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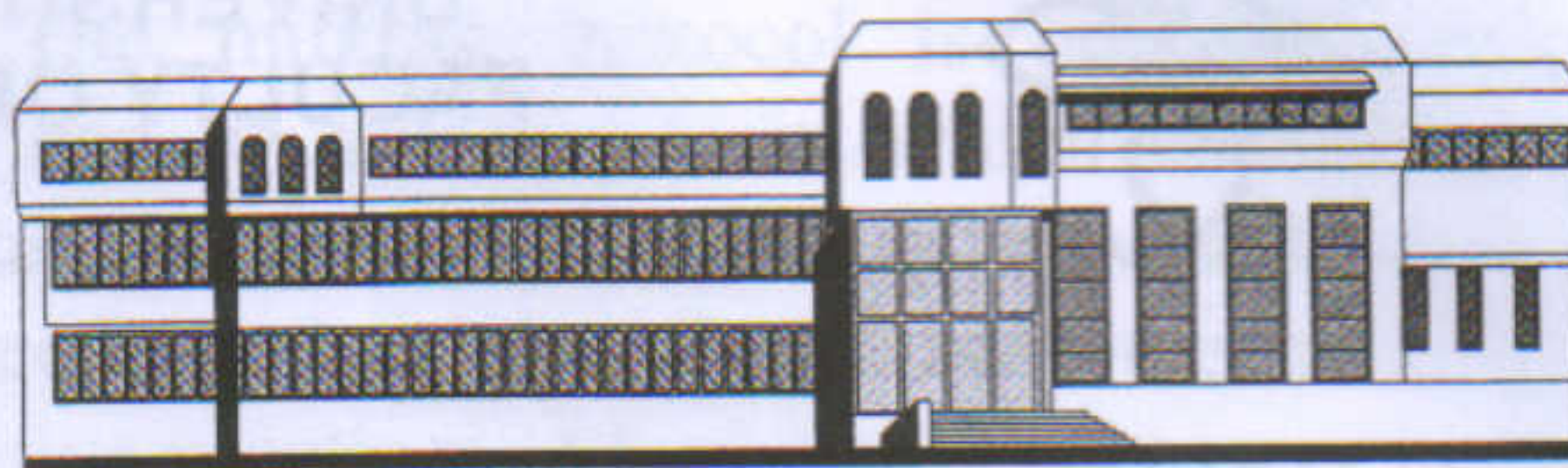
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Hazards And Risks Analysis Of Milking, Affecting The Milk Hygienic Safety

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Abstract: This research was conducted on four farms which use different milking and keeping systems (separate milking in tie stall and central milking in loose type of keeping the cows). For the purpose of study bacteriological status of the milk was monitored by determining the total bacteria number, the number of coliform bacteria, E. coli, the psychrophilic bacteria, the thermophilic and the lactic acid bacteria on the hands/palms of the people who perform the milking, the udder, the raw milk, the milking containers and machines, the water, the air and the mat. According to the obtained results, the microorganisms' number is very large, especially in the water and in the mat, where there were huge numbers of bacteria found and which can affect the quality of the final product. For these reasons, it is essential to properly implement the good hygienic practices in order to reduce the total bacteria number. Furthermore, there can be large numbers of coliform, thermophilic and the lactic acid bacteria in the raw milk; the average number of bacteria in the milk on the tie stall farms with and a separate milking was 640000/ml and total bacteria number in the raw milk on farms with loose type of keeping the cows and central milking was 176000/ml.

Key words: risk, hygienic safety, dairy farm

Introduction

Milk has a high nutritive value, not only for the new-born mammal and for the human consumer, but also for the microbes. The quality and the safety of the market milk begin with the milk producers (farmers). In order to get a quality

and safe product that will meet the demands of the consumers, there needs to be traceability or security of milk production beginning at the farm. It is very important to properly identify the risks and dangers that exist on the farm and to determine the CCP in order to obtain a quality product, preserving the traceability from farm to fork.

The hygienic quality of milk is measured by the extent of milk contamination and can be determined by the bacterial population present in milk. A high bacteria count is an indication of poor hygiene, reduces the shelf life of the milk, and enhances the risk of milk-borne bacterial infections.

