African Journal of Dairy Farming and Milk Production Vol. 1 (5), pp. 085-090, December, 2013.
Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Effect of storage temperature on shelf life of standardized buffalo milk *Ujani basundi*

Gaikwad S. M.[1]* and Hembade A. S.[2]

[1]Department of Dairy Science, Shivneri College, Shirur Anantpal, District Latur (M.S), India.
[2]Department of Dairy Science, Yeshwant College, Nanded (M.S.) India.

Accepted 24 October, 2013

The effects of storage of buffalo milk *Ujani basundi*, incorporated with or without potassium sorbate (0.1% w/w) and with or without cardamom (0.1% w/w) under ambient (30±1°C) and refrigerated temperature (5±1°C) over a period of 20 days were s tudied. The physicochemical as well as sensory quality of stored product samples were studied. The stored product samples at refrigerated and ambient temperature with potassium sorbate gave shelf life up to 20 and 10 days respectively. The product stored with cardamom gave best flavor score in both the temperature.

Key words: Shelf life, *Ujani basundi*, flavor, cardamom, refrigerated temperature.

INTRODUCTION

Ujani basundi is the heat desiccated indigenous dairy product of Ujani village and popular throughout the Latur district in Maharashtra state. Nowadays many researchers, that is Landge (2007), Navjeevan and Rao (2005) worked on packaging materials, to increase the shelf life of indigenous dairy products at room temperature.

Misra (1997) stated that most of the Indian milk products are sterile when fresh; it is the post manufacture contamination during storage that deteriorates their quality. Hence, it is of utmost importance from economic as well as safety point of view, to prevent any type of contamination before, during or after the preparation of the products. However, researchers Kulkarni et al. (1983), Palit and Pal (2005), and Kumar and Anand (2003) studied channa, burfi and khoa indigenous dairy products to increase their shelf life respectively.

Shelf life of dairy products can be increased by the addition of antibacterial agents like potassium sorbate and antifungal agent like cardamom. So researchers Natta et al. (2008), Mahafuz and Khalequzzaman (2007), used essential oil from cardamom in their investigation and reported that cardamom found fumigant effects on the adult C. amaculates and beneficial effects on such organisms.

U. basundi contains 28 to 35% moisture Gaikwad and Hembade (2010). It is a common knowledge that moistures food does not keep longer at room temperature. Hence, this product also does not keep longer than 4 days at room temperature. The product can remain safe number of days at refrigerator temperature, but it is costly method of preservation, hence an attempt was therefore made to develop a technology for improving the shelf life of *U. basundi* at 30°C applicable in village conditions by employing the food grade antimycotic agents like potassium sorbate and antifungal agent like cardamom. Therefore due to beneficial effects of potassium sorbate and cardamom in present study potassium sorbate and cardamom were used to extend the shelf life of this popular desiccated milk sweet meat.

MATERIALS AND METHODS

Buffalo milk *U. basundi* was prepared according to the method standardized by Gaikwad and Hembade (2010). When the product get ready potassium sorbate and cardamom (in powder form) were added separately, as preservatives each @ 0.1% (w/w) level. *U. basundi* samples were then filled in previously cleaned and sterilized low density poly ethylene (LDPE) pouches of 100 g capacities after attaining the room temperature. Three types of

*Corresponding author. E-mail: gaikwadsunil39@yahoo.com.

U. basundi samples as given below were stored at 30±1°C and 5±1°C observed daily and analyzed at an interval of 5 days.

C = without preservative (control)
T_1 = with potassium sorbate
T_2 = with cardamom

The samples were analyzed for chemical composition, namely Fat using method as per Indian standards (IS, Sp:18, part XI,1981), protein by AOAC method (2005), Sucrose volumetrically by Lane Eynon method (IS, Sp:18, part XI,1981), Ash (IS, Sp:18, part XI,1981), and moisture (IS, Sp:18, part XI,1981). Lactose was determined as per the procedure recommended by Gojiya and Lata (2005). The acidity of prepared samples was determined as described in (IS, SP: 18 Part XI, 1980). Free fatty acid The (FFA) was determined as described by Aggrawal and Sharma (1961) with modifications that 10 g of sample was taken and dissolved in 25 ml of chloroform to this 50 ml of neutralized alcohol was added and titrated against N/10 NaOH using phenolphthalein indicator.

