



## RECENT RESEARCH TRENDS IN SHELF LIFE DETERMINATION OF *KHOA-PEDA* - CRITICAL REVIEW

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**Abstract:** Many attempts have been made for the shelf life extension of *khoa-peda*- an Indian traditional sweet, by using different packaging materials and packaging techniques. Changes in the various parameters such as sensory, physico-chemical, textural, bio-chemical and microbiological have been studied with storage period at the different temperature and packaging conditions respectively. This paper review the methodology adopted, instruments used, the time line of references quoted by the researchers and results compared with earlier studies.

**Keywords:** *khoa, peda, packaging, review, milk, traditional.*

### Introduction

*Khoa-peda* a popular Indian sweet originated in the Indian state Uttar Pradesh (Aneja et al 2002). It is estimated that 50-55% of total milk produced in converted to traditional dairy products by the halwais (Patil, GR, 2006). *Khoa* is prepared from buffalo milk of good quality by continuous heating on fire in an open pan for desiccation of water till the semi-solid consistency is achieved towards the end stage. *Khoa* is used as a base material for the preparation of number of traditional heat desiccated milk products such as *burfi, peda, gulabjamun, milk cake, kalakand, kunda* etc. *Peda* is one of the major *khoa*, based sweets, which is very popular among the Indians mainly because of its delicious taste and relative long shelf life. It has been reported that the quantity of *peda* produced in India is more than any other indigenous milk based sweet (Mahadevan 1991, Aneja et al 2002, Jha et al 2014, Singh et al 2015). Word *peda* in general refers to blob of any doughy substance (Singh et al 2014). *Khoa-peda* is prepared first by making *khoa* from the milk followed by addition of sugar @ 1/3<sup>rd</sup> of *khoa* weight, followed by heating till desired consistency, colour i.e. white, creamy, *lal* (red) or brown and cooked flavour is achieved, after that flavouring ingredients are added followed by cooling it (Aneja et

al 2002). It is usually 20-25gm in weight disc-round in shape prepared by rolling between the hand palms to smooth outer surface (Pal, 2000, Singh et al, 2014). There are many types of *khoa-peda* available in the Indian market. Some are named after their place of origin such as *Mathura peda* - from Uttar Pradesh, *Dharwad peda*-from Karnatka and *Rajkot peda*- from Gujarat, *Thabdi-peda*- Gujarat, *Kunthalgiri peda*- from Karnatka ((Modha HM et al 2015, Jha A et al 2012). Some are famous based on their flavour such as *Kesar-peda, Elaichi-peda, fat rich Malai-peda, Plain-peda* (Sharma HK et al 2003). Some are famous based on the colour and size of *peda* such as *White peda, Lal peda, Brown peda, Minni peda* (Londhe G et al 2012).

**Milk sweets** in general during storage undergo several physical, biochemical and microbiological changes. Various researchers have conducted study on shelf life and physico-chemical changes in *khoa-peda* as shown in table no. 1. *Khoa-peda* being a heat desiccated milk product have quite longer shelf life as compared to other milk sweets. *Khoa-peda* being an intermediate moisture range product and non-acidic nature it's spoilage is mostly caused by growth of surface yeasts and moulds and manifests as fermentive and acidic odour (Thakur et al 1992). Various studies have been conducted on

further extending the shelf life by using different packaging materials (Londhe et al 2012), different packaging techniques (Londhe et al 2012, Jha et al 2015) and different additives (Yadav & Beniwal 2009), without impacting on the quality attributes of *khoapeda*.

## Methods adopted for testing

### 1. Sensory Evaluation

For sensory evaluation Jha et al 2014 and Yadav & Beniwal 2009 used nine point hedonic scale while Londhe et al 2012 done sensory evaluation on 50 points with Flavour (10), Body and Texture (10), Colour and appearance (5) and overall acceptability (25).

### 2. Physico-chemical Testing

Moisture- Londhe et al 2012, Singh G et al 2014, (Results obtained are shown in table no. 2) used Mojonnier method as described in Indian Standards for determination of moisture in hard Cheese (IS:2785, 1964). Jha et al 2014, 2015 used AOAC (2000) method for determination of moisture. Yadav and Beniwal 2009 used Gravimetric method as described in AOAC (1995) Titrable acidity and Ph.

Londhe et al 2012 measured titrable acidity in terms of % lactic acid by the method as described by AOAC for cheese (AOAC, 1975). Ph of the fresh stored samples was measured using a digital ph. metre. (Model: Lab India). Jha et al 2014, 2015 and Yadav & Beniwal 2009 have not determined the titrable acidity and Ph.

#### Water activity

Londhe et al 2012 determined water activity using water activity metre "Aqua lab" (Model Series 3 TE) supplied by Decagon Devices, WA, USA. Prior to measurement the samples were tempered at 25°C. Ash, Protein, Sucrose, lactose and fat

Jha et al 2014, 2015 determined ash, protein, sucrose and lactose by using AOAC (2000) methods. Yadav & Beniwal 2009 determined moisture, fat, protein, lactose and ash by Gravimetric method as described in AOAC (1995).

