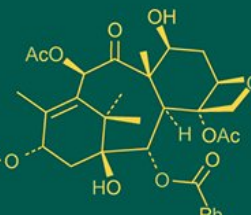
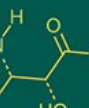
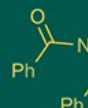
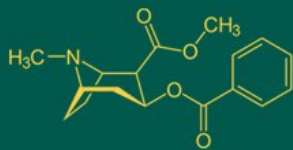


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Shinde Sejal

M.Sc. Student, Department of
Animal Husbandry and Dairy
Science, College of Agriculture,
Latur, Maharashtra, India

Thombre Babasaheb

Director of Instruction,
VNMKV, Parbhani,
Maharashtra, India

DS Chauhan

Professor, Department of
Animal Husbandry and Dairy
Science, College of Agriculture,
Latur, Maharashtra, India

AT Shinde

Professor (CAS), Department
of Animal Husbandry and
Dairy Science, College of
Agriculture, Latur,
Maharashtra, India

Effect of Date Palm (*Phoenix dactylifera* L.) Pulp Incorporation on the Physico-chemical Properties of Lassi

Shinde Sejal, Thombre Babasaheb, DS Chauhan and AT Shinde

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Abstract

The research entitled “Studies on Preparation of Lassi Blended with Date Palm Pulp (*Phoenix dactylifera*)” was conducted in the Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur, Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani during 2025-26. The Lassi was prepared by blending 6, 9 and 12 per cent date palm pulp. The physico-chemical properties of Lassi blended with date palm pulp in T₂, T₃ and T₄ showed significant changes compared with the control T₁. Titratable acidity increased from 0.68 per cent in T₁ to 0.74, 0.80 and 0.86 per cent in T₂, T₃ and T₄, respectively, whereas pH decreased from 4.60 to 4.54, 4.48 and 4.41, respectively. Fat, protein and moisture contents decreased significantly with increasing pulp levels, from 7.29, 3.24 and 76.08 per cent in T₁ to 6.88, 2.64 and 75.02 per cent, respectively, in T₄. However, total solids and ash contents increased from 23.92 and 1.17 per cent in T₁ to 24.98 and 1.36 per cent in T₄, respectively.

Keywords: Date palm pulp, Lassi, physico-chemical properties, titratable acidity, ph, dairy beverage, total solids

Introduction

India is the leading milk-producing country in the world. Milk production increased from 146.31 million tonnes in 2014-15 to 247.87 million tonnes in 2024-25, registering a 69.41 per cent increase, with an annual growth rate of about 6.3 per cent, compared with around 2 per cent globally. Per capita milk availability increased from 319 to 485 g/day during the same period, compared with the world average of 394 g/day. The livestock sector contributed 30.87 per cent to the economic value added of the agricultural and allied sectors and 5.49 per cent to the national economic value added in 2023-24, highlighting the growing importance of the dairy sector in India (Anonymous, 2025-26)^[2].

Milk is a rich source of essential minerals, including calcium, magnesium, riboflavin, selenium, thiamine and pantothenic acid. Changes in dietary patterns have contributed to the increasing prevalence of lifestyle-related diseases such as diabetes, cancer and neurological disorders (Dixit *et al.* 2018)^[6].

Lassi is a traditional fermented milk beverage and a popular indigenous dairy product in India. It is commonly prepared by blending *curd* with water and may be served sweetened with sugar or flavoured with salt and spices. Widely consumed as a refreshing summer drink, Lassi is valued for its pleasant taste, cooling effect and health benefits (Pagore *et al.* 2025)^[14].

Date fruit is a nutritious fruit rich in carbohydrates, proteins, fibre, minerals and vitamins. It contains 44-88 per cent sugars, 2.3-5.6 per cent proteins, 0.2-0.5 per cent fats and 6.4-11.5 per cent fibre, depending on variety and ripeness. It is also a good source of minerals such as potassium, calcium, magnesium, phosphorus, iron and zinc, along with vitamins C, A, thiamine, riboflavin and niacin. Owing to its rich nutritional composition, date fruit is considered beneficial for human health (Al-Shahib and Marshall 2003)^[1].

Materials and Methods

The present study was conducted during 2025-26 in the Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur, Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani.

Corresponding Author:**Shinde Sejal**

M.Sc. Student, Department of
Animal Husbandry and Dairy
Science, College of Agriculture,
Latur, Maharashtra, India

Materials

Collection of Materials

Buffalo milk (6% fat and 9% SNF) was procured from the local market of Latur city (Natural Milk Pvt. Ltd., Latur). Fresh date palm (*Phoenix dactylifera* L.) fruits were purchased from the local market of Latur city. Standard culture (NCDC-167) was procured from NDRI, Karnal (Haryana). Clean, white crystalline cane sugar was purchased from the local market of Latur city.

