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Impact of Clean Milk Production Practices on Total Viable Count and Coliform Count in Raw Milk

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ABSTRACT: Milk is a nutrient rich food which is subjected to various contaminations at production level and ensuring the microbial quality is very much essential to safeguard the public. This study aimed to reduce the microbial count at the production level by implementing the good milk production practices. Rural dairy farmers (50) having 4 to 5 cows and dairy farms having 50 to 80 cows were involved in implementing the clean milk production practices. Clean milk production practices *viz.*, milking in separate place, washing of animal and udder, using clean stainless steel utensils, healthy milk man, hand washing before milking, avoid feeding before milking and avoid using lubricant such as oil, water or milk etc. were demonstrated among the participants and implemented across the several constraints. Before and after implementation milk samples were collected hygienically and assessed the total viable count and coliform count. Before adoption, mean total viable count and coliform count of raw milk of farm level and individual farmer level were 9.05 ± 0.06; 9.16 ± 0.25 and 5.21 ± 0.21; 5.15 ± 0.04 log 10 cfu/ml respectively. After a period of 4 weeks of adoption the counts were reduced significantly.

Keywords: total viable count, coliform count, clean milk production.

INTRODUCTION

Milk is a complete food due to its rich nutrient content and had a wide range of consumers worldwide irrespective of age, religion, region etc., There is always a huge demand for milk and milk products especially among vegetarians. But considering the food safety aspect, milk is highly perishable and we must ensure the safety of the food product. Shelf-life of milk and milk products is generally shorter in developing countries like India due to quality of milk at the production level and unsanitary environment of processing places. FAO (2013) stated that raw, under processed milk and milk products causes severe illness to human. Milk is sterile when it is in udder provided the animal should be free from infectious disease. Substandard milk with elevated microbiological load results from unsanitary production and processing (Boor *et al*., 1998). Microbial load in milk is due to unhealthy udder, infectious animal, poor hygiene of milk man, dirty environment, improperly cleaned milking utensils etc.

Ensuring milk quality and safety is a critical challenge in the dairy sector, with contamination largely stemming from unsanitary conditions and poor practices (Kumar *et al*., 2022). Foodborne infections represent a critical public health danger, particularly in developing countries where unsanitary food production is prevalent, with raw milk and its products posing a significant risk due to frequent contamination by pathogens such as *E. coli*, *Salmonella* spp., *Campylobacter* spp., and *Listeria monocytogenes* (Zelalem *et al*., 2007; Abera *et al*., 2010; Abebe *et al*., 2018).

Worku *et al*. (2012) opined that, the inherent composition of milk renders it highly susceptible to microbial growth, with potential contamination from internal udder sources, external animal surfaces, handling equipment, and the surrounding air.

There is a known truth that, good management practices improve the quality of raw milk. Furthermore, clean milk production and mastitis are interrelated and if the farmer is practicing the clean milk production practices, mastitis can also be avoided (Jayalalitha and Shibi Thomas 2020). But implementing the good practices at rural farmer's level who owned one or two milch animal is very difficult. It is challenging to adopt the good practices even in farms having 20 to 50 animals, where contractual family labour performing the duties.

Maintaining the milch animals as healthy is the main role in achieving the clean milk production. Milking parlour should be hygienic and it should be different

from shed where the animals always tied. Milk man with communicable diseases like diarrhoea or typhoid and having symptoms like coughing and sneezing, should not be allowed for milking and they should maintain their cleanliness by cutting nails, hair and avoiding bad habits such as smoking, drinking etc. He or she should wash the hands before milking. Likewise udder should be cleaned before milking and use of clean containers for milking. Further mastitis cows should be milked in the last and their milk should be discarded. Isolation of sick animals and proper treatment should be given to affected animal to prevent further spread in the herd.

In this study, it is aimed with the objective of implementing the clean milk production practices and reducing the microbial load of raw milk at field level.

MATERIALS AND METHODS

50 rural dairy farmers in Thuraiyur block who were having 4 to 5 cows and 5 dairy farms in Tiruchirappalli district having 20 to 80 milch animals were involved in this study. Random sampling was done to assess the microbial load of raw milk before implementing the clean milk production practices. From each farmer and farm, pooled sample is taken for analysis. Samples were collected in sterile containers and transported with proper packing to the laboratory. Microbial analysis was carried out on the same day of collection. Standard Plate Count (SPC) and coliform count were done to assess the microbial quality of raw milk.

SPC and coliform count: 1 ml of sample is taken 10 fold serial dilutions were prepared in a sterile saline solution and appropriate dilution was transferred into the sterilized petri dishes in duplicates. Plate count agar and violet red bile agar were used for SPC and coliform count respectively. After standard mixing with inoculum and media, it was allowed for solidification and incubated at 37°C for 24-48 h. Colonies grown in respective media were counted and the counts were expressed as $\log_{10}$ cfu/mL of sample. Coliform organisms were confirmed based on the colony characteristics and production of gas in Brilliant Green Lactose Broth (BGLB) incubated at 35°C for 24-48 h.

Implementation of clean milk production practices in Thuraiyur block was initiated by method demonstration. Table 1 represents the constraints faced during implementation and probable solution for clean milk production practices at farmer's field. Farmers are instructed to follow the clean milk production practices and periodical milk sampling was done with an interval of 7 days for assessing the reduction of microbial load in raw milk.

Table 1: Implementation of clean milk production practices at field level.

