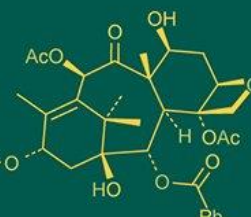
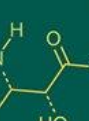
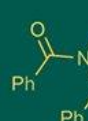


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Ambili MV
M.Tech. Scholar, Verghese
Kurien Institute of Dairy and
Food Technology, Kerala
Veterinary and Animal
Sciences University,
Mannuthy, Thrissur, Kerala,
India

Sapna Tomar
College of Dairy Science,
U.P. Pandit Deen Dayal
Upadhyaya Pashu Chikitsa
Vigyan Vishwavidyalaya
Evam Go-Anusandhan
Sansthan, Mathura,
Uttar Pradesh, India

Dinker Singh
College of Dairy Science,
U.P. Pandit Deen Dayal
Upadhyaya Pashu Chikitsa
Vigyan Vishwavidyalaya
Evam Go-Anusandhan
Sansthan, Mathura,
Uttar Pradesh, India

Corresponding Author:
Dinker Singh
College of Dairy Science,
U.P. Pandit Deen Dayal
Upadhyaya Pashu Chikitsa
Vigyan Vishwavidyalaya
Evam Go-Anusandhan
Sansthan, Mathura,
Uttar Pradesh, India

Changes in colour characteristics of fibre-incorporated reduced-calorie herbal *Rasmalai* during storage

Ambili MV, Sapna Tomar and Dinker Singh

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Abstract

Rasmalai is a traditional Indian dairy product prepared by dipping flattened chhana patties in concentrated sweetened milk. Herbs like *tulasi* and *ashwagandha* are rich source of natural antioxidants which act as compatible vehicle for delivering health benefits to the hosts. Addition of *isabgol* (*psyllium husk*) to any dairy product increases the soluble dietary fibre content and improves the water holding capacity, viscosity, bulking ability of the product. Addition of these adjuncts in any functional dairy product, may affect its organoleptic properties, especially the colour characteristics, which directly affects the consumer acceptance. This study highlights the changes occurring in colour parameters (L, a and b values) in control and fibre incorporated reduced calorie herbal *rasmalai* samples when kept at ambient and refrigerated storage conditions. The colour parameters were significantly affected ($p < 0.05$) when kept at ambient ($32 \pm 1^\circ\text{C}$) and refrigerated ($5 \pm 1^\circ\text{C}$) storage conditions on addition of herbs, dietary fibre and non-nutritive sweetener.

Keywords: Traditional Indian dairy product, *Rasmalai*, reduced calorie, colour analysis, fibre

Introduction

Milk is highly perishable in nature and needs conversion to various value-added products to preserve its nutritive quality and enhance the shelf life. The development of traditional Indian dairy products dates back to 6000 years. *Rasmalai* is a chhana and concentrated milk based traditional dairy product containing about 60% total solids including sugar as sweetening agent with extremely delicate texture and taste (Sharma, 2004) [10]. Chhana and concentrated milk are used as its base materials for its preparation. The flattened chhana patties or *Rasmalai* balls (Tikki) are dipped in concentrated sweetened milk before serving. The product has a mild sweet and rich creamy flavor (Rupom *et al.*, 2025) [8].

Rapid urbanization has led to drastic changes in lifestyle which has caused various health related conditions and chronic diseases. Functional foods containing different bioactive compounds provide health benefits to the host along with the basic nutrition. Addition of herbs into dairy products not only provide preservative effects, but they also possess anti-inflammatory, anticarcinogenic, antihypertensive properties due to presence of polyphenols, carotenoids, flavonoids, curcumins etc. (Maji *et al.*, 2023) [5]. Preparation of dairy products using low calorie sweeteners, dietary fibres and other herbal concoctions like *Tulasi* and *Ashwagandha*, is the need of the hour. Replacing cane sugar with the sucralose and addition of dietary fibre is a right choice for diabetic and health-conscious people.

