*Original Research Article*

# Effect of Packaging Materials on Storage Stability of Traditional Indian Dairy Confection *Peda*


## ABSTRACT

*Peda*, a heat desiccated traditional dairy product popular in northern India suffers from poor shelf life due loss of moisture from the surface, mold growth, rancidity etc. Packaging plays important role in controlling microbial growth as well as biochemical changes and the shelf life can be increased by changing the packaging system. In the present study the role of packaging materials on the storage stability of *peda* was evaluated at ambient (30±1ºC) and refrigerated (7±1ºC) conditions. *Peda* was prepared in the laboratory from standardized cow milk (4.5% fat and 8.5% SNF) with addition of 8% sugar on the basis of milk and kept without packaging ($P_0$) as well as packaged in two most suitable packaging materials viz. paper box ($P_1$) and polypropylene pouches ($P_2$). During storage the sensory quality, physico-chemical properties, texture profile and microbiological quality was carried out at regular interval. It was found that the rate of most of the quality deteriorative parameters was rapid in $P_0$ followed by $P_1$ and $P_2$ at both storage temperatures. Based on the results obtained in this study it can be concluded that at ambient temperature *peda* samples could be best preserved up to 4 days without packaging, 8 days in paper box and 14 days in polypropylene pouches whereas refrigerated samples kept well up to 20, 30 and 50 days in $P_0$, $P_1$ and $P_2$ respectively.



***Key words:*** *Biochemical changes, Storage stability, Polypropylene, Paper box, Texture profile*




## 1. Introduction

As per the statistics of the Department of Animal Husbandry, Ministry of Agriculture, India is the largest milk producing country in the World with 176.35 million tonnes milk production during the year 2017-18 of which 50 – 55% is converted into various traditional milk products [1, 2, 3]. The indigenous milk products are developed at household and farm levels to preserve surplus milk using some traditional techniques. These traditional dairy products have commercial importance as they account for over 90% of all the milk products consumed in the country [4]. Milk based sweet delicacies are an integral part of social, religious and cultural heritage in Indian society and have great social, economic significance [5]. *Peda* is mostly consumed in India as religious *'prasad'* in temples. *Khoa*, prepared by heat desiccation of whole milk in an open iron pan into a thick concentrated mass, is used as base material for manufacturing of *peda* [6]. It is made by admixture of *khoa* with 30 – 35% sugar, with or without addition of natural or artificial color

and flavor and heated until the desired characteristic texture, brown color and caramelized flavor develops [7]. The physico-chemical, rheological and sensory properties of *peda* depends on the manufacturing techniques, type and quality of raw materials used, additives, individual skills, trade practices and consumers choices. However, being prepared at small scale in unorganized sectors, proper hygienic conditions are not maintained and thus inferior quality product is often marketed [8].

Milk based sweets undergo several physical, biochemical and microbiological changes during storage making them unfit for human consumption and reducing their market value [9]. *Peda* is expected to have good shelf life due to combined effect of low moisture and high sugar percentage which are sufficient to prevent microbial growth [9]. However, improper handling and packaging result in limited shelf life of this popular sweetmeat through loss of moisture, development of rancidity and surface mold growth during storage making it unfit for consumption [10, 11]. Because of its intermediate moisture range and non-acidic nature bacterial growth is not common in *peda* and the spoilage occurs mainly due to growth of surface yeasts and molds [12]. Packaging plays an important role in both handling and storage of *peda* and the shelf life can be increased by changing the packaging system. Varieties of packaging material had been used by early researchers for packaging of *peda*. Some researchers packed *peda* in three types of polythene bags viz. low density transparent, medium density blue and low density opaque polythene pouches [13]. Packaging of *peda* in 100 and 300 gauge low density polyethylene pouches followed by heat sealing was done by [14]. *Peda* can be packed in paper boards/ boxes having a parchment paper liner or grease proof paper liner [15], in multilayer transparent laminates with oxygen scavenger [16], in low density polyethylene (LDPE) materials [17]. Many researchers worked on modified atmosphere packaging (MAP) of *khoa* based sweets for extension of shelf life [2, 9, 18, 19, 20]. However, the high cost of MAP may restrict its application in these popular traditional sweetmeats which are still dominated by unorganized sectors.

Therefore, with a view to determine the shelf life of *peda* prepared in laboratory and packaged in various packaging materials for characterizing this traditional sweetmeat of India as well as generating valuable database on the basis of their sensory, chemical and microbiological changes during storage the present work has been under taken.



## 2. MATERIALS AND METHODS

The study was carried out in the laboratory of Department of Dairy Chemistry, Faculty of Dairy Technology, West Bengal University of Animal & Fishery Sciences, Kolkata, India.

### 2.1 Raw Materials

Standardized cow milk (4.5% fat and 8.5% SNF) and sugar used for manufacturing of *peda* were procured from the local market. Paper board boxes and polypropylene pouches for packaging of *peda* were purchased from market of Kolkata, India. All the chemicals used were of analytical grade and purchased from HIMEDIA®.

