

Original Research Article

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Sensory and Chemical Quality Changes during Storage of Bottle gourd Halwa: Research Article

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ABSTRACT

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Bottle gourd halwa is a popular khoa based traditional dairy delicacy. It is produced on small scale by local sweetmeat makers. In order to commercially manufacture and market bottle gourd halwa, studies on its shelf-life were considered to be very important. Bottle gourd halwa samples prepared using skim milk powder and khoa as base material were packed in polystyrene packaging material and stored at two different temperature i.e. 7 ± 2 °C and 30 ± 2 °C. Chemical aspects with respect to free fatty acids (FFA) and acidity and sensory changes of bottle gourd halwa such as colour and appearance, body and texture, flavour and overall acceptability were monitored during storage period. The FFA and acidity content in bottle gourd halwa increased significantly ($p<0.05$) during storage and these changes were found to be temperature sensitive. Sensory quality of bottle gourd halwa samples found to be gradually decreased significantly ($p<0.05$) during storage irrespective of temperature. Bottle gourd halwa samples stored at 7 ± 2 °C and 30 ± 2 °C were acceptable up to 20 days and 3 days, respectively on the basis of sensory attributes.

Introduction

India is the largest milk producing country in the world and accounting to 19% of world's total milk production (Keerthi and Kartikeyan, 2017). Conversion of liquid milk into traditional dairy products increases the longevity of milk solids. The consumption of sweets is an integral part of Indian dietary

system. Traditional dairy products have great commercial significance as they account for over 90% of all dairy products consumed in the country (Aneja *et al.*, 2002). About 50-55% of milk produced is converted into a variety of Indian milk products by the traditional sector (Modha *et al.*, 2015) using processes such as heat desiccation, heat acid coagulation and fermentation, out of which

about, 5.5% of total milk production is utilized for khoa making in India (Bandyopadhyay *et al.*, 2006).

In recent years, a lot of interest has been gained in the development of composite food and milk based sweets prepared by combining one or more dairy products with appropriate non-dairy ingredients. These products have higher demand and profit margin (Gaikwad *et al.*, 2015) and having the nutritional value of both milk and non-dairy ingredients such as fruits, vegetables or cereals. Amongst them, *khoa* based sweets like bottle gourd *halwa* is very popular.

Bottle gourd (*Lagenaria Siceraria Mol. Standley*) *halwa* is a sweet, which is widely popular in North India and many other states. It is traditionally prepared by roasting and cooking of shredded bottle gourd in *ghee* followed by addition of sugar and *khoa* with or without edible green colour. *Khoa* and *khoa* based sweets, including bottle gourd *halwa*, have a poor shelf life due to development of rancidity and surface mould growth upon storage. Shelf life studies of any product can provide information to product developers, which make them to ensure good quality product for a significant period of time even after production. The standardized bottle gourd *halwa* was prepared in the laboratory for characterizing the traditional dairy products of India and generating a valuable database on the chemical and sensory changes of bottle gourd *halwa* during storage at two different temperature i.e. 7 ± 2 °C and 37 ± 2 °C.

Materials and Methods

The work was carried out at Department of Dairy Engineering of Sheth M. C. College of Dairy Science, Anand Agricultural University (G.J.). "SAGAR" brand skim milk powder manufactured by AmulFed Dairy (Mother Dairy, Gandhinagar) was procured from the

local market of Anand, Gujarat. Fresh *khoa* and *ghee* were procured from the Department of Dairy Processing Operations (Anubhav Dairy), Sheth M. C. College of Dairy Science, Anand Agricultural University, Anand. A white fine crystalline sugar (sucrose) of commercial grade, good quality green cardamom and apple green color of food grade quality were obtained from the local market of Anand, Gujarat. Specially designed horizontal scraped surface heat exchanger was used for manufacturing of bottle gourd *halwa* using skim milk powder as a base material instead of *khoa*.

