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Influence of Packaging Materials on Quality of Banana Burfi during Storage

Venkata Satish Kuchi[1*], J. Kabir[2], F.K. Bouri[3], Rajesh Gupta[4] and R.S. Dhua[2]

[1]Department of Postharvest Technology, College of Horticulture, Dr. YSRHU, Anantharajupeta, Andhra Pradesh-516105, India
[2]Department of Postharvest Technology, [3]Department of Fruits and Orchard Management, BCKV, Nadia, West Bengal 741252, India
[4]Scientist, Krishi Vigyan Kendra, RVSKVV, Gwalior, Madhya Pradesh-458001, India
**Corresponding author*

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A B S T R A C T

The present study was carried out in the department of Postharvest Technology of Horticultural Crops, Bidhan Chandra Krishi Viswavidyalaya Mohanpur, Nadia, West Bengal during 2012-2015. Preparation of banana burfi was standardized in the laboratory by varying proportions of milk, sugar and banana pulp. It was found that 15% banana pulp+ 30% sugar + 55% milk preferred by the taste panel constituted in the Faculty of Horticulture. Burfi was packed in different packaging materials *i.e.,* Aluminium foil (P_1), butter paper (P_2) and polyethylene film (P_3) and stored in ambient conditions (29±3 °C and 68-81% Relative Humidity (RH)) *i.e.,* T_1 and low temperature conditions (5±1 °C and 85-90% RH) *i.e.,* T_2. Burfi packed in aluminium foil at low temperature (T_2P_1) recorded higher score for all sensory parameters (colour: 8.1; flavour: 8.5; texture: 8.5 and overall acceptability: 8.3) followed by T_2P_3 (Low temperature with polyethylene film) and T_2P_2 (Low temperature with butter paper). The influence of packaging materials and storage conditions on microbial count revealed that total bacterial count and yeast and mould count were least in T_2P_1 (Low temperature + Aluminium foil) followed by T_2P_3 (Low temperature + polyethylene) and T_2P_1 (Low temperature + butter paper) on 5th day of storage. Burfi samples stored at ambient condition irrespective of packaging material deteriorated faster due to high microbial count and not available after 5 days of storage. Burfi samples packed in aluminium foil retained moisture and could be stored for 15 days at low temperature with low microbial load and high consumer acceptability.

Introduction

Banana is one of the oldest fruits known to mankind. It is one of the widely grown and consumed fruits due to their distinct aroma and taste, in all parts of the world. It is highly nutritive and every part of the plant is useful. For these reasons it is often referred as 'Apple of Paradise' and 'Tree of paradise'. It is a good source of vitamin A, C and B_2. Fruits are rich source of minerals like magnesium, sodium, potassium, phosphorous, calcium and iron. The ripe fruits are delicious and are used for table purpose. Many products are made from banana such as banana chips, fig, soft drink, flour and jam. Banana flour is prepared from unripe fruits and banana powder from ripe fruits.

India is the largest producer of banana in the world. In West Bengal, banana is cultivated in an area of 45,500 ha with a production of 1.09

million tonnes for the year 2013-14 (Anonymous, 2015). Moreover, with increasing population and urbanization leading to conversion of agricultural land in to industrial areas it is hardly possible to make an increase in area under cultivation. Instead, if we minimize the post-harvest losses, automatically there will be increase in production. However, this high production will have significance only when it reaches consumers in good condition.

Faulty handling practices coupled with underdeveloped and exploitive marketing systems results in postharvest losses to the extent of about 30% and value deterioration, leaving little quality surpluses for export and processing (Anonymous, 2002).

In Nadia district of West Bengal most of the banana produced is consumed in fresh form. Thus processing of banana into value added products will reduce post-harvest losses and add value to it. People in this region are fond of sweets. Innovative products like banana burfi will gain prominence in this region. The shelf life of burfi can be further increased by using suitable packing material. It will also help small scale industries and provide employment to rural youth and women. Therefore, keeping these points in view a plan of research programme on "Influence of packaging materials on quality of burfi during storage" was undertaken.

Materials and Methods

The present study was carried out in the department of Postharvest Technology of Horticultural Crops, Bidhan Chandra Krishi Viswavidyalaya Mohanpur, Nadia, West Bengal during 2012-2015. Preparation of banana burfi was standardized in the laboratory by varying proportions of milk, sugar and banana pulp. It was found that 15% banana pulp+ 30% sugar + 55% milk preferred by the taste panel constituted in the Faculty of Horticulture.

