

## An analytical study on shelf-life of milk and acceptability of milk products in household refrigerators

■ **Pushpinder Sandhu, Sharanbir Bal and Gurinder Kaur**

Department of Family Resource Management, Punjab Agricultural University, LUDHIANA (PUNJAB) INDIA

Email : spushi@rediffmail.com; balsharanbir@yahoo.co.in

### ARTICLE INFO :

**Received** : 19.03.2012  
**Revised** : 07.08.2012  
**Accepted** : 06.09.2012

### KEY WORDS :

Refrigerator, Shelf-life of milk, Milk production

### HOW TO CITE THIS ARTICLE :

Pushpinder Sandhu, Sharanbir Bal and Gurinder Kaur (2012). An analytical study on shelf life of milk and acceptability of milk products in household refrigerators, *Adv. Res. J. Soc. Sci.*, 3 (2) : 116 - 120.

### ABSTRACT

Indian housewives make intensive use of milk and milk products in their cuisine and due to climatic conditions of the country, need refrigerated storage of these items. However, the power cuts and materials they choose to store them makes safety of such products questionable. Keeping this in mind, the present study was conducted with the objective to examine existing refrigerated food storage practices pertaining to milk and milk products, to undertake organoleptic evaluation of selected milk products and blue methylene test of milk. Results indicated that milk products with longer shelf-life remained unaffected with type of container used to store them in refrigerator, compared with milk samples, *malai* and yoghurt. Methylene blue reductase test of *verka* milk indicated that boiled milk can be stored in refrigerated conditions for 4 days. These results are indicative of change in physical appearance as well as non safety of raw milk storage for longer duration in household refrigerators.

## INTRODUCTION

Milk and milk products need to be stored under refrigerated conditions. Refrigeration preserves the taste, texture and nutritional value of milk and milk products better than any other preservation method and as a result, refrigerated food market has experienced enormous growth. Refrigeration is employed to control the rates of certain chemical and enzymatic reactions as well as rates of growth and metabolism of food microorganisms (Srivastava and Kumar, 1994). By cool storage, we generally mean storage temperature above freezing and its maximum limit of 16°C. However, temperature in danger zone (16-49°C) allows rapid growth of bacteria and production of toxins by some bacteria (Sri Lakshmi, 2005).

Factors that reduce the shelf-life of milk include having the refrigerator temperature set too high. Ideally, the refrigerator should be at 38° to 40°F, or as cold as you can keep the refrigerator without freezing milk and milk products. The low temperature will slow bacterial growth, while the sealed container will prevent contamination and absorption of

flavours from other foods in the fridge. However, if the milk develops an off-odor or taste, it should be discarded. Storing dairy products in their original packaging with a securely closing lid will help decrease spoilage. In case of other dairy products, such as cheese and yoghurt, bacteria play an important role in flavour, function and good health.

Time and temperature are important factors in ascertaining milk and milk product's shelf life. Household refrigerators usually run at 4.4-7.2°C. Perishable foods like milk needs to be stored in the refrigerator at a temperature between 3-4°C. Moreover, studies have shown that perishable food like milk and milk products will deteriorate, even at refrigerator temperature, due to spoilage because of microorganisms, enzymes and oxidation (Jay, 2000). Moreover, the temperature and climatic conditions prevalent in India; as well as the pH values of most food items are conducive to growth and proliferation of bacteria causing food borne diseases.

Various kinds of containers (metallic and non-metallic), wraps, and covers are used by housewives for storing milk and milk products (Sri Lakshmi, 2005). However, there are

evidences of seepage of metals or chemicals from materials and containers in which milk and milk products are cooked and stored even for shorter duration as reported by Bhutani (2005). Apart from this, changes in physical appearance, texture, taste and flavour are also noticed. Therefore, a clear indication of other factors like effect of material of container, place in refrigerator and unhygienic handling of food items (in refrigerator) is seen.

The methylene blue reduction test for testing, the keeping quality of milk is based on the fact that the color imparted to milk by the addition of a dye such as methylene blue will disappear more or less quickly. The removal of the oxygen from milk and the formation of reducing substances during bacterial metabolism causes the colour to disappear. The agencies responsible for the oxygen consumption are the bacteria. It means greater the number of bacteria in milk, the quicker will the oxygen be consumed, and in turn the sooner will colour disappear. Thus, the time of reduction is taken as a measure of the number of organisms in milk.