Preparation of bottle gourd *halwa* in horizontal SSHE

Initially LPG fuel supply for gas burner was started to get the desirable steam pressure in water jacket of the SSHE. When it reaches to operating pressure, *ghee* @7 per cent (w/w) of shredded bottle gourd was taken in clean and dry SSHE and scraper assembly was started. On heating the *ghee*, shredded bottle gourd was added in the SSHE through feed hopper. As heating continue, cooking of shredded bottle gourd takes place. Cooking of shredded bottle gourd was judged by intermittently stopping the machine. When shredded bottle gourd was cooked properly, sugar @ 30 per cent (w/w) of shredded material was added in the machine.

After 5-6 min of time interval 50 percent TS reconstituted skim milk (SMP @ 20 per cent w/w of shredded material) was added. The process of evaporation and concentration continued during this operation until it reaches to desired lump formation stage. Finally permitted food grade apple green colour was added at this stage to impart little greenish appearance of the product. Then LPG supply was put off and the product was removed from the SSHE and transferred to greased (with *ghee*) stainless steel plate, cardamom was

added before spreading evenly. Control product (bottle gourd *halwa* using *khoa*) was prepared according to the method reported by Aneja *et al.*, (2002). Samples were then packed in polystyrene packaging material.

Storage and analysis of bottle gourd *halwa*

The samples of bottle gourd *halwa* were stored in polystyrene packaging material at two temperature i.e. 7 ± 2 °C and 30 ± 2 °C. The samples stored at 7 ± 2 °C and 30 ± 2 °C were analyzed at 5 d and 1 d interval of storage for sensory and chemical changes.

Sensory evaluation

The sensory attributes of bottle gourd *halwa* were analyzed for colour and appearance, flavour, body and texture and overall acceptability by a trained panel of judges consisting of six members by using a nine point hedonic scale (1 = dislike extremely; 9 = like extremely).

The samples of products stored at refrigeration temperature were tempered at room temperature for 1-2 h before judging. The samples were coded for judging and the criticism expressed by common agreement of the judges was recorded. Stored products were rejected on sensory basis as well as visible yeast and mould growth.

Chemical analysis

The samples of bottle gourd *halwa* were evaluated for FFA and titratable acidity during storage at 7 ± 2 °C and 30 ± 2 °C temperature. The method prescribed by Deeth *et al.*, (1975) was used to estimate the FFA content of bottle gourd *halwa*.

Titratable acidity was determined by procedure described as per BIS Handbook, BIS: Part XI, 1981.

Results and Discussion

Chemical changes in bottle gourd *halwa* during storage

Effect of storage period on FFA content of bottle gourd *halwa*

The FFA content of control and experimental bottle gourd *halwa* samples stored at 7 ± 2 °C and 30 ± 2 °C is shown in Fig. 1a and Fig. 1b respectively. The FFA content of both bottle gourd *halwa* samples increased significantly ($p<0.05$) with the progression of storage period. A gradual increase of fatty acids in bottle gourd *halwa* samples was noticed during storage. The rate of increase in FFA was maximum in bottle gourd *halwa* samples stored at 30 ± 2 °C, wherein free fatty acids of control and experimental samples increased from initial value of 0.07, 0.06 on the first day to 0.269, 0.264% oleic acid after storage period of 3 d, respectively (Fig. 1a). The FFA content of fresh control and experimental bottle gourd *halwa* samples increased to 0.152, 0.148% oleic acid on 20 d during storage at 7 ± 2 °C (Fig. 1b). It was noted that rate of increase in FFA content was slower in bottle gourd *halwa* samples stored at 7 ± 2 °C as compared to bottle gourd *halwa* samples stored at 30 ± 2 °C. The release of free fat during the preparation of bottle gourd *halwa* and presence of high moisture content could be responsible for lipolysis during storage, the rate of which is expected to be higher at higher temperature of storage. Kumar *et al.*, (2010) in *khoa*, Yadav and Beniwal (2009), Jha *et al.*, (1977) and Vijaykader and Patel (1983) in *peda* also found a significant increase in free fatty acids with storage time.