The product was evaluated by conducting sensory evaluation of panel of 6 semi-trained judges using 9 point hedonic scale. The packaging material was not used at the time of sensory evaluation hence maximum points given. Results were analyzed using complete randomized design to test the statistical significance as per Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Effect of storage period on moisture content in buffalo milk *U. basundi* at refrigerated (5±1°C) and ambient temperature (30±1°C) at refrigerated temperature

The control sample showed low moisture (37.41%) content on 5th day and it was again reduced to 36.72, 35.18 and 33.31 on 10, 15 and 20th day of storage respectively (Table 1). The sample T_1 containing potassium sorbate showed 38.06% of moisture on 0th day which was then reduced to 37.64, 36.86, 35.39 and 34.44% on 5, 10, 15 and 20th day of storage respectively. The sample T_2 containing cardamom did not showed any different results than the control sample. This sample showed 36.06% initial moisture and reduced to 37.53, 36.75, 35.23 and 33.36% on 5, 10, 15 and 20th day of storage respectively.

At ambient temperature

Effect of storage period on moisture content in buffalo milk *U. basundi* at ambient temperature (30±1°C) shown in Table 2. The control sample showed low moisture (36.71%) content on 5th day as compared to T_1 (37.48%) and T_2 (36.84%) but these values are not significant ($P<0.05$). The sample T_1 containing potassium sorbate showed 38.06% moisture on 0th day which was then reduced to 37.48 and 35.12% on 5 and 10th day of storage respectively. The sample T_2 containing cardamom did not show any difference with control. The control sample showed 41.68% initial moisture and reduced to 36.84% on 5th day of storage. The reduced moisture contents in khoa, khoa, khoa, khoa, and burfi also reported by Kumar et al. (1975), Rao et al. (1977), Jha et al. (1977), Malhotra and Prasad (1997) and Palit and Pal (2005) respectively.

The control and T_2 sample showed mold growth over the surface of experimental samples on 6th day of storage at ambient temperature (30±1°C) therefore discarded from the experiment. Sample containing potassium sorbate did not show mold growth over the surface of product till the completion of investigation. However, rancid flavor developed on 11th day of storage therefore; it was discarded from the present investigation.

Effect of storage period on fat content in buffalo milk *Ujani basundi* at refrigerated temperature (5±1°C) and ambient temperature (30±1°C)

Initially the fat content in control, T_1 and T_2 sample was 18.34, which increased to 18.53, 18.36 and 18.51% on 5th day of storage respectively (Table 1 and 2). The control sample showed 18.71, 18.88 and 19.71% whereas sample containing the cardamom showed 18.67, 18.84 and 19.76% fat contents on 10, 15 and 20th day of storage respectively. The sample containing the potassium sorbate showed 18.51, 18.59 and 19.63% fat contents on 10, 15 and 20th day of storage respectively. The control sample showed the higher percentage of fat content on 5th day whereas potassium sorbate treated sample showed the lowest fat content as compared to control and T_2 sample and these values are not statistically significant ($P<0.05$).

The fat content in control, T_1 and T_2 sample at ambient temperature (30±1°C) increased to 18.68, 18.51 and 18.66% on 5th day of storage respectively from the initial value of 18.34%. The increase in fat content on 5th day of storage might be observed due to loss of moisture. Therefore, fat contents increased. The control sample showed the higher loss of moisture therefore it showed higher (18.68) percentage of fat content on 5th day whereas potassium sorbate treated sample showed the lowest fat than the control and T_2 sample but that values are not statistically significant ($P<0.05$). The similar findings in present investigation were also reported by Kumar et al. (1975), Rao et al. (1977), Jha et al. (1977), Malhotra and Prasad (1997) and Palit and Pal (2005).

Effect of storage period on sucrose content in buffalo milk *U. basundi* at refrigerated temperature (5±1°C) and ambient temperature (30±1°C)

Initially the sucrose content in control, T_1 and T_2 sample was 18.24 which increased to 18.29, 18.26 and 18.30 on 5th day of storage at refrigerated temperature respectively (Tables 1 and 2). The control sample showed showed 18.36, 18.48 and 18.69% of sucrose whereas

Table 1. Effect of storage temperature on physicochemical properties of *Ujani basundi* stored at refrigerated temperature (5±1°C).