Starter Culture, Its Maintenance and Propagation

Sterilized skim milk was used for the maintenance of the standard freeze-dried *dahi* culture comprising *Lactococcus lactis* and *Streptococcus thermophilus*. About 100 ml of fresh skim milk was transferred into 250 ml conical flasks and covered with non-absorbent cotton plugs. The flasks were sterilized for 15 minutes at 15 psi pressure in an autoclave. The sterilized skim milk was inoculated with active starter culture NCDC-167 @ 1.5 per cent under a laminar airflow chamber for propagation of the culture. After 12 hours of incubation at 37 °C, the flasks were stored under refrigerated conditions at 5-7 °C. Culture propagation

was repeated at weekly intervals to maintain an active starter culture for use in the preparation of Lassi.

Sugar: Good quality, clean, crystalline, cane sugar was purchased from local market of Latur city.

Methodology

Fresh Kimia dates were peeled, deseeded, and ground into a smooth pulp. The pulp was collected in clean containers and refrigerated until further use. Buffalo milk standardized to 6 per cent fat and 9 per cent SNF was heated at 85 °C for 10 minutes and subsequently cooled to 35 °C. The cooled milk was inoculated with 2 per cent starter culture and incubated at 35 °C for approximately 8 hours to obtain firm *curd*. After complete coagulation, the *curd* was gently stirred to break the coagulum and achieve a uniform consistency. Potable water, equivalent to 20 per cent of the *curd* weight, was added, followed by the incorporation of date palm pulp according to the respective treatment combinations. Sugar was added according to the desired level of sweetness, and the mixture was thoroughly blended to obtain a smooth and homogeneous Lassi. Finally, the prepared Lassi was packed in clean, sterilized containers and stored under refrigerated conditions (7±2 °C) until further analysis.

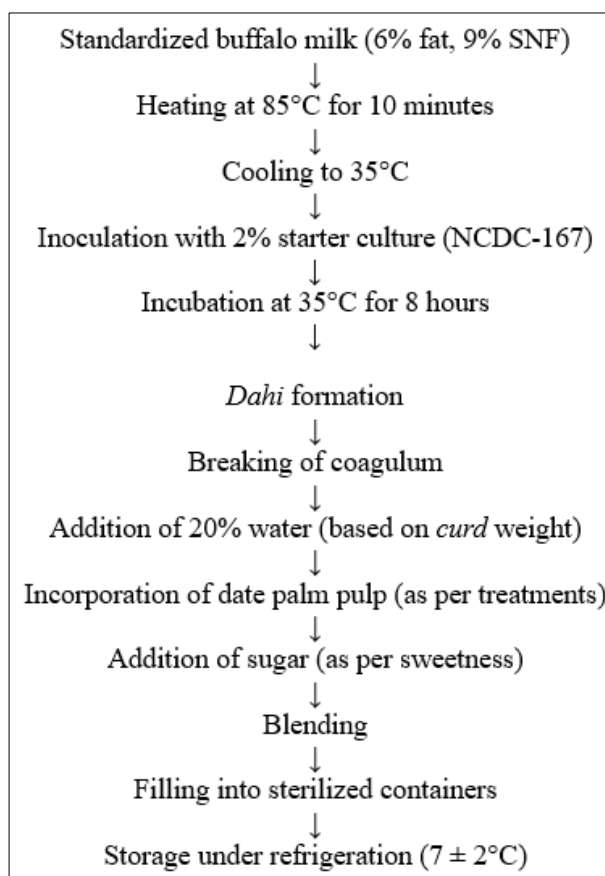


Fig 1: Flow chart for the preparation of Lassi blended with date palm pulp (Kedaree *et al.* 2021a)^[10]

Treatment combination

For the preparation of Lassi incorporated with date palm (*Phoenix dactylifera* L.) pulp, different treatment combinations were evaluated on a weight basis as given below:

T₁: (Control): 100% *curd* + 15% sugar

T₂: 94% *curd* + 6% date palm pulp + 14% sugar

T₃: 91% *curd* + 9% date palm pulp + 12% sugar

T₄: 88% *curd* + 12% date palm pulp + 10% sugar

The control and date palm pulp blended Lassi were analysed for titratable acidity, pH, moisture, ash, fat, total solids and protein using standard methods. Titratable acidity was determined as per the method described in IS: 1479 (Part-I), 1960^[8]. The pH was determined using a digital pH meter (Model 335). Moisture, ash and total solids contents were determined as per the methods described in IS: SP (Part XI), 1981^[9]. The fat content was determined by using Gerber's method described in IS: 1224 (Part II), 1977^[7]. The protein

content was determined by the method of Lowry *et al.* (1951)^[12].