Effect of storage period on titratable acidity of bottle gourd *halwa*

The titratable acidity (expressed as percent lactic acid) is an important chemical change,

changes in acidity may even influence the consumer's acceptability of the product too. The acidity of control and experimental bottle gourd *halwa* samples stored at 7 ± 2 °C and 30 ± 2 °C is graphically represented in Fig. 2a and Fig. 2b respectively. Acidity content of bottle gourd *halwa* increased gradually with the storage period at 7 ± 2 °C and 30 ± 2 °C. It showed the significant difference ($p<0.05$) in acidity content on storage. The acidity of bottle gourd *halwa* samples stored at 30 ± 2 °C increased consistently with the increase in storage period as compared to bottle gourd *halwa* samples stored at 7 ± 2 °C. On the initial day of storage, the acidity content of bottle gourd *halwa* stored at 30 ± 2 °C and 7 ± 2 °C were 0.342, 0.350 for control and experimental samples, which increased to 0.430, 0.436 and 0.393, 0.398 during storage after 3 d and 20 d, respectively. Despite the gradual increase in acidity none of the samples tasted sour and the acidity levels were within the acceptable limits. The acidity development could be attributed to production of acids like formic acid, acetic acid, lactic acids and other organic acids and FFA as reported by O'Brien (1997). Similar findings were reported by Kalra *et al.*, (1983) in *khoa* and Sachdeva and Rajorhia (1982) in *burfi* during storage. Thus the results obtained in the present investigations corroborate with those reported in the literature.

Changes in sensory attributes of bottle gourd *halwa* during storage

Effect of storage period on flavour scores of bottle gourd *halwa*

The flavour of any food product including bottle gourd *halwa* is most important sensory attribute, as far as consumer like is concerned because it determines its acceptance or rejection. The flavour scores of control and experimental bottle gourd *halwa* samples stored at 30 ± 2 °C and 7 ± 2 °C are shown in

Table 1 and Table 2, respectively. Flavour scores of bottle gourd *halwa*, decreased continuously during the storage period irrespective of temperature. During storage of bottle gourd *halwa* at 30 ± 2 °C, flavour score up to 3 d was observed and thereafter the product became unacceptable due to visible mould growth. It can be seen that the flavour score decreased rapidly at 30 ± 2 °C as compared to 7 ± 2 °C during storage. The decrease in flavour score could be attributed to slight loss of freshness, which is inherent in any food product. In fresh product, the compounds formed during browning reactions are responsible for the typical flavour of the product, but as storage period progresses, the chemical reactions disturbed the delicate balance of the compounds. The findings of the present study are in accordance with the result reported by Chawla *et al.*, (2013) in *doda burfi*, Londhe *et al.*, (2012), Jha *et al.*, (2012) and Biradar *et al.*, (1985) for brown *peda*, Rao and Goyal (2007) in *kalakand* and Sharma *et al.*, (2003) in malai *peda* samples during storage study.

Effect of storage period on colour and appearance scores of bottle gourd *halwa*

The colour and appearance of the product is important for the consumer appeal. The bottle gourd *halwa* samples showed significant ($p<0.05$) decrease in colour and appearance scores at 30 ± 2 °C and 7 ± 2 °C during storage as shown in Table 1 and Table 2, respectively. The score ranged between 8.54-6.94 and 8.38-6.88 during storage at 30 ± 2 °C for control and experimental bottle gourd *halwa*, respectively. At the end of 20 d score was decreased to 7.11, 7.06 for control and experimental samples during storage at 7 ± 2 °C. During storage, the samples became drier in appearance and lacked the greasy appearance desired in good quality bottle gourd *halwa*, which resulted in a steady decrease in colour and appearance scores.

