ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating (2026): 4.97
IJAFS 2026; 8(6): 86-93
www.agriculturaljournals.com
Received: 14-03-2026
Accepted: 16-04-2026

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Effect of microwave heating treatments on the sensory attributes of *Shrikhand* during storage at 5 ± 1 ˚C

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DOI: https://www.doi.org/10.33545/2664844X.2026.v8.i6b.1581

Abstract
Shrikhand is a popular fermented dairy product with limited shelf life due to its high moisture content and susceptibility to microbial spoilage. The present study was conducted to evaluate the effect of microwave heating on the sensory quality and storage stability of *shrikhand* during refrigerated storage at 5 ± 1 ˚C. *Shrikhand* samples were subjected to microwave heating at 800 W for 10, 20 and 30 seconds and compared with an untreated control. Sensory attributes including colour and appearance, body and texture, flavour and overall acceptability were assessed using a 9-point hedonic scale. All sensory scores decreased significantly (p<0.05) during storage irrespective of treatment. However, microwave treated samples retained higher sensory scores than the control throughout the storage period. Among the treatments, microwave heating at 800 W for 20 seconds (M_2) consistently recorded the highest scores for all sensory attributes. The untreated control remained acceptable for 35 days, whereas heating for 10 seconds extended acceptability to 42 days. Treatments heated for 20 and 30 seconds remained acceptable for up to 49 days. The results indicated that microwave heating at 800 W for 20 seconds was the most effective treatment for preserving sensory quality and extending the shelf life of *shrikhand* under refrigerated storage.

Keywords: *Shrikhand*, microwave heating, sensory evaluation, Shelf-life extension etc.

Introduction
Milk is one of the most complete and nutritious foods consumed by humans since ancient times. Over the years, various milk products have been developed to enhance its utilization, nutritional value and sensory characteristics. Fermentation is an important preservation technique that improves the nutritive quality, flavour, texture and acceptability of dairy products. *Shrikhand* is a traditional Indian fermented milk product widely consumed in Maharashtra, Gujarat, Karnataka and parts of Rajasthan due to its pleasant taste, characteristic flavour, therapeutic benefits and high nutritional value. It possesses a smooth, firm and semi-solid consistency that makes it a popular accompaniment to poories and bread (Nigam *et al.*, 2009) [7]. The shelf life of *shrikhand* is limited because of its high moisture content and susceptibility to microbial spoilage. Therefore, extending its storage stability while maintaining product quality is of considerable importance. Microwave heating has emerged as a promising thermal processing technology for food preservation. Unlike conventional heating methods, microwave treatment generates heat directly within the food through the interaction of electromagnetic waves with water molecules, resulting in rapid and uniform heating (Tulsidas, 2004) [12]. Foods containing higher levels of moisture, fat and sugar exhibit greater absorption of microwave energy, leading to faster heating rates (Young and Jolly, 1990) [14]. Microwave heating offers several advantages, including shorter processing times, energy efficiency, improved product quality, and better retention of nutrients, flavour, and texture compared to conventional thermal treatments (Rao and Ramesh, 1995) [8]. The technology has been successfully applied in the processing of fruits, vegetables, cereals and dairy products (Kar, 2000) [5]. However, information regarding its application for extending the shelf life of fermented dairy products such as *shrikhand* remains limited (Bach, 1978) [3]. Microwave processing has also gained attention due to its ability to minimize losses of heat sensitive nutrients while effectively reducing microbial

load (Kalla and Devaraju, 2016) [4]. Therefore, the present study was undertaken to evaluate the effect of microwave treatment on the shelf life and quality characteristics of *shrikhand* during refrigerated storage.

Materials and Methods

Materials

The fresh, clean whole buffalo milk was procured from local market of Rahuri, Ahmednagar (MS). The freeze-dried culture of LF-40 was procured from National Collection of Dairy culture (NCDC) unit, NDRI, Karnal (Haryana) and used @ 1 per cent of milk for preparation of *dahi* for every trial. All chemicals required for the analytical work were used of analytical (AR) or guaranteed reagent (GR) grade manufactured by Merk, India Ltd / Glaxo India Ltd. A domestic microwave oven manufactured by LG Electronics India Pvt. Ltd, Model No. MG-608AP was used for heating *shrikhand* samples. Polypropylene cups (100 gm capacity) used for storing and serving of *shrikhand*, were procured from Tarsons Products Pvt. Ltd., Kolkata, India.