## 2.2 Preparation of *peda*

In the laboratory *peda* was manufactured following the method described by [21]. Standardized cow milk was concentrated in open pan with continuous stirring. When heat coagulation of milk solids started sugar (8% of milk) was added and heated for desiccation with continuous stirring till the product attained characteristic colour and texture. *Peda* was cooled to room temperature , shaped and packaged in paper board boxes and polypropelene pouches of dimensions 17cm × 15cm × 0.022cm.

## 2.3 Storage stability of *peda*

The *peda* samples were analyzed every alternate day during ambient storage (30±1ºC) and at 5 days interval during refrigerated storage (7±1ºC) for sensory, physico-chemical textural and microbiological changes.

### 2.3.1 Changes in sensory attributes

The sensory quality of *peda* was analyzed on the basis of colour, flavour, body & texture and overall acceptability throughout the storage by a semi-trained panel of judges consisting of seven members by using a nine point hedonic scale [22].

### 2.3.2 Changes in physico-chemical parameters

The changes in moisture content during storage were determined by oven drying method [23]. The titratable acidity was measured in terms of percent lactic acid [24] and the free fatty acid (FFA) content in terms of percent oleic acid [25]. The extent of lipid oxidation was measured in terms of peroxide value and determined by iodometric titration method [26]. The changes in HMF content in *peda* during storage indicated the degree of Maillard browning reaction and was determined using Spectrophotometer [27]. Tyrosine value was measured to determine the extent of protein degradation [28].

### 2.3.3 Changes in texture profile

A Texture Analyzer (Model: TAHDi, Stable Micro System, UK) fitted with a 250 kg load cell was used for two bites linear compression of *peda* samples. A cross head pretest speed of 2 mm/s, test speed of 5 mm/s, post-test speed of 5 mm/s and interval of 5 s between two successive bites were employed for 50% compression of the samples. A cylindrical probe of 75 mm diameter was used for textural study. The texture analyzer having separate software (Texture Expert) for its operation was run under Windows environment to get the Texture Profile Analysis (TPA) data from the measurements. The hardness, fracturability and adhesiveness were directly calculated from Force—Time curve while other parameters like springiness, cohesiveness, gumminess and chewiness were obtained directly from the Microprocessor.

### 2.3.4 Changes in microbiological quality

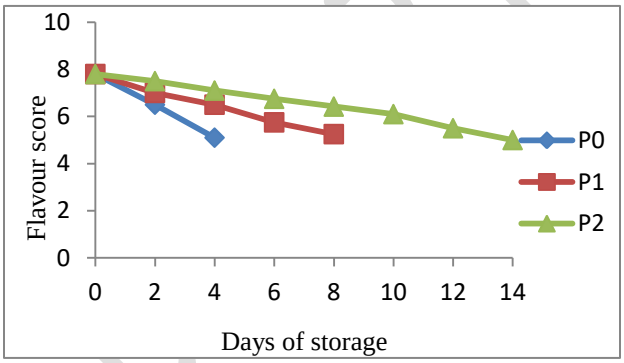
Microbiological analysis of *peda* samples during storage was examined for total viable count as well as yeast and mould counts as per the standard methods [29]. The data on microbiological quality is presented in $\log_{10}$ values.

## 3. RESULTS AND DISCUSSIONS

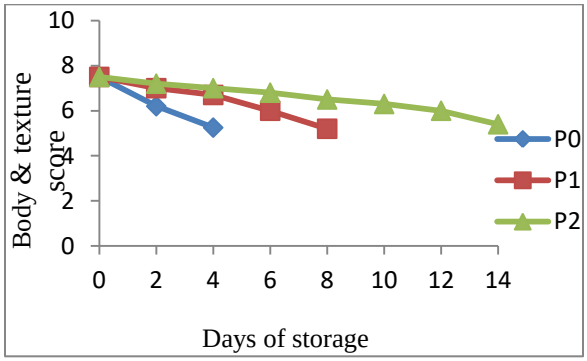
For any dairy product, the physico-chemical behavior during storage is one of the prime interests of the producers and the consumers since it leads towards the termination of the shelf life of the product. In the present study two types of most suitable package viz. paper box and polypropylene pouches were used for packaging of *peda* to observe their effectiveness. It was noted that *peda* samples kept under ambient temperature (30±1ºC) were acceptable up to 4 days without packaging ($P_0$), 8 days in paper box ($P_1$) and 14 days in polypropylene pouches ($P_2$) whereas refrigerated samples (stored at 7±1ºC) kept well up to 20, 30 and 50 days in $P_0$, $P_1$ and $P_2$ respectively.

