Chapter 1

Analysis of Contamination Points of Milk through the Whole Value Chain Process and the Quality of Milk Products in the Dairy Industry

Peter Chege* and Zipporah Ndungu

1Kenyatta University, Kenya
2Jomo Kenyatta University, Kenya

*Corresponding Author: Peter Chege, Kenyatta University, P. O. Box 43844 00100, Nairobi, Kenya, Tel: +254-722 642356; Email: chegepeterm@gmail.com

First Published June 04, 2016

Copyright: © 2016 Peter Chege and Zipporah Ndungu.

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source.

Introduction

Product value chain is the full range of activities including production, processing, marketing and distribution a product takes until it gets to the consumer. In the dairy world, milk is a very vital food commodity for the growth and development of individuals; it’s a good source of calcium, vitamin B2, vitamin C and D and amino acids. Milk however, goes through a number of very important steps before it can be presented in the markets and stored to be purchased by the consumers. At every stage, there is milk contamination, starting from the health of the animal, the hygiene of the personnel, the safety levels of the animal’s feed, to more advanced levels of contamination such as during transportation, preservation, processing and at the shelves [1,2]. To ensure quality milk, it is necessary to understand the various causes and sources of milk contamination. It is also important to understand the effects of these contaminants to the consumers of milk and milk products.

Milk and milk products are rich in nutrients, contain high moisture and have an early neutral pH. Based on the above characteristics, milk thus easily favour the growth and multiplication of many bacteria. This is observed even in cases where the milk has been pasteurized or refrigerated. Milk contamination can originate from different sources such as air, milking equipment, feeds, soil, faeces and housing [3]. Contaminated milk may cause diseases such as tuberculosis, brucellosis, lysteriosis, different kinds of gastrointestinal disorders, poisoning among oth-
ers [15]. This chapter focuses on all the major hot spot areas regarded as important in milk contamination.

**Health of the Animal**

Milk is normally sterile when it is synthesized from a healthy cow’s udder. Interestingly, cow’s milk, has numerous beneficial bacteria. However, some bacteria are harmful to human beings. Sometimes the mammary glands of a cow may be inflamed due to mastitis. Mastitis produces pus that can easily get into the milk.

Moreover, cows can also release toxins through their milk, as milk is a natural exit-portal for substances that the body cannot use. Hormones introduced to relieve these animals from stress such as pituitary, steroid, hypothalamic and thyroid hormones may deteriorate the cows’ health. The rate of microbial contamination of milk is influenced by the health status [1].

**Feeding of Animals**

Low nutritive value forage can produce low quality milk. The number and types of micro-organisms in milk are also affected by the feeds [3]. Research that the quality of the animal feeds affects the quality of milk produced [4].

**Milking Process**

Most farmers lack knowledge on hygiene during the milking process. Poor hygiene during milking and the subsequent handling of the milk increases the risk of contamination with bacteria [5]. This reduces the milk shelf life and can cause diseases to the consumers. Quality milk requires adequate measures to be taken to improve udder health, milking process and the management routines. Proper farm hygiene measures can ensure availability of milk free from contaminations [6].

Milking involves manipulation of the teats which are the main point of entry of microorganisms. This occurs due to the opening of teat canal. Prevalence of mastitis is higher in cows with poor hygiene during the milking process than in cows where good hygiene is observed in the milking process [7].

Cleaning the udder before milking is very important because it would have come into contact with the ground, urine, dung and feed refusals while resting. Not washing the udder before milking can impact possible contaminants into the milk.

Studies show that some farmers do not wash the cow’s under before milking [8], but rather let the calves to suckle before milking. Such practices cannot however replace washing. Some don’t use a towel while washing the under at all, while others use the same towel to clean the udder of two or more cows which is not recommended.

Dirt bacteria and pathogens may also emanate from the milkers hand. Hand hygiene is particularly important in hand milking. Therefore, the cleanliness of the cow in general as well as the immediate environment dur-
ing milking may also have a great contribution to under health and eventually the milk hygiene.

If milking takes place inside a shade, there is a high risk of contamination of the milk from the air and by insects [8]. The optimal shade should protect against rain, wind, and excessive heat but at the same time have sufficient light and ventilation. The floor should be made of concrete so that it can be cleaned easily.

The cow itself is a significant source of dirt or contamination and mastitis bacteria [8]. The skin provides a large surface area for possible contamination as well as urine, manure, uterine discharge, dirt, hairs and dust that drop from the skin and the udder.

Equipment used for milking, processing and storage similarly determines the hygiene level of milk and milk products. The milk contact surface must be effectively cleaned and where appropriate, disinfected immediately after each milking. All equipment must therefore be kept clean and in good condition. All rubber parts must be changed regularly. Notably, failure to change the teat cup liners may also be a source of contamination [9].

Sufficient supply of water is required for hand washing, udder washing, teat washing, rinsing and cleaning equipment. Storage areas for the water must be completely protected to prevent contamination by rodents, birds, insects and dust. Keeping the milk for long before collection exposes the milk to mesophilic microflora. Due to this, cooling is needed. However, low temperatures may also allow the growth of psychrotrophic microflora in milk [10].

