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Cow Milk Handling Practices and Factors Contributing to Quality Deterioration in Ethiopia

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Abstract
Milk, being a wholesome food with high nutritive value is often prone to early contamination and spoilage if not handled properly. Most losses of dairy products occur as a result of a combination of poor production and /or handling practices and lack of technical knowledge. Among others, lack of knowledge on clean milk production, use of unclean milking equipment coupled with lack of potable water for cleaning purpose probably contributed to the poor hygienic quality of dairy products produced in Ethiopia. The basic consideration during milk handling practices are: Housing and cleaning practices, milking practices, Milking Equipment and Milk hygienic practices. Factors that will contributes to the quality deteriorations of raw milk are Physical, chemical and biological contaminations. In addition to this the way identifying whether milks deteriorate or not by using various techniques such as Methylene blue reduction and resazurine reduction, Alcohol test, Standard plate count, Somatic cell count and etc. Other methods of milk quality tests are: - Organoleptic test, Clot-on-boiling test, Lactometer test. Losses of dairy products occur as a result of a combination of poor production and /or handling practices and lack of technical knowledge. In order to prevent raw milk deterioration, training and awareness creation should be given to all farm communities concerning on milk handling, personal hygienic , use of equipments, storage and transportation of milk. This paper cover milk handling practice in detail, factors that will contributes to deterioration and ways testing and method of controlling raw milk deterioration
Keywords: milk handling, milk quality, milk deterioration

1. INTRODUCTION

1.1 Background and Justification

Milk, being a wholesome food with high nutritive value is often prone to early contamination and spoilage if not handled properly. Several workers have reported milk to be an ideal growth medium for microorganisms (Ali and Abdelgadir, 2011). In Ethiopia Cows are the main source of milk and milking is practiced under the shade, in grazing field and in front of the homestead, none of which are clean environments for hygienic production of milk because of this hygienic qualities of products are generally poor (Zelalem,2010 and Faye 2006). As a result the milking cows become soiled with dung and urine that may increase the microbial load in milk. As stated by different authors the ways of milk handling vessels in rular areas are normally made either from woven grass, calabash, hollowed wood or skin, gourd, clay pots, metal or plastic containers (Alganesh, 2002 and Lemma, 2004). Some Consideration associated with milk handling practice is: Housing and cleaning practices, milking practices, milking equipment and milk hygienic practices.

As reported by Food and Agricultural Organization, raw milk quality deterioration is caused by physical (storage, transportation, milk utensil, poor quality of water, animal dung and Animal hair), chemical (antibiotics, sanitizer and detergent or soap) and biological contaminations such as psychrophilic, mesophilic and thermophilic bacteria (FAO, 2003). The methods of identification spoilage of raw milk are by various methods such as Methylene blue reduction and resazurine reduction), Alcohol test, Standard plate count and Somatic cell count. Other methods of milk quality tests are: - Organoleptic test, Clot-on-boiling test, Lactometer test (Tezira and Amos, 2006).

The techniques of controlling quality of raw milk are good farming practice, animal health management, Control of feed, Facility hygiene, milking operations, milking machine design and operations, bulk tank design and operations. But, production of high quality milk is generally not easy to achieve in developing countries due to factors such as poor hygiene and sanitation during milking and milk handling, unclean water, high ambient temperatures, lack of cooling facilities and inadequate infrastructures for milk transportation to the processing facilities (Berg, 1988).

Therefore the purpose of this review was to evaluate different reviews in different countries concerning on milk handling practice and factors that contribute to the quality deteriorations

2. METHODOLOGY

2. 1 Milk Quality Tests

Some tests commonly employed to determine the quality of milk include dye-reduction (Methylene blue reduction

and resazurine reduction), Alcohol test, Standard plate count, Somatic cell count and etc.

2.1.1 Dye-reduction tests

These tests are less precise criterion for classifying raw milk according to its bacteriological quality. This calls for the need to periodically verify the quality of milk with more precise microbiological tests such as standard plate count (Ombui *et al.*, 1995).

2.1.1.1 Methylene blue reduction test

Methylene blue is a blue-colored reagent which is used to estimate the bacterial population of a given milk sample. A known dilution of the methylene blue solution is added to the milk sample and observation is made at fixed intervals until the blue color disappears. The number and species of organisms present in the milk determines the time required for the disappearance of the blue color in the milk (Teka, 1997). On the basis of this test, raw milk is graded as follows (Kurwijilla *et al.*, 1992): Very good: not decolorizing in 5 hours, Good: decolorized in less than 4 hours, but not less than 3 hours..Fair: decolorized in less than in 2 hours, but not less than 1 hour and poor: decolorized in less than ½ hour.