Keeping in view, the practices and preferences of Indian housewives for storing various milk and milk products under refrigeration for longer duration and using containers of their choice and fancy, present study was conducted to know the safety aspect of these food items to reduce health hazards. The specific objectives of the study were:

- To examine selected milk and milk products refrigerated storage practices.
- To organoleptically evaluate selected milk and milk products stored under refrigeration conditions.
- To undertake methylene blue reductive test for ascertaining shelf-life of fresh and boiled milk under refrigeration conditions.

## **METHODS**

### **Milk and milk products refrigerated storage practices:**

The household survey was conducted in Ludhiana city through interview method by using pre-tested interview schedule on a sample of 60 respondents, randomly selected from two colonies which were selected from Ludhiana city and a sample of 30 households was drawn from each locality. These localities were BRS Nagar and Haibowal. The questions were structured to know the commonly used milk and milk products storage practices in refrigerator in selected households. The data thus collected were analyzed and simple percentages were worked out.

### **Organoleptic evaluation of samples:**

Thirteen milk products and 3 types of milk samples were kept under refrigeration conditions after procuring them as fresh as possible. These were kept in top most shelf of refrigerator with a setting of medium cool air. Refrigerator door

was kept closed for 5 days with uninterrupted power supply in the month of July' 2010. The organoleptic evaluation of selected milk and milk products samples (stored in selected containers and materials) was done by 5 judges after the samples were taken out of refrigerator (after 5 days). Selected milk and milk products were evaluated immediately upon removal from refrigerator for changes in physical appearance, taste, texture, colour and flavour. Mean scores were worked out following systematic procedure. The qualitative responses were quantified with the help of proper statistical scoring technique: No deterioration, 4. Slight deterioration, 3. Slightly unacceptable: 2; Deteriorated considerably: 1 and Totally rejected: 0. The mean scores were then calculated by using the following formula :

$$\text{Mean score} = \frac{\text{Total score earned by individual factor}}{\text{Total no. of respondents}}$$

### **Methylene blue reductive test:**

0.01 ml of methylene blue dye was taken to dissolve it in milk sample. Reagent used was methylene blue solution (25,000). Equipment used were: Sterile screw-cap test tubes, sterile 10 ml and 1 ml pipettes, 37°C water bath and burner. Test tubes were labeled with 1 and 2 and using a different 10 ml pipette both times, 10 ml of each type of milk was transferred into each test tube, 1 ml of methylene blue dye was added to each test tube. Stopper was placed, test tubes inverted gently few times and placed in water bath. Time of incubation was recorded. Changes in the colour were observed. It started discolouring with time. It is called reduction.

### **Analysis of results:**

- Reduction within 30 minutes is indicative of very poor quality.
- Reduction occurring between one-half hour and two hours is indicative of poor quality.
- Reduction occurring between 2 and 6 hours is indicative of fair quality.
- Reduction occurring between six and eight hours is indicative of good quality.

## **OBSERVATIONS AND ANALYSIS**

The findings of the present study as well as relevant discussion have been summarized under following heads:

### **Milk and milk products refrigerated storage practices:**

Results of the surveyed report revealed that majority of the respondents, were young graduate, not-employed, and belonged to nuclear family with small family size and falling in middle income group. Ordinary brand of Kelevinator refrigerator with 270 l capacity was most acquired refrigerator. They procured milk products as and when needed and preserved few like ghee

on yearly basis. Fresh milk was purchased almost on daily basis. Respondents mostly stored them for few days. They preferred keeping milk products in kitchen shelves and sealed, preserved ones like ghee in store, pantry or kitchen cabinet. They usually chill tray to keep milk products, milk pouch in freezer and boiled one in upper shelf. Mostly respondents cooled the hot milk before shifting in refrigerator. They often kept milk products in original packing. For storing boiled milk, stainless steel container was most preferred. Milk was spoiled within a week even under refrigeration conditions. Curd, *paneer*, *malai* and butter could last up to fortnight. These items were spoiled even when kept in refrigerator for prolonged duration, was reported by most of the respondents.

