**Abstract**

The keeping quality of raw cow milk at room temperature was evaluated in different containers with or without borax. Milk samples stored in containers of glass, plastic, aluminium, and earthen at 25 to 28◦C in November, 2013 were analyzed every 2 hours for acidity and clot-on-boiling (COB) tests. Milk from the organised dairy farm kept well in aluminium containers up to 10 hours, but milk from vendor’s deteriorated after 6 hours. The keeping qualities of milk were poorer in other containers, and worst in earthen container. In COB test, milk from dairy farm showed no changes for 8 hours in all containers. Milk in aluminium container kept 14 hours, but only 8 hours in earthen pot. Milk collected from villages kept for 10 hours in aluminium container and 6 hours in earthen container. After mixing borax 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 borax improved the keeping quality till 24 hours of storage at 25 – 28◦C in aluminium container.

**CHAPTER-I**

**Introduction**

Milk is the highly nutritious food. It contains almost the entire important nutrient to nourish the body. So, it is mostly susceptible to affected by the numerous microbes and spoiled quickly. Milk preservation before selling, it is a important task. Milk can be preserved for a while by keeping the milk in cold room or refrigerator, but in rural areas of Bangladesh such type of facilities are not available. In rural areas, milk is kept in earthen, plastic, glass, aluminium containers before selling it to village markets. The type of container might have some effect on the keeping quality. Islam et al.(1981) reported that, types of container significantly affect the keeping quality of fried butter (ghee). Because, different containers made by chemically variable substances and may differ in microbial load. Most rural people don’t know what is the effect of containers in keeping quality of milk. They store their raw milk in different unhygienic earthen container to make dahi (Singh et al.1997). If we can identify the keeping quality of borax as preservative and container which is the most appropriate for long term preservation with or without any chemical preservatives, then we can suggest the farmers to use the borax or this container in crisis period or when borax might not be found. However, Borax has public health significance. Basically borax is a boron containing compound. Boron is a non-metallic element and occurs naturally in food, water and soil as borate or boric acid. For the general population, the greatest boron exposure comes from the oral intake of food, mainly fruits and vegetables. At low concentrations, borax can be converted to boric acid in body prior to absorption. In humans, it is believed that adverse reactions associated with low doses of borax per day are unlikely to occur. However, exposure to large amounts of borax over a short period of time can affect the stomach, bowels, liver, kidney, and brain, and may even lead to death. The World Health Organization (WHO) has estimated the average daily intake of the population is about 1.2 mg boron from diet, which falls well within the safe range of population mean intakes for adults (1.0-13 mg boron/day) suggested by the WHO. These can be used in a wide range of consumer products as preservative and milk is one of these products.There are many techniques to estimate the keeping quality of raw milk with or without borax in different containers.But,among those techniques acidity percentage and clot-on-boiling test are more suitable to determine quality of milk in short time(Eckleset al.1951).The present study was undertaken to investigate the effects of types of container on the keeping quality of milk with or without borax as preservative.

**CHAPTER-II**

**Materials and Methods**

**2.1. Sampling procedure**

 A total of 10 milk samples were collected from 2 different sources; 1from vendor's milk sorrounding CVASU and another from sorrounding Dairy farms in containers of glass, plastic, aluminium, and earthen materials. All containers were almost uniform in size having capacity to contain 250 ml milk. About 250 ml milk from each vendor’s or farm was stored in the containers for 24 hours at 25 to 28◦C in November, 2013.The tests were done in Dairy Science laboratory of the CVASU. The replication for each treatment (container) for each source of milk was 10. For testing the keeping quality of milk mixed with borax as a preservative, another batch of fresh cow milk was collected from Dairy farm. After thorough mixing, milk was divided into 4 groups. Fresh milk without borax was kept as control (group = A) and other three groups were kept with borax 0.05% (group B), 0.10% (group C) and 0.15% (group D). All the milk samples were kept in aluminium containers at 25 to 28◦C for 24 hours. A total of 10 milk samples were analyzed.



Earthen container

Aluminium container

Plastic container

Glass container

**Fig:** Earthen, glass, plastic and aluminium containers respectively

**2.2: 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 2 hours for judging the effect of container or every 4 hours in case of milk preserved with borax

**2.2.1: 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 (Na2CO3) 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 Na2CO3 used was noted and the acidity calculated using the formula:

 % of acidity = {mL of Na2CO3 × 0.09 × strength of Na2CO3 /weight of the sample}× 100

 Where, 0.09 is the grams of lactic acid equivalent to 1 ml of normal strength alkali, N is the normality of the Na2CO3 solution, 17.6 ml of milk is equivalent to 18g

**2.2.2: 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.

**CHAPTER-III**

**Results and Discussion**

**3.1:** **Effect of containers on keeping quality of milk**

**3.1.1: 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& 2).

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, and plastic and 6 hours in earthen containers. A similar trend was seen for milk from the village, but it had poorer keeping quality.

