International Journal of Innovative Research in Engineering & Management (IJIREM)
ISSN: 2350-0557, Volume-9, Issue-1, February 2022
https://doi.org/10.55524/ijirem.2022.9.1.76
Article ID IRP229174, Pages 369-372
www.ijirem.org

An Overview of On-Farm Hygienic Milk Production

Dr. Pramod[1], and N.N. Saxena[2]

[1,2]Assistant Professor, Department of Agriculture, Sanskriti University, Mathura, Uttar Pradesh, India

Correspondence should be addressed to Dr. Pramod; farm.agri@sanskriti.edu.in

ABSTRACT- The dairy sector has adopted hazard analysis of critical control points (HACCP) systems to ensure the food safety of dairy products. Through a chain management strategy, this allows for quality verification of final goods (European Commission, 2004b). Raw milk's quality and safety are critical for milk and the dairy products' safety and quality. Milk contamination with bacteria, chemical residues, and other pollutants affects the safety and quality of the products. Microbial contamination is the subject of this chapter. Salmonella spp, Listeria monocytogenes and Campylobacter jejuni are examples of human microbial pathogens discovered in raw milk. A very high microbiological quality of raw milk is essential for preventing process losses and achieving an optimum shelf life for dairy products, in addition to its importance for the public health. For example, faults in semi-hard cheeses are caused by the spore formers of butyric acid bacteria in the raw milk, and raw milk contamination with Bacillus cereus bacteria reduces the shelf life of pasteurized dairy products. Quality assurance methods for dairy farms are being created, and bacteriological structures are being used in farms bulk of raw milk payment systems, in order to guarantee that bulk tank milk has a high microbiological quality. Furthermore, dairy producers' sanitary milk production is critical for animal's welfare and dairy industry's image. Infections of pathogenic microorganisms affect cows (e.g., udder tissue, gastrointestinal tract), resulting in lower milk production and even mortality. In conclusion, all components of the dairy production chain benefit from the management of the microbial ecology at the dairy farm, which leads to on-farm hygienic milk productions.

KEYWORDS- Dairy Products, Lactose, Milk, Pasteurized.

I. INTRODUCTION

When milk is secreted into the udder's alveoli, it is sterile. The majority of microbial contamination happens during and after milking. Microorganisms in bulk tank milk come from the interior of teats, the farm environment, and the surfaces of milking equipment. Bacteria are usually conveyed to milk from the farm environment via dirt (e.g., excrement, bedding, and soil) sticking to the outside of teats; nevertheless, germs adhered to the outside of teats can enter the teat canal and cause mastitis [1]. Finally, contamination can occur when germs clinging to the surfaces of milking equipment are released into the milk during the milking process. Under typical manufacturing circumstances, aerial contamination is negligible. Due to their development, the attentiveness of bacteria in the bulk tanks milk may rise even more [2]–[5].

A wide range of bacterial species may be found in bulks tank milk's microbial community. The genesis of most species may be traced back to a particular point in time [6]. The presence of Staphylococcus aureus in the bulk tanks milk, for example, can usually be linked back to cows with mastitis, while the most probable source of butyric acid bacteria spores in bulk tanks milk is silage. When high microbial concentrations are detected in bulk tanks milk, the makeup of the microbial flora may be used to determine the source of the increased concentration. 73 bulk tanks milk samples having a colony forming unit (cfu) count of higher than 4.5 log10 per millilitre 1 [7]. In 48 cases, one microbial species, such as Lactococcus spp. or S. aureus, predominated. In 64% of the samples, significant microbiological quantities were discovered, which were connected to poor hygiene (dirty teats and insufficiently cleaned milking equipment) [8]. Psychotrophic bacteria that may have formed as during preservation of chilled bulk tank dairy outnumbered other germs in 28% of the samples. Endometrial hyperplasia bacteria were found in 48 percent of the collections, and in 8% of them, they were the dominant flora [9]–[13].