2.1.1.2 Resazurine reduction test

This test is also used for grading the sanitary quality of raw milk by applying the chemical reagent resazurin. The procedure is similar to that for the methylene blue test, except that this test is quicker and the result is obtained in much less time (Teka, 1997). Resazurin imparts blue color to milk which when reduced to resorufin changes to pink and finally to white when reduced to dihydroresorufin. The time required for complete decolorization, reduction of the resazurin and the degree of colour change is directly related to the number of bacterial organisms in the milk. A comparator disc reading value of 4 and above for 10 minutes resazurin test indicates good quality but while a comparator disc reading value of less than 4 at 10 minutes indicates poor quality milk (Ombui *et al.*, 1995).

2.1.2. Alcohol test

The test is quick and simple. The specific type of alcohol used is known as “ethanol”. This test is more sensitive to lower levels of acidity and can therefore detect bad milk that may have passed the previous two tests. It also detects milk that has kept for long without cooling, colostrum or milk from a cow with mastitis. Because this test is quite sensitive, milk that passes this test can keep for some hours (at least two hours) before it goes bad.

2.1.3. Standard plate count (SPC)

The standard plate count of raw milk gives an indication of the total number of aerobic bacteria present in the milk at the time of pick up. Obviously, very clean milk will have lower bacterial counts than milk collected or handled under unsanitary conditions. The standard plate count is a basis for grading milk (Volk and Wheeler, 1980). Milk samples are plated on standard plate count agar media and then incubated for 48 hrs at 32 ^{o}C to encourage bacterial growth. Single bacteria or clusters grow to become visible colonies that are then counted. This method is used mainly to estimate the bacterial population of raw milk prior to heat treatment. It has a limited value in that it doesn't indicate the quality of microbial populations in terms of pathogens and non pathogens (Teka, 1997). The standard plate count is generally accepted as the most accurate and informative method of testing bacteriological quality of milk (Kurwijilla *et al.*, 1992).

Table 1:.Standard plate count

Bacterial Count/ml	Grade
Not exceeding 200,000	Very good
200,000-1,000,000	Good
1,000,000-5,000,000	Fair
>5,000,000	Poor

2.1.4. Somatic cell counts (SCC)

The somatic cell count (SCC) is internationally recognized as a parameter for assessing milk quality and udder heath (Degraaf *et al.*, 1997). Somatic cell counts levels are monitored to ensure compliance with set milk quality standards. Today, most markets in developed countries pay a premium for low SCC, good quality milk. One can appreciate the reasons, for paying a bonus for quality milk when the relationship between mastitis (high SCC) and milk composition is understood. Chemical changes in milk composition due to mastitis reduce milk quality (Rice and Bodman, 1997).

2.2. Other milk quality tests

2.2.1. Organoleptic test

This test is performed first and involves assessing the milk with regard to its smell, appearance and colour. This test is quick and cheap to carry out, allowing for segregation of poor quality milk. No equipment is required, but the tester should have a good sense of sight and smell.

2.2.2. Clot-on-boiling test

This test is quick and simple. It allows for detection of milk that has been kept for too long without cooling and has developed high acidity, or colostral milk that has a very high percentage of protein. Such milk does not

withstand heat treatment hence this test could be positive at a much lower acidity.

2.2.3. Lactometer test

This test is used to determine if the milk has been adulterated with added water or solids. Addition of anything to milk can introduce bacteria that will make it spoil quickly. Adulteration of milk is dishonest to consumers and is therefore illegal. The lactometer test is based on the fact that milk has a heavier weight or density (1.026–1.032 g/ml) compared to water (1.000 g/ml). When milk is adulterated with water or other solids are added, the density either decreases (if water is added) or increases (if solids are added). If milk fat (cream) is added to milk, the density decreases.