### 3. Textural properties testing

Londhe et al 2012 carried out TPA using a texture analyser, TA-XT2i (M/s Stable Micro Systems, UK) fitted with a 25 kg load cell and was calibrated with 5 kg standard dead weight prior to use. For determining the TPA parameters the samples which were previously tempered to 25°C were cut into cylindrical shape of 1 cm height and were subjected to mono-axial compression of 0.8 cm/cm of the initial sample height using a probe (P-70) during the first stage of the two bite test with a cross head test speed of 2.5 mm/s. from the resulting force-time curves various textural characteristics such as hardness, cohesiveness, adhesiveness, springiness, gumminess and chewiness were calculated using the Texture Expert Exceed Software (v 2.55) supplied by the manufacturer along with the instrument. A minimum of five replicates per sample was done.

Jha et al 2014 carried out TPA on *lal peda* samples using Texture analyser (TA.XT plus), Exponent Lite (Stable Micro Systems, UK). TPA was done to characterized hardness, adhesiveness, springiness, Cohesiveness, gumminess and chewiness. The sample of *lal peda* was cut into 1 cm<sup>3</sup> size pieces and temperature of the sample maintained at 25°C during the analysis. The samples were subjected to mono-axial compression of 5 mm height. The force displacement curve was obtained for a two bite compression cycle with the test speed of 1 mm/s and trigger force of 5 g.

Jha et al (2015) carried out TPA on *lal peda* samples using Texture analyser (TA.XT plus), Exponent Lite (Stable Micro Systems, UK). TPA was done to characterized hardness, adhesiveness, springiness, Cohesiveness, gumminess and chewiness. The sample of *lal peda* was cut into size of 1.5 cm length, 1.5 cm breadth and 1 cm height and temperature of the sample maintained at 25°C during the analysis. The samples were subjected to mono-axial compression of 5 mm height. The force displacement curve was obtained for a two bite compression cycle with the test speed of 1 mm/s and

trigger force of 5 g. The time gap between the two successive bites of TPA test was 11 s.

Singh et al 2014 carried out TPA on *peda* samples using texture analyzer TA-XT2i (Stable Micro Systems, Godalming, Surrey, UK) fitted with a 25 kg load cell was done to determine hardness, adhesiveness, springiness, cohesiveness, gumminess and chewiness. Results obtained are shown in table no. 3.

#### 4. Bio-chemical testing

Free Fatty acids (FFA)

Londhe et al 2012, Jha et al 2014, 2015 used the method prescribed by Deeth, Fitz-Gerald and Wood 1975 to estimate free fatty acids (FFA) content of *brown peda* and *lalpeda*. Yadav & Beniwal 2009 used the method of Koniecko 1979 for determination of FFA in *peda*.

Peroxide value

Londhe et al 2012 used idometric method as described in Indian Standard (IS: 3508, 1966).

Jha et al 2014, 2015, and Yadav & Beniwal 2009 has not determined the peroxide value of *peda*.

Hydroxy Methyl Furfural (HMF)

Londhe et al 2012, Jha et al 2014, 2015 used the method prescribed by Keeney and Bassette 1959 with slight modification. Yadav & Beniwal 2009 has not determined the HMF value in *peda*.

Thiobarbituric acid (TBA value)

The extent of oxidation of fat in *peda* was measured in terms of thibarbituric acid reactive substances (TBARS) value. Jha et al., 2014, 2015 and Yadav & Beniwal 2009 used the extraction method of Strange et al. 1977 with slight modification for the determination of TBA value.

Free fat

Yadav & Beniwal 2009 used the method prescribed by Rangadham and Rajorhia 1989 for the determination of free fat in *peda*.

#### 5. Microbial testing

Londhe et al 2012 analysed the *peda* samples for total viable count, yeast and mould count and coliform count as per the standard methods described in manual of Dairy Bacteriology (ICAR,

1982). The data on microbiological quality was presented in  $\log_{10}$  values.

Jha et al 2015 subjected to microbiological analysis for Total plate count (TPC), Yeast and Mould count (Y&M) and Coliform counts. The TPC was determined by surface spreading the homogenate (prepared by macerating the *lalpeda* samples in pestle and mortar) with 10<sup>-2</sup> dilution on the plate count agar (PCA) and incubated at 37 °C for 24 - 48 h. For mould & Yeast detection, 10<sup>-2</sup> dilution of sample was spread on potato dextrose agar (PDA) and incubated at 25°C for 24-48 h. Coliforms in the samples were estimated by plating 10<sup>-2</sup> dilution on Violet Red Bile Agar (VRBA) before being incubated at 37 °C for 24-48 h.

Yadav & Beniwal 2009 used four plate methods of BIS (1981) to estimate the standard plate count.