Table.1 Sensory scores of control and experimental bottle gourd *halwa* during storage at 30±2 °C

Periods (P in days)	Flavour scores		Body and Texture scores		Colour and Appearance scores		Overall Acceptability scores	
	Control	Experimental	Control	Experimental	Control	Experimental	Control	Experimental
0	8.45±0.26	8.26±0.21	8.47±0.23	8.41±0.24	8.54±0.20	8.38±0.21	8.51±0.24	8.39±0.25
1	8.32±0.25	8.15±0.27	8.31±0.26	8.29±0.23	8.46±0.18	8.24±0.20	8.36±0.31	8.22±0.27
2	7.65±0.31	7.61±0.28	7.80±0.18	7.78±0.20	7.51±0.26	7.45±0.24	7.58±0.26	7.51±0.24
3	6.76±0.21	6.71±0.23	7.12±0.28	7.07±0.27	6.94±0.23	6.88±0.27	6.84±0.21	6.81±0.23
	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%
P (Periods)	0.104	0.314	0.097	0.294	0.093	0.280	0.103	0.312
T (Treatment)	0.073	NS	0.069	NS	0.065	NS	0.073	NS
P*T	0.147	NS	0.138	NS	0.131	NS	0.146	NS

Each observation is a mean ± SD of three replicate experiments (n=3); NS=Non significant at 5% level of significance

Table.2 Sensory scores of control and experimental bottle gourd *halwa* during storage at 7±2 °C

Periods (P in days)	Flavour scores		Body and Texture scores		Colour and Appearance scores		Overall Acceptability scores	
	Control	Experimental	Control	Experimental	Control	Experimental	Control	Experimental
0	8.45±0.26	8.26±0.21	8.47±0.23	8.41±0.24	8.54±0.20	8.38±0.21	8.51±0.24	8.39±0.25
5	8.25±0.23	8.05±0.25	8.30±0.32	8.26±0.25	8.41±0.22	8.22±0.26	8.32±0.24	8.18±0.26
10	7.53±0.27	7.47±0.22	7.92±0.21	7.89±0.26	7.95±0.28	7.87±0.25	7.56±0.21	7.45±0.21
15	7.09±0.20	7.01±0.19	7.67±0.27	7.60±0.22	7.30±0.21	7.27±0.18	7.17±0.27	7.12±0.29
20	6.85±0.24	6.81±0.25	7.27±0.19	7.22±0.23	7.11±0.29	7.06±0.25	6.87±0.22	6.83±0.25
	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%
P (Periods)	0.095	0.283	0.100	0.296	0.097	0.289	0.100	0.297
T (Treatment)	0.060	NS	0.063	NS	0.062	NS	0.063	NS
P*T	0.135	NS	0.141	NS	0.138	NS	0.142	NS

Each observation is a mean ± SD of three replicate experiments (n=3); NS=Non significant at 5% level of significance

Fig.1a FFA content of control and experimental bottle gourd *halwa* stored at 30 ± 2 °C