The culinary herb Basil, (*Ocimum tenuiflorum*) commonly known as *Tulasi* is native to India and other tropical regions of Asia, having been cultivated there for more than 5,000 years. It is a rich source of essential oils such as α -Pinene, β -Pinene, Methyl chavicol, 1,8 Cineole, Linalool, Ocimene, Borneol, Geraneol, B Caryphyllone, n-Cinnamate and Eugenol (Taie *et al.*, 2010; Shahrajabian *et al.*, 2020) [13, 9], phenolic components like Phenolic acids and flavonol-glycosides (Javanmardi *et al.*, 2002; Kivilompolo & Hyötyläinen, 2007; Shahrajabian *et al.*, 2020) [3, 4, 9] and anti-oxidants such as caffeic, vanillic, rosmarinic acids, quercetin, rutin, apigenin, chlorogenic and p-hydroxybenzoic (Teofilovic *et al.*, 2017; Shahrajabian *et al.*, 2020) [9]. Purported health benefits for *Tulasi* and other *Ocimum* species include relief of stress and treatment of respiratory, gastrointestinal, and kidney ailments, as well as blood disorders and skin and eye diseases.

Isabgol husk (*Psyllium*), an indigenous natural dietary fibre is particularly rich in alimentary fibres and mucilage. It consists of 85% water-soluble fibre; which is partly fermentable. It is popularly used as a bulk laxative and biological experiments have confirmed its cytoprotective action (Purohit and Rathore, 2019) [7]. Dietary supplementation with *isabgol* has been shown to lower blood cholesterol levels, and especially LDL cholesterol. It is popularly used as a therapeutic agent for the treatment of constipation, diarrhoea, irritable syndrome, diabetes, and hypercholesterolemia (Sharma, 2015) [11].

Ashwagandha (*Withania somnifera* L.), commonly known as 'Indian Winter cherry' or 'Indian Ginseng' is considered as one of the most important medicinal plant in Ayurvedic medicine. The root of *Ashwagandha* is regarded as a tonic, aphrodisiac, narcotic, diuretic, anthelmintic, astringent, thermogenic and stimulant (Singh *et al.*, 2011) [12]. The biologically active chemical constituents include alkaloids, steroidal lactones and saponins (Mishra *et al.*, 2000) [6]. Sitenosides and acyl steryl glucosides in *Ashwagandha* are stress busters (Singh *et al.*, 2011) [12].

Sugar act as a bulking agent in food products, which is also associated with negative effects on the health of the consumers. Therefore, alternatives like sucralose, saccharin and aspartame are used as substitutes for sugar. These non-nutritive sweeteners possess the high sweetness potency which impart negligible calorie and are required in low amount (Campos *et al.*, 2024) [2].

Rasmalai manufactured by fortification of *Tulasi*, *Ashwagandha* and *Isabgol* not only increase medicinal and functional value of the product but addition of *sucralose* to it, also makes the product suitable for dietetic people. Substitution of sugar and preparing functional dairy product by addition of *Tulasi*, *Ashwagandha* and *Isabgol*, may likely affect the colour profile of the product and can change the consumer acceptance. This study highlights the effect of these adjuncts on colour characteristics of fibre incorporated reduced calorie herbal *rasmalai* during storage conditions. In view of the above, an attempt was made to study the colour characteristics of the fibre incorporated reduced calorie herbal *rasmalai* during storage at ambient (32 ± 1 °C) and refrigerated storage conditions (5 ± 1 °C).

Materials and Methods

Cow and Buffalo milk were procured from University Dairy Plant, KVASU, Mannuthy, Thrissur, Kerala. Other ingredients like *Ashwagandha* root powder, *Tulasi* leaves, *Isabgol/Psyllium* husk powder, suji, citric acid, sugar, nuts and saffron were purchased from local market. Analytical grade chemicals were procured from approved firms of KVASU.

Preparation of Fibre-Incorporated Reduced-Calorie Herbal Rasmalai

Fibre incorporated reduced calorie herbal *rasmalai* was prepared as per the standardized method given by Sharma (2004) [10] with slight modifications and Ambili *et al.* (2023) [1].