There are three types of hazards that can pose food safety and quality risks in a milk production system (Vágány et al. 2007), for example:

- biological (harmful bacteria, parasites and other disease-causing organisms)
- chemical (livestock medicine, pesticide residues, cleaning compound residues and contaminated feeds)
- physical (sediment, dust, flies, hair, glass, "black specs" in milk)

Hazard is any biological, chemical or physical agent in food or feed, or biological, chemical and physical conditions for food or feed capable of causing undesirable health effects. Risk is a function of the probability of action harmful to health and the severity of that effect, as a consequence of that danger.

Proper milking techniques should be a top priority for all dairy managers. Milking procedures are important to the milk quality, the production level, the incidence of mastitis and the udder injuries. Deficiencies in recommended milking practices can lower the total efficiency of the dairy operation. Regardless of the type of milking facility, three important factors should be considered in developing a sound milking management program: pre-milking preparation, milking practices and postmilking procedures.

Material and methods

Different milking systems were used during the research. Depending on the way of milking and the way of keeping the milk, the milking machines can be divided into two systems:

- Separate milking and a fastened way of keeping the cows (farms A and B)
- Central milking parlor and an unfastened way of keeping the cows (farms C and D)

For the purpose of the research, the parameters considered for determining the farms' cleanness were: the hands/palms of the people who perform the milking, the udder, the milk, the milking containers, the milking machine, the water, the air and the mat. The total bacteria number, the coliform bacteria, *E. coli*, the psychrophilic bacteria, the thermophilic and the lactic acid bacteria

were examined within the period of three months and three revisions were performed.

The point where the dairy farmer has the greatest opportunity to control the quality of the dairy is the milking routine. The seven habits of highly effective milking routines identified by Ruegg P., (2006) are summarized as:

1. Cows are calmed and clean before milking.
2. Cows are grouped by infection status (or milked in a way to avoid transfer of pathogens by the milking machine).
3. A consistent pre-milking cow preparation is used.
4. Teats are clean and dry before attaching the milking units.
5. Milking units are attached properly (At the correct time, without excessive air admission and adjusted to hang evenly on all four quarters.)
6. Milking units are promptly and properly removed at the end of milking.
7. Cows are managed in the post-milking (Application of post-milking sanitizer, kept standing to allow teat canals to close).

In this part, the biological hazard will be elaborated, as a part of the risk control programme.

Results and discussion

The risks and hazards which can appear on the farm can be defined in three ways: biological, physical and chemical. During this research the biological hazard which can affect the hygienic status of the milk were examined.

The raw milk quality is determined by its chemical composition and its sanitation. The health of the milk gland is a marker of the sanitation of the raw milk. It is necessary to be healthy in order to yield a product of a high quality and sanitation. Because of that, it is necessary to pay considerable attention to the appearance of mastitis as a part of the programme for mastitis prevention.

From the obtained data collected on farms A and B, which used a separate milking and a tied way of keeping the cows, the data for the total bacteria number, the number of coliform bacteria, *Escherichia coli*, psychrophilic, thermophilic and the lactic acid bacteria which can be found on the hands/palms of the people who perform the milking, on the udder, in the raw milk, on the milking containers and machines, in the water, the air and the mat are presented in tables 1 and 2.

Table 1: Bacteriological status of the farm A

	Total number of bacteria	Coliform bacteria	Escherichia coli	Psychrophilic bacteria	Thermophilic bacteria	Lactic acid bacteria
Hands/palm	4.500	0	0	0	0	0
Udder/50 cm ²	300.000	0	0	1.000	80.000	1.000
Milk/1ml	1.000.000	24.000	0	721.000	20.000	1.000
Milking containers	3.200.000	0	0	1.120.000	1.000	6.000
Milking machines	120.000	0	0	50.000	0	0
Water/1ml	40.000	0	0	3.000	1.000	0
Air/m ³	7.000	/	/	/	/	/
Cow mat/1g	73.000.000	284.000	280.000	52.000.000	1.400.000	/

According to the performed bacteriological analysis on farm A, as can be seen on table 1, the udder hygiene is poor and the hand hygiene of the milking person is good. On farm B, table 2, the hand hygiene of the milking person is bad while the udder hygiene is excellent. The number of microorganisms in the raw milk is large at both farms A and B and the dominant micro-flora consists of the psychrophilic microorganisms which can develop at the temperatures to 15⁰C in a refrigerator. There are also some coliform bacteria present from the mat, so that is why it is necessary to change the mat twice a day.

