includes appearance, aroma, mouth feel/ texture, flavor, overall taste as well as the overall acceptability. According to the sensory evaluation results there was no significant difference between the considered attributes up to 14 days. Sensory mean rank scores were above seven in all attributes except aroma and overall taste on 14th day. In 9-point hedonic scale sensory evaluation, the rank seven is considered as the mid-point between neither like nor dislike and like extremely. So, this product was acceptable for commercialization in terms of consumer preference.

The shelf life of the developed herbal milk beverage was 14 days and it was the recommended shelf life for pasteurized products under the storage condition of 4 ^{0}C [6]. This product can be tested to store for extended time periods because of its low microbial count.

On present investigation, efforts were made to develop different blends of Aloe incorporated herbal milk beverage and tried to evaluate its quality [10]. Healthy and long leaves were suitable for the gel extraction as they contain large amount of leaf pulp. Care should be taken while extracting the gel, don't let the yellow substance that is anthraquinone to mix with the gel. Sensory qualities of all blends were carefully evaluated to find out the most favorite blend. An effort was made to make Aloe incorporated herbal milk beverage using the available resources and to develop awareness about its importance among the people.

4. Recommendations

In future, studies on development of UHT treated herbal milk beverage with same formulation can be done to extend the shelf life of the product and studies based on survey to find beneficial health effects such as reducing gastritis and effect on reducing weight.

5. Conclusion

Aloe incorporated herbal milk beverage, which was acceptable to consumers formulated with 5% aloe pulp, 9% sugar, ginger flavor and with the pH of 4.5. It consisted of 0.2% of ash content, 1.13% of crude protein, and 1.03% crude fat and it showed good overall acceptability, physiochemical quality, microbial quality and shelf life of 14 days.

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