Procurement of banana fruits

Banana fruits cultivar 'Martaman' were procured from the farm maintained by AICRP on Tropical fruits, Mandoli, Nadia district. Hands were ripened at room temperature. Healthy, unblemished fruits were selected for the preparation of burfi. Peeled fruits were washed and cleaned, and the pulp was extracted manually. It was homogenized in a deluxe pulper (mixer) machine to obtain fine pulp.

Banana burfi preparation

Banana burfi was prepared as per the procedure laid down by Sachdeva and Rajorhia (1982), with slight modification. Buffalo milk standardized to 6% fat and 15% total solids was concentrated in a stainless steel pan by open pan boiling with continuous stirring and scraping until a semi-solid mass of paste-like consistency was obtained. Sugar @ 30% of khoa was added to sweeten the product. When the product showed a tendency to form compact mass, the temperature was lowered to 88–90 °C and selected levels of banana pulp (15 %) was added. Finally, this mixture was heated on a low fire with gentle stirring till the desired consistency of banana burfi was obtained. Just before the finish point potassium sorbate @ 0.2% was added which acts as preservative. It was then spread uniformly in a tray with ghee and allowed to cool. After setting, banana burfi was cut into blocks of 25×25×25 mm. Later, burfi was packed in different packing materials (Figure 3) and studied for quality attributes under ambient conditions (29±3 °C and 68-81% RH) and low temperature conditions (5±1 °C and 85-90% RH). The details of treatments were presented in table 1.

Details of observations

Burfi packed and stored in ambient and low temperature conditions were studied for quality parameters such as moisture content, microbial count and sensory analysis.

Sensory analysis

A total of 15 male and female panellists were selected and trained for scoring. Each panellist was first briefed with the important sensory evaluation conceptual knowledge. Each panellist received and evaluated the same amount of duplicate coded sample chips in a controlled sensory evaluation laboratory with separate boxes for each panellist. The samples were evaluated on the basis of their texture, flavour, colour and overall acceptability. Furthermore, all panellists given scores for the samples for each quality feature using a hedonic scoring scale of 1 to 9 on the provided evaluation sheet according to Gupta (1976) given in table 2.

Moisture content

The moisture content was determined by taking 10 g of sample and dried in an oven at 65±2 °C to constant weight. The moisture content in banana burfi samples was analyzed using the AOAC (2000) method.

Microbial analysis

All the samples were subjected to total plate count (TPC) for bacteria, yeast and mold count (YMC) and coliform count. The TPC was determined by surface spreading the homogenate (prepared by macerating the burfi samples in mortar and pestle) with 10−2 dilutions on plate count agar (PCA) and incubated at 37 °C for 24 h. For mould and yeast detection, appropriate dilutions (10−2) of sample was spread on potato dextrose agar (PDA) and incubated at 25 °C for 24 h. Coliforms in the samples were estimated by plating appropriate dilutions (10− 2) on Violet Red Bile Agar (VRBA) before being incubated at 37 °C for 24 h (Jain *et al.*, 2015 and Abdalla and Ahmed, 2010).

Statistical design

The data obtained from four replications were subjected to the analysis of variance by 'F' test for two factor Factorial Completely Randomized Design (Gomez and Gomez, 1984).

Results and Discussion

The treatment which performed best in experiment "Standardization of banana burfi making and quality assessment" *i.e.* T_6 (15% banana pulp + 30% sugar + 55% Milk) was taken in this experiment to study the effect of packaging materials on quality of burfi under different storage conditions.

The quality of burfi standardized with 15% banana pulp + 30% sugar + 55% Milk is presented in table 3. The colour, flavour texture and overall acceptability of the prepared burfi were recorded 8.8, 8.5, 8.5 and 8.6 respectively. The effect of storage condition on the sensory quality of burfi has been depicted in table 4. In general it has been found that the burfi stored at T_2 (Low temperature) was found superior to T_1 (Ambient condition) and colour, flavour, texture and overall acceptability of T_2 remained significantly higher (*i.e.* 8.0, 8.3, 8.3 and 8.2 respectively) than T_1 (6.9, 6.9, 6.8 and 6.9 respectively) on 5^{th} day of storage. Although sensory score for packaging with aluminium foil (P_1) was higher than that of polyethylene film (P_1), the score for colour, flavour, texture and overall acceptability of both the treatments *i.e.* P_1 (Aluminium foil) and P_3 (Polyethylene film) were at par. Interaction effect of packaging and storage

condition on 5th day of storage revealed that sensory score for texture was significant (P≤0.05), while colour, flavour and overall acceptability were non-significant (P≤0.05). The interaction effect of T_2P_1 (Low temperature storage and aluminium foil) recorded higher score for all sensory parameters followed by T_2P_3 (Low temperature storage and polyethylene film) and T_2P_2 (Low temperature storage and butter paper).

