Development of Herbal Spiced Buttermilk

ABSTRACT

Aims: The study aimed to develop the herbal spiced buttermilk added with functional ingredients.
Study design: Development of herbal spiced buttermilkand its analysis.
Place and Duration of Study: Department of Dairy Technology, Dairy Science College, Hebbal, Bengaluru, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka, India. Between January 2024 and September 2024.
Methodology: Ingredients for the herbal spiced buttermilk were optimized based on the 9-point hedonic sensory score by panel judges. The optimized product was then analyzed for its rheological attributes, chemical quality and microbiological quality.
Results: The optimized herbal spiced buttermilk contains rock salt (1%), spice mix of ginger, garlic, chili and coriander (0.3%), Tamarind (2%) and fenugreek seed powder (0.3%)The optimized herbal spiced buttermilk had 1.16% fat, 2.31% protein, total solids at 7.43% and ash at 1.35%. Acidity was 0.53% LA, viscosity of herbal spiced buttermilk was 4.75 cP,Water activity was 0.892 and colour measured at L* 60.60, a* 1.66 and b* 14.66. Coliforms, yeast and molds were nil.
Conclusion: The developed herbal spiced buttermilk product exhibited excellent taste and shelf life at refrigeration temperature.

Keywords: Herbal spiced; buttermilk; spice mix; tamarind; fenugreek seed powder.

1. INTRODUCTION

India is the highest milk producer in the world stands in the first position with the total of 230.58 MT during the year 2022-2023 with per-capita availability of 459 gram/day, about 45 to 50 % is converted into indigenous dairy products and the fermented sector having the annual rate of more than 20% per annum BAHS [5].

The Indian dairy market size is INR 16,792.1 billion in 2023 and it is estimated to grow INR 49,953.5 billion by 2032 and the dairy market size CAGR (Compound annual growth rate) of 13 % during the year 2024-2032[4].

IMARC [3] studied the curd market size in India reached INR 1.571.7 billion in 2023 and it is expected to reach INR 4,988.0 billion by 2032, the exhibiting a growth rate that is Compound annual growth rate of 13.2% during 2024-2032. The By-product is the buttermilk having the market size in India reached INR 162.3 billion in 2023 and it is estimated to grow INR 819.4 billion by 2032, exhibiting the compound annual growth rate of 19.1% during 2024-2032 [2].

The fermented milks and milk products with addition of herbs which may contribute towards variety of health benefits. Development of suitable dairy products using by-product with incorporation of the spices and herbs. Curd is fermented milk product obtained by fermentation of milk and it promotes the health of the host boosting the immune system. Curd strengthens natural immunity by stimulation of mucosal and systemic host immunity,

immunoglobins level is increased, higher levels of natural killer cell activities and cytokines in the host body[22].

Salt is also used extensively in cooking as a flavour enhancer while rock salt having lot of health benefits which can improves appetite, removes gas and soothes heartburn and also stabilizes blood pressure by maintaining a balance of high and low blood pressures. Rock salt is used as a home remedy for curing many disorders and ailments such as rheumatic pain and herpes, inflammation and irritation from insect bites and rock salt will strengthens the bones and connective tissue [23].

Ginger scientific name *Zingiber officinale*, it is an herb and ginger spice comes from the roots of the plant. It is a culinary element used as traditional medicinal. Commonly used for the treatment of nausea, common cold, asthma, and muscle pain. Ginger can be used as fresh, dried, powdered, or in the form of juice or oil [7].The active constituents in garlic are sulphur containing compounds that are rapidly absorbed and metabolized. Garlic's medicinal uses are to lower blood pressure and cholesterol, fight infections, and prevent cancer [20].Chilies having wide range of vitamins especially vitamin A (carotene) and C (ascorbic acid), vitamin C is the only vitamin with strong antioxidant properties that can scavenge free radicals also chili as distinct bioactive compounds include capsaicin, homo-capsaicin and 6,7-dihydrocapsaicin, it is also having anti-inflammatory agent, immunity booster and good retinoid activity [12].Coriander is known to possess antidiabetic, antimutagenic and anticancer, antioxidant, antimicrobial, anti-inflammatory, anticonvulsant, hypnotic, hypolipidemic, insecticidal, nematicidal and larvicidal activities [24].

Tamarind is having beneficial activities like antidiabetic, hypolipidemic, hepatoprotective, anti-ulcer, anti-inflammatory, analgesic, antivenom, antimicrobial and antihelmintic properties. In the medicinal values this plant is also consumed by rural people as vegetable and it is also used a flavouring agent to impart flavour to various dishes and beverage[13].