Attribute	Storage temperature (°C)	Treatment (%)	Storage period (days)				
			0	5	10	15	20
		Control	38.06	37.41	36.72	35.18	33.31
Moisture	5	T_1	38.06	37.64	36.86	35.39	34.44
		T_2	38.06	37.53	36.75	35.23	33.36
SE			0	0.06	0.04	0.06	0.36
CD			0	0.14	0.09	0.13	0.78
		Control	18.34	18.53	18.71	18.88	19.71
Fat	5	T_1	18.34	18.36	18.51	18.59	19.63
		T_2	18.34	18.51	18.67	18.84	19.76
SE			0	0.05	0.06	0.09	0.03
CD			0	0.12	0.12	0.19	0.08
		Control	18.24	18.29	18.36	18.48	19.69
Sucrose	5	T_1	18.24	18.26	18.30	18.39	19.48
		T_2	18.24	18.30	18.35	18.44	19.68
SE			0	0.01	0.01	0.02	0.06
CD			0	0.02	0.03	0.05	0.14
		Control	13.65	13.56	13.51	13.42	13.26
Lactose	5	T_1	13.65	13.61	13.6	13.56	13.48
		T_2	13.65	13.58	13.54	13.44	13.29
SE			0	0.01	0.02	0.04	0.06
CD			0	0.03	0.05	0.09	0.14
		Control	11.76	11.83	11.91	11.96	12.63
Protein	5	T_1	11.76	11.79	11.84	11.90	12.41
		T_2	11.76	11.81	11.89	11.97	12.58
SE			0	0.01	0.02	0.02	0.06
CD			0	0.02	0.04	0.04	0.14
		Control	1.96	1.96	2.03	2.07	2.11
Ash	5	T_1	1.96	1.96	1.98	2.01	2.06
		T_2	1.96	1.96	2.03	2.06	2.10
SE			0	0	0.01	0.01	0.01
CD			0	0	0.03	0.03	0.03
		Control	0.54	0.56	0.59	0.63	0.66
FFA	5	T_1	0.54	0.54	0.55	0.57	0.6
		T_2	0.54	0.55	0.58	0.61	0.64
SE			0	0.005	0.01	0.02	0.02
CD			0	0.01	0.02	0.03	0.03
		Control	0.53	0.57	0.64	0.77	0.96
Acidity	5	T_1	0.53	0.53	0.56	0.65	0.71
		T_2	0.53	0.56	0.62	0.74	0.96
SE			0	0.01	0.02	0.03	0.08
CD			0	0.03	0.05	0.08	0.2

sample containing the cardamom showed 18.35, 18.44 and 19.68% of sucrose contents on 10, 15 and 20th day of storage respectively. The sample containing the potassium sorbate showed 18.30, 18.39 and 19.48% of sucrose contents on 10, 15 and 20th day of storage respectively. The increase in sucrose content during storage period might be observed due to decrease in moisture contents.

The sucrose content in control, T_1 and T_2 sample increased to 18.39, 18.33 and 18.36 on 5th day of storage at ambient temperature (30±1°C) respectivel y. The increase in sucrose content on 5th day of storage might be observed due to loss of moisture contents. The control sample showed the higher (18.39) percentage of sucrose content on 5th day whereas potassium sorbate treated sample shows the lowest (18.33) fat content as compared to control (18.39) and T_2 (18.36) sample. The sample treated with potassium sorbate showed the19.12% of sucrose contents on 10th day of storage period.

Effect of storage period on lactose content in buffalo milk *U. basundi* at refrigerated temperature (5±1°C) and ambient temperature (30±1°C)

Initially the lactose content in control, T_1 and T_2 sample was 13.65, decreased to 13.56, 13.61 and 13.58 on 5th day of storage respectively (Tables 1 and 2). The control sample showed 13.51, 13.42 and 13.26% of lactose whereas sample containing the cardamom showed 13.54, 13.44 and 13.29% of lactose contents on 10, 15 and 20th day of storage respectively. The sample containing the potassium sorbate showed 13.60, 13.56 and 13.48% of lactose contents on 10, 15 and 20th day of storage respectively.