### 3.1 Changes in sensory properties during storage

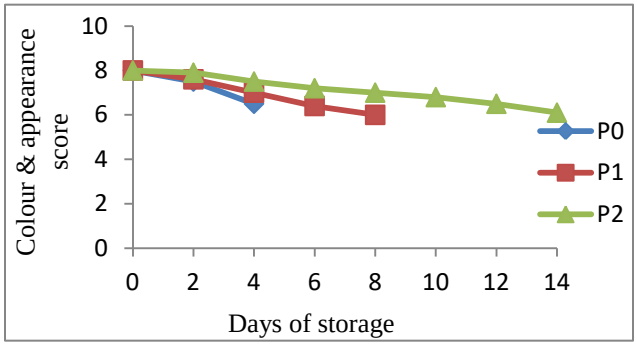
The changes in sensory profile of *peda* during storage at 30±1ºC and 7±1ºC were represented in graph 1 and 2 respectively. From these figures it was clear that irrespective of packaging materials all samples showed a decreasing trend in sensory scores during storage. The changes were faster in ambient temperature as compared to refrigerated storage and more prominent during the later stage of storage. It was also found that the product degrade rapidly when stored unpackaged followed by paper box and polypropylene pouches. The decrease in the scores caused due to loss of freshness, loss of moisture, releasing of free fat on the product surface and changes in various physico-chemical parameters during storage.



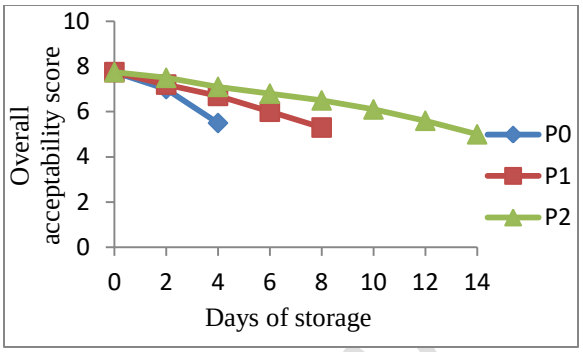

Graph 1(a)




Graph 1(b)



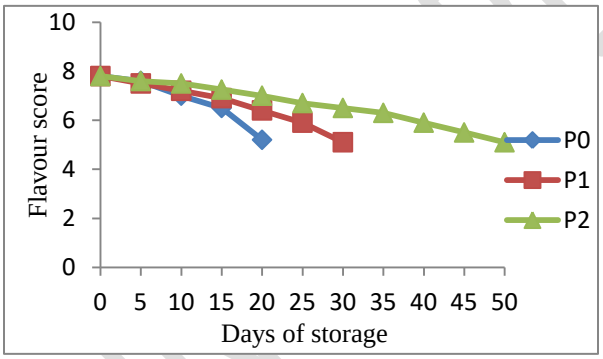

Graph 1(c)



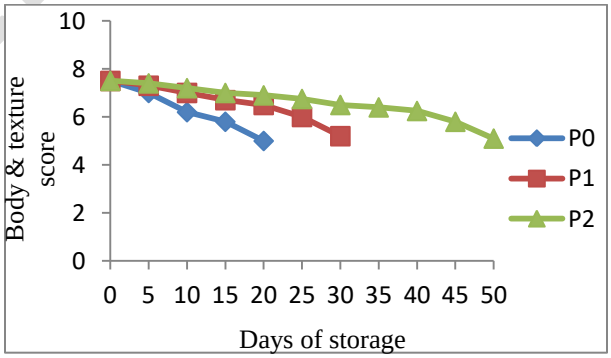

Graph 1(d)

**Fig. 1: Changes in sensory profile of *peda* during storage at 30±1ºC**

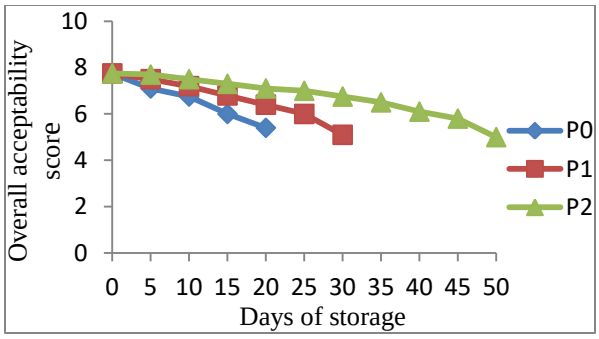




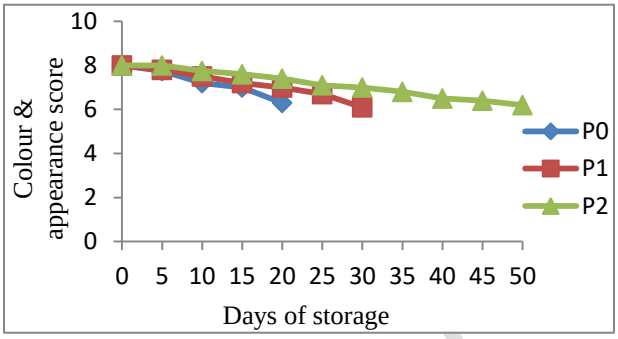

Graph 2(a)