Fenugreek seeds have been known and valued as medicinal material from very early times and it is widely cultivated as a drug plant. Fenugreek is employed for medicinal purpose in many traditional systems and it is used as a Lactation Aid, Diabetes Management, Hypoglycaemic Effects, Antioxidant Activity, Antibacterial Activity. Diosgenin, 4-hydroxyisolecuine and the fibre component is the most bioactive constituent present in the fenugreek that has beneficial effect on glucose tolerance, inflammation, insulin action, liver function, blood lipids and cardiovascular health [9].Fenugreek seeds are aromatic, bitter taste and it includes many chemical components like alkanoids, amino acids, steroidal includes diosgenin, flavonoids, fibres, coumarin, vitamins, minerals, lipids, mucilage, and proteins [19].

2. MATERIAL AND METHODS

2.1 Materials

Fresh cow milk is procured from the student's experimental dairy plant (SEDP) at Dairy Science College, Bengaluru, curd culture procured from department of dairy microbiology added at 2% followed by incubation at SEDP.Rock salt was be procured from Natural tattva manufactured by Mehrotra consumer products PVT.LTD. Gautam Buddha Nagar, Uttar Pradesh.Ginger, garlic, chili and coriander were procured from the local market it is cleaned and trimmed the edible portions. Spice mix were ground using a mechanical blender into a fine, smooth paste and stored for further usage.Tamarind was procured from the Indras manufactured by Indira food PVT.LTD. Kanakapura Road, Bengaluru and Fenugreek seed

was procured from organic tattva manufactured by Sriveda Sattva PVT. LTD. Udayapura, Bangalore.

2.2Methods

The buttermilk is prepared as described by the Ghandhi [10]with slight modification. Raw milk heated to 90℃ for 5 min and added culture at 2% followed by incubation at 37℃ for 6 hours. After curd formed water added at 1:1.5 ratio packed in the pouches then stored at refrigeration condition (5±1℃)

2.2.1 Optimization of base spice mix for the development of spiced buttermilk

To enhance the Flavour, taste of buttermilk added rock salt at 0.5, 1.0 and 1.5 % to the plain buttermilkfor the preparation of spiced buttermilk. With 1.0 % rock salt is optimized and spice mix which includes ginger, garlic, chili and coriander added at 0.3, 0.5 and 1.0 % at equal proportion to the buttermilkfor the preparation of spiced buttermilk. Spice mix is optimized based on the sensory evaluation evaluated by the panelists.

2.2.2Optimization of herbs for the development of herbal spiced buttermilk

To enhance the flavour and functionality of spiced buttermilk added tamarind extract at 2.0, 4.0 and 6.0 % to the spiced buttermilkfor the preparation of herbal spiced buttermilk. Tamarind extract of is optimized based on the sensory evaluation evaluated by the judges. Fenugreek seed powder at 0.3, 0.5 and 1.0% to the spiced buttermilkfor the preparation of herbal spiced buttermilk. Fenugreek seed powder is optimized based on the sensory evaluation evaluated by the panelists.

2.2.3 Sensory evaluation

The sensory characteristics of the developed herbal spiced buttermilk were assessed by six sensory panelists using a 9-point hedonic scale ranging from 1 (disliked extremely) to 9 (liked extremely). The panelists assessed the herbal spiced buttermilk for its colour and appearance, flavour, body and texture, and overall acceptability at refrigeration temperature (5±1℃).