A. Mastitis

The mastitis bacteria enter the infect and teat canal the teats' inner tissues. The number of mastitis germs in the teat increases dramatically after inflammation. As a result, large quantities of pathogenic organisms may be transferred to milk during milking [14]. The kind of microorganism, contagion state within the herd (sub-clinical/clinical), stages of illness, and percentage of the herd affected all influence the attentiveness of mastitic-associated bacteria in the bulk tanks milk.

Contagious and environmental diseases are differentiated in general, but precise categorization for all species is not feasible. Environmental infections are an unavoidable aspect of farming. They may be found in feces, bedding, and dirt, for example. These bacteria enter the teat canal and cause illness after being polluted with (contaminated) feces and bedding [1]. The most common environmental pathogens include Streptococcus dysgalactiae, Streptococcus uberis, and gram-negative bacteria including E. coli and Klebsiella spp. Environmental infections, unlike infectious diseases, cannot be completely eradicated from the agricultural environment. The percentage frequency of mastitis instigated by environmental infections has risen in current decades in countries such as the Netherlands and the United States, probably owing to the effective adoption of measures to limit the transmission of infectious diseases [15].

Mastitis is divided into 2 types: sub-clinical and clinical. Cows with the former kind exhibit recognizable and visible symptoms, and milk is usually of a deviant color. Although clinical mastitis is so easy to spot, cows with illness are frequently evacuated from the milk flock and thus only contributes to the mastitis microorganism percentage in bulk tanks milk by accident. Cows with sub-clinical mastitis have no visible signs of the mastitis, and diagnosis is usually made via laboratory testing. Sub-clinical mastitis is more difficult to detect than clinical mastitis because it lacks obvious signs [16], [17].

Based on the stage of sickness, a single cow might discharge up to 7 log10 mastitis pathogens mL. In a herd of 100 milking cows, only one cow might be responsible for a total bulk tank count of 5 log10 cfu mL. Streptococci species have been reported to contribute for 52 per cent of both the bacterial count fluctuation at 48 milk production examined, whereas S. aureus and month's supply bacteria accounted for just 3% of the variability. Spike values were caused by sudden increases in the total microbial count in bulk tanks milk; S. uberis was responsible for 55% of the spike values and E. coli for 20%. S. uberis and E. coli, on the other hand, are environmental infections that may not always originate from the inside of diseased teats.

B. Environment

Feeds, feces, bedding material, and soil are the most frequent microbial causes in the agricultural environment, as previously stated. In a series of processes, microorganisms from various sources are introduced to milk. The contamination route refers to the series of processes that go from the source to the milk. The transfer of dirt to milk, which may include feces, bedding, and/or soil, is a critical stage in the contamination process. Microorganisms from the soil are diluted in the milk and pass through the milking system's filter. When dirt attaches to the exterior of teats and is rinsed away during milking, it is primarily transmitted to milk. Additional dirt and germs from of the farmer's field may be transmitted to bulk tanks milk when teat plates (that fall to the floor or are kicked off the teats) become infected or even suction up dirt from the dairy parlour floor. The mass of transferred dirt per given volume may be determined using a marker approach. Dirt levels ranging from 3 to 300 mg per litre of milk on eleven farms, with an average of 59 mg L1.

The related dirt's structure and microbial concentrations determine the races and quantities of microorganisms transported from the agricultural environment to milk through to the surface of teats. Teats of pasture-raised cows are primarily contaminated with soil, but teats of barn-raised cows are much more polluted with excrement and mattress debris. Increased Bacillus cereus spore percentages in bulk tanks milk are assumed to be the result of contamination of soil of teats during in the grazing period.

Natural occupants, pathogenic bacteria, and microbes or their spores that come straight from the meals are all found in feces. Spore concentrations in feces are 2 to 10 times higher than the concentration in the cows' diet. This rise is due to the digestion of food components, while microorganisms pass through the gastrointestinal system unharmed.

Barns utilize a variety of bedding materials, including straw, wood shavings, shredded paper and sawdust. A wide range of the microorganisms may be found in new bedding. The microbial concentration in new bedding are often lower than those in worn bedding. Due to faecal contamination and microbial development, the concentrations in eiderdown material seem to rise substantially on the first day after it is put down. However, unused bedding material has been shown to contain significant coliform levels (7–9 log10 cfu g1).