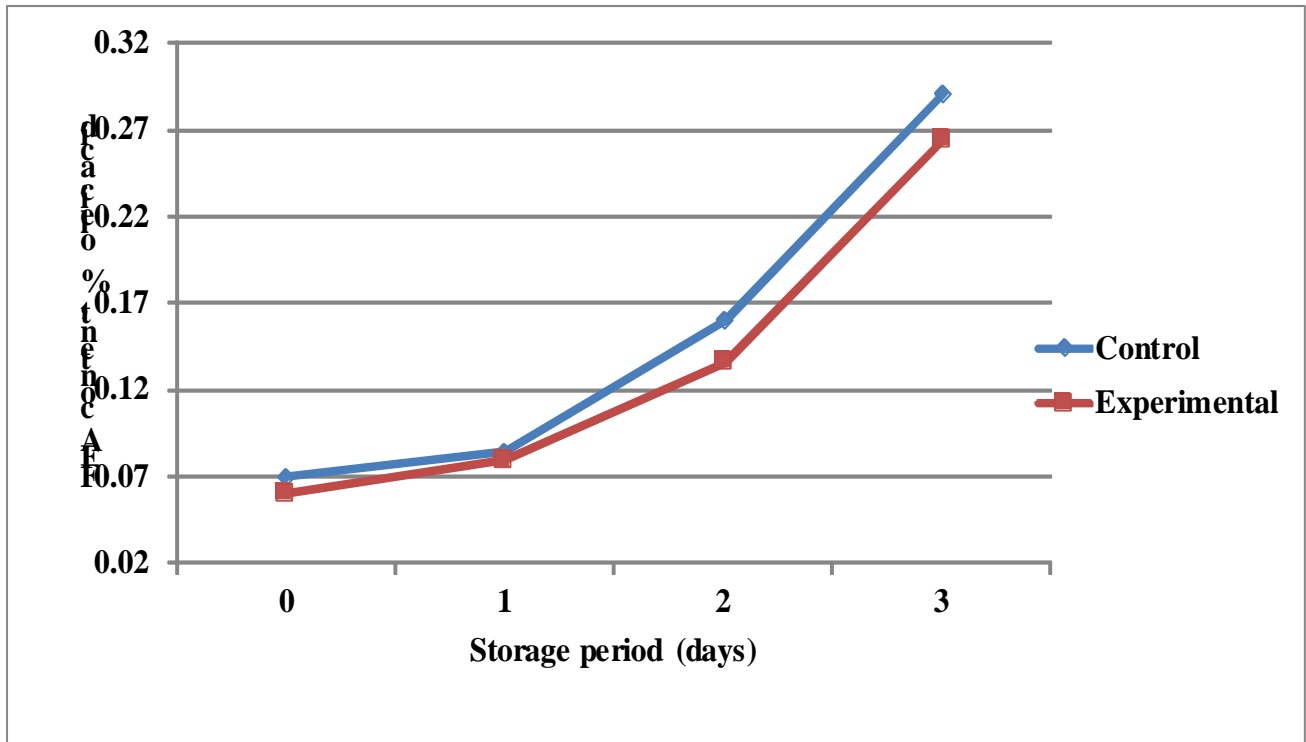


Fig.1b FFA content of control and experimental bottle gourd *halwa* stored at 7 ± 2 °C