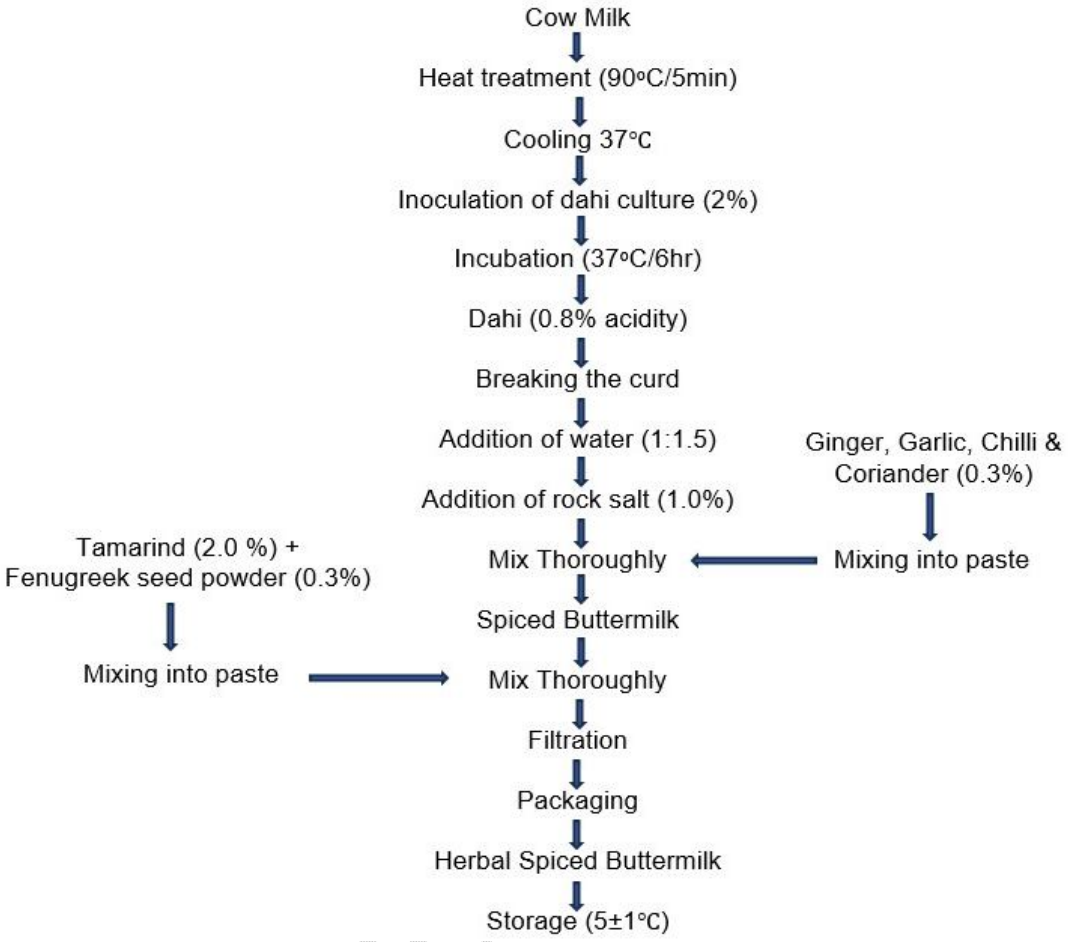

Figure 1: Preparation of Herbal spiced buttermilk

2.2.4 Assessment of techno functional and quality attributes for developed herbal spiced buttermilk

Developed herbal spiced buttermilk analyzed Acidity (titration method), total solids (gravimetric method), the fat content (Mojonniermethod) Protein content (Kjeldahl method) and ash content (gravimetric method) were determined as per the ISI: SP18 Part (XI) 1981 [11].

Viscosity for the developed herbal spiced buttermilk was measured using a Lamy viscometer (B-One Plus LR module)with low, medium, and high range values, viscosity measurements done with different spindles and the spindle duration can be adjusted from 1 to n seconds. For the viscosity measurement of herbal spiced buttermilk spindle L1 was used with duration of 30 seconds.

For colour measurement the tool used was a spectrophotometer (3nh), which calculates the intensity of colour in the developed herbal spiced buttermilk. Certain wavelength is absorbed by the particular solution that is herbal spiced buttermilk shows the reading as L*, a* and b* value. It works on the principle ofBeer Lambertlaw; it determines the concentration of known solutes in solutions.

Water activity is measured by the equipment the LabSwift water activity analyzer. This device determines the fraction of free water in sample. The equilibrium air humidity over a sample (water vapour pressure) was measured. This behaves proportional to the aw-value for the determination of water activity.

Microbiological analysis is done with dilutions of 2, 3, and 4 for the dilution sodium citrate solution (2%) is used. Different media were used for the analysis: Violet Red Bile Agar for coliforms and Potato Dextrose Agar for yeast and mold. Coliforms were incubated at 37 °C for 18-24 hoursand yeast and molds at 30 °C for 3-5 days.