Feeds introduce a diverse spectrum of microorganisms into the farm environment, and therefore into the milk. Feed has two effects as a resource or transmission vehicles for viruses that cause illness in calves: first, it can be a resource or transmission vehicles for pathogens that spread disease in cattle, and second, it is a primary source of microbial spores in unpasteurised milk. Roughages and concentrates make up the majority of the diet of high-yielding dairy cows. The former feed provides dietary fibre, which is required for the cow's intestines to function effectively. The most important roughage commodities are grass, wheat, and lucerne.

After harvesting, the two most common methods for preserving nutritional value are ensiling and haymaking. Grass has a peculiar condition in that it is often given fresh during the planting season and as fodder or hay from outside that time. To address the high nutritional requirements of steeply dairy cows, indigestible fiber diets are complemented with concentrate feeds that are rich in calories and protein. Cereal grains, cereal bran, pulses, and by-products of soybean, rapeseed, and other oilseed processing are some examples. Compound feed makers can utilise these low-moisture feeds as separate components or combine them into specialised recipes. High-moisture concentrated feeds (such as sugar cane pulp, brewer' grains, as well as other harvest sector byproducts) are also employed. These products are typically delivered directly to the farmer by the processor and then stored as silage.

C. Milking Equipment

Milk contamination happens when the milking equipments is contaminated.

- Microorganisms attach to the milking equipment's surfaces,
- Milk residues left in the equipments after the cleaning sequence.

Under these circumstances, adherent microorganisms may develop, particularly in cracked and degraded rubber components that are susceptible to microorganism buildup. Adhered bacteria may be discharged into the milk during the following milking.

The amount and kind of contamination of milk caused by milking equipment is mainly determined by the cleaning method used. The milking apparatus is cleaned it after every milking and at frequent intervals in the instance of automatic milking systems to remove residue and prevent contamination throughout milking. Aureus also has been recovered from of the contact of milking machinery. Micro - organisms from the crop field (such as dirt, excrement, bedding, and feeds) are frequently discovered on environmental surfaces, but Bacterium has been isolated from the surface of milking materials. Gram-negative rods like coliforms and Pseudomonas multiply fast when milking apparatus is cleaned at low temperatures or without hand sanitizer. Growth in the number of organisms in the level of technology to milking (i.e. more time for development) and increased temperature during this period (i.e. faster percentage growth) expand the amount of microorganisms in the apparatus and, hence, the amount of pollution of milk.

D. A Microbial Development During the Milk Storage

Before transporting milk to the dairy, it is standard repetition to gather milk from many milkings in a bulks tank. Milk must be chilled during storage to avoid microbial development in the farm bulk tank. When milk is composed daily, the European Union mandates that bulk tank milk be chilled to below 8°C, and when milk is not collected daily, it must be chilled to below 6°C. However, chilling milk does not entirely inhibit the development of germs. Few psychrotrophic species, like Pseudomonas spp. and L. monocytogenes, may still thrive at temperatures below 6 degrees Celsius, although at a slower pace. The quantities of psychrotrophic L. monocytogenes and B. cereus in properly operating bulk tanks do not rise substantially, according to modelled research.

II. CONTROL FOR MICROBIAL CONTAGIONOF THE BULK TANKS MILK

A. Good Agricultural Practice

2.1. Good agricultural practice: The Codex Alimentarius Code of Practice contains guidelines for implementing HACCP (FAO, 2003). The use of HACCP concepts to dairy farms is explored, although it is seen to be impractical at this time. The difficulty in setting limits through the identification of key control point, the use of regular surveillance methods, and efficient record keeping and the documentation of standards operations limit the broad application of the HACCP program to dairy farm (Ruegg, 2003a). Moreover, under the HACCP approach, proper monitoring is a key concept. The lack of appropriate and low-cost monitoring tests limits the use of HACCP programs on dairy farms.