Table 1: Treatment detail

Treatment Code	Treatment details
M_0	Absolute Control
M_1	Microwave heating 800 Watt for 10 seconds
M_2	Microwave heating 800 Watt for 20 seconds
M_3	Microwave heating 800 Watt for 30 seconds

M-Microwave heating

Sensory evaluation

Sensory evaluation of both fresh and stored control and experimental *shrikhand* samples were carried out by a semi-trained panel of five judges from the Department of Animal Husbandry and Dairy Science. The samples were assessed for colour and appearance, body and texture, flavour and overall acceptability using a 9-point Hedonic scale (Annexure) according to Amerine *et al.* (1965) [2].

Statistical analysis

Data generated during the course of investigation was analyzed with the help of statistical design namely Completely Randomized Design (CRD) as described by Snedecor and Cochran (1967) [11].

Preparation of *Shrikhand*

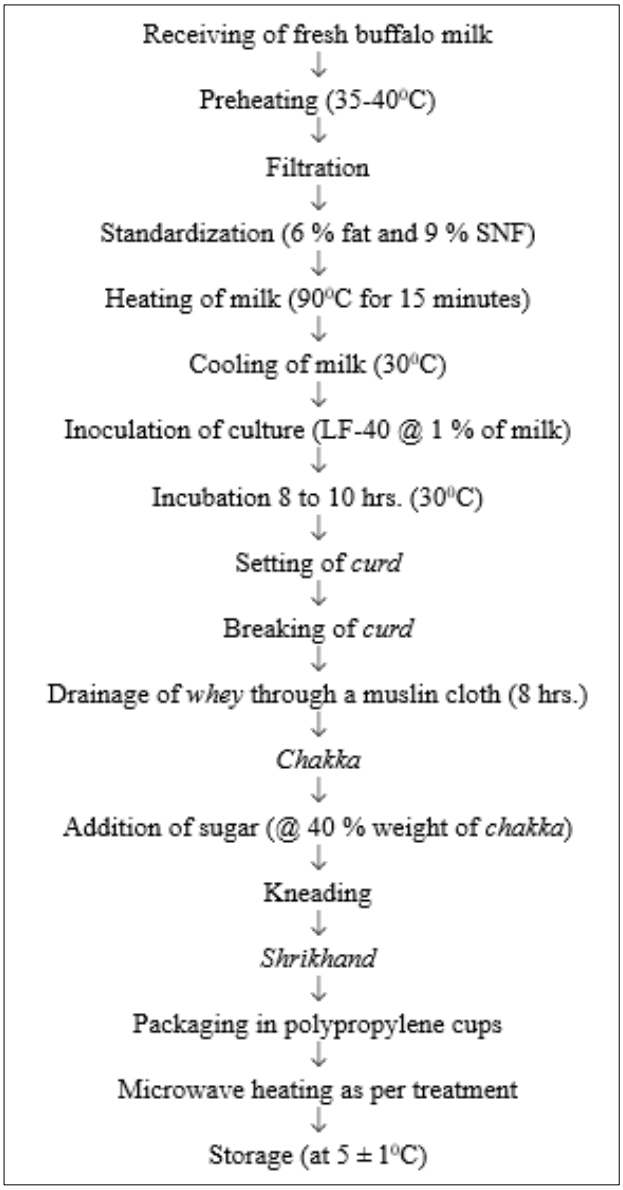

Fig 1: Flow diagram for the preparation of microwave treated *shrikhand*

Results and Discussion

Effect of different microwave heating times on changes in sensory attributes of *shrikhand* during storage at 5 ± 1 ˚C

Shrikhand samples treated with microwave heating were stored at 5 ± 1 ˚C to assess the sensory attributes over storage. The sensory evaluation focused on key parameters including colour and appearance, body and texture, flavour and overall acceptability. The data presented in upcoming table demonstrate the effect of microwave treatment on the sensory quality of *shrikhand* throughout storage.

Colour and appearance

The data presented in Table 2 and graphically represented in Fig. 2 revealed that the colour and appearance score of *shrikhand* samples (M_0 to M_3) decreased gradually during refrigerated storage at 5 ± 1 ˚C.

Table 2: Effect of different microwave heating times on changes in colour and appearance score* of *shrikhand* during storage at 5 ± 1 ˚C

Treatment	Storage period (Days)							
	0	7	14	21	28	35	42	49
M_0	8.75^a	8.55^d	8.20^d	7.73^d	7.00^d	6.02^d	-	-
M_1	8.73^b	8.69^a	8.37^c	8.17^c	7.92^c	7.63^c	6.01^c	-
M_2	8.71^c	8.68^b	8.64^a	8.56^a	8.42^a	8.05^a	7.59^a	6.13^a
M_3	8.67^d	8.64^c	8.56^b	8.43^b	8.18^b	7.86^b	7.52^b	6.11^b
S.E.m (±)	0.0121	0.0119	0.0117	0.0113	0.0108	0.0100	0.0089	0.0059
CD at 5 %	0.0372	0.0368	0.0359	0.0349	0.0333	0.0309	0.0275	0.0182

