Keeping quality of cow milk in different containers with or without sodium bicarbonate

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Abstract

The keeping quality of raw cow milk at room temperatures was evaluated in different containers with or without sodium bicarbonate. Milk samples stored in containers of glass, tinned iron, plastic, aluminium, earthen and bronze at 12 to 20°C were analyzed every two hours for acidity and clot-on-boiling (COB) tests. Milk from the organised dairy farm kept well in aluminium containers up to ten hours, but milk from villages deteriorated after six hours. The keeping qualities of milk were poorer in other containers, and worst in earthen container. In COB test, milk from BAU dairy farm showed no changes for eight hours in all containers. Milk in aluminium container kept 14 hours, but only eight hours in earthen pot. Milk collected from villages kept for ten hours in aluminium container and six hours in earthen container. After mixing sodium bicarbonate 0.05 and 0.1%, milk kept well up to 16 hours, and up to 20 hours with 0.15% based on acidity test. Addition of Na_2Co_3 improved the keeping quality till 24 hours of storage at 10 – 19°C in aluminium container. (*Bangl. vet*. 2012. Vol. 29, No. 2, 90 – 95)

Introduction

Milk can be preserved for a while by keeping the milk in cold room or refrigerator, but not in rural areas of Bangladesh. In rural areas, milk is kept in earthen, plastic, glass, aluminium or bronze containers before selling it to village markets. The type of container may have some effect on the keeping quality. Islam *et al.* (1981) found that type of container significantly affected keeping quality of fried butter (ghee). The present study was undertaken to investigate the effect of type of container on the keeping quality of milk with or without sodium bicarbonate as preservative.

Materials and Methods

Sampling procedure

A total of 120 milk samples were collected from two different sources; one from villages surrounding Bangladesh Agricultural University (BAU) and another from BAU Dairy farm in containers of glass, tinned iron, plastic, aluminium, earthen

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material and bronze. All containers were almost uniform in size having capacity to contain 250 mL milk. About 250 mL milk from each village or farm were stored in the containers for 24 hours at 12 to 20°C. The replication for each treatment (container) for each source of milk was ten.

For testing the keeping quality of milk mixed with Na_2Co_3 as a preservative, another batch of fresh cow milk was collected from BAU Dairy farm. After thorough mixing, milk was divided into four groups. Fresh milk without sodium bicarbonate was kept as control (group = A) and other three groups were kept with sodium bicarbonate 0.05% (group B), 0.10% (group C) and 0.15% (group D). All the milk samples were kept in aluminium containers at 10 to 19°C for 24 hours. A total of 40 milk samples were analyzed (10 in each group).

Testing methods for sample evaluation

The parameters used to judge the quality of milk were acidity (%) and clot-on-boiling (COB) tests. These tests were done at the start of the experiment and every two hours for judging the effect of container or every four hours in case of milk preserved with sodium bicarbonate.

Acidity test

Bacteria that normally develop in raw milk produce lactic acid. In the acidity test the acid was neutralized with 0.1N sodium bicarbonate and the percentage of lactic acid produced was calculated. For measuring normal acidity, 7.6 mL of milk was taken in a conical flask and 2 to 3 drops of phenolphthalein was added as an indicator. Decinormal (0.1N) sodium bicarbonate (Na_2CO_3) in a burette was poured into the milk drop by drop and the content of flask was stirred. Appearance of pink colour indicated the end point of the reaction. The number of mL of Na_2CO_3 used was noted and the acidity calculated using the formula:

$$\% \text{ of acidity} = \frac{\text{mL of } Na_2CO_3 \times 0.09 \times \text{strength of } Na_2CO_3}{\text{weight of the sample}} \times 100$$

Where, 0.09 is the grams of lactic acid equivalent to 1 mL of normal strength alkali,
N is the normality of the Na_2CO_3 solution, 17.6 mL of milk is equivalent to 18g

COB test

This is an old test for detecting acid milk (pH<5.8) or colostral or mastitis milk. If a milk sample fails the test, the milk must contain much acid or rennet-producing micro-organisms or an abnormally high percentage of protein. About 2 mL of milk in a test tube was heated on flame or water bath until it boiled. Clotting, coagulation or precipitation of milk indicates the milk has failed.

Statistical model and data analysis

All data materials were completely homogenous and statistical analyses were carried out as suggested by Steel and Torrie (1960) using completely randomized design (CRD).

Results and Discussion

Effect of containers on keeping quality of milk

Acidity test

At the beginning of this study, acidities in all containers were same. The acidity of milk increased gradually with storage time (Table 1).