Graph 2(b)




Graph 2(c)

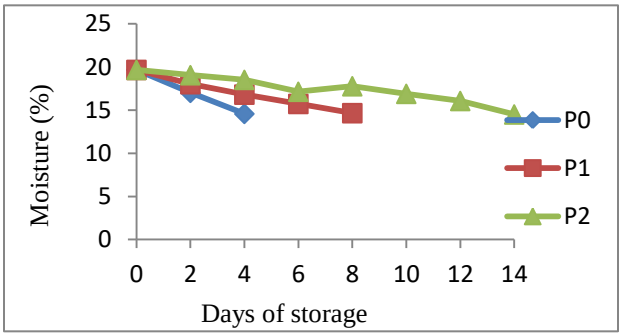



Graph 2(d)

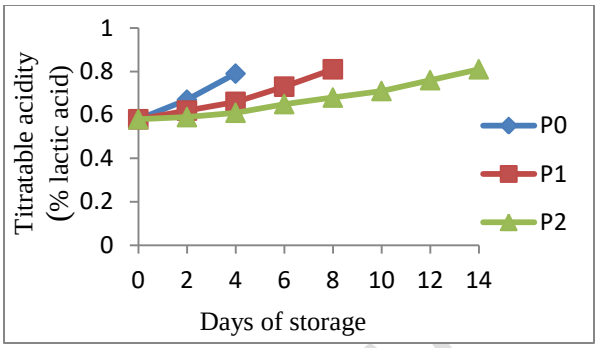
**Fig. 2: Changes in sensory profile of *peda* during storage at 7±1ºC**

### 3.2 Changes in physico-chemical properties during storage

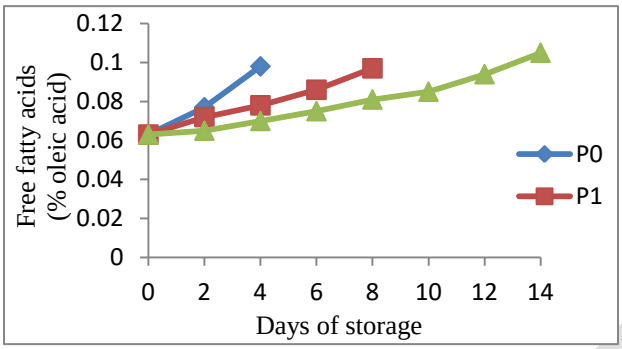
Graph 3 and 4 illustrated the changes in physico-chemical properties of *peda* samples under various packaging conditions during storage at 30±1ºC and 7±1ºC respectively. Moisture content had profound role on acceptability of the product during storage as far as browning reaction, release of free fatty acids, protein degradation and other biochemical changes are concerned. The moisture content decreases from an initial value of 19.37% during storage which was rapid in the product without packaging at 30±1ºC (Graph 3(a)). Earlier researchers had also reported considerable loss of moisture during storage making the product dry, hard and unacceptable on sensory evaluation [15, 17]. Due to conversion of lactose into lactic acid by the microorganisms the titratable acidity of *peda* samples rapidly increased during storage which attained a maximum value of 0.88% from an initial lactic acid content of 0.58% on 50$^{th}$ day of storage at 7±1ºC and packaged in $P_2$. The lipid breakdown was represented in terms of free fatty acids and peroxide value which reached to maximum value of 0.112 from 0.063% of oleic acid and 1.98 from 1.12 m. eq. of $O_2$ per kg samples respectively in $P_2$ stored under refrigeration. The free fat released during preparation of *peda* and high moisture content of the product could be responsible for lipolysis during storage [19]. Free fat present in *peda* is also susceptible to oxidation leading to the increase in peroxide value and development of off-flavour. The protein degradation and browning index were reported as tyrosine value (mg/ 100 gm) and HMF (micromoles/ 100 gm) respectively which also showed similar trends during storage. The -SH groups were converted to S-S group in presence of oxygen leading to increase in browning and HMF value during storage [30].



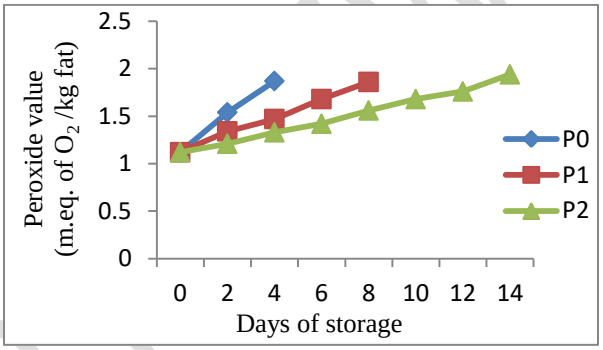

Graph 3(a)