*The average value of four replications

(-) Indicates that product was spoiled and no further analysis was carried out

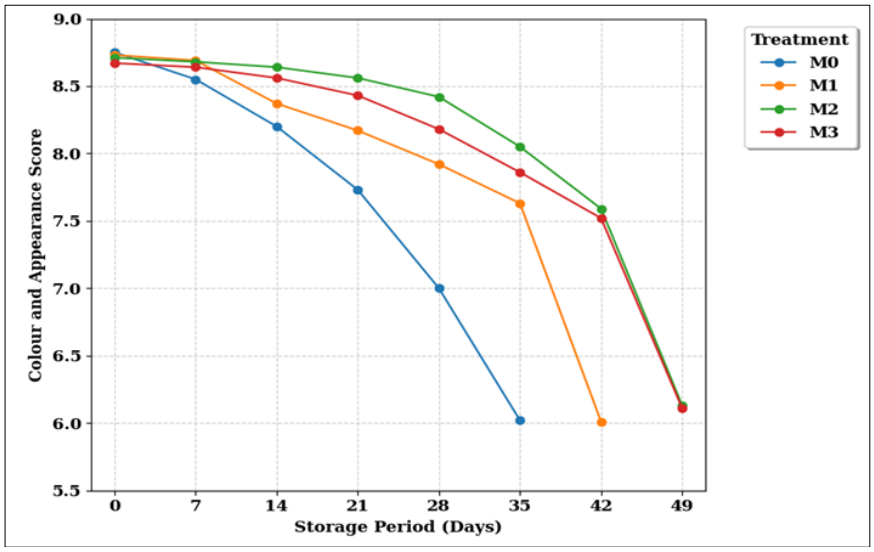

Fig 2: Effect of different microwave heating times on changes in colour and appearance score of *shrikhand* during storage at 5 ± 1 ˚C

The initial colour and appearance scores of all treatments were high and ranged from 8.67 to 8.75 on the 9-point hedonic scale, indicating excellent product quality immediately after preparation. However, a progressive decline in sensory score was observed with advancement of storage period in all samples, which may be attributed to physicochemical and microbiological changes affecting product colour stability, surface texture and overall visual acceptability.

Among the treatments, the control sample M_0 showed the fastest decline in colour and appearance score, decreasing from 8.75 on day 0 to 6.02 on day 35, after which the product spoiled and no further evaluation was carried out. The rapid deterioration in colour and appearance of the control sample might be due to higher microbial activity and oxidative changes occurring in the absence of heat treatment, resulting in pigment degradation and slight surface dullness during storage. Treatment M_1 showed comparatively slower decline in colour and appearance score than M_0, with values decreasing from 8.73 at day 0 to 6.01 on day 42. Mild microwave heating might have reduced initial microbial load and enzymatic activity to some extent, thereby delaying deterioration in colour and visual quality compared to the untreated sample. However, the shorter heating time was insufficient to provide prolonged stability throughout storage.

Treatment M_2 recorded the highest colour and appearance scores throughout the storage period, declining gradually from 8.71 at day 0 to 6.13 on days 49. The comparatively slower reduction in score indicated better retention of desirable colour and visual characteristics. Microwave heating for 20 seconds may have effectively reduced spoilage microorganisms and inactivated certain enzymes responsible for colour degradation, while avoiding excessive heat exposure that could adversely affect product quality. As a result, the sample maintained a smooth, uniform and appealing appearance for a longer storage duration. Treatment M_3 also showed good stability in colour and appearance, with scores decreasing from 8.67 at day 0 to 6.11 on days 49. However, slightly lower scores than M_2 during later stages of storage might be due to marginal heat induced changes such as slight browning or alteration in surface characteristics caused by comparatively longer microwave exposure.

Statistical analysis of the data indicated that the differences among treatments were significant (p<0.05) at all storage intervals. The calculated S.E.m (±) and critical difference (CD at 5 per cent) values indicated that the duration of microwave heating exerted a statistically significant influence on the colour and appearance scores of *shrikhand* throughout the storage period. The gradual decline in sensory scores across storage period was statistically significant for all treatments. Overall, microwave heating improved the colour and appearance of *shrikhand* as compared to the control sample. Among all treatments, M_2 maintained the highest colour and appearance scores throughout the storage period, indicating optimum balance between microbial control and preservation of desirable visual characteristics. Treatment M_2 was significantly superior (p<0.05) to the other treatments in terms of colour and appearance using Microwave heating.