#### Results and discussion

The recent studies on effect of different packaging conditions on shelf life of *keboa-peda* was considered for review to compare the methodologies used, parameters considered and instruments used to measure the parameters using the storage studies. It was observed that the various researchers have not deviated themselves in the use of methodology, type of equipments used and selection of quality parameters. However type of packaging material and storage conditions were different. It was also observed that although it was established during the study in 2009 that *peda* could be stored for more than 60 days at -15±2°C while packed in LDPE (50-55µm). The study conducted in 2012, the packages used were cardboard, MAP and vacuum packaging. The product was stored at 30±2°C. The shelf life of *peda* was formed out to be 20, 30 and 40 days respectively. In the study conducted in 2014, the *peda* was packed in paper boxes and stored at 4°C and 37°C showed shelf life of 31 days and 9 days respectively. The study during 2015 reported that *peda* was packed in polyethylene bags filled with 3 different MAP conditions and was stored at 10°C which showed shelf life of 60 days. The selection of 10°C was not explained and nowhere in the paper

quoted references. It was mentioned with some references in earlier studies.

It was observed that all the researchers used similar type (make & model) of equipment for textural analysis of the stored product. Beniwal, 2009 mentioned that as a result of vacuum packaging, crushing/squeezing of peda takes place making its appearance far less appealing, in reference to Birader et al 1985. But still in 2012 researchers are comparing MAP and vacuum packaging. The study in 2009 has quoted the oldest reference of 1964 and latest was that of 2002. Indicating the review gap from 2002 to 2009 i.e. of 7 years, the paper published in 2012 quoted only about 22% references which fall from 2002 to 2012 i.e. within the immediate preceding decade and oldest reference was that of 1940. The paper published in 2015 was only having 23% references within one decade immediately preceding the 2015 i.e. 2005 to 2015. Hence 73% references were older than one decade with oldest of 1959.

The trend shows that either the work on shelf life determination of peda or similar milk product is being a repetition of the older work or no new work is defined. It may reflect that whatever studies are being undertaken are of merely academic in nature and hardly find any way for adoption in industry.

### Conclusion

Recent research is repetition of earlier studies with non-significant inputs. It is concluded from the review of recent trends on shelf life of *khoa-peda*. It is observed that there is need of development of new equipments or new indigenous equipments, so that the results of equipments being used under the present scenario are used. Since these equipments are proprietary items which were developed in the developed countries taking their perception of sensory properties comparing with the instrument values. Indian sensory perception may differ that of the country of origin of these instruments.

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**Table No.1: Shelf life study and physico-chemical analysis conducted by various researchers on *khao-peda***

Research work done	Packaging material	Sensory parameters	Physico-chemical parameters	Textural parameters	Bio-chemical parameters	Microbiological parameters	Researcher
Effect of packaging techniques on shelf life of brown peda, a milk based confection	1. Conventional cardboard boxes	Was done by panel of 9 judges	1. Moisture	All 6 parameters were evaluated	1. FFA	1. Total Viable count	Londhe et al (2012)
	2. Modified atmosphere	1. Flavour (10)	2. Titrable acidity and Ph.		2. Peroxide value	2. Yeast and mould count	
	3. Vacuum packaging techniques	2. Body and texture (10)	3. Water activity		3. HMF	3. Coliform count	
3. Colour and appearance (5)							
Physico-chemical and sensory changes during the storage of lal peda	Paper boxes	Was done by panel of seven members by using nine point hedonic scale (1= dislike extremely, 9=like extremely)	1. Moisture	All 6 parameters were evaluated	1. FFA	Not Done	Jha et al (2014)
			2. Ash		2. HMF		
			3. Fat		3. TBA		
			4. Protein				
			5. Sucrose				
6. Lactose							
Effect of modified atmosphere packaging on the shelf life of lalpeda	Polyethylene bags filled with	Not Done	Moisture content	All 6 parameters were evaluated	1. FFA	1. Total Viable count	Jha et al (2015)
	1. Air				2. HMF	2. Yeast and mould count	
	2. 70% Nitrogen				3. TBA	3. Coliform count	
	3. 30% Carbon dioxide						
4. 98% Nitrogen							
Effect of antioxidants and preservatives on keeping quality of peda stored at sub-zero temperature	LDPE bags (50-55 micron)	Was done by panel of 8 Judges on nine point hedonic scale	1. Moisture	Not done	1. Free fat	Standard plate count	Yadav & Beniwal (2009)
			2. Fat		2. FFA		
			3. Protein		3. TBA		
			4. Lactose		4. NPN		
			5. Ash				
Multi-factor optimization for mechanized formation of khoa-peda	Not done	Not done	1. Moisture		Not Done	Not Done	Singh G et al (2015)
			2. Density				

**Table 2: Moisture and density determination in *Lal-peda***

<i>Lalpeda</i>	Moisture (% Wet basis)	Density (g/cm <sup>3</sup> )
1	16.9	1.11
2	16.5	1.09
3	17.1	1.11

**Table 3: Textural analysis of *Lal-peda***

1. <i>Lalpeda</i>	Hardness	Adhesiveness	Springiness	Cohesiveness	Gumminess	Chewiness
1	16.1	-0.056	0.093	0.072	1.161	0.108
2	22.9	-0.086	0.079	0.074	1.697	0.135
3	18.5	-0.142	0.07	0.064	1.185	0.083