A steady decrease in lactose content in control and cardamom treated samples during the storage period might be observed due to microbial growth which resulted in decreased lactose contents. The lactose content in control, T_1 and T_2 samples at ambient temperature (30±1°C) decreased to 13.22, 13.44 and 13.20 on 5th day of storage respectively. Potassium sorbate treated sample showed the highest lactose content as compared to control and T_2 sample it might be due to microbial resistance power of potassium sorbate added which is considered effective antimicrobial agents (Hossain et al., 2001). The microbial resistance power potassium sorbate was also reported by researchers Jha et al. (1977), Rao et al. (1977), Rudreshappa and De (1971), Ghodekar et al. (1978) and Sachdeva and Singh (1990a, b). Despite slow but steady decrease in lactose contents in control and T_2 these values are not statistically significant ($P<0.05$).

Effect of storage period on protein content in buffalo milk *U. basundi* at refrigerated temperature (5±1°C) and ambient temperature (30±1°C)

Variations in the protein contents of *U. basundi* stored for 20 days were observed at refrigerated temperature (5±1°C). The T_1 sample showed low protein (11.79%) content on 5th day as compared to T_2 (11.81%) and control (11.83%) (Tables 1 and 2). However, the fresh sample showed the (11.76%) protein content. The control sample showed 11.91, 11.96 and 12.63% protein whereas sample containing the cardamom showed 11.89, 11.97 and 12.58% of protein contents on 10, 15 and 20th day of storage respectively. The sample containing the potassium sorbate showed 11.84, 11.90 and 12.41% of protein contents on 10, 15 and 20th day of storage respectively.

At ambient temperature (30±1°C) the T_1 sample showed low protein (11.86%) content on 5th day as compared to T_2 (11.89%) and control (11.91%). The sample T_2 containing cardamom did not show any different results than the control sample. The sample T_1 containing potassium sorbate showed 12.16% protein on 10th day of storage.

Effect of storage period on ash content in buffalo milk *U. basundi* at refrigerated temperature (5±1°C) and ambient temperature (30±1°C)

The ash contents of *U. basundi* stored for 20 days were observed at refrigerated temperature (Tables 1 and 2). The T_1, T_2, and control showed similar percentage of ash contents on 5th day of storage might be due to low reduction in moisture reduced during storage period hence it showed similar percentage of ash contents that is 1.96%. However, the fresh sample of *U. basundi* showed the (1.96%) ash content. The control sample showed 2.03, 2.07 and 2.11% of ash whereas sample containing the cardamom showed 2.03, 2.06 and 2.10% of ash contents on 10, 15 and 20th day of storage respectively. The sample containing the potassium sorbate showed 1.98, 2.01 and 2.06% of ash contents on 10, 15 and 20th day of storage respectively.

Variations in the ash contents of *U. basundi* stored for 10 days were observed. The T_1 sample showed low ash (1.96%) content on 5th day as compared to T_2 (1.97%) and control (1.98%). However, the fresh sample of *U. basundi* showed the (1.96%) ash content. The sample T_2 containing cardamom did not showed any different results than the control sample. The sample T_1 containing potassium sorbate showed 1.97% of protein on 10th day of storage.

Effect of storage period on free fatty acid content in buffalo milk *U. basundi* at refrigerated temperature (5±1°C) and ambient temperature (30±1°C)

Free fatty acidity (per cent oleic acid) was measured to quantify hydrolytic changes during storage (Table 1). The initial FFA found (0.54%) and these increased slowly during storage, however, the rate of increase of FFA in potassium sorbate (T_1) was very low as compared to control (T_0) and cardamom (T_2) treated samples. The control sample showed 0.59, 0.63 and 0.66% of free fatty

acid whereas sample containing the cardamom showed 0.59, 0.61 and 0.64% of free fatty acid contents on 10, 15 and 20th day of storage respectively. The sample containing the potassium sorbate showed 0.55, 0.57 and 0.60% of FFA contents on 10, 15 and 20th day of storage respectively.