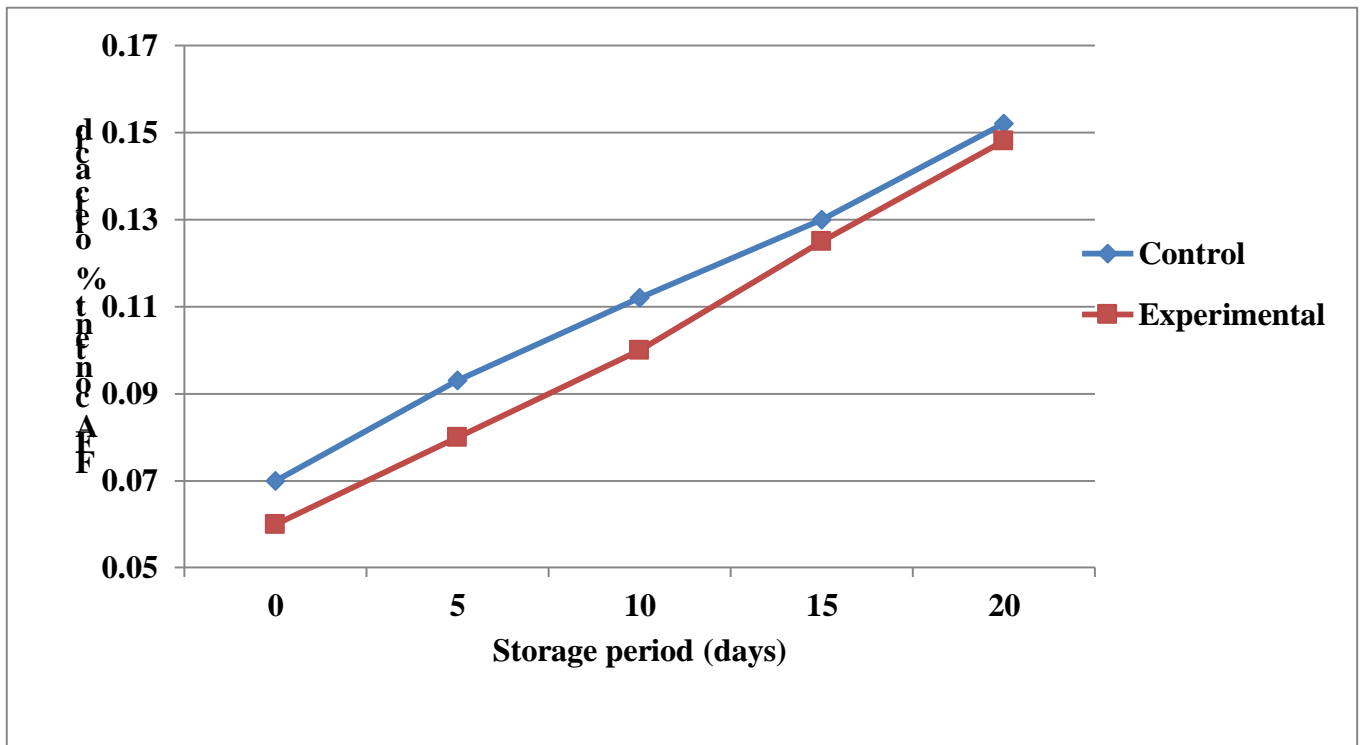


Fig.2a Acidity of control and experimental bottle gourd *halwa* stored at 30 ± 2 °C