The gradual decrease in colour and appearance scores of *shrikhand* during storage observed in the present study is in agreement with Venkatesh (2014) [13] and Narhare (2003) [6], who reported that microwave treated *shrikhand* maintained higher colour and appearance scores than the untreated control during refrigerated storage, indicating improved visual stability due to microwave heating. The present findings are also supported by Ahmed (1998) [1], who observed better appearance score in microwave treated *yoghurt* during storage as compared to control. Sinha (2007) [10] reported that microwave treated *dahi* retained acceptable colour and appearance scores for longer duration than untreated samples, while Saha (2004) [9] also found slower deterioration in colour and appearance of microwave treated *dahi* and *yoghurt* compared to control samples. Several researchers have also documented a steady decline in the colour and appearance of control *shrikhand* during storage, confirming the pattern observed in the present study.

Body and texture

The data put up in Table 3 and Fig. 3 indicate that the body and texture score of *shrikhand* samples (M_0 to M_3) gradually decreased during refrigerated storage from 0 to 49 days.

Table 3: Effect of different microwave heating times on changes in body and texture score* of *shrikhand* during storage at 5 ± 1 ˚C

Treatment	Storage period (Days)							
	0	7	14	21	28	35	42	49
M_0	8.00^{d}	7.91^{d}	7.68^{d}	7.30^{d}	6.82^{d}	6.03^{d}	-	-
M_1	8.88^{b}	8.72^{c}	8.53^{c}	8.21^{c}	7.73^{c}	7.02^{c}	6.01^{c}	-
M_2	8.93^{a}	8.86^{a}	8.76^{a}	8.60^{a}	8.32^{a}	7.79^{a}	7.08^{a}	6.09^{a}
M_3	8.86^{c}	8.80^{b}	8.68^{b}	8.49^{b}	8.24^{b}	7.69^{b}	6.95^{b}	6.02^{b}
S.E.m (±)	0.0118	0.0117	0.0115	0.0112	0.0107	0.0098	0.0085	0.0058
CD at 5 %	0.0365	0.0361	0.0355	0.0344	0.0328	0.0301	0.0261	0.0180

*The average value of four replications

(-) Indicates that product was spoiled and no further analysis was carried out

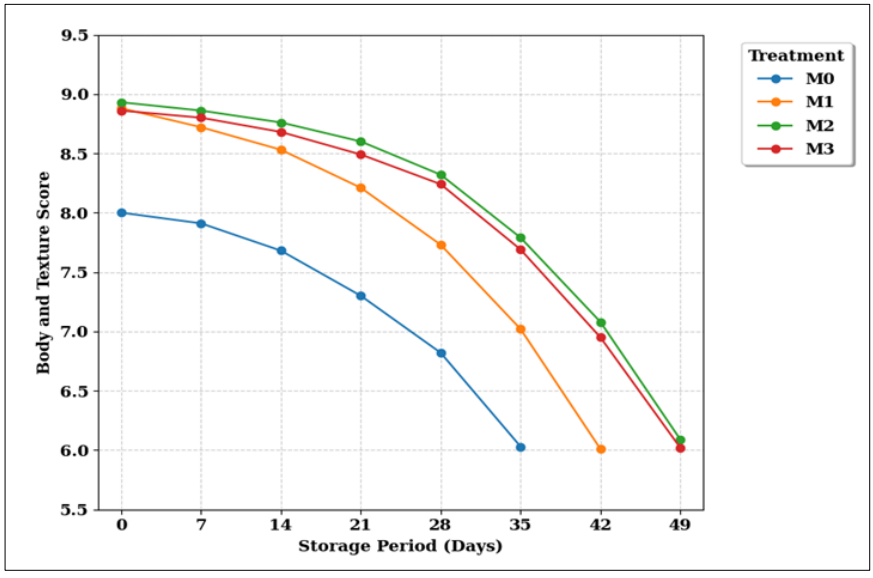

Fig 3: Effect of different microwave heating times on changes in body and texture score of *shrikhand* during storage at 5 ± 1 ˚C

The initial body and texture scores ranged from 8.00 to 8.93, indicating that all freshly prepared samples possessed desirable consistency, smoothness and firmness. However, a progressive decline in scores was observed throughout the storage period, which may be attributed to physicochemical and microbiological changes such as moisture loss, protein destabilization and slight syneresis during storage. The control sample (M_0), which was not subjected to microwave heating, showed the lowest initial score (8.00) and a rapid decline in body and texture during storage. The score decreased continuously to 6.03 by 35 days, after which the product was spoiled and no further observations were recorded. The faster reduction in score of the control sample may be due to higher microbial activity and gradual breakdown of protein structure, leading to loss of firmness and smooth texture.