Table 1. Acidity of milk stored in different containers

Storage period (hours)	Glass container	Tinned iron container	Plastic container	Aluminium container	Earthen container	Bronze container
Farm milk						
0	0.140	0.140	0.140	0.140	0.140	0.140
2	0.145	0.149	0.145	0.143	0.150	0.150
4	0.152	0.158	0.152	0.150	0.162	0.155
6	0.169	0.171	0.160	0.161	0.175	0.161
8	0.184	0.186	0.175	0.170	0.196	0.182
10	0.193	0.210	0.210	0.183	0.239	0.205
12	0.221	0.243	0.231	0.191	0.251	0.240
14	0.250	0.252	0.250	0.219	0.295	0.265
16	0.275	0.271	0.262	0.241	0.321	0.295
Village milk						
0	0.161	0.161	0.161	0.161	0.161	0.161
2	0.172	0.173	0.172	0.167	0.175	0.174
4	0.185	0.190	0.182	0.175	0.195	0.190
6	0.187	0.197	0.195	0.182	0.222	0.199
8	0.201	0.210	0.205	0.191	0.241	0.220
10	0.235	0.231	0.231	0.215	0.281	0.241
12	0.256	0.260	0.249	0.231	0.301	0.259
14	0.279	0.282	0.261	0.259	0.350	0.285
16	0.310	0.325	0.295	0.275	0.370	0.321

Acidity was highest in earthen container and lowest in aluminium container. Milk from farms was good up to 10 hours in aluminium container, 8 hours in glass, plastic,

tinned iron and bronze containers and 6 hours in earthen containers. A similar trend was seen for milk from the village, but it had poorer keeping quality. In this case, milk was good for about two hours in earthen container, and 6 hours in aluminium container. Aluminium container was best and the earthen container was worst. There was significant difference between containers in terms of keeping quality of milk. There is no comprehensive report published on this aspect of study. The porous nature of the earthen pot probably allowed access of moisture; as a result the earthen pot may have been damp and thus contaminated.

Clot-on boiling (COB) test

The results of COB are presented in Table 2. COB test was negative on farm milk for all containers up to 8 hours, 10 hours in tinned iron and bronze containers, 12 hours in glass and plastic containers and 14 hours in aluminium container (Table 2). For village milk all samples spoiled after 10 hours of storage.

Table 2. Results of clot-on-boiling test (COB) in different containers with different storage time

Storage period (hours)	Glass container	Tinned iron container	Plastic container	Aluminium container	Earthen container	Bronze container
Farm milk						
0	-	-	-	-	-	-
2	-	-	-	-	-	-
4	-	-	-	-	-	-
6	-	-	-	-	-	-
8	-	-	-	-	-	-
10	-	-	-	-	+	-
12	-	+	-	-	+	+
14	+	+	+	-	+	+
16	+	+	+	+	+	+
Village milk						
0	-	-	-	-	-	-
2	-	-	-	-	-	-
4	-	-	-	-	-	-
6	-	-	-	-	-	-
8	-	-	-	-	+	-
10	+	+	+	-	+	+
12	+	+	+	+	+	+
14	+	+	+	+	+	+
16	+	+	+	+	+	+

The keeping quality of milk from local villages was lower than the milk from BAU dairy farm. The poor keeping quality of village milk may be due to unhygienic condition of milking. Bacterial population in milk might have increased. The results are in agreement with Rao *et al.* (1979) who found that total number of bacteria in milk collected from local villages under ordinary milking condition was higher than milk collected after applying hygienic measures during milking. In BAU dairy farm milkers were well trained. Similar results were reported by Mannan (1989) who stated that the quality of milk collected from local villages was inferior to the milk produced in BAU dairy farm ($18.89 \pm 3.6832 \times 10^5$/mL vs $15.107 \pm 2.7490 \times 10^5$/mL).

Effects of sodium bicarbonate on keeping quality of milk

Acidity test

The acidity for milk with different concentrations of sodium bicarbonate is shown in Table 4.

Table 4. Acidity of milk with different concentrations of sodium bicarbonate

Storage time (hours)	% Acidity			
	A (0% Na_2CO_3)	B (0.05% Na_2CO_3)	C (0.10% Na_2CO_3)	D (0.15% Na_2CO_3)
0	0.150	0.150	0.150	0.150
4	0.169	0.152	0.150	0.150
8	0.184	0.155	0.152	0.150
12	0.205	0.163	0.156	0.152
16	0.252	0.185	0.179	0.169
20	0.264	0.201	0.195	0.175
24	0.335	0.215	0.201	0.191

From Table 4 the initial percentage of acidity for all samples was the same (0.15% lactic acid). The acidity increased gradually with time in all samples but the rate of increase was higher in the milk with no sodium bicarbonate. Milk was good for only 8 hours of storage at room temperature for milk with no sodium bicarbonate. But good keeping quality was sustained till 16 hours for sample B and C and 20 hours for sample D (Table 4).

COB test

Results of COB test are shown in Table 5. Milk sample A clotted after 16 hours of storage. But samples B, C, and D remained good for 24 hours. The result indicates that milk with sodium bicarbonate as preservative were in good condition up to 24 hours. The results are in agreement with Pilkhane and Bhalerao (1971) who found that 0.10% sodium bicarbonate keeps milk for two days at room temperature. It is suggested that

milk can be preserved for a short period of time with 0.05% sodium bicarbonate at room temperature.

Table 5. Result of clot-on-boiling test

Storing time (hours)	Clotting condition of different milk samples			
	A (0% Na_2CO_3)	B (0.05% Na_2CO_3)	C (0.10% Na_2CO_3)	D (0.15% Na_2CO_3)
0	-	-	-	-
4	-	-	-	-
8	-	-	-	-
12	-	-	-	-
16	+	-	-	-
20	+	-	-	-
24	+	-	-	-

Conclusions

Aluminium container was best for keeping milk, while earthen container was worst. Sodium bicarbonate helped to preserve milk, and could be used in rural areas where chilling and freezing facilities are not available. Preservation of milk with sodium bicarbonate 0.05% may keep milk good for up to 24 hours at room temperature.

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