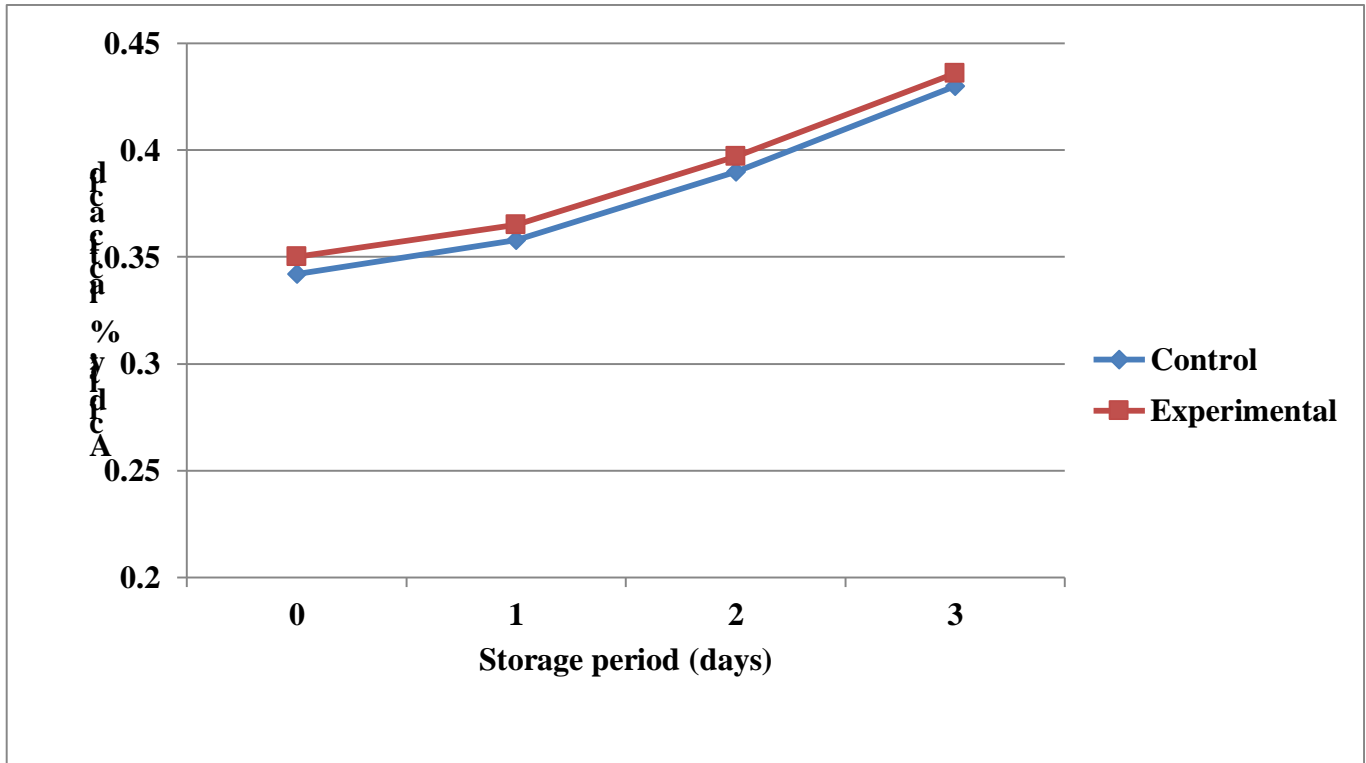
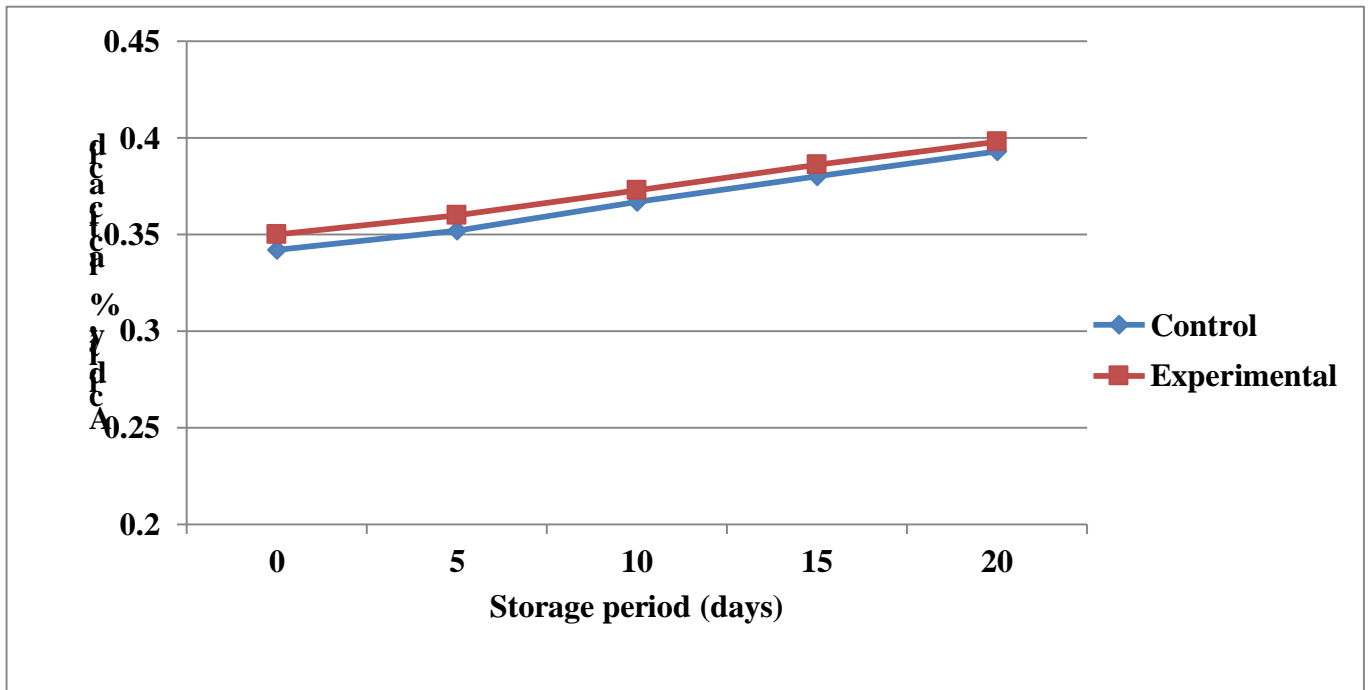