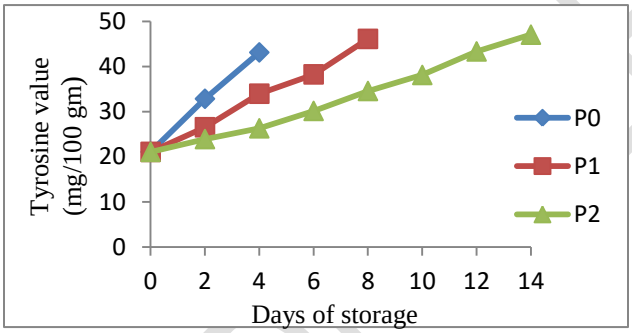

Graph 3(b)



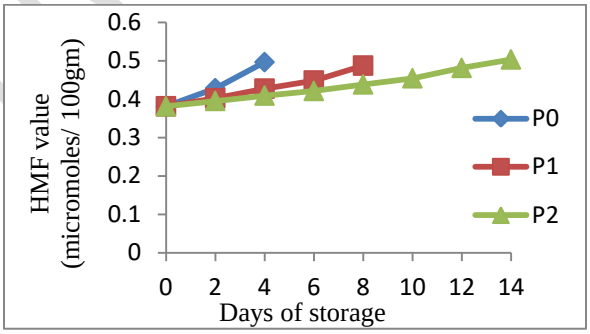

Graph 3(c)




Graph 3(d)

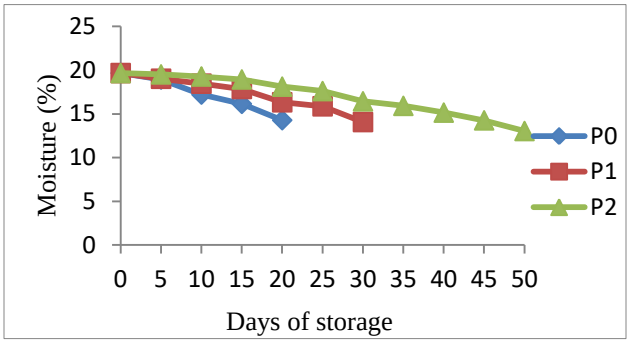



Graph 3(e)

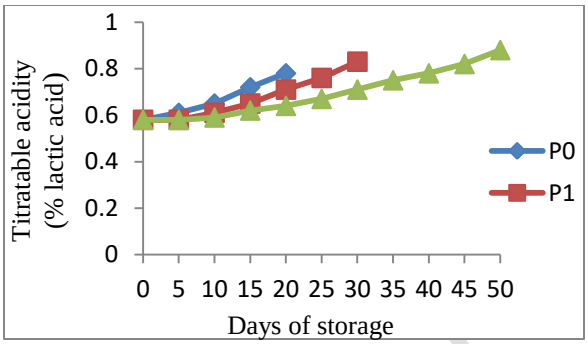



Graph 3(f)

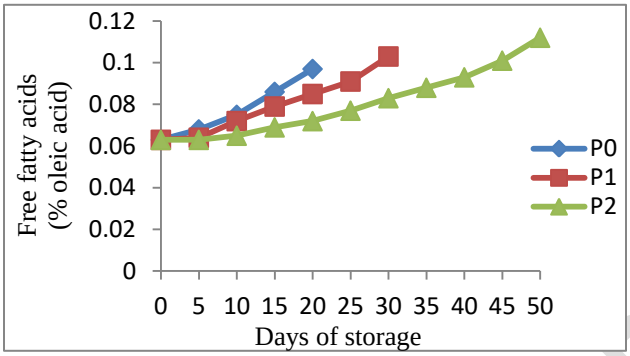
**Fig. 3: Changes in physico-chemical properties of *peda* during storage at 30±1ºC**



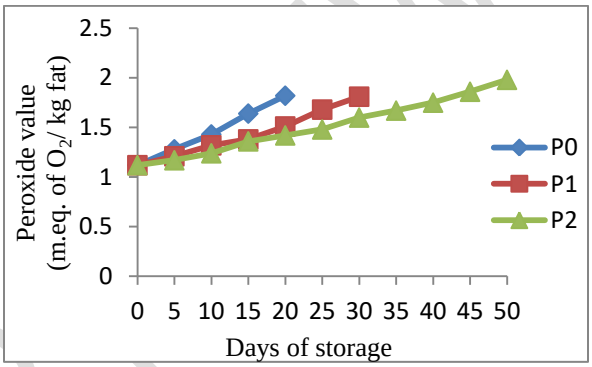

Graph 4(a)



