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## Clean Milk Production: Its importance and Key Management Practices

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In the modern era, growing consumer awareness regarding milk quality, hygiene, and sanitation has made clean milk production a crucial component of the dairy. Clean milk production is defined as the process of obtaining milk from healthy animals in a hygienic environment. Clean milk is obtained from healthy dairy animals, with a natural flavour, free from dirt and impurities, containing an acceptable level of bacteria, and free from adulterants, harmful pathogens, toxins, abnormal residues, pollutants, and metabolites. There are mainly four factors to be considered in clean milk production practices: Animal hygiene, milking hygiene, equipment hygiene, and processing hygiene. This includes keeping cows clean, washing hands, using sterile equipment, and rapid, cool storage. Producing clean milk is a key factor in the country's economic growth. By implementing clean milk production practices, there is significant potential to enhance the quality of milk produced. Clean milk production requires maintaining cleanliness throughout various stages of handling animals, processing, and transporting milk and dairy products. In our country, milk production and distribution are currently being followed in an unorganized way. Only 10% of total milk production in India is under organized sector. Milk production and processing play a vital role in the livelihood of rural households.

Women, being primary contributors in dairy farming and milk handling, are key stakeholders in ensuring the quality and safety of milk. Milk, if it is not fit for human use is a financial loss to the producing farmer. Poor hygiene, poverty, malnutrition, lack of education, and close contact with animals are predisposing factors for zoonotic diseases. Dairy farmers, who are in close contact with their animals, are always at risk of acquiring infections from animals. Some of the zoonotic diseases that spread through milk are Brucellosis, Tuberculosis, Salmonellosis, etc. In developed countries, it is a common practice to cool the milk immediately in the farm, and the same is collected by the dairy plants every day. In advanced countries, the problem of milk borne diseases has been solved completely by enforcing strict laws. Animals are periodically tested for contagious diseases and all measures are taken to produce milk free from pathogens. In our country, these conditions are not strictly followed and there is habit of boiling the milk before consumption by the consumer has saved them from serious milk borne infections and intoxications. As consumers become increasingly concerned about food safety, it is crucial for dairy farmers to understand the impact of cleanliness on milk quality. Training programs on clean milk production and milk processing are essential to enhance the knowledge and skills of the farmer, leading to improved milk quality, reduced contamination, and increased income opportunities.

### Key Benefits of clean milk production

- **Public Health:** Clean milk is free from disease-causing bacteria (e.g., Salmonella, E. coli), reducing the risk of milk-borne diseases like tuberculosis, brucellosis, typhoid fever, dysentery, and diarrhea. Clean milk production ensures nutrient-rich, pure milk

with low bacterial counts for safer consumption. Proper animal health management prevents mastitis and reduces the need for antibiotics, which in turn prevents drug residues from entering the human food chain and triggering antibiotic resistance. Clean milk is critical for ensuring the safe nutrition of children, the elder people, and immune-compromised person.

- **Better shelf life of milk and milk products:** Proper hygiene during milking minimizes contamination, ensuring the milk remains fresh for longer periods. It involves reducing initial contamination during milking, which prevents the rapid multiplication of bacteria that leads to spoilage. Clean milk is defined as milk from healthy animals, handled hygienically, with low bacterial counts.
- **Adulteration Control:** Milk adulterants are foreign substances deliberately added to milk to increase volume, enhance appearance, or boost certain characteristics like density and total solids content to maximize profits by selling diluted or enhanced milk at full price, often putting consumer health at serious risk. Clean milk production ensures the product is free from adulterants like water or chemicals, maintaining its natural nutritional value.
- **Economic Sustainability for Farmers:** High-quality, clean milk fetches better market prices, increasing profitability. High-quality, clean milk fetches better prices in the market, allowing farmers to increase their income.
- **Facilitates Long-Distance Transport:** Clean, hygienic milk is more stable, allowing for easier transport and distribution to distant markets. Clean and hygienic milk is more stable for long-distance transport because it has a lower initial microbial load and higher chemical stability, reducing the rate of spoilage during transit. By minimizing contamination, such milk remains fresh, resists coagulation when heated, and is less likely to turn sour, allowing for extended transportation times to distant markets.
- **Animal Health & Productivity:** Monitoring animal health and clean milk production practices helps in minimizing the incidence of disease and mortality which causes huge loss to the already marginalized dairy farmers. Therefore, the health care and management practices followed by the farmers play a vital role in enhancing income from dairy enterprise. Proper sanitation in the milking parlor reduces the risk of mastitis and other infections in cows, leading to higher yields.

### Factors affecting nature of milk

- **Stage of lactation:** Clean milk production excludes milk obtained from the first 5 days after calving (colostrum phase) and 15 days before the end of lactation, focusing on the mature lactation stage. Immediately after calving, a cow produces colostrum during the first five days, after which the milk reverts to its normal composition.
- **Milking practices:** Incomplete milking results in low milk yield and low fat content because the last milk (strippings) contains higher fat content than the foremilk.
- **Udder diseases:** With poor hygiene, up to more than 70% per cent of the cows may be affected with mastitis. Mastitis milk has more whey proteins, less casein and less water-soluble vitamins. It also tends to be more alkaline, has a higher chloride content than normal milk, and tastes salty.
- **Nutrition:** Nutrition plays very important role in milk composition. If cows are fed a diet low in forages and high in starch, the fat content of the milk may fall below 2.5 per cent. A good forage-to-concentrate ratio is important to enable cows produce good quality milk to their potential.
- **Cold storage:** On cooling milk, the multiplication of bacteria delays and increases the shelf life of milk. If milk is kept chilled at 4°C for more than 72 hours, the Psychrophilic bacteria will multiply and produce lipase and protease enzymes that, respectively, break down milk fat and proteins. These enzymes are also heat resistant, and can cause spoilage of pasteurised milk and other processed dairy products. Cooling of milk for longer period

also makes calcium in the milk less soluble and unavailable during coagulation of milk by rennet in cheese making.