Colour Analysis of Fibre Incorporated Reduced-Calorie Herbal Rasmalai

Colour of the *Rasmalai* samples and concentrated sweetened milk was measured by reflectance spectroscopy technique employing reflectance meter, colour flex (Hunter lab

Miniscan XE plus Spectrocolorimeter, Virginia, USA) with geometry of diffuse/8° (sphere-8 mm view) and an illuminant of D65/10°. Before the test, the instrument was calibrated with standard black glass and white tile as specified by the manufacturer. The light source was dual beam xenon flash lamp. Data were received from the software in terms of L* [Lightness, ranges 0 (black) to 100 (White)], a* [Redness, ranges from + 60 (red) to -60 (green)], and b* [Yellowness, ranges from + 60 (yellow) to -60 (blue)] in values of the international colour system.

Statistical Analysis

The data collected from the preliminary analysis were statistically analysed using Kruskal Wallis test (SPSS). In case of storage studies, repeated measures ANOVA and Independent t-test was performed for comparing between the samples in each period. Data obtained from the sensory analysis was statistically analysed using Friedman's test followed by Wilcoxon Signed Rank test (SPSS version 22.0). Each experiment was conducted in three replications.

Result and Discussion

Table 1 and 2 depicts the colour characteristics of fibre incorporated reduced calorie herbal *Rasmalai* ball and concentrated sweetened milk, respectively. The control and treated samples were analysed statistically using independent t-test. The colour parameters are expressed in terms of L, a, b values and their test static obtained by comparing with the control is given in the table 1 and 2.

When the colour characteristics of the *rasmalai* ball is considered, 'L' value, which indicates lightness intensity, was significantly higher ($p < 0.05$) for the control (74.68 ± 0.03). The 'a' value which is the measure of redness for *rasmalai* ball was 1.25 ± 0.01 while for control, it was 1.19 ± 0.02 at $p < 0.05$. The optimized herbal *rasmalai* ball had a 'b' value of 15.87 ± 0.04 at $p < 0.05$. Hence, there was a significant difference ($p < 0.05$) in the colour characteristics (L, a and b value) of control and treated samples.

In table 2, the comparison of values of colour characteristics indicated that there is no significant difference ($p > 0.05$) between the control sweetened concentrated milk and reduced calorie sweetened concentrated milk.

Table 1: Colour characteristics of fibre incorporated reduced calorie herbal *rasmalai* ball

Parameter	Control Sample	Fibre incorporated reduced calorie herbal <i>rasmalai</i>	t-value
L	74.68 ± 0.03	71.88 ± 0.13	21.468***
a	1.19 ± 0.02	1.25 ± 0.01	-2.722*
b	17.62 ± 0.04	15.87 ± 0.04	28.368**

Figures are the Mean $\pm$ Standard error of six replications, * significant at five percent level ($p < 0.05$), **significant at one percent level ($p < 0.01$), ns-non significant ($p \geq 0.05$)

Table 2: Colour characteristics of sweetened concentrated milk

Parameter	Control Sample	Reduced calorie milk	t-value
L	75.42 ± 0.27	76.10 ± 0.44	-1.329 ^{ns}
a	3.59 ± 0.07	3.45 ± 0.10	1.164 ^{ns}
b	20.18 ± 0.09	19.72 ± 0.26	1.690 ^{ns}

Figures are the Mean $\pm$ Standard error of six replications, *significant at five percent level ($p < 0.05$), ** significant at one percent level ($p < 0.01$), ns-non significant ($p \geq 0.05$)

The variation in colour characteristics of herbal *rasmalai* in terms of L, a and b values during the ambient temperature storage ($32 \pm 1^\circ\text{C}$) and refrigerated temperature storage is depicted in the table 3 and table 4, respectively. When samples were stored at ambient temperature ($32 \pm 1^\circ\text{C}$), L, a and b values were non-significant for control and herbal *rasmalai*.

The mean L value of control increased from 76.44 to 83.44 and that of herbal *rasmalai* from 74.91 to 82.41 within 6 days of storage (table 2). When 'a' value was considered, the 'a' value of control decreased from 2.83 to 1.60 and similar decrease was observed in case of herbal *rasmalai* from 2.62 to 1.71 which may be due to the long-time soaking in the sweetened concentrated milk as the storage period increased. The b value of control varied from 18.88 to 19.58 and that of herbal *rasmalai* from 18.27 to 20.16. The table indicated that refrigerated storage had no significant effect on b value of control *rasmalai*.