Regula et al. [11] have stated that the bacterial count in milk is lower in loose housing compared to the system of stanchion housing. Gonzalo et al. [12] also reported lower microbial contamination of milk in loose cubicle littered housing with milking in a milking parlour in comparison with stanchion littered housing and an in-stall milking pipeline system. In addition, it is known that loose housing provides cows with more comfort [13].

**Milk Delivery to Collection Centers**

Milk in the formal markets is normally transported to chilling and bulking centers and finally to a processing facility. Once milk is processed, it is normally delivered by agents or distributors to a point of sale or directly to the consumers through brokers and hawkers. This is through milk bars, milk traders, shops and kiosks. The means of circulation is through motorbike, bicycles, or through the public transport. The composition of several nutrients and other features of the milk, such as high water activity make the milk an outstanding medium for bacterial growth.

When the milk is not well cooled, there is also high risk of diseases such as zoonoses, tuberculosis and bru-
cellosis. A large problem in this section is the absence of proper ways to maintain a cold chain. The cold chain from farmer to processor is underdeveloped and together with unhygienic milking and handling practices all results in poor milk quality.

**Milk Distribution from Collection Centers to Industry**

The dairy industry in Kenya is heavily dependent on the transportation of milk from the highly productive areas to factories and milk processing plants. Milk transportation methods employed currently include; use of trucks by farmers where milk is transported in plastic buckets or drums or milk cans. The conditions of the milk cans used in the process of transportation largely affect the quality of milk.

**Milk Processing**

If milk is untreated, spoilage occurs within a few days. This spoilage is due to the action of the bacteria’s. Bacteria can change the flavor, texture or color of dairy products. This spoilage renders the milk unacceptable for sale. There are four main methods used to process and preserve milk. These include; heating to destroy both contaminating micro-organisms and naturally occurring enzymes that change the flavor, making the milk acidic to slow down the growth of spoilage bacteria or food poisoning bacteria and reducing the amount of water in milk products to slow down or prevent the growth of bacteria. Notably, milk can be processed and preserved using different forms for use at a later time. Milk can be processed into dry milk powder, sterilized milk (Ultra-High-Temperature of Long-life milk) and bottled sterilized milk, canned (evaporated or condensed) milk, or milk by-products such as casein.

**Milk Packaging**

Milk is a complex mixture of protein, water, lipids, carbohydrates, enzymes, vitamins and minerals. Due to its specific composition and its pH being close to neutral, it is a highly perishable product with high spoilage potential that can result in rapid deterioration of its quality and safety.

Light and oxygen causes light induced oxidation and anti-oxidation of the milk fat. Physico-chemical or microbial changes in the product may cause off-flavors. Psychotropic bacterial activity/enzymic activity results in considerable flavor changes in product. Pick-up odorous compounds at any stage of production and processing or interaction with the packaging material moreover result in product flavor deterioration [14].

Some packaging materials like styrene is the precursor to polystyrene and several co-polymers. It is a weakly toxic chemical. Bisphenol A (BPA) is used to make polycarbonate plastic and epoxy resins coating of the can. It could
migrate from the can into the milk powder, concentrated liquid formula, ready-to-eat liquid formula and whole evaporated milk. Fluorochemical-treated paper, grease/oil resistant, is generally used for food in the fast-food industry. The major incorporated contaminants form rappers are di-isoprpylnaphthalates (DiPNS) and phthalates. To avoid these, proper packaging, forms an integral part of milk processing operations which can offer effective protection to the product from such hazards.

**Milk at Supermarket Shelves**

The milk in supermarket shelves and stores has been approved by regulatory bodies. Most high-end supermarkets demand packaged products to have bar codes for ease of sales and stock control. The extension of shelf life from hours to months has been a prime objective of the dairy industry for many years to meet the demands for increasing distribution times and distances (Goff and Griffiths, 2006). Milk products in poorly labeled containers and wrappings in the case of butter and cheese ultimately affect the quality of the milk.

**Conclusion**

Milk quality is assessed by checking on the numbers of bacteria that exceed the maximum acceptable limits specified by regulatory bodies. Additionally, the quality of milk is as a result of the level of control of all activities performed throughout the production process. Quality of milk ensures consumers’ confidence and ensures generation of high income. Milk quality control is thus key in the dairy industry. The hazards can either be biological hazards, chemical and physical hazards. Milk quality can be affected through contamination at the various points within the value chain. It is essential to identify the Critical Control Points (CCP), and develop standard operating procedures to minimize contamination arising from these points. Moreover, Hazard Analysis and Critical Control Point (HACCP) system is necessary during milk production to ensure high quality milk. All milk handlers as well as institutions dealing with milk need public health license with constant monitoring and evaluation of the process. In addition, continued training on quality milk production should be enhanced. When these controls are ensured throughout the whole milk value chain, quality milk free from any contaminants will be produced for increased income and better health of the population.

**References**