### Organoleptic evaluation of samples:

It can be clearly seen in Table 1 that when these selected food items were stored using the existing practice of storage as compared to the suggested method; the mean scores of organoleptic evaluation of items stored by using existing practice were found to be lower; in all food items except for Ghee, condensed milk and milk powder.

Results indicated that for the experiments which were conducted using existing storage practice, when ghee was kept in glass container with plastic lid in refrigerator and condensed milk and milk powder was kept in its original packing, the mean score remained unchanged *i.e.* 4.00 upon change in containers. It means that since these products were meant to have higher shelf-life, did not get affected by any change in the container. The appearance, texture, flavour and colour of processed food products do not change in refrigeration conditions whether

they are kept in original bottles or shifted to stainless steel bin or tupper ware plastic containers.

However, milk samples (pasteurized, raw and boiled) when stored in aluminum vessel was adjusted second best on organoleptic scoring with mean score of 3.90 each which improved slightly when same samples were stored in stainless steel vessel and kept in refrigerator for 5 days.

Third rank was obtained by sample of *khoya* which was kept in plastic container (existing storage practice) with mean score of 3.46; followed by 4<sup>th</sup> and 5<sup>th</sup> ranking given by panel of the judges to sample of yoghurt (mean score 3.36) and processed butter (mean score 2.58) when these were stored in glass bottle with plastic lid and original packing, respectively under existing storage practice during the experimental conditions in refrigerator for 5 days.

Sixth, seventh and eighth rank were obtained by samples of homemade *Lassi*, processed cheese and cream which were kept in glass bottle with plastic lid, plastic container and polythene bag, respectively with mean score between 2.78-2.74. Minimum scores (showing maximum changes in physical appearance) were observed for *malai* sample with mean score 1.80, home made butter (mean score 2.42) followed by cottage cheese and butter milk (processed) with mean score between 2.56-2.58.

However, there was slight improvement in organoleptic evaluation of all the experimental samples (judged by panel) which were kept in suggested containers in refrigerator. Apart from food products with longer shelf-life (*ghee*, ccondensed milk and milk powder) which indicated no change in organoleptic properties, minimum change (2.50 per cent) was observed in all

**Table 1 : Organoleptic evaluation of selected samples kept in refrigerators using existing and suggested storage practice**

Food items stored	Existing storage practice	Mean score	Suggested storage practice*	Mean score	Percentage change in scoring	Rank
Butter processed	Plastic container	2.88	Stainless steel bin	3.60	30.0	1
<i>malai</i>	Polythene bag	1.80	Stainless steel bin	2.90	27.5	2
Cream	Polythene bag	2.74	Plastic net bag	3.82	27.0	2
Cottage cheese	Plastic container	2.56	Tupper ware bin	3.56	25.0	3
Processed cheese	Plastic container	2.76	Tupper ware bin	3.68	23.0	4
<i>Lassi</i> homemade	Glass bottle with plastic lid	2.78	Tupper ware bottle	3.62	21.0	5
Buttermilk processed	Original packing	2.58	Tupper ware bin	3.34	19.0	6
Butter homemade	Plastic container	2.42	Stainless steel bin	3.62	18.0	7
<i>khoya</i>	Plastic container	3.46	Stainless steel bin	4.0	13.5	8
Yoghurt	Glass bottle with plastic lid	3.36	Tupper ware bottle	3.68	8.0	9
Pasteurized milk	Aluminum vessel	3.90	Stainless steel vessel	4.00	2.50	10
Milk raw	Aluminum vessel	3.90	Stainless steel vessel	4.0	2.50	10
Milk boiled	Aluminum vessel	3.90	Stainless steel vessel	4.0	2.50	10
Milk powder	Original packing	4.00	Tupper ware bin	4.00	-	11
<i>Ghee</i>	Glass container with plastic lid	4.00	Stainless steel bin	4.00	-	11
Condensed milk	Original packing	4.00	Tupper ware bin	4.00	-	11