The initial FFA found (0.54%) and these increased slowly during storage, however, the rate of increase of FFA in potassium sorbate (T_1) was very low as compared to control (T_0) and cardamom (T_2) treated samples. Therefore present investigation reports that storage at low temperature with potassium sorbate retards the increase in FFA (Tables 2).

Changes in the FFA were recorded low in the samples with potassium sorbate, indicating that the release of FFA was controlled by this preservative. The same result was also observed by Hossain et al. (2001). Increased level of FFA during storage indicating lipolytic and proteolytic changes Singh et al. (2007), Chavan et al. (2009), Suresh and Jha (1994). This indicates that potassium sorbate is beneficial in reducing the initial level of FFA of *Ujani basundi* samples and subsequently checking the proteolytic and lipolytic changes during storage.

Effect of storage period on acidity content in buffalo milk *U. basundi* at refrigerated temperature (5±1°C) and ambient temperature (30±1°C)

The initial titratable acidity (0.53%) in the control *U. basundi* samples gradually increased and approached to 0.57% on the 5th day of storage (Table 1). Titratable acidity of *U. basundi* samples remain unchanged in potassium sorbate treated sample (T_1) from the day of preparation to 5th day of storage however it reached 0.71% (% lactic acid) on 20th day of storage period. Titratable acidity of *U. basundi* increased from 0.53 to 0.96% (%lactic acid) in cardamom treated sample (T_2) from the day of preparation to 20th day of storage. The control sample showed 0.64, 0.77 and 0.96% of acidity whereas sample containing the cardamom showed 0.64, 0.74 and 0.96% of acidity contents on 10, 15 and 20th day of storage respectively. The sample containing the potassium sorbate showed 0.56, 0.65 and 0.71% of acidity contents on 10, 15 and 20th day of storage respectively.

Effect of storage period on acidity content in cow milk *U. basundi* at ambient temperature (30±1°C) are given in table. The initial titratable acidity (0.53%) in the control *U. basundi* samples gradually increased and approached 0.71% on the 5th day of storage. Titratable acidity of *U. basundi* increased from 0.50 to 0.58% (%lactic acid) in potassium sorbate treated sample (T_1) from the day of preparation to 5th day of storage however it reached 0.64% (% lactic acid) on 10th day of storage period. Titratable acidity of *U. basundi* increased from 0.50 to 0.67% (% lactic acid) in cardamom treated sample (T_2) from the day of preparation to 5th day of storage.

It is however said that, the rate and the net increase in acidity of potassium sorbate treated samples of *U. basundi* over control and T_2 during storage is lower indicating the inhibitory effect of added potassium sorbate on the microbial activity in the product. Palit and Pal (2005) also reported the inhibitory effect of potassium sorbate on dairy products. *U. basundi* samples containing 0.1% potassium sorbate showed practically no change in the titratable acidity up to 5 days of storage and then slowly increased. Increase in acidity is an indication of spoilage in dairy products (Bajwa et al., 2005). Earlier researchers Jha et al. (1977), Rao et al. (1977), Rudreshappa and De (1971) and Sachdeva and Singh (1990a, b) also reported similar trend of increase in acidity of stored dairy products.

Effect of storage period on flavour in buffalo milk *U. basundi* at refrigerated temperature (5±1°C) and ambient temperature (30±1°C)

Organoleptic quality of *U. basundi* presented in Tables 3 and 4, representing rate of flavor deterioration during storage for each type of treatment at each storage temperature. As expected, rate of flavor deterioration in all treatments except T_1 was greater. The flavor deteriorated with length of storage, except in T_1 treated with potassium sorbate and cardamom treated samples (T_2). During storage a slight rancid flavor was observed in control sample. Rancidity results from the hydrolysis of the fat due to lipase enzyme secreted by bacteria. That defect seemed not to be objectionable at storage condition. On 0th day all the treatments secured nearly equal score except cardamom it might be due to pleasant flavor of cardamom. But the score was not significant ($P<0.05$). But when the storage increased the flavor score also decreased on 5^{th} day of storage in all treatments. The cardamom treated sample got highest score than the rest of two treatments it might be due to flavor of cardamom. But yet flavor score of all the treatments was not significant ($P<0.05$). After 15th day of storage declined the flavor score at this temperature it might be due to sharp increase in FFA value, same findings also reported by Adhikari and Singhal (1992), Prasad et al. (1989), Chavan et al. (2009).