Sr. No.	Practices for clean milk production	Constraints in adoption	Probable solutions
1.	Milking is to be done in a separate place	No separate place can be allotted for milking by farmers having 2 to 3 cows	Make the place clean without any dung or litter prior to milking
2.	Washing of the animal and udder	Due to water scarcity, washing cannot be done	Advised to wash atleast udder prior to milking
3.	Using clean stainless steel utensils for milking	Plastic buckets only used for milking.	Insisted to buy stainless steel container for easy cleaning
4.	Healthy milk man without having sneezing or coughing	Depending only milk man	Created the awareness about communicable disease and avoid sick person to milk the cows
5.	Hand washing before milking	Most of the milkman resist to hand wash due to urgency	Advised the milkman to wash every time before milking
6.	Avoid using lubricant such as oil, water or milk etc.	Practicing castor oil for lubricant is common	Advised to practice full hand milking
7.	Avoid feeding before milking	Faulty perception that feeding only stimulates milking	Insist to feed only after milking

RESULTS AND DISCUSSIONS

Adoption of clean milk production practices at field level is a very difficult task and achieved in the smaller group. Before and after adoption of clean milk production practices, milk samples were assessed for SPC and coliform. Results are grouped in to two categories *viz.*, individual farmer level and farm level.

Means of SPC log values (Table 2) revealed that adoption of clean milk production practices had significant effect on quality of raw milk. Generally milk quality gets deteriorated after 4 hours due to microbial load of raw milk. It is essential to reduce the initial microbial load at the production level which determines the quality of end product prepared from raw milk. In this study, significant reduction of microbial load was observed in every week interval upto 4 weeks. Here, adoption takes place upto 4 to 5 weeks at the farmer's level and the constraints were depicted in Table 1. Before adoption of clean milk production practices, standard plate count of raw milk at farm and farmers level was around 9 log cfu units/ml and it is reduced upto 6 log cfu per ml. De Silva *et al*. (2016) reported a similar results like reduction of 2 log cfu/ml in SPC of raw milk before and after implementing the good management practices in Sri Lanka. Dinki and Balcha (2013) from Guwahati, India revealed that the total count of raw milk was 6.32 $\log_{10}$ cfu/mL. Similarly, El Zubeir and Ahmed (2001) reported the bacterial count in raw milk during summer and winter season is 5.3×1010^{7} cfu mL^{-1} and 5×10^{7} cfu mL^{-1} respectively. But in a recent study, Kakati *et al*. (2021) reported in

Guwhati city, India that total viable count in raw milk ranged from 10.59 to 13.22 log cfu/ml.

Table 3 revealed that significant reduction of coliform count in raw milk every week after adoption of clean milk production practices. Presence of coliform indicated that poor hygienic environment and water maintained at milk production sites. In this study area, both farm and farmer's level, hygienic practices not adopted and poor practices followed during milking like no hand washing, udder washing before milking. Further, improper cleaning of milking utensils and improper drainage system in barns are the reasons for coliform count in raw milk. Even in farms, adoption of hygienic practices was difficult due to contractual family labour. Before adoption of clean milk production practices, coliform count was around 5 log cfu units per ml and it has been reduced upto 2 log cfu units per ml. similar results observed in studies that 3.70, 4.84, 4.49 log cfu/ml (Oumer *et al*., 2017) and 3.61 log cfu/ml (Haile *et al*., 2012) and 2.4 × 10^3 cfu/ml in India (Kalilur *et al*., 2002). High coliform count from 6.39 to 7.52 log cfu/ml was also reported in raw milk samples in a study of Kakati *et al*. (2021).

Table 2: Standard Plate Count (log_{10} cfu/ml) of milk in different field level.

Field	Before adoption	After adoption of clean milk production practices			
		I week	II week	III week	IV week
Individual Farmer level (n=20)	9.05^{a}± 0.06	8.86^{b} ± 0.13	8.14^{c} ± 0.05	7.96^{d} ± 1.01	6.81^{d} ± 0.18
Farm level (n=5)	9.16^{a} ± 0.25	8.75^{b} ± 0.12	8.05^{c} ± 0.12	7.25^{d} ± 0.95	6.21^{d} ± 0.15

Different superscripts within a row differ significantly

Table 3: Coliform Count (log_{10} cfu/ml) of milk in different field level.

Field	Before adoption	After adoption of clean milk production practices			
		I week	II week	III week	IV week
Individual Farmer level (n=20)	5.21^{a} ± 0.21	5.05^{a} ± 0.18	4.90^{b} ± 0.16	3.96^{c} ± 0.15	2.87^{d} ± 0.18
Farm level (n=5)	5.15^{a} ± 0.04	4.85^{a} ± 0.15	4.21^{b} ± 0.07	3.52^{c} ± 0.85	2.05^{d} ± 0.05

Different superscripts within a row differ significantly

CONCLUSIONS

The microbial quality of raw milk at individual farmer level and farm level was poor, very hazardous and may be the cause of milk borne diseases. There are several consumers in rural and urban areas of India rely on raw milk for their household needs. If quality of raw milk is not good, it affects the quality of processed milk and milk products too. After the intervention of good milk production practices, it is achieved that reduced total viable count and coliform count in raw milk. But implementing the good hygienic practices among the numerous milk producers is very difficult task. To achieve this, policy makers should implement the standards for procurement *viz.*, remunerative price for the good quality milk, rejection of poor quality milk, monitoring committee at the field level etc. Veterinarians and other field extension staff have to create awareness among the producers about the hygienic practices for good quality milk production and healthy dairy herd. Food safety authority should ensure the quality of raw milk to safeguard the public.

FUTURE SCOPE

The significant findings of this study will take up by the extension personnel to introduce hygienic practices among the milk producers to get good quality raw milk.

Conflict of Interest. None.

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