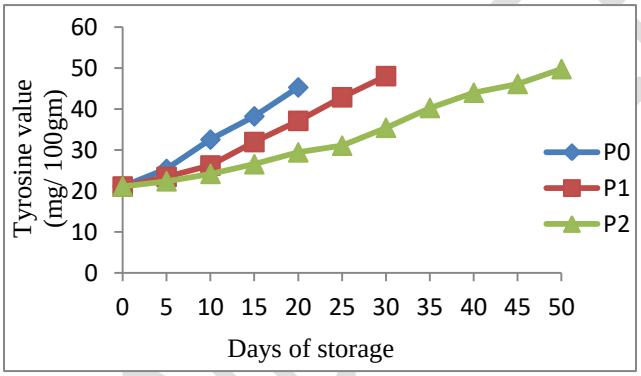

Graph 4(b)



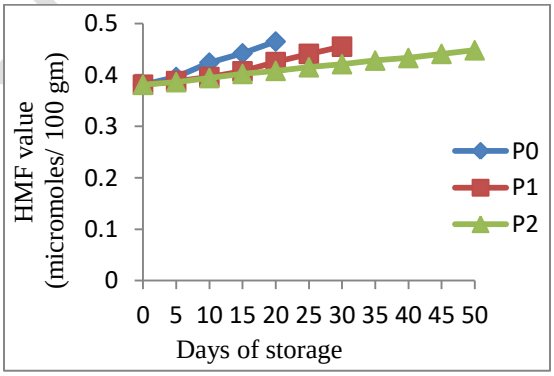

Graph 4(c)




Graph 4(d)




Graph 4(e)




Graph 4(f)

**Fig. 4: Changes in physico-chemical properties of *peda* during storage at 7±1ºC**

### 3.3 Changes in texture profile during storage

Texture is the attribute which determine ultimate acceptance of the product by consumers. Table 1 showed the texture profile of *peda* samples stored under various conditions. In the table texture profile was represented initially and the day up to which the product was acceptable on the basis of sensory quality. The table clearly depicted significant increase in all the textural parameters of *peda* samples except springiness and cohesiveness which showed decreasing trend during storage under various

conditions. Increase in hardness was responsible for lowering of body and texture score of the samples during storage. The hardness was increased from an initial value of 55.247 to 250.63 kg in $P_2$ after 50 days of storage at 7±1ºC. The fracturability value was increased to 0.086 from 0.037 kg in $P_0$ at 30±1ºC. The springiness value decreased from 0.368 to 0.257, 0.239 and 0.225 mm in $P_0$, $P_1$ and $P_2$ respectively during storage at 30±1ºC whereas at 7±1ºC the values were 0.213, 0.195 and 0.181 mm respectively in $P_0$, $P_1$ and $P_2$ at the end of storage period. For cohesiveness highest decrease was 0.0227 – 0.139 mm in $P_0$ at 30±1ºC after 4 days of storage. The gumminess was increased from 11.244 to 21.273 kg in $P_2$ at 7±1ºC after 50 days of storage and chewiness from 0.003 to 0.014 kg-mm in $P_0$ at 7±1ºC after 20 days of storage. Almost similar observations were reported by other researchers [9, 17, 19, 31].

**Table 1: Effect of packaging material on texture profile of *peda* during storage**

| Textural properties | Initial value | Storage at 30±1ºC | | | Storage at 7±1ºC | | |
|---|---|---|---|---|---|---|---|
| | | $P_0$ | $P_1$ | $P_2$ | $P_0$ | $P_1$ | $P_2$ |
| Hardness (kg) | 55.247 ± 1.733 | 218.375 ± 4.898 | 205.861 ± 11.137 | 221.463 ± 4.978 | 237.596 ± 25.017 | 238.453 ± 11.545 | 250.630 ± 13.345 |
| Fracturability (kg) | 0.037 ± 0.005 | 0.086 ± 0.008 | 0.082 ± 0.005 | 0.081 ± 0.001 | 0.085 ± 0.003 | 0.082 ± 0.002 | 0.084 ± 0.007 |
| Springiness (mm) | 0.368 ± 0.012 | 0.257 ± 0.013 | 0.239 ± 0.010 | 0.225 ± 0.007 | 0.213 ± 0.011 | 0.195 ± 0.004 | 0.181 ± 0.008 |
| Cohesiveness (mm) | 0.227 ± 0.006 | 0.139 ± 0.007 | 0.142 ± 0.012 | 0.154 ± 0.007 | 0.145 ± 0.005 | 0.147 ± 0.002 | 0.155 ± 0.007 |
| Gumminess (kg) | 11.244 ± 1.077 | 18.732 ± 1.243 | 20.407 ± 1.33 | 19.716 ± 2.962 | 18.205 ± 1.195 | 19.284 ± 2.437 | 21. 273 ± 1.958 |
| Chewiness (kg-mm) | 0.003 ± 0.001 | 0.008 ± 0.001 | 0.008 ± 0.002 | 0.009 ± 0.001 | 0.014 ± 0.003 | 0.013 ± 0.003 | 0.012 ± 0.002 |

