Journal of Food Science Research

Review | Vol 6 Iss 4

Factors Affecting Quality of Raw Milk and Livestock Health: Status and Perspectivesn

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Received: July 16, 2021; **Accepted:** July 30, 2021; **Published:** August 06, 2021

Abstract

Milk and milk products is major source of revenue generation and basis of livelihood for major percentage of global population. Due to nutritional qualities, taste and health benefits; people have increased the consumption of raw, unpasteurized milk. But, at the same time this raw milk can also be harmful to human health. The milk got contaminated by a variety of pathogens and cattle's are also got infected with pathogens and parasites, both of which are associated with human illness and diseases. The prevalence of pathogenic organisms in raw milk was demonstrated in many surveys. Emergence of drug-resistant pathogenic bacteria in milk poses a greater public health threats, especially in the children's and adults. The transfer of antibiotic resistance genes and selection of resistant bacteria in milk can occur through a variety of ways, which not always linked to specific antibiotic use. Various countries are having stringent restrictions on use of antibiotics in dairy cattle care and these restrictions on growth-promoting antibiotics appear to have resulted in decrease in prevalence of drug resistance. Apart from microorganisms, parasites also affect the raw milk yield and quality. Storage and temperature conditions of raw milk preservation are also important factors for quality control. This review is carried out to find reasons behind factors decreasing quality of raw milk such as presence of multidrug resistant bacteria in milk, parasites, and storage conditions. Apart from this discussion is made to reduce such events.

***Keywords:* Raw milk; Dairy cattle; Milk borne infection; Antimicrobial drug resistance**

Introduction

In recent times, there is an enhanced consumer demand towards natural products for health and wellbeing. Milk is one of the major food product in human diet. Approximately 750-900 million households around the globe are engaged in milk production. In most developing countries, milk is produced by smallholders. Milk production contributes to household livelihood, food security and nutrition. Developing countries have increased their share in global dairy production. This leads to an increase in numbers of milk producing animals and a rise in productivity.

Citation: Naik A, et al. Factors affecting quality of raw milk and livestock health: status and perspectives. J Food Sci Res. 2021;6(4).

Milk in India is largely safe for human consumption, even though quality issues often persist. An interim report released by food safety and standards authority of India (FSSAI) found that less than 10% milk samples had contaminants that make milk unsafe for consumption, while over 90% of samples were found safe [1]. Farm dairies mostly use raw milk for preparation of many dairy products like cheese, butter, sweets and other dairy products. These products are prepared by using locally available water, food and other dairy facilities. In several places production and processing of milk are mediated by sub-standardized method & usually supplied to the consumer in an unhygienic way. Consumption of such unhygienic milk product leads to mild to severe health hazards.

Antibiotics are an important tool to treat animals as well as human diseases, safeguard animal health and welfare and support food safety. Antibiotics are used in the husbandry of livestock for treatment of ill animal, management of a group of animals when at least one of them is diagnosed with clinical infection as preventative treatment. The antimicrobial drugs which are used in animals food is an important tool to ensure animal health and product safety [2]. In milk producing animals, antibiotics are used for the prevention and treatment of bacteria associated infectious diseases as well as for growth promotion purposes. Many antibiotics, when given in low dose are known to improve feed conversation efficiency and promote greater growth, by affecting gut flora. The drugs given in (Table 1) are used to increase feed conversion ratio and weight gain of cattle.

TAB.1. **Antibiotic as growth promoters used in livestock.**

Drug	**Class**	**Livestock**
Bacitracin	Peptide	Beef cattle, chickens, swines promotes egg production in chickens
Bambermycin	Flavophospholipol	Beef cattle, chickens, swine and turkeys
Carbadox	Quinoxaline-di-N-oxide	Swine
Laidlomycin	Polycyclic polyether antibiotic	Beef cattle
Neomycin	Aminoglycoside	Beef cattle, chickens, swine and turkeys
Penicillin	β lactams	chickens, swine and turkeys
Salinomycin	Ionophore	Beef cattle, chickens

The blind and unnecessary use of antimicrobials in livestock production and treatment has led to the development of antimicrobial resistance in pathogens having current public health concern. Antimicrobial resistance threatens the efficient prevention and treatment of an ever increasing range of infections caused by bacteria, parasites, viruses and fungi. Antimicrobial resistance happens when microorganisms adopt different strategies to nullify the inhibitory effect of antibiotics. Antibiotic resistance results in survival and grow of bacteria in the presence of one or more antibiotics. Bacterial antibiotic resistance is a specific type of antimicrobial drug resistance. Bacterial antibiotic resistance may arise by spontaneous mutation or extra chromosomal inheritance in animals brought by selective pressure of antibiotics used in therapy and prophylaxis or for growth promotion. Resistant bacteria are eliminated from animals into the environment via its secretary products such as milk or from its excretory products and contaminate the food, water, soil and other objects.