The development of good agricultural practices guidelines has been suggested as an alternative to HACCP (European Commission, 2004a). These guidelines should encourage farmers to adopt proper hygienic procedures; however, the International Dairy Federation (IDF) and the United Nations Food and Agriculture Organization (FAO) have produced such a handbook (Morgan, 2004). The main goal is for the milk to come from healthy cows raised under widely recognized circumstances. People working and overseeing on the farm must be knowledgeable in animals husbandry, sanitary milking, and the organization of veterinary medicines in order to follow good dairy farming methods. The book includes recommendations for many areas of farm management.

B. Animal Health Management

For sanitary milk production, animal health care is critical. Mastitis infections cause milk contamination from the inside of the teats, whereas gastrointestinal illnesses promote contamination from the outside of the teats. According to European Union standards, fresh milk should also originate from cows that are free of infectious illnesses that may be passed to humans through lactation, are in excellent condition, but don't have udder lesions that could impact milk. Purification of milking from animals that have been treated with approved treatments is also necessary.

Basically, the goal of animal health managements is to achieve and maintain the disease-free herd. This may be accomplished by curing or removing sick animals from the herd (e.g., culling) and preventing future infections. A disease-free herd requires a closed herd, which means no animals from other farms are brought in. The treatment of sick animals and their isolation from the rest of the herd inhibits pathogen transfer from cow to cow. Furthermore, excellent feed quality, facility cleanliness, and sanitary milking procedures are critical for preventing infections of healthy cows with the pathogens found in the farms environment.

III. DISCUSSION

The humans have maintained animals for the purpose of producing milk for the human consumption since ancient times. Dairy farmers and producers have been pushed to modify and enhance their production methods as a result of economic, social, and technical changes. Milk prices are under pressure as a result of globalisation, and consumers and government agencies are increasingly concerned about the safety and quality of fresh milk. On the other hand, as dairy farms grow in size and technology advancements like as automated milking systems become more common, new possibilities for enhancing farm production processes emerge. Three important technology developments for milk handling on farms will emerge in the future:

A. Milk Concentration

The use of membrane filtering to concentrate milk at the dairy farm reduces transportation expenses and energy consumption. Dairy producers are becoming more interested in this alternative as their herd numbers grow. Concentration of milk at the farm is already practiced in New Zealand, and it is being considered in a number of other nations.

B. Heat Treatments of the Milk

The raw milk is usually subjected to a preliminary heat treatment (10 seconds at 65 degrees Celsius) immediately after received at the dairy dispensation facility and before being stored in a silo. Thermisation is a therapy that is used to render psychrotrophic bacteria inactive. At low temperatures, these organisms generate heat-stable enzymes like proteinases and lipases, which are responsible for the spoiling of dairy products. At the dairy farm, pasteurization or thermostability reduces the time it takes for psychrotrophic bacteria to grow and generate heat-stable enzyme, lowering the danger of deterioration.

IV. CONCLUSION

Farmers, the dairy business, and consumers all benefit from sanitary milk production on the farm. Farmers need hygienic milk yield not just for the integrity of bulk tank milk, and for wildlife conservation. Microscopic organisms in quantity tank dairy come through teat interiors, the farm atmosphere, and the surface of milk apparatus on the farms. Different control approaches are necessary since distinct microorganisms have different origins. As a result, hygienic milk production necessitates a diverse set of agricultural management abilities, ranging from animal protection to feed administration to bulk tank design. Mathematical model are helpful for identifying efficient microbial contamination control strategies. It's critical to keep in mind that complete control is unachievable. Seasonal fluctuations in microbial concentrations of nutrients, for example, and periodical stress, such as calving, have an impact on the contaminate of bulk tanks milk. Farmers' knowledge of the effect of cleanliness on milk quality in many areas of farm management, as well as their attitude toward hygiene in daily activities, are critical variables in hygienic milk production. As a result, greater emphasis on agricultural education and communication is required to achieve success in this area.

REFERENCES

[1] A. Agarwal, Y. D. S. Arya, G. Agarwal, S. Agarwal, and K. K. Gola, "A fuzzy based decision support system for irrigation process in precision Agriculture," 2020, doi: 10.1109/SMART50582.2020.9337080.