- **Pasteurisation of milk:** Pasteurisation of milk involves heating it to 63°C for 30 minutes or 72°C for 15 seconds in order to destroy harmful microorganisms. Pasteurisation technique kills most of the bacteria and causes minor denaturation of proteins and loss of some water-soluble vitamins.
- **Antibiotics treatment:** When cows suffer from mastitis they are treated with antibiotics by intra-mammary or intramuscular injection. Longer acting antibiotics, mostly used in dry cow therapy against mastitis, remain in the blood longer period of time. Drug residues in milk are undesirable because they can cause allergies and drug resistance in humans. These antibiotic residues also inhibit the lactic acid starter cultures used in the manufacture of fermented milk products. For this reason, milk processors routinely screen raw milk for antibiotic.

### Key Practices for Clean Milk Production & Extended Shelf Life

- **Animal hygiene:** Ensure the animal is healthy, the udder and teats are clean, and the milker practices good personal hygiene. Udder and teats should be wash with lukewarm water and wipe with towel. Immediately after milking, the teat should be dip in cup containing disinfectants. Regularly trim long hair from the udder, teats, and sides. Daily grooming and washing of the animal are also necessary to prevent airborne dirt from getting into the milk. Ideally, this should be done before milking.
- **Maintain clean bedding and housing:** Regularly clean and disinfect cow bedding and housing areas to prevent the buildup of dirt, feces, and harmful bacteria. Proper ventilation and drainage are essential for maintaining a clean and healthy environment for your cows. **Milking parlor** for animals must be situated on high elevation with a natural drainage system. Have a pucca (concrete) floor that is water resistant, durable, and simple to maintain. The faeces and urine are properly drained into the sewer or are regularly removed.
- **Feeding management:** Balanced diet for the animals will decrease the possibility of disease development. To prevent microbial growth, clean the water tubs and the feeding manger frequently. Prevent from feeding hay and silage while milking. Avoid letting the animal drink contaminated water since it could cause waterborne diseases. Make sure that the water used for drinking and cleaning is of high quality and free from contaminants. Regularly test water sources and treat them if necessary to prevent the transmission of harmful bacteria or pollutants.
- **Sterile Equipment:** Use clean, sanitized milking equipment, containers, and, to prevent contamination from bacteria, which can cause off-flavors and spoilage. Milking pen should be clean thoroughly before and after milking with disinfectants. Milking container should be made up of stainless steel or aluminum. Milking cans should be thoroughly washed with detergent and sun dried every day immediately after milking. The milking machine and milk storage equipment such as milk churns are kept clean and are in good condition.
- **Screening of animal for mastitis:** This can be done by “strip cup” method before milking. If the animal is suffering from mastitis, flakes of milk will be seen on black cloth and milk from affected quarters shall be totally discarded. If mastitis is detected, do not mix the milk of that animal in milk can containing milk from healthy animals.
- **Milker hygiene:** Milker should be free from any infectious diseases. Cut his nails regularly, wash his hands and legs before milking and wear cap or head gear. During milking the hand should not wet water or milk or saliva of calf/cow. The milker should not have any open wounds, sores, boils, or infected wounds because these conditions would undoubtedly cause microbial contamination of the milk. Never allow the milker to milk the animal if they have stomach problems. Hand washing with soap and drying with

a clean towel are requirements before milking. Avoid eating, drinking, and spitting while milking. Prevent from sneezing and coughing when milking.

- **Proper Milking technique:-** Milking should be full hand method only avoid knuckling and stripping, It cause injure and wounds on treats. Filter the fresh milk using clean dry muslin cloth. Milk quickly, gently, and completely, ideally finishing within 5–8 minutes.
- **Rapid Cooling:** Immediately after milking, the milk must be cooled preferably to 4°C. Cooling of milk is done immediately to inhibit bacterial growth (especially psychrotrophs).
- **Cold Chain Maintenance:** Maintain strict temperature control from the point of production to consumption. The Milk cans to be transported in a Covered /protected hygienic Milk Vans.
- **Training and education:** Proper training and education are vital for ensuring that farmers understand and follow hygiene protocols. Regular training on best practices for milking, cleaning equipment, and animal care to minimize the risk of contamination. A comprehensive education and training program can help farmers and workers stay updated with the latest best practices and regulations in the industry.
- **Milk Testing:** The milk samples to be drawn using an appropriate and cleaned sample device as per the Quality Control guidelines. Clean milk production (CMP) requires rigorous, regular milk testing to ensure safety, high quality, and profitability. Key tests include examining for organoleptic properties (smell/taste), acidity, sediment (dirt), fat/SNF content, and adulteration (water, starch, urea). These tests are critical for detecting mastitis and preventing bacterial contamination from milking equipment or improper handling.

## Conclusion

Key management practices in clean milk production include washing udders with antiseptic solution, cleaning milking barns, maintaining personal hygiene, using sterilized stainless steel equipment, and rapid cooling. Experts in the field (Veterinarians) must educate the farmers about technique of producing clean milk and its benefits for farmers and consumers. Clean milk production should be motivated through organizing various training and demonstrations at the field level. The public should be made aware of the health hazards associated with consumption of contaminated and raw milk.

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