3. RESULTS AND DISCUSSION

3.1 Optimizationof base spice mix for the development of spiced buttermilk.

3.1.1 Optimization of rock salt

The control sample received a mean sensory score of 7.85 for color and appearance, while buttermilk samples with 1.0%, 1.25%, and 1.5% rock salt had scores of 8.66, 8.33, and 7.83, respectively. Statistical analysis showed that the buttermilk with 1.0% rock salt had a significantly higher score in color and appearance compared to both the control and the other samples. For body and texture, the 1.0% rock salt sample achieved the highest score of 8.66, whereas the 1.5% rock salt sample had the lowest score at 7.66. The control sample and the 1.25% rock salt sample received scores of 7.7 and 8.33, respectively. The 1.0% rock salt sample showed a statistically significant difference in body and texture from the control and the other samples. Regarding flavor, the buttermilk with 1.0% rock salt again scored the highest at 8.63, while the sample with 1.5% rock salt had the lowest score at 7.00. There was a significant difference between the flavor score of the 1.0% sample and the other samples, including the control (7.83), the 1.25% rock salt sample (7.50), and the 1.5% rock salt sample (7.00). The flavor score for the 1.5% sample was significantly lower than both the control and the other treated samples. For overall acceptability, the 1.0% rock salt sample received the highest score of 8.58, while the 1.5% sample had the lowest score of 7.33. There were significant differences between the control (7.80) and the samples with 1.25% (7.91) and 1.5% (7.33) rock salt. Overall, statistical analysis confirmed that the buttermilk with 1.0% rock salt was significantly different from the other samples in all sensory attributes.Pavithra [18] prepared cream spread with 0.5, 1.0 and 1.5 % levels of sodium chloride and 1.0 % sodium chloride was optimized for the preparation of cream spread got maximum sensory scores of colour and appearance 8.39, body and texture 8.39 and flavour 8.49.Bari *et al*. [6] prepared borhani, it is a traditional drink (yoghurt drink) observed 0.7 % of rock salt with the overall sensory score of 91.33 out of 100.

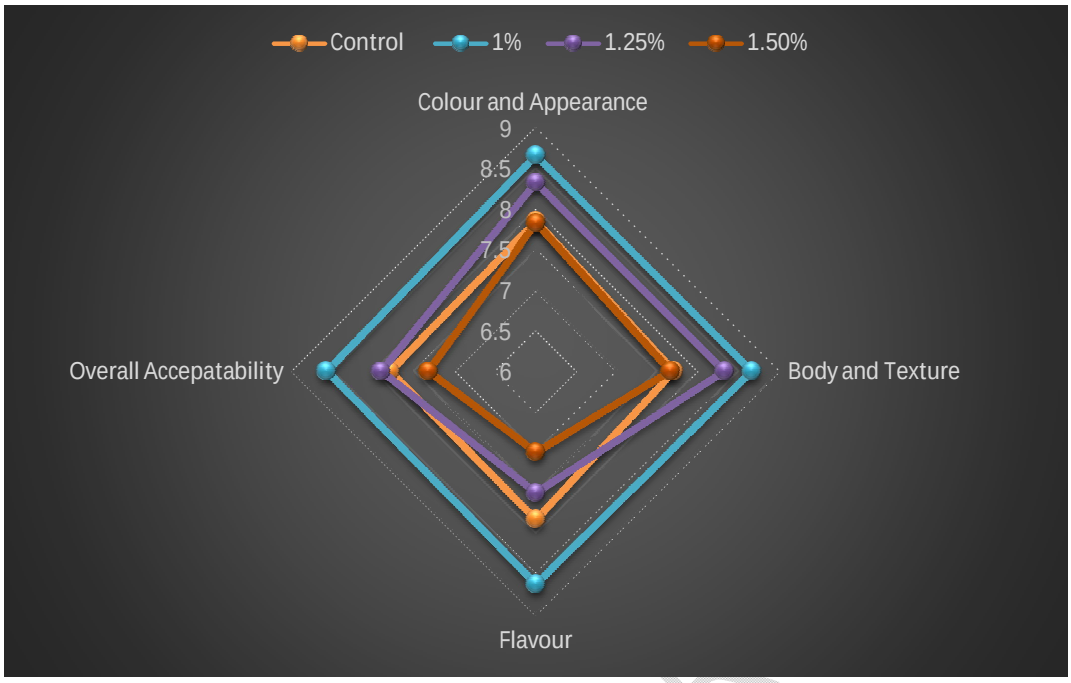

Figure 2: Effect of various levels of rock salt on the sensory characteristics ofbuttermilk