[2] L. D. Warnick, D. Janssen, C. L. Guard, and Y. T. Gröhn, "The effect of lameness on milk production in dairy cows," J. Dairy Sci., 2001, doi: 10.3168/jds.S0022-0302(01)74642-5.

[3] R. C. Neves, B. M. Leno, M. D. Curler, M. J. Thomas, T. R. Overton, and J. A. A. McArt, "Association of immediate postpartum plasma calcium concentration with early-lactation clinical diseases, culling, reproduction, and milk production in Holstein cows," J. Dairy Sci., 2018, doi: 10.3168/jds.2017-13313.

[4] M. A. Thomassen, R. Dalgaard, R. Heijungs, and I. De Boer, "Attributional and consequential LCA of milk production," Int. J. Life Cycle Assess., 2008, doi: 10.1007/s11367-008-0007-y.

[5] T. R. Dunn et al., "The effect of lung consolidation, as determined by ultrasonography, on first-lactation milk production in Holstein dairy calves," J. Dairy Sci., 2018, doi: 10.3168/jds.2017-13870.

[6] P. Chaudhary et al., "Impact of nanophos in agriculture to improve functional bacterial community and crop productivity," BMC Plant Biol., 2021, doi: 10.1186/s12870-021-03298-7.

[7] N. Jain and Y. Awasthi, "WSN-AI based Cloud computing architectures for energy efficient climate smart agriculture with big data analysis," Int. J. Adv. Trends Comput. Sci. Eng., 2019, doi: 10.30534/ijatcse/2019/1581.22019.

[8] S. Kumar, M. Shamim, M. Bansal, B. Gangwar, and R. P. Aggarwal, "Computational modeling and emerging trend in agriculture," 2015.

[9] L. Bava, A. Sandrucci, M. Zucali, M. Guerci, and A. Tamburini, "How can farming intensification affect the environmental impact of milk production?," J. Dairy Sci., 2014, doi: 10.3168/jds.2013-7530.

[10] A. Bates, R. O'Brien, S. Liggett, and F. Griffin, "The effect of sub-clinical infection with Mycobacterium avium subsp. paratuberculosis on milk production in a New Zealand dairy herd," BMC Vet. Res., 2018, doi: 10.1186/s12917-018-1421-4.

[11] H. Hosseinzadeh, M. Tafaghodi, S. Abedzadeh, and E. Taghiabadi, "Effect of aqueous and ethanolic extracts of Pimpinella anisum L. seeds on milk production in rats," JAMS J. Acupunct. Meridian Stud., 2014, doi: 10.1016/j.jams.2013.10.004.

[12] K. Köstenberger, A. Tichy, K. Bauer, P. Pless, and T. Wittek, "Associations between fasciolosis and milk production, and the impact of anthelmintic treatment in dairy herds," Parasitol. Res., 2017, doi: 10.1007/s00436-017-5481-3.

[13] M. D. Murphy, M. J. O'Mahony, L. Shalloo, P. French, and J. Upton, "Comparison of modelling techniques for milk-production forecasting," J. Dairy Sci., 2014, doi: 10.3168/jds.2013-7451.

[14] M. Jain, Y. Rajvanshi, S. Sharma, and R. P. Agarwal, "BER analysis for various modulation techniques under diffferent fading environment," 2012, doi: 10.1109/ICCCT.2012.61.

[15] A. Goswami, J. Singh, D. Kumar, S. Gupta, and Sushila, "An efficient analytical technique for fractional partial differential equations occurring in ion acoustic waves in plasma," J. Ocean Eng. Sci., 2019, doi: 10.1016/j.joes.2019.01.003.

[16] M. Yano, H. Shimadzu, and T. Endo, "Modelling temperature effects on milk production: A study on Holstein cows at a Japanese farm," Springerplus, 2014, doi: 10.1186/2193-1801-3-129.

[17] H. Bahrami-Yekdangi, M. Khorvash, G. R. Ghorbani, M. Alikhani, R. Jahanian, and E. Kamalian, "Effects of decreasing metabolizable protein and rumen-undegradable protein on milk production and composition and blood metabolites of Holstein dairy cows in early lactation," J. Dairy Sci., 2014, doi: 10.3168/jds.2013-6725.