Results and Discussion

Titrateable acidity of Lassi blended with date palm pulp

The mean titrateable acidity values of the control (T₁) and the date palm pulp-incorporated treatments (T₂, T₃ and T₄) were 0.68, 0.74, 0.80, and 0.86 per cent, respectively. The titrateable acidity of T₁ was significantly lower than those of the pulp-incorporated treatments and increased with increasing levels of date palm pulp, with T₄ (0.86 per cent) recording the highest value. The increase in titrateable acidity may be due to organic acids in date palm pulp and lactic acid production during fermentation. The results obtained in the present study are in consonance with Deshmukh *et al.* (2022)^[4], who reported an increase in titrateable acidity of *shrikhand* with the incorporation of date palm pulp at 10, 20, and 30 per cent levels, from 0.90 to 1.07 per cent.

Table 1: Titrateable acidity of Lassi blended with date palm pulp (per cent)

Treatment	Replication				Mean
	R1	R2	R3	R4	
T ₁	0.68	0.69	0.67	0.66	0.68 ^d
T ₂	0.73	0.74	0.72	0.76	0.74 ^c
T ₃	0.79	0.81	0.78	0.82	0.80 ^b
T ₄	0.87	0.86	0.84	0.88	0.86 ^a
S.E.±0.0082 C.D. at 5% 0.0254					

The values with different superscripts differ significantly ($p < 0.05$)

pH of Lassi blended with date palm pulp

The mean values for pH of the control (T₁) and Lassi blended with date palm pulp (T₂, T₃ and T₄) were 4.60, 4.54, 4.48 and 4.41, respectively. A significant decrease in pH was observed with increasing levels of date palm pulp in Lassi. The pH in control T₁ (4.60) was the highest, whereas in treatment T₄ it was the lowest (4.41). The decrease in pH may be attributed to the acidic constituents present in date palm pulp, which contributed to the increased acidity of Lassi with increasing levels of date palm pulp. The results of the present study are similar to Deshmukh *et al.* (2022)^[4], who reported a decrease in pH from 4.55 in the control to 4.33 with incorporation of date palm pulp at 10, 20 and 30 per cent levels in *shrikhand*. Similarly, Mane *et al.* (2022)^[13] reported a decrease in pH from 4.29 in the control to 4.15 with increasing levels of jamun powder at 0.5, 1.0 and 1.5 per cent in Lassi.

Table 2: pH of Lassi blended with date palm pulp

Treatment	Replication				Mean
	R1	R2	R3	R4	
T ₁	4.61	4.58	4.59	4.60	4.60 ^a
T ₂	4.53	4.54	4.52	4.55	4.54 ^b
T ₃	4.49	4.47	4.48	4.46	4.48 ^c
T ₄	4.43	4.41	4.42	4.39	4.41 ^d
S.E.±0.0070 C.D. at 5% 0.0217					

The values with different superscripts differ significantly ($p < 0.05$)

Fat of Lassi blended with date palm pulp

The mean fat contents of the control (T₁) and Lassi blended with 6, 9 and 12 per cent date palm pulp (T₂, T₃ and T₄) were 7.29, 7.16, 7.02 and 6.88 per cent, respectively. The fat content decreased significantly with increasing levels of

date palm pulp, and all the treatments differed significantly from one another. The control treatment T₁ (7.29%) recorded the highest fat content, whereas T₄ (6.88%) recorded the lowest fat content. The decrease in fat content may be attributed to the relatively low fat content of date palm pulp (0.15 g/100 g) compared with *curd*. The results obtained in the present study are similar to Kedaree *et al.* (2021b)^[11], who reported a decrease in fat content of Lassi from 7.49 to 7.02 per cent with incorporation of apple powder at 2, 4, 6 and 8 per cent levels. Similarly, Deshmukh *et al.* (2022)^[4] reported a decrease in fat content of *shrikhand* from 8.02 to 7.78 per cent with incorporation of date palm pulp at 10, 20 and 30 per cent.