Lactoferrin and immunoglobulin’s are inactivated above pasteurization temperature. Their concentration is mainly high in colostrum and decreases significantly during lactation to levels of little relevance in the context of raw milk consumption. Antimicrobial systems are inactivated after UHT (Ultra High Temperature) treatment or sterilization of milk, their activity is no longer required hence such milk is called as sterile.

Literature Review

Bacterial drug resistance system

Antimicrobial resistance is one of the biggest coercion for global public and animal health as well as welfare. Antibiotic resistance occurs naturally, but misuse of antibiotics in humans and animals drastically increases the process of resistance generation. Its development and spread is influenced by the use of antibiotics in human and animals.

Antibiotic resistance can be determined by vertically or horizontally in natural microbial communities. A vertical dissemination is mediated by the clonal spread of a particular resistant strain. Horizontal gene transfer in bacteria is operated by three mechanisms including transformation, conjugation, and transduction [3]. Antibiotic resistant can be transferred from one bacterium to another as genetic elements on plasmids. Plasmids may mediate their own conjugal transfer or be co-transferred with another plasmid. When plasmid is inserted into other bacteria, antibiotic resistance can spread easily and quickly among bacteria.

Bacteria become antibiotic resistance by a various ways. The main reason is selective pressure. It happens when not all bacteria are susceptible to antibiotics used to treat infections and surviving bacteria can continue to multiply. This creates bacterial population resistant to the antibiotic to which bacteria was exposed.

History of antimicrobial resistance associated with animals

The common cattle diseases are bovine respiratory disease, clostridial disease, bovine viral diarrhea, infectious bovine rhinotracheitis, bovine serum mastitis for which antibiotics are generally prescribed. Use of antibiotics are having its own disadvantages as antibiotics do not discriminate between pathogens and beneficial bacteria, exposure to antibiotics has profound effects on the microbiome. Therapeutic use generally involves individual antibiotic treatment for a long time. There is a significant use of some medicated feeds to treat larger livestock for higher yield.

Antibiotics are given to animals that are sick, in order to help reduce the pain and suffering, help the animal to feel better and get recovered from disease. Antibiotics may also be given to animals that are at risk of becoming sick in order to prevent the illness or infection. These types of antibiotics are also used in lower concentration by mixing in cattle feed to treat illness. Antibiotics can be given to animals with injections under their skin or in a muscle, with pills, by mixing in drinking water or with their feed. Injectable antibiotics are normally used when cattle’s are sick or are at high risk for getting sick.

Therapeutic use of antibiotics in animals is probably a little more complicated than it is for human medicine, given the variations between species and the reasons for which animals are owned and are being treated. The bacterial susceptibility is not the only consideration when selecting an antibiotic from a range of options. Factors to consider in the appropriate selection of antimicrobial therapies should include the drug's attributes, the host characteristics, and the accountability to the public and other issues such as cost effectiveness.

Growth promoting use

Antibiotics are also used as a growth promoting agent in animals. Antibiotic Growth Promotant [AGPs] are used as an animal fed for extended periods of times or for a whole life of animal. Prolonged use of AGPs creates an essential environment for selection of antibiotic- resistant bacteria and the spread of resistance genes in the intestinal tract of treated animals.

The mode of action of AGPs remains unclear, but they appear to exert their effect by: Reducing the production of bacterial toxins, reducing the amount of essential nutrients used by bacteria, allowing increased synthesis of vitamins and other growth factors and improving absorption of nutrients by reducing the thickness of the intestinal epithelium.

Antimicrobials which are used in cattle treatment are similar to antibiotics that are of critical importance to human medicine. The main antibiotics used in cattle care are bacitracin, flavophopholipol, pleuromutilins, quinoxalines, virginiamycin and arsenical compounds.