Sensory scores for T_1P_1 were least. Burfi samples kept at ambient conditions (29±3 °C and 68-81% RH) were not available after 5 days of storage for further evaluation.

Initial moisture content of burfi was recorded 14.81% (Table 5). On the 5th day of storage there was a slight decrease in moisture content of burfi samples stored at ambient conditions (29±3 °C and 68-81% RH) and low temperature conditions (5±1 °C and 85-90% RH) except in treatment combination T_2P_1 (Low temperature storage and aluminium foil) where it remained the same (Table 4).

In general, at ambient condition (T_1), moisture content reduced significantly (P≤0.05) in comparison to low temperature (T_2). In butter paper package moisture content was significantly lower than P_1 (Aluminium foil) and P_3 (Polyethylene film) on 5th day of storage. Although P_1 (Aluminium foil) retained higher moisture content treatment P_1 and P_3 were at par. On 5th day, interaction effect of temperature and package revealed that moisture content was least in T_1P_2 (Ambient condition and butter paper) and maximum in T_2P_1 (Low temperature storage and aluminium foil).

Regarding influence of packaging materials and storage conditions on microbial count of banana burfi on 5th day of storage were statistically analysed (Table 5). No coliforms were detected in any of the samples. Total bacterial count and yeast and mould count significantly (P<0.05) higher (9.42 log10 CFU/g and 8.84 log10 CFU/g) in the samples stored in T_1 (ambient conditions) than T_2 (Low temperature conditions). However, the samples stored in P_1 (Aluminium foil) were found to be containing significantly low (4.60 log10 CFU/g and 2.28 log10 CFU/g) total bacterial count and yeast and mould count than P_3 (Polyethylene film) and P_2 (butter paper). Interaction effect showed that total bacterial count and yeast and mould count were least (2.45 log10 CFU/g and 1.41 log10 CFU/g) in T_2P_1 (low temperature storage and aluminium foil) followed by T_2P_3 (Low temperature storage and polyethylene film) and T_2P_1 (Low temperature storage and butter paper). While at ambient condition T_1P_2 (Ambient condition and butter paper) and T_1P_3 total bacterial count (Figure 5) and yeast and mould count were significantly high. Highest counts (12.55 log10 CFU/g and 13.76 log10 CFU/g) for bacterial and mould and yeast were observed in T_1P_2 (Ambient condition and butter paper). As a result of high microbial count burfi kept in ambient conditions was not suitable beyond 5th day but burfi samples kept in low temperature conditions could be stored for 15 days.

Sensory data of low temperature at 10 and 15 days of storage is shown in bar diagram (Figure 1). Colour, flavor, texture and overall acceptability of T_2P_1 (Low temperature storage and aluminium foil) was high (8.00) on 10th day of storage followed by T_2P_3 (Low temperature storage and polyethylene film) and T_2P_2 (Low temperature storage and butter paper). On 15th day also the trend of sensory quality was similar, only the score was less than 10 days. The sensory score of T_2P_2 (Low temperature storage and butter paper) for colour, flavor, texture and overall acceptability was appreciably low.

Table.1 Details of the treatments

Storage conditions	Packing materials	Treatment symbol
Ambient conditions (T_1)	Aluminium foil (11µ) (P_1)	$T1P_1$
	Butter paper (P_2)	$T1P_2$
	LDPE (100 guage) (P_3)	T_1P_3
Low temperature (T_2)	Aluminium foil (11µ) (P_1)	T_2P_1
	Butter paper (P_2)	T_2P_2
	LDPE (100 guage) (P_3)	T_2P_3

Table.2 Score acceptability for panellists

Score	Acceptability
9	Extremely desirable
8	Very much desirable
7	Moderately desirable
6	Slightly desirable
5	Neither desirable nor undesirable
4	Slightly undesirable
3	Moderately undesirable
2	Very much undesirable
1	Extremely undesirable