The F values of control for the terms L, a and b were 58.58, 23.35 and 1.591 respectively. The F values of herbal *rasmalai* for the terms, L a and b were 49.330, 5.886 and 24.051, respectively. Yikmis *et al.*, 2020 [15] analysed the colour characteristics of functional sirkencubin syrup with purple basil during the refrigerated storage and reported non-significant difference between the control and developed product in terms of all colour parameters. He

observed decrease in the value of L, a and b during the storage and explained that it may be due to anthocyanin degradation and the formation of maillard reaction products. These findings are contradictory to our findings.

Table 3: Effect of storage on colour characteristics of fibre incorporated reduced calorie herbal *Rasmalai* at ambient temperature ($32 \pm 1^\circ\text{C}$)

Sample	Days of Storage	
	0 th Day	1 st Day
L value		
Control	77.47 $\pm$ 0.16	Spoiled
Herbal <i>Rasmalai</i>	74.97 $\pm$ 0.67	Spoiled
t-value	1.073 ^{ns}	-
a value		
Control	2.31 $\pm$ 0.25	Spoiled
Herbal <i>Rasmalai</i>	2.23 $\pm$ 0.26	Spoiled
t-value	0.236 ^{ns}	-
b value		
Control	18.43 $\pm$ 0.54	Spoiled
Herbal <i>Rasmalai</i>	16.90 $\pm$ 0.44	Spoiled
t-value	2.201 ^{ns}	-

Figures are the Mean $\pm$ Standard error of six replications, *significant at five percent level ($p < 0.05$), **significant at one percent level ($p < 0.01$), ns-non significant ($p \geq 0.05$). Similar super script are non-significant

Table 4: Effect of storage on colour characteristics of fibre incorporated reduced calorie herbal *Rasmalai* at refrigerated temperature ($5 \pm 1^\circ\text{C}$)

Sample	Days of Storage					F-value
	0 th Day	2 nd Day	4 th Day	6 th Day	8 th Day	
L value						
Control	76.44 ± 0.57 ^{xa}	77.92 ± 0.41 ^{xb}	81.44 ± 0.26 ^{xc}	83.44 ± 0.37 ^{xd}	Spoiled	58.58**
Herbal <i>Rasmalai</i>	74.91 ± 0.40 ^{xa}	76.98 ± 0.67 ^{xa}	78.92 ± 0.35 ^{yb}	82.41 ± 0.32 ^{xc}	Spoiled	49.330**
t-value	2.201 ^{ns}	1.203 ^{ns}	6**	6 ^{ns}	-	
a value						
Control	2.83 ± 0.11 ^{xa}	2.30 ± 0.16 ^{xa}	1.47 ± 0.16 ^{xb}	1.60 ± 0.08 ^{xc}	Spoiled	23.35**
Herbal <i>Rasmalai</i>	2.62 ± 0.20 ^{xa}	2.58 ± 0.35 ^{xa}	1.40 ± 0.26 ^{xb}	1.71 ± 0.15 ^{xb}	Spoiled	5.886*
t-value	0.923 ^{ns}	-7.02 ^{ns}	-2.30 ^{ns}	+ 0.650 ^{ns}	-	
b value						
Control	18.88 ± 0.33 ^{xa}	19.05 ± 0.30 ^{xa}	18.81 ± 0.23 ^{xa}	19.58 ± 0.23 ^{xa}	Spoiled	1.591 ^{ns}
Herbal <i>Rasmalai</i>	18.27 ± 0.09 ^{xa}	18.68 ± 0.17 ^{xa}	19.54 ± 0.22 ^{xb}	20.16 ± 0.19 ^{xc}	Spoiled	24.051**
t-value	1.768 ^{ns}	1.091 ^{ns}	2.298 ^{ns}	1.939 ^{ns}	-	