3.1.2Optimization of spice mix

The average sensory evaluation for the colour and appearance of the control sample was 7.83, while samples with 0.3%, 0.5%, and 1.0% spice mix scored 8.66, 7.66, and 7.66, respectively. Statistically, the sample containing 0.3% spice mix achieved a significantly higher score for colour and appearance compared to both the control and other spice-mix samples.In terms of body and texture, the sample with 0.3% spice mix received the highest score of 8.33, whereas the 1.0% spice mix sample obtained the lowest score of 7.00. The control and 0.5% spice mix samples scored 7.46 and 7.16, respectively. Statistical analysis showed that the 0.3% spice mix had significantly better body and texture compared to the control and other spice-mix samples.Flavour-wise, the buttermilk sample containing 0.3% spice mix scored the highest at 8.66, while the 1.0% sample had the lowest score of 7.16. There was a significant difference between the 0.3% sample and the other samples, including the control (7.76), 0.5% (7.33), and 1.0% (7.16) spice mix samples. The overall acceptability was highest for the 0.3% spice mix sample, scoring 8.58. Significant differences were found between the control (7.83), the 0.5% sample (7.33), and the 1.0% sample, which had the lowest score of 7.08. Statistical analysis confirmed that the buttermilk with 0.3% spice mix was significantly different in overall acceptability compared to the other treated samples.

Maji et al. [14] studied incorporation of ginger extract into lassi at 2 % got the body and texture 8.1, flavour 8.55, colour and appearance 7.5, overall sensory score 8.25. Study conducted by Aamir et al. [1] added 1.5 % ginger into the yoghurt got the maximum flavour score 8.47 and the control flavour score is 6.19. Increase in the spice mix harsh, intense flavour is observed.

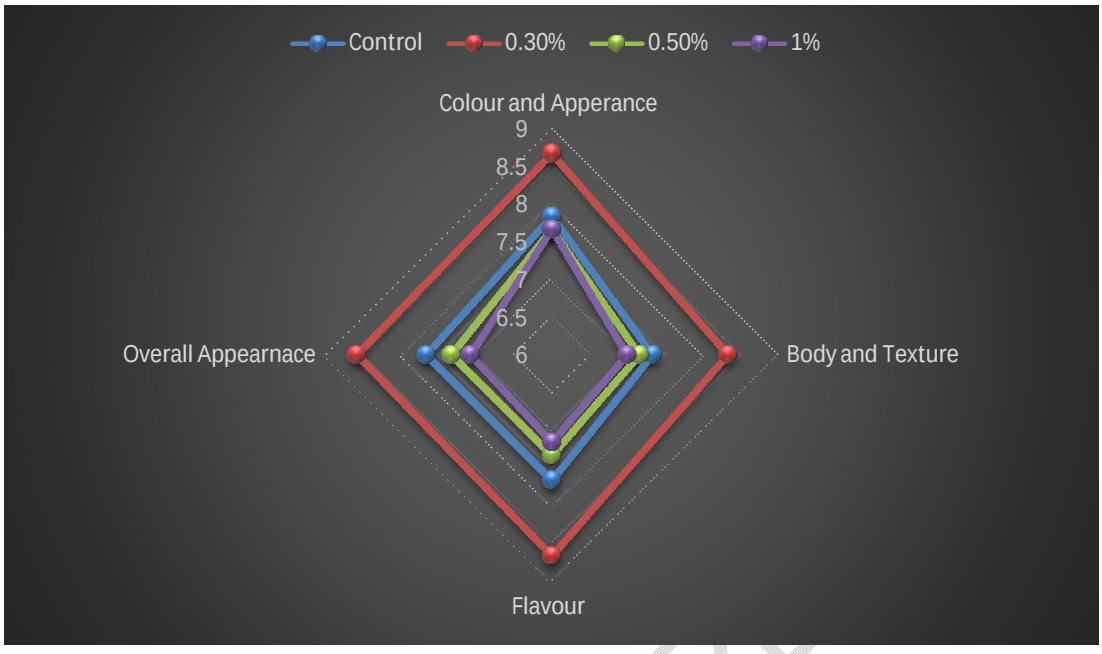

Figure 3: Effect of various levels of spice mix on the sensory characteristics ofbuttermilk

3.2Optimization of herbs for the development of herbal spiced buttermilk.