Table.3 Sensory quality and moisture content of fresh burfi

Sensory quality	Mean score
Colour	8.8
Flavour	8.5
Texture	8.5
Overall acceptability	8.6
Moisture content	14.81%

Table.4 Effect of packaging and storage condition on sensory quality of burfi on 5th day

Treatments	Colour	Flavour	Texture	Overall acceptability
T_1	6.9	6.9	6.8	6.9
T_2	8.0	8.3	8.3	8.2
SEm	0.13	0.09	0.05	0.06
$CD_{0.05}$	0.40	0.25	0.14	0.19
P_1	7.5	7.9	7.8	7.8
P_2	7.3	7.3	7.1	7.2
P_3	7.5	7.7	7.7	7.6
SEm	0.16	0.10	0.06	0.08
$CD_{0.05}$	NS	0.31	0.17	0.23
T_1P_1	7.0	7.3	7.2	7.2
T_1P_2	6.7	6.4	6.2	6.4
T_1P_3	6.9	7.1	7.1	7.0
T_2P_1	8.1	8.5	8.5	8.3
T_2P_2	8.0	8.1	8.1	8.1
T_2P_3	8.1	8.3	8.3	8.2
SEm	0.23	0.15	0.08	0.11
$CD_{0.05}$	NS	NS	0.24	NS

T_1: Ambient temperature, T_2: Low temperature storage
P_1: Aluminium Foil, P_2: Butter paper, P_3: Polyethylene Film

Table.5 Effect of packaging and storage condition on moisture content (%) and Microbial count of burfi on 5th day of storage

Treatments	Moisture content (%)	Total bacterial count (log_{10} CFU/g)	Total mould and yeast count (log_{10} CFU/g)
T_1	13.88	9.42	8.84
T_2	14.77	3.18	3.46
SEm	0.06	0.17	0.06
$CD_{0.05}$	0.17	0.50	0.18
P_1	14.44	4.60	2.28
P_2	14.16	8.35	9.79
P_3	14.38	5.95	6.38
SEm	0.07	0.21	0.07
$CD_{0.05}$	0.21	0.61	0.22
T_1P_1	14.13	6.75	3.15
T_1P_2	13.56	12.55	13.76
T_1P_3	13.96	8.95	9.63
T_2P_1	14.81	2.45	1.41
T_2P_2	14.75	4.15	5.83
T_2P_3	14.77	2.95	3.14
SEm	0.10	0.29	0.11
$CD_{0.05}$	0.30	0.87	0.31

T_1: Ambient temperature T_2: Low temperature storage, P_1: Aluminium Foil, P_2: Butter paper, P_3: Polyethylene Film
CFU: Colony forming units

Fig.1 Effect of packaging on sensory quality of burfi on 10th and 15th day of storage at low temperature