Effect of storage period on body and texture in buffalo milk *U. basundi* at refrigerated (5±1°C) and ambient temperature (30±1°C)

The body and texture of samples of *U. basundi* during storage at 5±1°C significantly ($P<0.05$) affected (T ables 3 and 4). The highest value of body and texture was obtained in potassium sorbate treated samples. The control and cardamom treated samples got lowest score

than the potassium sorbate treated samples. This may be due to high moisture loss during storage. Due to moisture loss the product became slightly thicker; however body and texture scores were not much influenced with increase in storage period. The scores remained around liked very much to liked slightly range throughout the storage period of 20 days for control sample whereas it also remained same for cardamom and potassium treated samples. Indicating thereby the products were sensorial acceptable when stored at 5°C for 20 days . Our findings are in agreement with Geetha and Rao (2005), Bajwa et al. (2005) and Prajapati et al. (1986). However in ambient temperature body and texture score reduced greatly.

Effect of storage period on color and appearance in buffalo milk *U. basundi* at refrigerated temperature (5±1°C) and ambient temperature (30±1°C)

The color and appearance of samples of *U. basundi* during storage at 5°C were not significantly (P<0.0 5) affected therefore no changes were observed in scores awarded by the panelists (Tables 3 and 4). The control and cardamom treated samples got lower score than the potassium sorbate treated samples. This may be due to the fact that these samples were more affected in this storage period. Sample added potassium sorbate did not much effect to color. It might be due to potassium sorbate which retarded biochemical as well the microbial changes during storage. Due to microbial as well as biochemical changes in control and cardamom treated samples the product became slightly brown therefore it scored lower during storage, however color and appearance scores of cardamom treated samples scored slightly higher than the control samples. The scores remained around liker moderately to liked extremely range throughout the storage period of 20 days. Indicating thereby the products were sensorial acceptable when stored at 5°C for 20 days. Our findings are in agreement with Geetha and Rao (2005), Bajwa et al. (2005) and Prajapati et al. (1986).

Conclusion

Potassium sorbate added product gave shelf life up to 20 days at refrigerated temperature whereas 10 days at ambient temperature (30±1°C). However, the control and cardamom added and control samples gave the shelf life up to 15 days at refrigeration temperature (5±1°C) and 5 days at ambient temperature (30±1°C). However, the flavor of cardamom added samples found superior among all the treatment during storage study. Therefore, it is concluded from the present investigation that the product can be stored at refrigerated temperature (5±1°C) by the addition of potassium sorbate for long time with acceptable quality. The potassium sorbate added samples showed great resistant power against microbial growth. It retarded the microbial and chemical changes at refrigerated as well as ambient temperature. Therefore, from the present investigation it is concluded that the product at village level at ambient conditions (30±1ºC) with potassium sorbate may be used to increase the shelf life.

ACKNOWLEDGEMENT

Authors gratefully acknowledge the financial assistance received from University Grants Commission, New Delhi, to conduct this research work for Ph.D. under Rajiv Gandhi National Fellowship for SC/ST students.

REFERENCES

Adhikari AK, Singhal OP (1992). Effect of heat resistant microorganisms on the fatty acid profile and the organoleptic quality of UHT milk during storage. Indian J. Dairy Sci., 45(5): 272-277.

Aggrawal AC, Sharma RM (1961). A laboratory manual of milk inspection. 4th Eds. Asia Publication House, Mumbai.

AOAC (2005), Official Methods of Analysis, 11th edition. Association of Official Agricultural Chemists, Washington, D.C., 2004.

Bajwa U, Gupta M, Sandhu KS, Ahluwalia P, Sohata PP (2005). Changes in physico-chemical, sensory and microbiological characteristics during storage of carrot milk cake in various packages. J. Food Sci., Technol., 42(2): 119-126.

Chavan RS, Prajapati PS, Chavan SR Khedkar CD (2009). Study of manufacture and shelf life of Indian dietetic and diabetic rosogolla. Int. J. Dairy Sci., 4(4): 129-141.