Treatment M_1 exhibited improved body and texture compared to the control sample throughout storage. The

initial score of 8.88 declined gradually to 6.01 by 42 days. The slight improvement in texture stability may be attributed to partial reduction of microbial load due to mild microwave heating, which helped in maintaining structural integrity of *shrikhand* for a longer period than the control sample. Treatment M_2 recorded the highest body and texture scores among all treatments during the entire storage period. The score decreased gradually from 8.93 at day 0 to 6.09 at 49 days, indicating better retention of desirable consistency and smoothness. The improved performance of M_2 may be attributed to optimum microwave exposure time, which effectively reduced spoilage microorganisms while maintaining the stability of milk proteins and fat matrix. Adequate microwave heating may have promoted better water binding capacity and uniform distribution of solids, thereby preventing rapid deterioration in texture.

Treatment M_3 also showed higher scores than control but slightly lower than M_2 throughout storage. The body and texture score decreased from 8.86 at day 0 to 6.02 at 49 days. Although microwave heating for 30 seconds helped in reducing microbial load, relatively longer exposure might have caused slight structural changes in milk proteins, leading to marginal reduction in smoothness and firmness compared to M_2. Statistical analysis of the data revealed that differences among treatments were statistically significant (p<0.05) at all storage intervals, as indicated by the S.E.m (±) and CD values given in Table 4.20. The consistent significance across storage periods indicates that microwave heating time had a measurable effect on the body and texture characteristics of *shrikhand* during storage.

Overall, microwave heating improved the stability of body and texture compared to the untreated control sample. Among all treatments, M_2 maintained the highest sensory score for the longest duration, suggesting that microwave heating for 20 seconds at 800 W was optimum for preserving desirable texture characteristics during refrigerated storage. Treatment M_2 was significantly superior (p<0.05) to the other treatments in terms of body and texture when microwave heating was used.

The present findings are supported by earlier studies on microwave heating and storage stability of fermented dairy products. Venkatesh (2014) [13] reported that *shrikhand* treated with microwave heating (1000 W for 40 seconds) maintained higher body and texture scores than the control during storage at 7 ± 1 ˚C. Similarly, Narhare (2003) [6] observed superior body and texture in microwave treated *shrikhand* compared to untreated samples stored at 7 ± 2 ˚C, indicating that microwave heating helps in maintaining structural stability during storage. Comparable observations were reported in other fermented milk products. Saha (2004) [9] found that *dahi* and *yoghurt* subjected to microwave heating at 600 W for 10 seconds showed a slower decline in body and texture scores during storage at 7 ± 2 ˚C. Sinha (2007) [10] also reported that microwave heating of *dahi* at 300 W for 30 seconds influenced changes in body and texture during storage at 30 ± 1 ˚C, with laboratory prepared samples showing better stability than market samples. A similar pattern of decline in untreated *shrikhand* has been reported by several researchers.

Flavour

The data dispensed in Table 4 and Fig. 4 indicate the effect of different microwave heating times on the flavour score of *shrikhand* during storage at 5 ± 1 ˚C. The flavour score of all samples decreased gradually with the advancement of storage period, which may be attributed to progressive biochemical changes such as development of acidity, slight oxidation of fat, and loss of desirable volatile flavour compounds during storage. However, microwave treated samples retained higher flavour scores compared to the control sample, indicating the beneficial role of microwave heating in maintaining sensory quality of *shrikhand*.

Among the treatments, M_0 recorded the lowest flavour scores throughout storage. The flavour score of M_0 decreased from 8.02 on day 0 to 6.05 on day 35, after which the product was considered spoiled and no further observations were recorded. The faster decline in flavour score in the control sample may be due to higher microbial activity and faster development of undesirable flavour compounds during storage. The sample M_1 showed better retention of flavour score compared to the control. The flavour score decreased gradually from 8.79 on day 0 to 6.02 on day 42. Microwave heating for a short duration might have reduced microbial load to some extent, thereby slowing flavour deterioration during storage. However, the relatively shorter heating time might not have been sufficient to provide prolonged flavour stability.

Treatment M_2 recorded the highest flavour scores throughout the storage period. The flavour score decreased from 8.89 on day 0 to 6.11 on day 49, indicating better preservation of flavour quality compared to all other treatments. The improved flavour retention in M_2 may be attributed to optimum microwave heating time, which effectively reduced microbial activity and enzymatic reactions responsible for flavour deterioration, while maintaining the desirable sensory attributes of *shrikhand*. Adequate microwave exposure might have minimized spoilage reactions without causing overheating or flavour damage.