Figures are mean $\pm$ Standard error of three replications, Means with different superscript a-d vary significantly within a row, Mean with different superscripts vary significantly x-y within a column. **-significant at one percent level ($p < 0.01$), *-significant at five percent level ($p < 0.05$), ns-non significant ($p \geq 0.05$)

Conclusion

It was concluded that there was a significant ($p < 0.05$) difference between the colour parameters i.e., L, a and b values of control and herbal *rasmalai* samples when kept at ambient ($32 \pm 1^\circ\text{C}$) and refrigerated ($5 \pm 1^\circ\text{C}$) storage temperatures. It was also observed that the control and herbal *rasmalai* balls had a significant difference ($p > 0.05$) was observed between control concentrated sweetened milk and reduced calorie concentrated sweetened milk samples.

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Conflict of Interest

The authors declare no conflict of interest.

References

- Ambili MV, Singh D. Optimisation of the formulation of fibre incorporated reduced calorie herbal *rasmalai*. 2023.
- Campos L, Tuma P, Silva T, Gomes D, Pereira CD, Henriques MH. Low fat yoghurts produced with different protein levels and alternative natural sweeteners. *Foods*. 2024;13(2):250.
- Javanmardi J, Khalighi A, Kashi A, Bais HP, Vivanco JM. Chemical characterization of basil (*Ocimum basilicum* L.) found in local accessions and used in traditional medicines in Iran. *Journal of Agricultural and Food Chemistry*. 2002;50(21):5878-5883.

4. Kivilompolo M, Hyötyläinen T. Comprehensive two-dimensional liquid chromatography in analysis of Lamiaceae herbs: Characterisation and quantification of antioxidant phenolic acids. *Journal of Chromatography A*. 2007;1145(1-2):155-164.
5. Maji S, Bumbadiya M, Sao K. Value addition of traditional Indian dairy products using herbs and spices-an overview. *International Journal of Bio-resource and Stress Management*. 2023;14(3):400-406.
6. Mishra LC, Singh BB, Dagenais S. Scientific basis for the therapeutic use of *Withania somnifera* (ashwagandha): a review. *Alternative Medicine Review*. 2000;5(4):334-346.
7. Purohit P, Rathore HS. Isabgol: a herbal remedy. *World Journal of Pharmaceutical Research*. 2019;8(7):579-585.
8. Rupom SRF, Tahmid MS, Deb GK, Alam MA, Hassan MR, Rahman A, et al. Physico-chemical characteristics, sensory properties and microbial quality of date fruit added Rasomalai prepared from buffalo's milk. *Food Science & Nutrition*. 2025;13(11):e71145.
9. Shahrajabian MH, Sun W, Cheng Q. Chemical components and pharmacological benefits of basil (*Ocimum basilicum*): a review. *International Journal of Food Properties*. 2020;23(1):1961-1970.
10. Sharma SP. Technological aspects on Rasmalai: an indigenous chhana-based sweet [doctoral dissertation]. Hisar: Animal Products Technology, CCSHAU; 2004.
11. Sharma V. Study on medicinal, nutritive and uses of Isabgol (Psyllium) husk. *Advances in Social Research*. 2015;1(1):79-81.
12. Singh N, Bhalla M, Jager P, Gilca M. An overview on Ashwagandha: a Rasayana (rejuvenator) of Ayurveda. *African Journal of Traditional, Complementary and Alternative Medicines*. 2011;8(5):208-213.
13. Taie HAA, Radwan S. Potential activity of basil plants as a source of antioxidants and anticancer agents as affected by organic and bio-organic fertilization. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*. 2010;38(1):119-127.
14. Teofilović B, Grujić-Letić N, Goločorbin-Kon S, Stojanović S, Vastag G, Gadžurić S. Experimental and chemometric study of antioxidant capacity of basil (*Ocimum basilicum*) extracts. *Industrial Crops and Products*. 2017;100:176-182.
15. Yikmiş S, Özpancar N, Bozkır ÇİĞDEM, Çöl BG. Functional sirkencubin syrup with purple basil; bioactive properties, organoleptic acceptability, and possible effects on blood pressure. *Food Science and Technology*. 2020;40(Suppl 2):550-557.