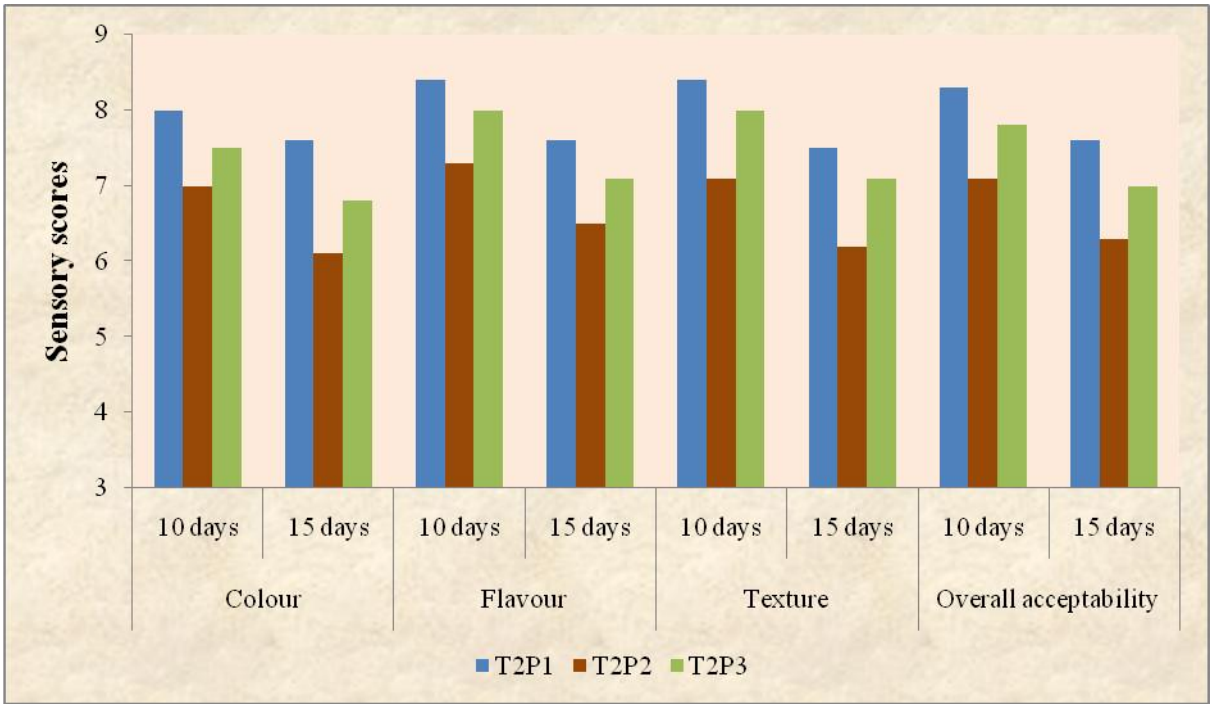


Fig.2 Effect of packaging on moisture content (%) of burfi on 10th and 15th day at low temperature storage

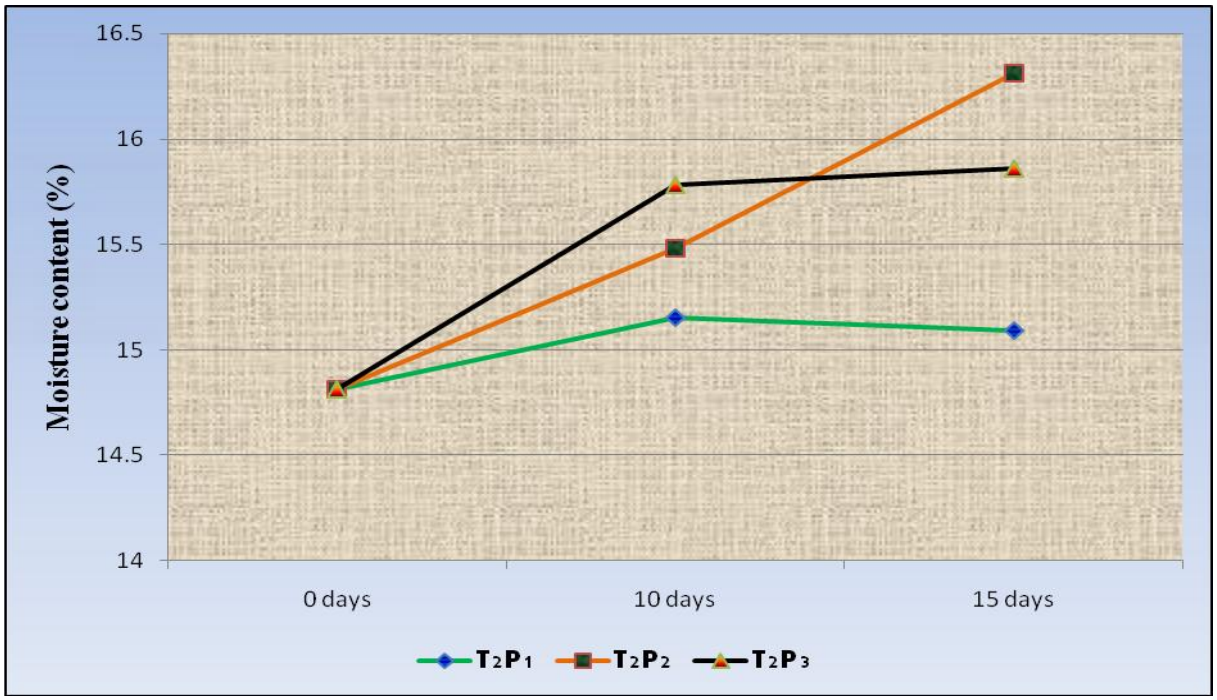
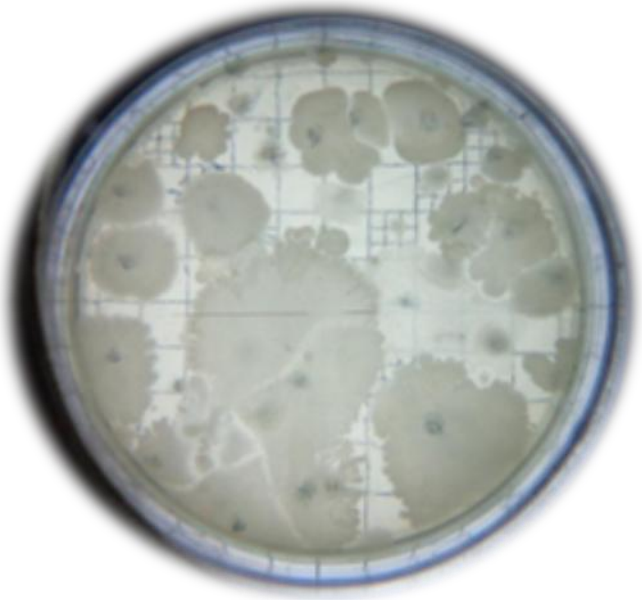