Table 4: Effect of different microwave heating times on changes in flavour score* of *shrikhand* during storage at 5 ± 1 ˚C

Treatment	Storage period (Days)							
	0	7	14	21	28	35	42	49
M_0	8.02^{d}	7.88^{d}	7.59^{d}	7.21^{d}	6.70^{d}	6.05^{d}	-	-
M_1	8.79^{c}	8.63^{c}	8.44^{c}	8.17^{c}	7.57^{c}	7.01^{c}	6.02^{c}	-
M_2	8.89^{a}	8.83^{a}	8.70^{a}	8.54^{a}	8.28^{a}	7.68^{a}	6.98^{a}	6.11^{a}
M_3	8.86^{b}	8.75^{b}	8.62^{b}	8.41^{b}	8.16^{b}	7.53^{b}	6.79^{b}	6.01^{b}
S.E.m (±)	0.0118	0.0117	0.0114	0.0111	0.0105	0.0097	0.0084	0.0059
CD at 5 %	0.0364	0.0360	0.0352	0.0341	0.0325	0.0299	0.0258	0.0181

*The average value of four replications

(-) Indicates that product was spoiled and no further analysis was carried out

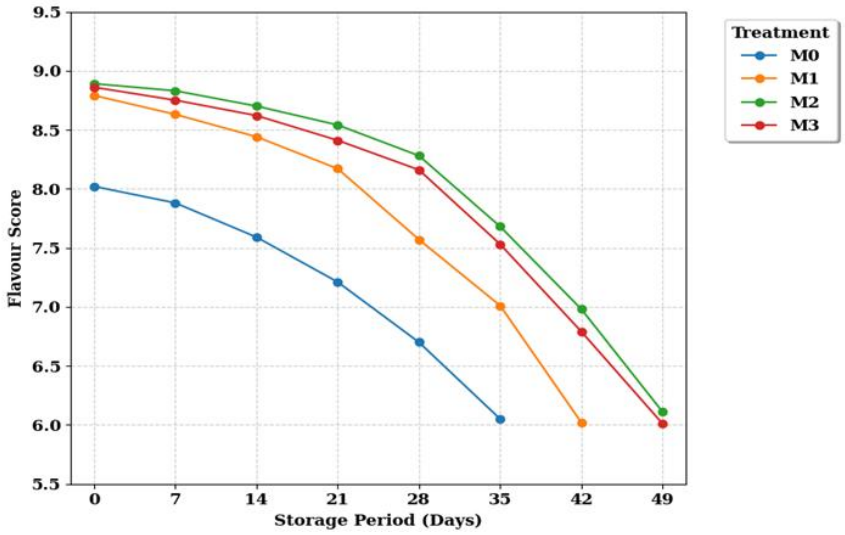

Fig 4: Effect of different microwave heating times on changes in flavour score of *shrikhand* during storage at 5 ± 1 ˚C

Similarly, M_3 also maintained relatively high flavour scores during storage, decreasing from 8.86 on day 0 to 6.01 on day 49. However, slightly lower flavour scores compared to M_2 may be due to comparatively longer microwave exposure, which might have caused minor changes in flavour compounds or slight cooked flavour in the product. Statistical analysis of the data revealed that the differences among treatments were statistically significant (p<0.05) at all storage intervals. The calculated S.E.m (±) and CD (at 5 per cent) value indicate a significant effect of microwave heating time on the flavour score of *shrikhand* during storage. The significant differences among treatments confirm that microwave heating duration plays an important role in maintaining flavour stability of *shrikhand*. Overall, microwave treated samples showed better flavour retention than the control sample throughout storage. Among the different treatments, M_2 showed maximum flavour stability and slower decline in sensory score, indicating that microwave heating at 800 Watt for 20 seconds was the most suitable treatment for preserving flavour quality of *shrikhand* during refrigerated storage. Treatment M_2 was significantly superior (p<0.05) to the other treatments in terms of flavour using Microwave heating.

The present findings are in agreement with earlier studies on the effect of microwave heating on flavour quality of fermented dairy products. Venkatesh (2014) [13] reported that *shrikhand* treated at 1000 W for 40 seconds retained higher flavour scores during 49 days of storage at 7 ± 1 ˚C, whereas untreated control samples deteriorated earlier. Narhare (2003) [6] also observed that *shrikhand* subjected to six microwave power levels for 45 seconds maintained better flavour than control during 20 days of storage at 7 ± 2 ˚C. Saha (2004) [9] reported that microwave heating of *dahi* and *yoghurt* at 600 W for 10 seconds resulted in slower decline in flavour during storage compared with untreated samples. Similarly, Sinha (2007) [10] reported that microwave heating of *dahi* at 300 W for 30 seconds resulted in a greater decline in flavour in market samples compared to laboratory-prepared samples during storage at 30 ± 1 ˚C. A progressive reduction in flavour scores of control *shrikhand* during storage has been reported by numerous authors.