Fig.2b Acidity content of control and experimental bottle gourd *halwa* stored at 7 ± 2 °C



These results are in accordance with those observed by Chawla *et al.*, (2013) in *doda burfi*, Londhe *et al.*, (2012) and Jha *et al.*, (2012) in *lal peda* who also noted a decrease in colour and appearance scores during storage study.

Effect of storage period on body and texture scores of bottle gourd *halwa*

Body and texture is an important sensory attribute of bottle gourd *halwa*. The body and texture of the product helps in its marketing value. It also shows product's inner makeup. The influence of storage period on body and texture scores of control and experimental bottle gourd *halwa* samples stored at 30 ± 2 °C and 7 ± 2 °C is presented in Table 1 and Table 2, respectively. Body and texture score of gourd *halwa* stored at 7 ± 2 °C was found to be acceptable up to 20 d as compared with 3 d for bottle gourd *halwa* stored at 30 ± 2 °C. The statistical analysis indicates that effect of storage temperature had significant effect ($p<0.05$) on body and texture scores of bottle gourd *halwa* samples. A similar decrease in body and texture scores was observed in multigrain *halwa* samples kept at 30 ± 2 °C and 7 ± 2 °C of storage (Itagi *et al.*, 2011). Jha *et al.*, (2012) reported that the body and texture score of *lal peda* decreased during storage.

Effect of storage period on overall acceptability scores of bottle gourd *halwa*

The overall acceptability score is the sum of all sensory attributes scores given by the judges while evaluating the product. The effect of storage period at 30 ± 2 °C and 7 ± 2 °C on overall acceptability scores of control and experimental bottle gourd *halwa* is shown in Table 1 and Table 2, respectively. There was a significant ($p<0.05$) effect of storage temperature on the overall acceptability scores. The overall acceptability scores of bottle gourd *halwa*, decreased with progressive period of storage at both the temperatures. The influence of storage period and temperature of storage was significant ($p<0.05$) for changes in flavour, colour and appearance and body and texture and

thus, overall acceptability scores. Jha *et al.*, (2012) also resulted that overall acceptability was significant ($p<0.01$) effect on storage temperature and it was decreased during period of storage at 37 ± 2 °C. It was observed that there was no difference in shelf life of control and experimental bottle gourd *halwa*.

The type of treatment and interaction between treatment and storage period was found to be non-significant for all sensory and chemical characters.

The present study was planned systematically to characterize and delineate the sensory and chemical changes of bottle gourd *halwa* during storage. This study showed that temperature of storage and storage period significantly ($p<0.05$) affects the sensory and chemical attributes of bottle gourd *halwa*. The shelf life of bottle gourd *halwa* prepared in horizontal SSHE using SMP as one of the ingredients and packed in metal coated polystyrene was at par ($p>0.05$) with the control product prepared using *khoa*. Bottle gourd *halwa* samples stored at 7 ± 2 °C were sensorial acceptable up to 20 d. However, samples stored at 30 ± 2 °C, could not be stored for more than 3 d in view of fast deteriorative changes. The changes in acidity and FFA content of experimental and control products during storage at 30 ± 2 °C and 7 ± 2 °C were significantly ($p<0.05$) increased. Low temperature always promotes a longer shelf life of many products and the same was confirmed in this study. This could be attributed to the lower rate of lipid oxidation and non-enzymatic browning reactions which decreases the shelf life of products stored at elevated temperatures. This study is useful from the point of view of the need to undertake concerted efforts in characterizing and enhancing the shelf-life of traditional dairy products of India.

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