3.2.1 Optimization of tamarind

The control sample achieved an average score of 7.81 for color and appearance, while the buttermilk containing 2.0% tamarind received the highest score of 8.33. Samples with 4.0% and 6.0% tamarind were rated at 7.16 and 6.83, respectively, showing a statistically significant difference compared to the control and the other concentrations (4.0% and 6.0%). For body and texture, the 2.0% tamarind sample also performed best, scoring 8.33, while the 6.0% tamarind sample had the lowest score of 7.00. The control and the 4.0% tamarind samples received scores of 7.70 and 7.50, respectively.In terms of flavor, the 2.0% tamarind sample again achieved the highest score of 8.66, while the 6.0% tamarind sample had the lowest score of 6.50. The 4.0% tamarind sample scored 7.00, and the control scored 7.81. A significant difference in flavor was observed between the 2.0% tamarind buttermilk and the samples with higher tamarind concentrations.For overall acceptability, the buttermilk with 2.0% tamarind scored the highest at 8.5, with significant differences compared to other samples. The 4.0% tamarind sample received a score of 7.16, the 6.0% tamarind sample scored 6.66, and the control had a score of 7.81. Statistical analysis indicated that the sample with 2.0% tamarind was significantly more acceptable than those with higher tamarind concentrations.

Kumar V [13]prepared Shrikhand with addition of tamarind and the result found that the 10% tamarind were optimized with colour and appearance score, body and texture score of 8.25, flavour. Mokbel and Abdeldaiem [15] studied flavored yoghurt drink by using tamarind extract optimized 7.0% of tamarind extract and got more score that is 98.13 out if 100, increase in concentration of tamarind it will affect the thickness of the yoghurt.

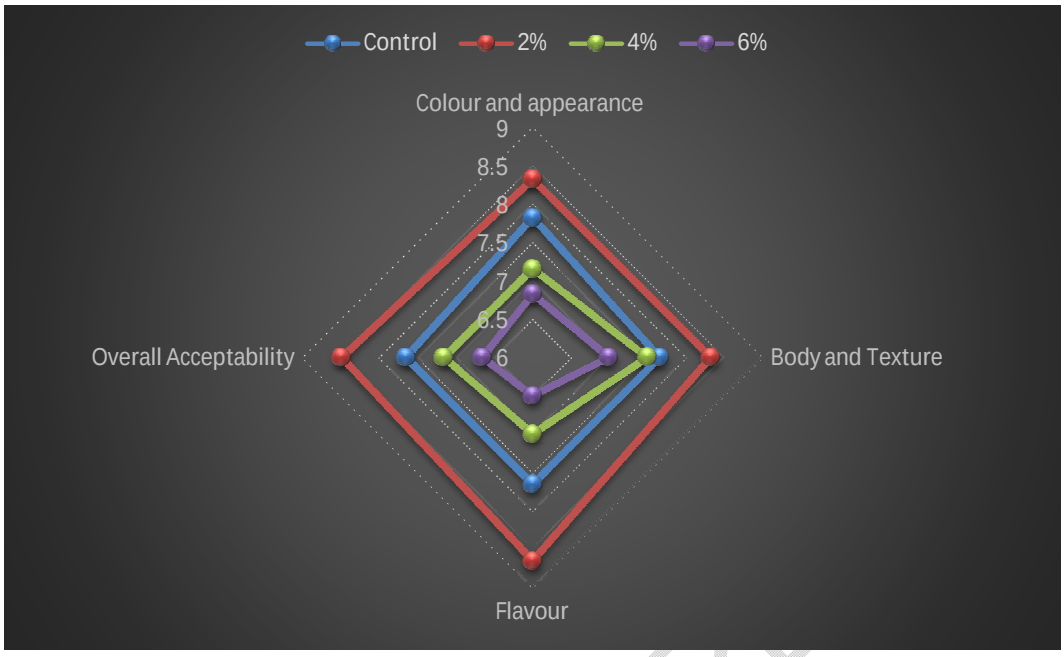

Figure 4: Effect of various levels of tamarind on the sensory characteristics ofbuttermilk

3.2.2Optimization of fenugreek seed powder

The addition of varying levels of fenugreek seed powder influenced the sensory evaluation of spiced buttermilk, particularly in terms of color and appearance. The average scores for these attributes were 7.83, 8.50, 7.66, and 7.50 for the control, 0.3%, 0.5%, and 1.0% fenugreek seed powder, respectively. Statistically, the sample containing 0.3% fenugreek seed powder received the highest score for color and appearance, outperforming the samples with 0.5% and 1.0% fenugreek seed powder.In terms of body and texture, the buttermilk with 0.3% fenugreek seed powder again secured the highest score of 8.33, whereas the sample with 1.0% scored the lowest at 7.00. The sample with 0.5% fenugreek seed powder scored 7.16, while the control scored 7.46. The flavor profile also showed significant differences, with the buttermilk containing 0.3% fenugreek seed powder achieving the highest flavor score of 8.66. In contrast, the sample with 1.0% fenugreek seed powder had the lowest flavor score of 6.83, and the control and 0.5% fenugreek powder samples received scores of 7.73 and 7.33, respectively. The flavor score for the 0.3% fenugreek powder sample was significantly higher than the control and other samples.Regarding overall acceptability, the sample with 0.3% fenugreek seed powder received the highest score of 8.58, while the sample with 1.0% fenugreek powder scored the lowest at 7.00. The control and 0.5% fenugreek seed powder samples received scores of 7.83 and 7.33, respectively. Overall, the buttermilk containing 0.3% fenugreek seed powder was statistically more acceptable than the other formulations.