Gaikwad SM, Hembade (2010). Studies on Process Standardization of *Ujani basundi*. A unsubmitted Ph.D. thesis to Ramanand Teerth Marathwada University, Nanded (Maharashtra).

Geetha P, Rao K, Jayraj (2008). Technology of retort processed poppy seeds (*Papaver somniferum*) payasam, 2. Shelf life studies. J. Food Sci. Technol., 45(6): 534-536.

Ghodekar DR, Ranganathan B, Dudani AT (1978). Effect of potassium sorbate on keeping quality of khoa. Int. Dairy Congress. 5: 1012-1013.

Gojiya NS, Lata R (2003). Chemical analysis of indigenous milk products. Laboratory quality assurance in dairy industry. Faculty of dairy science GAU, Anand campus, Anand-488110.

Hossain SA, Pal PK, Sarkar PK, Patil GR (2001). Extension and prediction of shelf life of dudh churpi. J. Food Sci. Technol., 38(2): 124 -16.

Indian Standards, SP: 18- Part XI (1980). Handbook of Food Analysis. XI. Dairy Products. Bureau of Indian Standards, New Delhi.

Jha YK, Singh S, Singh S (1977.) Effect of antioxidants and antimicrobial substances on keeping quality of khoa. Indian J. Dairy Sci., 30(1): 1-6.

Kulkarni S, Rajorhia GS, Chakroborty BK (1983). Studies on shelf life of channa. Indian J. Dairy Sci., 36(3): 392-395.

Kumar A, Rajorhia GS, Srinivasan MR (1975). Effect of modern packaging materials on the keeping quality of khoa. J. Food. Sci. Technol. 12(4): 172-177.

Kumar VM, Anand SK (2003). Alternative technique for extended shelf life (ESL) milk. Indian Dairyman, 55(5): 68-73.

Landge SN (2007). Studies on standardization and packaging of milk cake. Ph. D. Thesis, Swami Ramanand Teerth Marathwada University, Nanded (Maharashtra).

Mahafuz I, Khalequzzaman (2007). Content and fumigant toxicity of essential oils against callosobruchus maculates. Uni. J. Zool. Rajarshi, Uni., 26: 63-66.

Malhotra J ,Prasad DN (1999). Problem of molds in khoa and their prevention by chemical preservatives. Indian Dairyman, 51(3): 9-11.
Misra AK (1997). Microbiological code for dairy products. Indian Dairyman, 49(9): 29-33.
Navjeevan R, Jayraj K (2005). Physico-chemical changes in retort processsed Kunda. Indian J. Dairy Sci., 58(6): 392-399.
Palit C, Pal D (2005). Studies on mechanized production and shelf life of burfi. Indian J. Dairy Sci., 58(1): 12-16.
Prajapati JB, Ramachandran Lata, Dave JM (1986). Effect of added sugar on water activity and shelf life of khoa. Asian J. Dairy Res.,5(1): 25-29.
Prasad C, Prasad S, Singh MD (1989). Physico chemical changes in evaporated milk during manufacture and storage. Indian Dairyman, 41(10): 505-508,553.
Rao OV, Singh S, Singh S (1977). Effect of packaging materials on the keeping quality of khoa. J. Food Sci. Technol., 14: 152-155.
Rudreshappa KG, De Sukumar (1971). Studies on preservation of khoa. J. Food. Sci. Technol. 8: 50-52.
Sachdeva S, Singh S (1990a). Shelf life of paneer as affected by antimicrobial agents part I. Effect on sensory characteristics. Indian J. Dairy Sci., 43(1): 60-63.
Sachdeva S, Singh S (1990b). Shelf life of paneer as affected by antimicrobial agents part II. Effect on microbiological characteristics. Indian J. Dairy Sci., 43(1): 64-66.
Singh P, Tanwar VK, Kumar S, Singh KP (2007). Effect of storage temperature on the physico-chemical, sensory and microbiological quality of rosogolla. Indian J. Dairy Sci., 60(1): 19-24.
Snedecor CW, Cochran WG (1994). Statistical methods - 6th edition. The Iowa State Univ. Press Ames, Iowa, USA.
Suresh I, Jha Y (1994). Sensory, biochemical and microbiological qualities of kalakand. J. Food Sci. Technol., 31(4): 330-333.