*Average of three trials ± standard deviation

### 3.4 Changes in microbial quality during storage

The initial and final microbial count of peda samples packaged in different packaging materials during storage was represented in table 2. The average initial total bacterial count ($log_{10}$ cfu/ gm) in the *peda* samples was found to be 5.28 which were increased to 7.11, 6.75 and 6.83 in $P_0$, $P_1$ and $P_2$ after 4, 8 and 14 days of storage at 30±1ºC respectively. A similar trend in increase in total bacterial count was also noticed during storage of *peda* samples at 7±1ºC. Yeast and mold counts were also increased significantly during storage under various packaging conditions and temperature and the highest increase

was noticed in the product without packaging and stored at7±1ºC where the count was reported as 3.04 $log_{10}$ cfu/ gm. Earlier workers also reported increase in microbial counts during storage of various *khoa* based sweets [2, 9, 32, 33, 34]. From the trend of increase in microbial count it was clear that packaging materials offered some protection towards the growth of microorganisms by preventing ingress of moisture, light and air.

**Table 2: Effect of packaging material on microbial count of *peda* during storage**

| Parameters | Initial value | Storage at 30±1ºC | | | Storage at 7±1ºC | | |
|---|---|---|---|---|---|---|---|
| | | $P_0$ | $P_1$ | $P_2$ | $P_0$ | $P_1$ | $P_2$ |
| Total bacterial count ($log_{10}$ cfu/ gm) | 5.28 ± 0.18 | 7.11 ± 0.35 | 6.75 ± 0.36 | 6.83 ± 0.32 | 6.96 ± 0.57 | 6.27 ± 0.36 | 6.86 ± 0.57 |
| Yeast & mold count ($log_{10}$ cfu/ gm) | 1.34 ± 0.23 | 2.45 ± 0.18 | 2.50 ± 0.24 | 2.47 ± 0.25 | 3.04 ± 0.22 | 2.68 ± 0.15 | 2.91 ± 0.27 |

*Average of three trials ± standard deviation

## 4. CONCLUSION

With a view to improve the shelf life of *peda*, a popular Indian traditional sweet delicacy, the present study was undertaken where the storage stability of *peda* prepared in the laboratory from standardized cow milk was determined by packaging interventions. From the results of sensory, physico-chemical textural and microbial properties the shelf life of the product was found to differ considerably with different packaging techniques. During storage in all samples there was gradual decrease in the sensory parameter making the product unfit for consumption. Among physico-chemical parameters the moisture content decreased significantly whereas titratable acidity, free fatty acids, peroxide value, tyrosine value and HMF content gradually increased during storage as a result of lactose, lipid and protein breakdown. In the texture profile analysis it was found that all the textural parameters increased significantly throughout storage. The microbial counts were also rapidly increased in all samples during storage and the growth of yeast and molds was the major factor limiting the shelf life. It was noticed that the changes were rapid at ambient condition (30±1ºC) than refrigerated storage (7±1ºC) and the product degraded rapidly without packaging followed by paper box and polypropylene pouches respectively. From the results it can be concluded that *peda* samples were kept well up to 4 days without packaging ($P_0$), 8 days in paper box ($P_1$) and 14 days in polypropylene pouches ($P_2$) stored at 30±1ºC whereas refrigerated samples were acceptable up to 20, 30 and 50 days in $P_0$, $P_1$ and $P_2$ respectively. The study was useful as it will provide sufficient data for characterization as well as shelf life enhancement of this popular Indian sweetmeat and will help to undertake newer studies pertaining to improving the shelf life of various indigenous dairy products of India.