Similar study conducted by sargar[22] added 0.5 % fenugreek seed powder got overall acceptability score 8.0 with comparable to other treated samples and more levels of fenugreek seed powder will affect the flavour of the buttermilk.

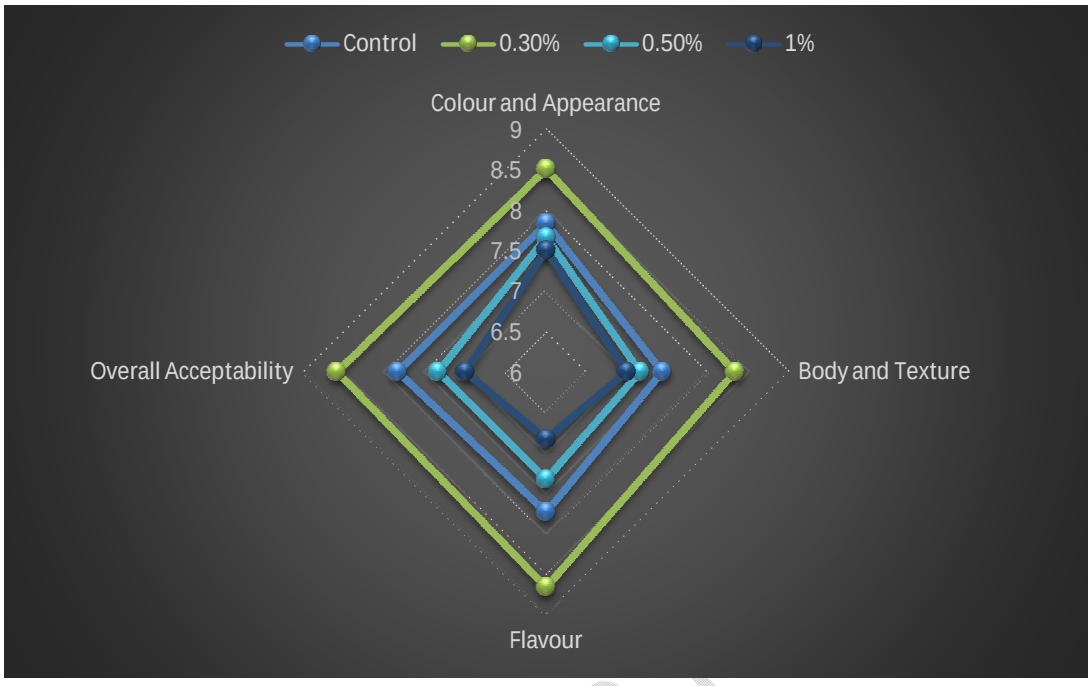

Figure 5: Effect of various levels of fenugreek seed powder on the sensory characteristics ofbuttermilk

3.3Proximate analysis of optimized herbal spiced buttermilk.

3.3.1 Fat, Protein, Total solids, Ash and Acidity

Herbal spiced buttermilk has a significantly higher fat percentage 1.16 % compared to control buttermilk 1.05 %, statistical analysis revealed that there were significant differences between the fat content of the control and herbal spiced buttermilk.Protein content observed in the control was 2.11% and in the herbal spiced buttermilk was 2.31. It was observed that there is a significant difference between the control and sample.Sample again shows a higher percentage of total solids (7.43%) compared to control (5.43%), herbal spiced buttermilk shows the highest total solids content compared to the control, while the lowest was observed for the control and a critical difference of 0.16, demonstrating a statistically significant difference.The ash percentages recorded for control and herbal spiced buttermilk were 0.41 and 1.35% respectively, herbal spiced buttermilk showing the highest ash content compared to the control and observed least in the control. There is a significant difference was observed between control and herbal spiced buttermilk.Acidity, measured in terms of lactic acid percentage, is higher in herbal spiced buttermilk 0.53% than in control is 0.36%. The acidity values indicate there is a significant difference.