Table 3: Fat of Lassi blended with date palm pulp (per cent)

Treatment	Replication				Mean
	R1	R2	R3	R4	
T ₁	7.31	7.26	7.30	7.28	7.29 ^a
T ₂	7.17	7.15	7.18	7.14	7.16 ^b
T ₃	7.03	7.04	6.99	7.01	7.02 ^c
T ₄	6.91	6.89	6.86	6.87	6.88 ^d
S.E.±0.0106 C.D. at 5% 0.0327					

The values with different superscripts differ significantly ($p < 0.05$)

Protein of Lassi blended with date palm pulp

The mean protein contents of the control (T₁) and Lassi blended with date palm pulp (T₂, T₃ and T₄) were 3.24, 2.96, 2.79 and 2.64 per cent, respectively. The protein content decreased significantly with increasing levels of date palm pulp, and all the treatments differed significantly from one another. The control treatment T₁ (3.24%) recorded the highest protein content, whereas T₄ (2.64%) recorded the lowest protein content. The decline in protein content may be attributed to the comparatively lower protein contribution of date palm pulp than the dairy base. The results obtained in the present study are similar to Deshmukh *et al.* (2022)^[4], who reported a decline in protein content of date palm pulp-incorporated *shrikhand* from 9.07 per cent in the control to 8.97, 8.88 and 8.80 per cent with incorporation of 5, 10 and 15 per cent date palm pulp, respectively.

Table 4: Protein of Lassi blended with date palm pulp

Treatment	Replication				Mean
	R1	R2	R3	R4	
T ₁	3.31	3.21	3.24	3.18	3.24 ^a
T ₂	2.95	3.01	2.89	2.98	2.96 ^b
T ₃	2.81	2.79	2.83	2.74	2.79 ^c
T ₄	2.66	2.62	2.68	2.59	2.64 ^d
S.E.±0.0235 C.D. at 5% 0.072					

The values with different superscripts differ significantly ($p < 0.05$)

Moisture of Lassi blended with date palm pulp

The mean moisture contents of the control (T₁) and Lassi blended with date palm pulp (T₂, T₃ and T₄) were 76.08, 75.68, 75.33 and 75.02 per cent, respectively. The moisture content decreased significantly with increasing levels of date palm pulp, and all the treatments differed significantly from one another. The control treatment T₁ (76.08%) recorded the highest moisture content, whereas T₄ (75.02%) recorded the lowest moisture content. The decrease in moisture content was due to the lower moisture content of date palm pulp (21.80%) compared with *curd*. The results obtained in the present study are similar to Bhutkar *et al.*

(2012) [3], who reported a decrease in moisture content of Lassi from 83.84 to 77.97 per cent with 10, 15 and 20 per cent coconut milk. Similarly, Pawar *et al.* (2024) [15] reported a decrease in moisture content of Lassi from 74.58 to 73.30 per cent with 2, 4 and 6 per cent apple powder.

Table 5: Moisture of Lassi blended with date palm pulp (per cent)

Treatment	Replication				Mean
	R1	R2	R3	R4	
T ₁	75.94	76.05	76.15	76.18	76.08 ^a
T ₂	75.54	75.76	75.74	75.68	75.68 ^b
T ₃	75.23	75.42	75.37	75.31	75.33 ^c
T ₄	74.92	75.08	75.01	75.07	75.02 ^d
S.E.±0.0459 C.D. at 5% 0.1415					

The values with different superscripts differ significantly ($p < 0.05$)

Total solids of Lassi blended with date palm pulp

The mean total solids contents of the control (T₁) and Lassi blended with 6, 9 and 12 per cent date palm pulp (T₂, T₃ and T₄) were 23.92, 24.32, 24.67 and 24.98 per cent, respectively. A significant increase in total solids content was observed with increasing levels of date palm pulp in Lassi. The total solids content in the control T₁ (23.92) was the lowest, whereas in treatment T₄ it was the highest (24.98 per cent). The increase in total solids content was due to the decrease in moisture content with increasing levels of date palm pulp in Lassi. The results of the present study are similar to Shinde *et al.* (2018) [16], who reported an increase in total solids content from 21.35 per cent in the control to 30.55 per cent with the incorporation of date palm pulp at 2.5, 5.0, 7.5 and 10 per cent levels in *milkshake*. Similarly, Mane *et al.* (2022) [13] reported an increase in total solids content of Lassi from 23.01 per cent in the control to 26.99 per cent with incorporation of jamun powder at 0.5, 1.0 and 1.5 per cent levels.