Overall acceptability

The data furnished in Table 5 and Fig. 5 stipulate the effect of different microwave heating times on the overall acceptability score of *shrikhand* during storage at 5 ± 1 ˚C. The overall acceptability scores of all samples showed a gradual decline throughout the storage period, which may be attributed to progressive changes in flavour, body and texture, and colour and appearance of the *shrikhand* during storage. However, microwave treated samples maintained higher acceptability scores than the untreated control sample, indicating the beneficial role of microwave heating in preserving sensory quality of *shrikhand*.

The control sample M_0 exhibited comparatively lower overall acceptability scores throughout storage. The score decreased from 8.26 on day 0 to 6.03 on day 35, after which the product spoiled and no further evaluation was carried out. The faster decline in acceptability of the control sample might be due to continuous microbial activity and physicochemical changes, resulting in deterioration of flavour and texture during storage. The microwave treated sample M_1 showed better overall acceptability than the control sample, with scores decreasing gradually from 8.80 on day 0 to 6.01 on day 42. The comparatively slower decline in acceptability of M_1 may be due to partial reduction in microbial load and slight stabilization of product characteristics due to mild microwave heating.

Table 5: Effect of different microwave heating times on changes in overall acceptability score* of *shrikhand* during storage at 5 ± 1 ˚C

Treatment	Storage period (Days)							
	0	7	14	21	28	35	42	49
M_0	8.26^{c}	8.11^{d}	7.82^{d}	7.41^{d}	6.84^{d}	6.03^{d}	-	-
M_1	8.80^{b}	8.68^{c}	8.45^{c}	8.18^{c}	7.74^{c}	7.22^{c}	6.01^{c}	-
M_2	8.84^{a}	8.79^{a}	8.70^{a}	8.57^{a}	8.34^{a}	7.84^{a}	7.22^{a}	6.11^{a}
M_3	8.80^{b}	8.73^{b}	8.62^{b}	8.44^{b}	8.19^{b}	7.69^{b}	7.09^{b}	6.05^{b}
S.E.m (±)	0.0119	0.0118	0.0115	0.0112	0.0107	0.0098	0.0086	0.0059
CD at 5 %	0.0367	0.0363	0.0355	0.0344	0.0329	0.0303	0.0265	0.0181

*The average value of four replications

(-) Indicates that product was spoiled and no further analysis was carried out

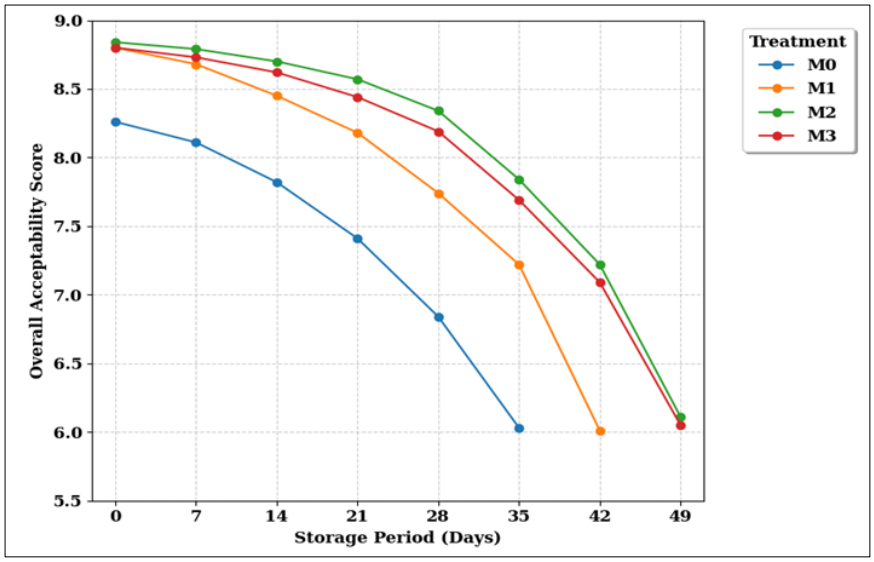

Fig 5: Effect of different microwave heating times on changes in overall acceptability score of *shrikhand* during storage at 5 ± 1 ˚C

The sample M_2 recorded the highest overall acceptability scores during the entire storage period. The score decreased gradually from 8.84 on day 0 to 6.11 on day 49, indicating better retention of desirable sensory attributes for a longer duration compared to other treatments. The superior performance of M_2 may be attributed to optimum microwave exposure time, which effectively reduced spoilage microorganisms and slowed down biochemical changes without adversely affecting flavour, texture, or appearance. Adequate microwave treatment might have helped in maintaining product stability, reducing moisture loss, and preserving desirable consistency, resulting in higher consumer acceptability. The sample M_3 also showed higher overall acceptability than M_0 and M_1, with scores decreasing from 8.80 on day 0 to 6.05 on day 49. However, the acceptability scores were slightly lower than M_2 during storage. Longer microwave exposure may have caused slight changes in sensory attributes such as minor flavour alteration or textural changes, leading to marginally lower acceptability compared to the optimum treatment M_2.