**Table 1.** Acidity of farm produced milk stored in different containers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage period(hours) | Glass containers | Plastic containers | Aluminium containers | Earthen containers |
| 0 | 0.141 | 0.141 | 0.141 | 0.141 |
| 2 | 0.145 | 0.144 | 0.143 | 0.152 |
| 4 | 0.154 | 0.155 | 0.153 | 0.162 |
| 6 | 0.169 | 0.160 | 0.161 | 0.175 |
| 8 | 0.184 | 0.175 | 0.170 | 0.196 |
| 10 | 0.193 | 0.210 | 0.183 | 0.239 |
| 12 | 0.221 | 0.231 | 0.191 | 0.251 |
| 14 | 0.250 | 0.250 | 0.219 | 0.295 |
| 16 | 0.275 | 0.262 | 0.241 | 0.321 |

In this case, milk was good for about 2 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.

**Table 2.** Acidity of vendor's milk stored in different containers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage period(hours) | Glass containers | Plastic containers | Aluminium containers | Earthen containers |
| 0 | 0.162 | 0.162 | 0.162 | 0.162 |
| 2 | 0.170 | 0.173 | 0.168 | 0.176 |
| 4 | 0.185 | 0.181 | 0.176 | 0.193 |
| 6 | 0.187 | 0.195 | 0.182 | 0.222 |
| 8 | 0.201 | 0.205 | 0.191 | 0.241 |
| 10 | 0.235 | 0.231 | 0.215 | 0.281 |
| 12 | 0.256 | 0.249 | 0.231 | 0.301 |
| 14 | 0.279 | 0.261 | 0.259 | 0.350 |
| 16 | 0.312 | 0.297 | 0.272 | 0.369 |

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.

**3.1.2:Clot-on boiling (COB) test**

 The results of COB are presented in Table 3. COB test was negative on farm milk for all containers up to 8 hours, 12 hours in glass and plastic containers and 14 hours in aluminium container (Table 3).

**Table 3.** COB test of farm produced milk in different containers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage period(hours) | Glass containers | Plastic containers | Aluminium containers | Earthen containers |
| 0 | - | - | - | - |
| 2 | - | - | - | - |
| 4 | - | - | - | - |
| 6 | - | - | - | - |
| 8 | - | - | - | - |
| 10 | - | - | - | + |
| 12 | - | - | - | + |
| 14 | + | + | - | + |
| 16 | + | + | + | + |

For vendor's milk (Table 4) all samples spoiled after 10 hours of storage. The keeping quality of milk from local vendor’s was lower than the milk from dairy farm. The poor keeping quality of vendor's milk may be due to unhygienic condition of milking. Bacterial population in milk might have increased.

**Table 4.** COB test of vendor’s milk in different containers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage period(hours) | Glass containers | Plastic containers | Aluminium containers | Earthen containers |
| 0 | - | - | - | - |
| 2 | - | - | - | - |
| 4 | - | - | - | - |
| 6 | - | - | - | - |
| 8 | - | - | - | + |
| 10 | + | + | - | + |
| 12 | + | + | + | + |
| 14 | + | + | + | + |
| 16 | + | + | + | + |

The results are in agreement with (Rao et al.1979) who found that total number of bacteria in milk collected from local vendor’s under ordinary milking condition was higher than milk collected after applying hygienic measures during milking. In 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 dairy farm.

 **3.2: Effects of borax on keeping quality of milk**

**3.2.1: Acidity test**

 The acidity for milk with different concentrations of borax is shown in Table 5. From Table 5 the initial percentage of acidity for all samples was same (0.148%). The acidity increased gradually with time in all samples but the rate of increase was higher in the milk with no borax.

**Table 5.** Changes of acidity of milk with different concentration of borax

|  |  |  |
| --- | --- | --- |
| Storage time(hours) |  % Acidity |  |
| A | B | C | D |
| 0 | 0.148 | 0.148 | 0.148 | 0.148 |
| 4 | 0.168 | 0.151 | 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 | 0.333 | 0.225 | 0.211 | 0.191 |

Here, Sample A = 0% borax, B = 0.05% borax, C = 0.10% borax, D = 0.15% borax respectively.

Milk was good for only 8 hours of storage at room temperature for milk with no borax. But good keeping quality was sustained till 16 hours for sample B and C and 20 hours for sample D (Table 5). Rahman et al. (2002) used Na2CO3 as preservatives in raw farm produced milk and the concentration was 0.01%, 0.05% and 0.10% .He takes 100 milk samples from farms and did acidity test. He was found that 0.01%,0.05% and 0.10% Na2CO3 keep storage quality of milk up to 16, 18, 20 hours respectively at room temperature.

**3.2.2:COB test**

Results of COB test are shown in Table 6. 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 borax as preservative were in good condition up to 24 hours.

**Table 6.** Changes in Clot-on-boiling test (COB) with different concentration of borax

|  |  |  |
| --- | --- | --- |
| Storage time(hours) |  COB test |  |
| A | B | C | D |
| 0 | - | - | - | - |
| 4 | - | - | - | - |
| 8 | - | - | - | - |
| 12 | - | - | - | - |
| 16 | + | - | - | - |
| 20 | + | - | - | - |
| 24 | + | - | - | - |

Here, Sample A = 0% borax, B = 0.05% borax, C = 0.10% borax, D = 0.15% borax respectively.

The results are in agreement with Pilkhane and Bhalerao, (1971) who found that 0.10% borax keeps milk for 2 days at room temperature. Milk can be preserved for a short period of time with 0.05% borax at room temperature.

**CHAPTER-IV**

**Conclusion**

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

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