## REFERENCES


1. Sharma A, Gautam A and Ranadey VL. Development and quality evaluation of peda manufactured from admixture of flaxseed and sesame seed. J. Pharm. Innov. 2019; 8(8): 183-186.
2. Dhage DA, Londhe GK, Kamble NS, Godage SH. Studies on effect of fat levels on quality of Peda. Int.J.Curr.Microbiol.App.Sci. 2018; Special Issue-6: 148-153.
3. Jain V, Rasane P, Jha A, Sharma N, Gautam A. Effect of modified atmospheric packaging on the shelf life of Kalakand and its influence on microbial, textural, sensory and physico-chemical properties. J. Food Sci. Technol. 2015; 52(7): 4090 – 4101.
4. Aneja RP, Mathur BN, Chamdan RC, Banerjee AK. Technology of Indian milk products. A Dairy India Publication, New Delhi; 2002.
5. Keerthi S, Manthani V and Swarnalatha G. Assessment of Quality of *Peda* Samples Sold in Kamareddy District - A Case Study. *Int. J. Curr. Microbiol. App. Sci*. 2018; *7*(2): 1427-1434.
6. Londhe GK, Pal D. Studies on the quality evaluation of market samples of brown peda. Indian J.Dairy Sci. 2008; 61(6): 347-352.
7. Banjare K, Kumar M, Goel B Uprit S. Studies on Chemical, Textural and Sensory Characteristics of Market and Laboratory *Peda* Samples Manufactured in Raipur City of Chhattisgarh. *Orie J. Chem*. 2015; 31(1): 231-238.
8. Patil GR. Present status of traditional dairy products. Indian Dairyman. 2002; 54: 35–46.
9. Londhe GK, Pal D, Raju PN. Effect of packaging techniques on shelf life of brown peda, a milk based confection. LWT-Food Sc. Technol. 2012; 47: 117–125.
10. Sutariya H, Rao KJ. Effect of Different Packaging Materials on the Physico-Chemical, Microbiological and Sensory Quality of Thirattupal during Storage. *Int.J.Curr.Microbiol.App.Sc.* 2017; *6*(7): 1529-1539
11. Londhe G, Pal D. Development in shelf life extension of khoa based sweets-an overview. Indian J. Dairy & Biosci. 2007; 18: 1-9.
12. Thakur BR, Semwal AD, Arya SS. Packaging requirements and stability of sorbate preserved khoa sweets (pedas). Indian Food Packer. 1992; 46: 53 - 56.
13. Vijayakhader, Patel KY. Composition and packaging of Pedha. Indian J. Dairy Sci. 1983; 36 (2): 187 – 191.
14. Biradar US, Dev DK, Ingle UM. Shelf life extension of Pedha by packaging. J. Food Sci. 1985; 50(1): 51–55.
15. Reddy CR. Process Modification for production of khoa based sweets. Ph. D. Thesis Kurukshetra University, Kurukshetra. 1985.
16. Kumar GK, Bandyopadhyay P, Punjrath JS. Shelf life extension of Peda using different packaging techniques. Indian J. Dairy Sci. 1997; 50(1): 40–49.
17. Banjare K, Kumar M, Goel BK. Effect of storage on chemical, textural and sensory attributes of traditional indigenous sweet peda. Asian J. Dairy Food Res. 2015; 34(2): 104-108.
18. Sharma HK, Singhal RS, Kulkarni PR. Effect of modified atmosphere packaging on the keeping quality of Malaipeda. J. Food Sci. Technol. 2003; 40(5): 543–545.
19. Jha A, Arvind, Jain P, Gautam AK, Rasane P. Effect of modified atmosphere packaging on the shelf life of Lal peda. J. Food Sci. Technol. 2013; doi 10. 1007/s13197-013-1064-1.
20. Andhare BC, Rai DC, Alam T. Effect of active packaging on sensory attributes of low sugar, low calorie and fibre enriched Lal Peda. Research Journal of Animal Husbandry and Dairy Science. 2016; 7(2): 61 – 67.

21. Dharampal. Technology of khoa based sweets, Advances in Traditional Dairy Products. Lecture compendium of CAS short course held at NDRI, Karnal. 1998; Pp 31-35.
22. Stone, H. and Sidel, J.L. In: Sensory evaluation prac-tices, 3rd Edn. Elsevier Acad. Press, NY. 2004; p 88
23. IS: SP (Part XI). Handbook of food analysis. Analysis of dairy products. New Delhi: Bureau of Indian Standards. 1981.
24. AOAC: Association of Official Analytical Chemists, Official Method of Analysis, 15th ed. Washington, DC and Arlington, VA. 2000.
25. Deeth HC, Fitz-Gerald CH, Wood AF. A convenient method for determining the extent of lipolysis in milk. Australian J. Dairy Technol. 1975; 30(3): 109 – 111.
26. AOAC Peroxide Value of Oils and Fats. Official Method 965.33. 2000; 41: 12.
27. Keeney M, Bassette R. Detection of intermediate compounds in early stages of browning reaction in milk products. J. Dairy Sci. 1959; 42: 945–960.
28. Juffs HS. Proteolysis detection in milk interpretation of tyrosine value data for raw milk supplies in relation to natural variation, bacterial counts and other factors. J. Dairy Res. 1973; 40: 33.
29. APHA, Vanderzant C. Compendium of methods for microbiological examination of foods. American Public Health Association, Washington. 1992; 14: 919-927.
30. Jenness R, Patton S. Principles of Dairy Chemistry. Wiley, New York. 1959.
31. Gupta SK, Patil GR, Patel AA, Garg FC, Rajorhia GS. Instron texture profile parameters of khoa as influenced by composition. J. Food Sci. Technol. 1990; 27: 209–213.
32. Garg SR, Mandokhot UV. Survival and growth of micro-organisms in burfi and pera during storage. Indian J. Dairy Sci. 1987; 40(1): 119 – 121.
33. Misra AK, Kuila RK. Microbiological quality of burfi and sandesh. Asian J. Dairy Res. 1988; 7(1): 51 -55.
34. Shrivas AA, Pinto SV, Patel SM, Balakrishnan S. Effect of storage on composition, physico-chemical, rheology, sensory and microbiological quality of Indian cookie *Rava Burfi.* J. Appl. Nat. Sci. 2018; 10 (1): 88 – 97.