Study conducted by Sanjay et al.[21] added 0.5 % cinnamon powder to the buttermilk finds that fat 0.64 % and Padghanet al.[17] found the physical and chemical properties of traditional lassi and he observed the total solids of 5.16 %, protein 2.26 %. Acidity 0.56 % LA and ash 3.99 %.

Table 1. Proximate analysis of optimized herbal spiced buttermilk

	Fat (%)	*Protein (%)*	*Total solids (%)*	*Ash (%)*	*Acidity (%LA)*
Control	1.05 [b]	2.11 [b]	5.34 [b]	0.41 [b]	0.36 [b]
HSBM	1.16 [a]	2.31 [a]	7.43 [a]	1.35 [a]	0.53 [a]
CD(P≤0.05)	**0.03**	**0.20**	**0.16**	**0.09**	**0.03**

*HSBM = Herbal spiced buttermilk; *% = Percent; *LA= lactic acid
*Same superscripts within the column indicate no significant difference, different superscripts in the same column indicates significant difference.

3.4Evaluation of Rheological parameters of herbal spiced buttermilk.

3.4.1 Viscosity, Water activity andColour

The viscosity recorded for the control and sample herbal spiced buttermilk was 1.16 and 4.75 cp respectively. The viscosity of the optimized sample is higher than the control. There were significant differences between the control and herbal spiced buttermilk. the control and herbal spiced buttermilk water activity are 0.911 and 0.892 respectively. the lowest water activity seen in the control and highest water activity is seen in the herbal spiced buttermilk and there is a significant difference between the control and herbal spiced buttermilk. Colour of control and herbal spiced buttermilk, the l* value, which represents lightness, was lower in the herbal spiced buttermilk 60.60 than in the control 75.45, indicating a darker colour in the herbal spiced buttermilk. the a* value, representing the red-green spectrum, showed that the herbal spiced buttermilk was more reddish that is 1.66 compared to the slightly greenish in control -1.74. the b* value, which corresponds to the yellow-blue spectrum, was also higher in the herbal spiced buttermilk 14.66 than the control 4.52. there is a statistically colour difference betweenthe control and herbal spiced buttermilk.
Felfoul et al. [8] observed that there is increase in the viscosity of the yoghurt added with 1 % ginger powder 89.0 cp and for the control yoghurt 60.0 cp. Colour of the control yoghurt l* value 91.58, a* value - 5.41 and b* value 15.60 and for 1% ginger powder incorporated into yoghurt l*, a* and b* 85.31, - 3.27 and 19.89 respectively, yogurts added with ginger powder is darker, red and yellow colour than control sample. Water activity study by Nandhini [16] prepared the functional yoghurt drink showed control and functional drink water activity 0.85 and 0.80 respectively.

Table 2: Study on Rheological parameters of optimized herbal spiced buttermilk

	Viscosity(cP)	*Water activity(aw)*	*Colour*		
			L*	**a***	**b***
Control	1.16 [b]	0.911 [a]	75.45 [a]	-1.74 [b]	4.52 [b]
HSBM	4.75 [a]	0.892 [b]	60.60 [b]	1.66 [a]	14.66 [a]

CD(P≤0.05)	**0.24**	**0.007**	**1.4**	**1.27**	**0.78**

*Same superscripts within the column indicate no significant difference, different superscripts in the same column indicates significant difference.
*cP = Centi poise; *aw = water activity
L* - lightness from darkness to lightness on a scale of zero to 100, a* - negative a* corresponds with green, positive a* corresponds with red, b* - negative b* corresponds with blue and positive b* corresponds with yellow.

3.4Study on Microbiological parameters of herbal spiced buttermilk.

Microbiological analysis was conducted on the control and herbal spiced buttermilk to check the coliform count and yeast and mold counts in the freshly prepared control and herbal spiced buttermilk. Microbiological analysis is for evaluating sample quality and safety, providing insights into microbial contamination levels. The counts analyzed for coliform and yeast and mold counts for the fresh control and herbal spiced buttermilk were found to be nil. Nandhini [16] developed functional yoghurt drink, fresh samples showed coliforms, yeast and molds counts Nil of control yoghurt drink and functional yoghurt drink.

4. CONCLUSION

The developed herbal spiced buttermilk having excellent health property and extended shelf-life with incorporation of rock salt, ginger, garlic, chili, coriander, tamarind and fenugreek seed powder, compared to the control buttermilk. The functionality and overall acceptance of the herbal spiced buttermilk were enhanced flavour with spices and functional ingredients.

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