Statistical analysis of the data revealed that the differences among treatments were statistically significant (p<0.05) at all storage intervals, as indicated by the CD values at 5 per cent level. The low S.E.m (±) values suggest good precision and reliability of the experimental results. The significant variation among treatments confirms that microwave heating time had a marked influence on the overall acceptability of *shrikhand* during storage. Overall, microwave heating improved the sensory quality and storage stability of *shrikhand* compared to the untreated control sample. Among the different treatments, the 20 second microwave heating treatment maintained better balance of flavour, texture, and appearance throughout storage, resulting in higher acceptability scores. Treatment M_2 was significantly superior (p<0.05) to the other treatments in overall acceptability using Microwave heating.

The present findings are in agreement with earlier research on the effect of microwave heating on sensory quality of fermented dairy products. Venkatesh (2014) [13] reported that *shrikhand* treated with microwave heating at 1000 W for 40 seconds retained higher overall acceptability scores during 49 days of storage at 7 ± 1 ˚C, whereas the control sample showed a faster decline and shorter shelf life. Sinha (2007) [10] observed that microwave heating of *dahi* at 300 W for 30 seconds resulted in a reduction in acceptability during storage at 30 ± 1 ˚C, with comparatively greater decline in market samples than laboratory prepared samples. Similarly, Saha (2004) [9] reported that *dahi* and *yoghurt* treated with microwave heating at 600 W for 10 seconds exhibited a slower decrease in acceptability scores during storage at 7 ± 2 ˚C compared to untreated samples. A consistent decline in overall acceptability of untreated shrikhand during storage has been documented by numerous researchers.

Conclusion

From the present study it was concluded that, during storage of *shrikhand*, the sensory scores for all attributes were decreased significantly (p<0.05) in four samples. Microwave heating significantly influenced the product shelf life. Without treatment, it remained acceptable for 35 days. Heating at 800W for 10 seconds extended this to 42 days, while 20 and 30 seconds of heating both maintained product acceptability for 49 days at 5 ± 1 ˚C. Based on sensory, microwave heating at 800 watts for 20 seconds is recommended as an effective method for preserving *shrikhand*.

Reference

1. Ahmed HA. Effect of microwave heating on yoghurt properties. Ann Agric Sci Moshtohor. 1998;36(4):2251-2260.
2. Amerine MA, Pangborn RM, Roesster EB. Principles of sensory evaluation of food. New York (USA): Academic Press Inc.; 1965.
3. Bach J. Improvement in or relating to the methods for effecting uniform heating of organic products. British Patent 1507069. Dairy Sci Abstr. 1978;40:5578.
4. Kalla AM, Devaraju R. Microwave energy and its application in food industry: a review. Asian J Dairy Food Res. 2016;35(1):37-44.
5. Kar A. Microwave processing: utilization in food industries. Processed Food Industry. 2000;3(6):11-13.

6. Narhare SA. Studies on effect of preservatives and packages on keeping quality of shrikhand [MSc thesis]. Rahuri (India): Mahatma Phule Krishi Vidyapeeth; 2003.
7. Nigam N, Singh R, Upadhayay PK. Incorporation of chakka by papaya pulp during the manufacture of shrikhand. J Dairying Foods Home Sci. 2009;28(2):115-118.
8. Rao K, Ramesh P. Use of microwaves for the synthesis and processing of materials. Bull Mater Sci. 1995;18(4):447-465.
9. Saha B. Studies on the effects of microwave radiation on the quality and shelf life of indigenous milk products [MSc dissertation]. Mohanpur, Nadia (India): West Bengal University of Animal and Fishery Sciences; 2004.
10. Sinha S. Studies on the effect of microwave radiation on the quality and shelf life of indigenous milk products [MTech thesis]. Kolkata (India): West Bengal University of Animal and Fishery Sciences; 2007.
11. Snedecor GW, Cochran WG. Statistical methods. 6th ed. Calcutta (India): Oxford and IBH Publishing Co.; 1967.
12. Tulsidas TN. Microwave ovens: microwave heating and its applications in food processing. Food Nutr World. 2004:18-21.
13. Venkatesh M. Application of continuous microwave processing and modified atmosphere packaging for enhancement of shelf life of shrikhand [MSc thesis]. Bidar (India): Karnataka Veterinary, Animal and Fisheries Sciences University; 2014.
14. Young GS, Jolly PG. Microwaves: the potential for use in dairy processing. Aust J Dairy Technol. 1990;45(1):34-36.