3. Result and Discussion

3.1 Handling practices during milking, milk processing and storage

According to Abebe et al (2013), proper sanitary milking practices were not followed by the majority of the respondents in the study area (*Ezha* district of the Gurage zone). Although, most of the respondents reported to wash their hands and milk vessels before milking their cows, washing of udders was not reported. Moreover, milkers dip their fingers in the milking vessel and moistening teats of the cows with the intention of facilitating milking. However, such practice may cause microbial contamination of the milk from the milker's hand. The majority of the respondents (57.2%) had access to river water followed by tap water (28%) and hand dug well water (7.2%). However, the quality of both river and hand dug well waters used for cleaning may not be of the required standard thus can attribute to the poor quality of milk in the area. It is, therefore, important to heat treat water from river and hand dug wells intended for cleaning purpose.

The interviewed households used different utensils for milking, storage and processing. All of the respondents reported to use plastic jar for milking, while clay pot was the only material used for churning (butter-making). As reported by most of the respondents (92%), clay pot is also used for storage of milk until the desired volume is collected for processing.

3.2 Processing milk and shelf life of milk and milk products

The major milk products produced in Ezha district of the Gurage zone, Southern Ethiopia were Ergo (Ethiopian naturally fermented milk), traditional butter (Kibe), traditional ghee (Neter Kibe), cottage cheese (Ayib), sour defatted milk (Arrera), and whey (Aguat) (abebe at al., 2013).

In the rural Ethiopia, in general and in the study area in particular, milk processing and other household activities are almost always the responsibility of women. In the *Woina Dega* (midland) area, the majority of the women (70%) process the milk twice per week followed by once per week (30%), while 53.4% the women around Dega area process their milk twice per week, whereas the remaining 38 and 8% of the respondents reported to process once per week and once fortnightly, respectively.

3.3 Constraints of handling, processing and utilization of milk and milk products

The major constraints pertaining to milk handling, processing and utilization as reported by the respondents in the Ezha district of the Gurage zone are summarized as 80% of the respondents reported lack of clean water for cleaning purpose, limited knowledge on the hygienic handling of milk and milk products and unimproved milk processing materials to be the three major constraints.

3.4 Microbiological quality of whole milk

According to Alganesh et al (2002) Total bacterial count and coliform count of the milk samples collected from Bila Sayo were significantly ($p<0.05$) higher than those from Guto Wayu. This might be due to the high environmental temperature in Bila Sayo at which the milk was held before sampling. TBC and CC were generally high and may be because the milk sampling was done in different villages, which were further apart, some samples were held in the traditional milking utensils like gourd, plastic containers, and woven grasses up to 1 and 1/2 hour after milking. Coliform bacteria could contaminate milk from manure, bedding materials, contaminated water, soil and inadequately cleaned milking utensils (Van den Ben, 1988; Kalogridou-Vassiliadau, 1991). A study conducted on raw milk from a dairy farm in Awassa indicated an initial coliform count of about10 cfu/ml in sterile containers. This reached a level of 10^8 cfu /ml within 24 hours (Mogossie and Fekadu, 1993).

3.5 Bacterial, coli form count and acidity

According to Asaminew and Eyasu (2011), the overall mean total bacterial count of cows' milk produced in bahirdar zuria and mecha district was 7.58 $\log_{10}$ cfu/ml, which is high as compared to the acceptable level of 1 x 10^5 bacteria per ml of raw milk (O'Connor 1994). The overall mean coliform count of milk produced in bahirdar zuria and mecha district was 4.49 $\log_{10}$ cfu/ml. The coliform count obtained in the current study is greater than that reported by Fekadu and Abrhamsen (1994) who found coliform counts of 3.8 logcfu/ml,

The overall mean titratable acidity of cows' milk produced in the study area was 0.23 percent (Table 1).

This figure is lower than the finding of Alganesh (2002) who reported an average acidity of 0.28 and 0.31 percent for raw cows' milk produced in Bila Sayo andd Guto Wayu districts of eastern Wollega, respectively.

3.6 Clot-on-boiling and Alcohol test

The clot-on-boiling test for cow milk samples collected in Bahirdar zuria and mecha district showed that 23 percent of the milk samples tested is likely to clot- on- boiling. Alganesh (2002) reported an overall mean value of 21 percent for cow milk samples collected from smallholder farmers in eastern Wollega of Oromia region.

The overall mean value shows that 51 percent of the milk samples tested is likely to clot by the alcohol test. The report of Alganesh (2002) indicated that 58 percent of cow milk samples collected from smallholder farmers in eastern Wollega of Oromia region is likely to clot by alcohol test.

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