Use of hormones to increase milk yield

Hormones are one of the important factors which is directly responsible for affecting milk production in cattle. Many hormones are commonly given to dairy cows to increase milk production. Bovine somatotropin, also known as bovine growth hormone is approved by the FDA for use in dairy cattle. Bovine somatotropin is a peptide hormone produced by cow's pituitary glands. It is produced in small quantities and it is used in regulating metabolic processes. It became possible to synthesize the hormone using recombinant DNA technology and termed as recombinant bovine somatotropin (rBST). The FDA approves commercial use animal drug only after sufficient information showing that the food from the treated animal is safe for people to consume and the drug does not harm treated animal or negative impact on environment.

Milk yield is significantly increased when cows are injected with rBST. To affect a cow’s milk production, rBST must be injected into the animal on a normal basis, similar to the way insulin must be regularly injected into people who have diabetes. The blood flow to the cow mammary gland is increased after administration of rBST causing an increased amount of nutrients available for milk production. More nutrients are extracted from the blood by the mammary gland, which improves efficiency of milk production and feed utilization efficiency. Milk production in rBST- treated cow’s increases from 4.8 to 11.2 pounds per day while feed efficiency improves from 2.7 to 9.3 %.

Milk contain natural BST that is produced by the cow. Both natural BST produced by cow and rBST produced by recombinant DNA techniques is immediately broken down into inactive amino acids and peptides in the digestive tract when they are consumed by humans.

The National Institute of Health has concluded that milk from rBST- treated cows is essentially the same as from untreated cows, and there is no difference in the safety of the products.

Effect of storage conditions on milk

The cleanliness of the milking system as well as milking equipment decreases the bacterial count in milk. Sometimes it happened that milk residue left on equipment contact surfaces support the growth of various types of bacteria [4]. Generally there are some environmental contaminants which are growing on solid equipment surfaces. Water used on the farm may also be a source of microorganisms, especially psychrotrophs. Psychrotrophic bacteria tend to be present in higher number in milk and are often entered into the milk due to improper cleaning or sanitizing procedures.

Discussion

Internal parasites

The effect of internal parasites on cattle will vary with the severity of infection as well as age and stress level of the animal. Mature cows acquire a degree of immunity to parasites that exist in the lower gastrointestinal tract.

Cattle can be infected by roundworms, tapeworms and flukes. Protozoan and helminthes are also a type of internal parasites. Roundworms are most common internal parasite. The medium or brown stomach worm and the Cooperia species are the most common roundworms. Internal parasites affect the nutritional status of the animal in three ways: decrease or increase in feed intake and diminution of nutrient absorption. They decrease nutrient absorption by the cattle and but increase nutrient requirement of the animal for feeding the internal parasite colonize within the cattle. Through these mechanisms, parasites affect the energy, protein, vitamin and mineral status of the animal, thereby affecting every aspect of biology of the animal that is relevant to milk production and general health status. Reduced nutrient intake and absorption is especially detrimental in high-stress cattle because it contributes to their inability to respond to a microbial disease challenge.

The major effect of internal parasites on beef cattle production is reduction in feed intake. Less feed intake means that the animals are consuming less energy, protein, vitamins and minerals all of which play a vital role in animal growth, reproduction and immunity. There is various methods to control internal parasites [5]. Pasture management and antiehelmintics are two methods used to control internal parasites.

External parasites

All animals including human are the hosts to parasites living on the skin surface. External parasites are also an important player like that of internal parasites with respect to cattle heath and production. Insects such as stable flies, mosquitoes, horseflies, deer flies, cattle grubs, lice, ticks and mites are major external parasites of dairy animals. These cause damage to livestock and economic loss. External parasites are usually differentiated easily. Cattle have been killed by extremely heavy infestations of lice and mosquitoes.

Conclusion

Use of antibiotics have both positive and negative impacts on animal health. Antibiotic resistance will not disappear instantly, but will rather amplify in the future. Therefor every effort must be made to delay its emergence and reduce its impact on animal health, and productivity. While protecting human health is essential, effective antibiotics are also desirable to treat animals. To increase food production in a sustainable way, alternatives to the widespread use of antibiotics as growth promotant need to be introduced. The effect of storage condition and temperature of raw milk is also important. The proper storage condition of milk and milking environment avoids higher concentration of pathogenic microorganisms in the dairy environment as well as an exchange of microorganisms between the animals, environment and the feed. The presence of antibiotic resistant bacteria in milk and of animal products are complex and of high importance to animal industries, consumers and health care providers. Both risks and benefits are realized in the use of antibiotics for food animal production. Prolong the efficacy of existing and new antimicrobial agents are desperately needed to control animal disease and to minimize the spread of resistant zoonotic pathogens to human through the food chain.

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