Fig.3 Packaging of burfi

Fig.4 Burfi samples after 15 days of storage under low temperature

Fig.5 Total plate count of bacteria on 5th day of storage



Moisture content at low temperature of T_2P_1 (Low temperature storage and aluminium foil), T_2P_2 (Low temperature storage and butter paper) and T_2P_3 (Low temperature storage and polyethylene film) on 10th and 15th day as shown in figure 2 indicated that T_2P_1 possessed least moisture both at 10th and 15th day followed by T_2P_3 and T_2P_2 in that increasing order.

Thus, it can be concluded that burfi samples packaged in aluminium foil could be stored for 15 days at low temperature with low microbial load while retaining moisture content with high consumer acceptability but at ambient condition for 5 days.

There is decrease in scores for sensory quality such as colour, flavour, texture and overall acceptability irrespective of the burfi packed in different packaging materials and storage conditions. The rate of decrease in sensory scores was much higher in burfi kept at ambient conditions than low temperature conditions. This might be due to loss of moisture from the product (Londhe *et al.,* 2012) resulting in darker burfi colour (Chawla *et al.,* 2013). The banana burfi packaged in aluminium foil and stored at low temperature were acceptable upto 15 days as shown from superior colour, flavour, texture and overall acceptability table 4 and figure 4. Low moisture content of T_2P_1 treatment on 15th day was because of low water vapour transmission rate of aluminium foil when compared to other packing materials. This was the reason for superiority of burfi of T_2P_1. These findings are in confirmation with Venkatesh *et al.,* (1984) who reported that sohan halwa packed in aluminium foil could be stored for 180 days with acceptable sensory quality. Parallel reports had been given by Bhatele (1983) on burfi; Sharma *et al.,* (2003) and Londhe *et al.,* (2012) while working on efficient packaging techniques on peda storage. The decrease in flavour might be attributed to slight loss in freshness, which is inherent with any food product. Similar observations were recorded by Biradar *et al.,* (1985), Rao and Goyal (2007) and Londhe *et al.,* (2012).

During the storage under different temperature conditions all the burfi samples contained differential microbial counts. There was higher microbial count (total plate count (bacteria) and mould and yeast growth) in burfi stored in ambient conditions than in low temperature conditions might be due to unfavorable temperature for the microbes to enter and multiply. Similar reports were presented by Garg and Mandokhot (1987); Misra and Kuila (1988) and Sachdeva (1980). Kumar *et al.,* (1997) in their study on the extension of shelf-life of peda did not observe increase in the microbial growth during storage in the product packaged under MAP with oxygen scavengers.

Burfi packed in aluminium foil at low temperature (T_2P_1) recorded higher score for all sensory parameters (colour: 8.1; flavour: 8.5; texture: 8.5 and overall acceptability: 8.3). The influence of packaging materials and storage conditions on microbial count revealed that total bacterial count and yeast and mould count were least in T_2P_1 (Low temperature + Aluminium foil) (Fig. 3). Burfi samples stored at ambient condition irrespective of packaging material deteriorated faster due to high microbial count and not available after 5 days of storage. Burfi samples packed in aluminium foil retained moisture and could be stored for 15 days at low temperature with low microbial load and high consumer acceptability. In conclusion, aluminium foil packaging along with low temperature storage is best for maintaining the quality and prolonging the shelf-life of banana burfi.

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