Table 6: Total solids of Lassi blended with date palm pulp (per cent)

Treatment	Replication				Mean
	R1	R2	R3	R4	
T ₁	24.06	23.95	23.85	23.82	23.92 ^d
T ₂	24.46	24.24	24.26	24.32	24.32 ^c
T ₃	24.77	24.58	24.63	24.69	24.67 ^b
T ₄	25.08	24.92	24.99	24.93	24.98 ^a
S.E.±0.0459 C.D. at 5% 0.1415					

The values with different superscripts differ significantly ($p < 0.05$)

Ash of Lassi blended with date palm pulp

The mean ash contents of the control (T₁) and Lassi blended with date palm pulp (T₂, T₃ and T₄) were 1.17, 1.23, 1.29 and 1.36 per cent, respectively. The ash content increased significantly with increasing levels of date palm pulp and all the treatments differed significantly from one another. The ash content was lowest in the control (T₁) at 1.17 per cent and highest in T₄ at 1.36 per cent, while T₂ and T₃ recorded 1.23 and 1.29 per cent, respectively. The increase in ash content may be attributed to the higher mineral content of date palm pulp than *curd*. The results of the present study are similar to Deshmukh *et al.* (2022) [4], who reported an increase in ash content of *shrikhand* from 0.85 per cent in the control to 1.05 per cent with the incorporation of 5, 10 and 15 per cent date palm pulp. Similarly, Dhumal *et al.* (2018) [5] observed that the ash content of Lassi increased

from 0.45 per cent in the control to 0.47 per cent with incorporation of 2.5, 5 and 7.5 per cent pudina extract.

Table 7: Ash of Lassi blended with date palm pulp (per cent)

Treatment	Replication				Mean
	R1	R2	R3	R4	
T ₁	1.16	1.19	1.14	1.18	1.17 ^d
T ₂	1.21	1.23	1.22	1.24	1.23 ^c
T ₃	1.27	1.29	1.32	1.29	1.29 ^b
T ₄	1.34	1.37	1.38	1.36	1.36 ^a
S.E.±0.0093 C.D. at 5% 0.0286					

The values with different superscripts differ significantly ($p < 0.05$)

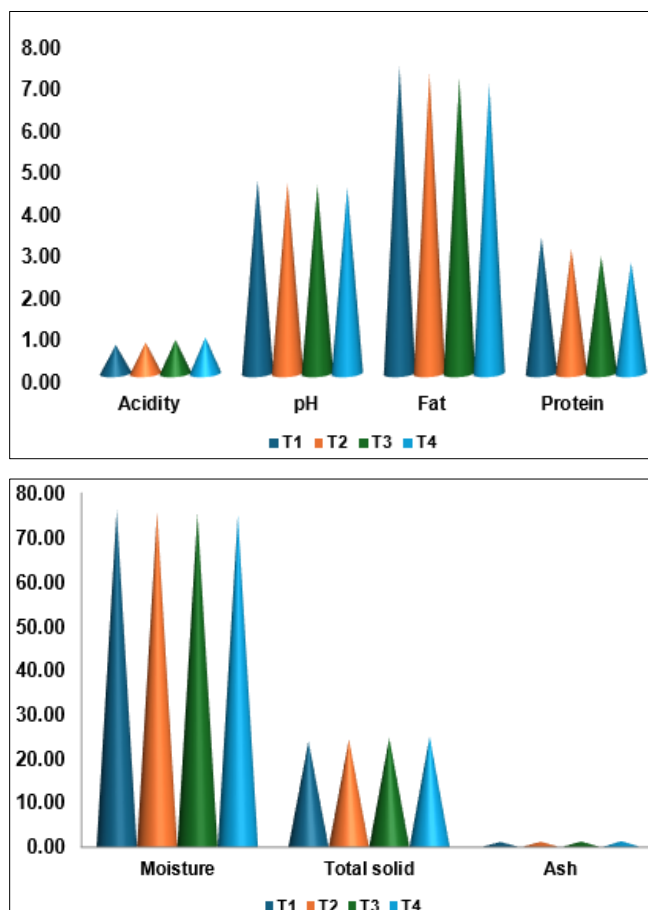


Fig 2: Graphical presentation of the physico-chemical properties of Lassi blended with date palm pulp

Conclusion

The value-added and nutritious Lassi was successfully prepared by adding date palm pulp to buffalo milk *curd*. The addition of date palm pulp significantly influenced the physico-chemical properties of the Lassi. Titratable acidity increased, while pH, fat, protein and moisture contents decreased with increasing levels of date palm pulp. In contrast, total solids and ash contents increased with increasing pulp addition. Among the different treatments, addition of 6 per cent date palm pulp was found to be suitable for the preparation of acceptable and nutritionally improved Lassi. Thus, date palm pulp can be effectively utilized for the development of value-added Lassi.

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