\* By panel of judges

Table 2 : Effect of storage containers on quality of milk		
Raw milk	Aluminum container	Stainless steel
Reduction time (hrs.)	½	½
Quality of milk	Very poor quality	Very poor quality
Duration	Boiled milk (aluminum container)	
	Reduction time (hrs.)	Quality of milk
0	No change in 6 hrs.	Good quality
2	4	Fair quality
3	2	Poor quality
4	1	Poor quality
5	½	Very poor quality
Duration	Boiled milk (stainless steel container)	
	Reduction time (hrs.)	Quality of milk
0	No change in 6 hrs.	Good quality
2	No change in 6 hrs.	Good quality
3	4	Fair quality
4	2½	Fair quality
5	2	Poor quality

the milk samples stored in aluminum vessel when compared to suggested storage practice of storing it in stainless steel container in refrigerator. This trend was followed by yoghurt and *khoya* which were kept in Tupper ware bottle and stainless steel vessel (when evaluated as compared to plastic container and glass bottle with plastic lid) as per cent change observed was 8 and 13.5 per cent only. Approximately 18-25 per cent changes in physical properties were evaluated in homemade butter, processed butter milk, homemade *lassi* and processed cheese samples with (mean scores between 3.34 and 3.62, respectively) with respect to suggested practice. More than 25 per cent improvement in organoleptic assessment was observed in case of cream and *malai* samples (stored in stainless steel bin). Top ranking (30%) on organoleptic evaluation was obtained by processed butter sample which was kept in stainless steel bin.

#### Shelf life of fresh and boiled milk:

Methylene blue reductive test was used to check level of spoilage in case of samples of boiled milk and raw milk. The results are presented in Table 2 which reveal that the blue dye which was mixed with boiled milk sample (which was kept in aluminum vessel) changed colour after 4 hours (it had become white). Milk sample kept in stainless steel vessel did not show any change during this period.

On third day of refrigerated storage of milk; the colour of mixture of boiled milk (kept in aluminum vessel) changed colour in 2 hours only and the one kept in stainless steel vessel took

4 hours to get into same condition. On fourth day of refrigerated storage of milk the colour of mixture of boiled milk (kept in stainless steel vessel) changed colour in 2½ hours only. Results on 5<sup>th</sup> day were more conspicuous as the mixture made from boiled milk (taken out from aluminum vessel) changed its colour within 30 minutes whereas it took 2 hours to become colourless for the milk sample which was taken from stainless steel vessel.

Methylene blue reductive test showed startling results when raw milk was used for experimentation. Colour of mixture become white within 15 minutes in case of samples drawn both from aluminum and stainless steel vessels. Results indicate that raw milk is not safe to keep in any metallic container even under refrigeration conditions. It should be immediately boiled (upon procuring) and stored for minimum duration. Safest method to store milk pouches is in freezer till its intended use. It should be consumed as fast as possible after boiling.

#### Conclusion:

It can thus be concluded from the present study that Indian way of storing food products in containers of the choice of housewives for refrigeration storage for longer duration is not a safe option. Therefore, it is recommended that these products (except for ghee, powdered milk and condensed milk) which when once opened may be changed into stainless steel bin or tupperware (a certified food grade plastic) bin. However, milk is not safe to store in any type of container once opened. It is better to keep milk in frozen condition and once boiled should be consumed within hours.

## REFERENCES

---

- Bhutani, A. (2005). Extent of toxin contents in cooked food: A comparison of different skillets. M.Sc. Thesis, Punjab Agricultural University, Ludhiana, PUNJAB (INDIA).
- Breene, W.M. (1985). *Industrial processing of fruits and vegetables*. pp 153-63. University of Minnesota, Department of Food Science and Nutrition St. Paul, Minnesota 55108.
- Jay (2000) *Food Analysis: Theory and Practices*. (3<sup>rd</sup> edn.) CBS Publishers and Distributors, 4596/1A, Darya Ganj, New Delhi, (INDIA).
- Srilakshmi, B. (2005). *Food Science*. (4<sup>th</sup> Edn. ) pp. 334-37, New Age International (P) Ltd. Publishers, New Delhi (INDIA).
- Srivastava, R.P. and Kumar, S. (1994). *Fruit and vegetable preservation: Principles and practices*. (3<sup>rd</sup> Edn.) pp 19-20, International Book Distributing Co. Lucknow (U.P.) INDIA.