Table 2: Bacteriological status of the farm B

	Total number of bacteria	Coliform bacteria	Escherichia coli	Psychrophilic bacteria	Thermophilic bacteria	Lactic acid bacteria
Hands/palm	10.000	0	0	0	0	0
Udder/50 cm ²	3.000	0	0	1.000	0	1.000
Milk/1ml	280.000	7.000	0	61.000	0	14.000
Containers for milking	6.100.000	0	0	1.920.000	10.000	26.000
Milking machines	240.000	0	0	28.000	0	0
Water/1ml	40.000	0	0	3.000	1.000	0
Air/m ³	4.000	/	/	/	/	/
Cow mat/1g	53.760.000	70.000	3.000	31.540.000	9.600.000	/

The milk containers and the milking machines are in a bad state on farm A and farm B, so it is crucial to pay more attention to the hygiene and to apply the cleaning protocols for the milking machines, to reduce the presence of the psychrophilic bacteria. The air quality is poor in both farms A and B as there is more movement on the farm during the milking process. Both farms A and B have a poor water quality.

In the bacteriological analysis of the total bacteria number, the coliform bacteria, the *Escherichia coli*, the psychrophilic, the thermophilic and the lactic acid bacteria which can be found on the hands/palms of the people who perform the milking, the udder, the raw milk, the milking containers and machines, the water, the air and the mat on farms C and D that have a central milking parlour and loose type of keeping the cows (tables 3 and 4), the following results were obtained:

Table 3: Bacteriological status of the farm C

	Total number of bacteria	Coliform bacteria	<i>Escherichia coli</i>	Psychrophilic bacteria	Thermophilic bacteria	Lactic acid bacteria
Hands/palm	1.000	0	0	0	0	0
Udder/50 cm ²	112.000	0	0	23.000	2.000	1.000
Milk/1ml	112.000	7.000	0	28.000	1.000	1.000
Containers for milking	30.000	0	0	2.000	0	0
Milking machines	3.000	0	0	2.500	0	1.000
Water/1ml	6.000	0	0	4.000	0	0
Air/m ³	602	/	/	/	/	/
Cow mat/1g	52.800.000	3.100.000	500.000	31.000.100	1.800.000	/

On the basis of the performed bacteriological analysis of farm C, table 3, it can be noticed that the udder hygiene is poor so it is necessary to pay more attention to the hygiene and to apply the milking protocol, and the hand hygiene is excellent. On farm D, table 4, the hand hygiene is bad and it is necessary to wash the hands before performing the milking, however, the udder hygiene is good.

Table 4: Bacteriological status of the farm D

	Total number of bacteria	Coliform bacteria	Escherichia coli	Psychrophilic bacteria	Thermophilic bacteria	Lactic acid bacteria
Hands/palm	6.000	0	0	0	1.000	0
Udder/50 cm ²	10.000	0	0	5.000	0	0
Milk/1ml	240.000	3.000	0	28.000	2.000	2.000
Containers for milking	28.000	0	0	2.000	16.000	0
Milking machines	6.000	0	0	2.000	2.000	1.000
Water/1ml	4.960.000	13.000	0	6.000	1.000	0
Air/m ³	450	/	/	/	/	/
Cow mat/1g	52.800.000	2.200.000	480.000	33.000.100	150.000	/

The hygiene of the milking containers on farms C and D needs to be improved and a thorough cleaning is inevitable. The milking machine is in a good state, but it can be improved even further as a lot of the lactic acid bacteria have remained. The air quality is good on farm C, however, the movement before and after the milking should be reduced. Farm D has an excellent air quality.

The water condition on farms A, B, C and D is poor as the normal number of the microorganisms should be 100/ml and this water requires chlorination (The Official Gazette of the Republic of Macedonia 46/2008). The water used on the farm is supposed to have a low bacteria number, sedimentation, minerals and ions and other substances which can cause problems to the animals' health. How often the water is controlled depends on the source where it comes from to the farm. The plumbing water is tested annually and the water supplied by other sources as wells, springs and the like is tested during the period of heavy rains, the beginnings of the summer and autumn when the levels drop and there is a highest risk potential (Bell J.R.M., Gallagher S.J., 2006).

The mats are in poor states on the farms A, B, C and D. There is a huge number of microorganisms and there is an enormous quantity of coliform bacteria and E.coli which not only can spoil the milk and the dairy products, but are also a potential disease source. The mat should be changed more often and a meticulous sanitation needs to be performed as according to Presilski, S. (2005) it represents a serious milk contamination factor and the mat straw can contain 7-10 million microorganisms in a gram. The organic mat contains a significantly larger bacteria number than the non-organic mats. Because of that, the organic mat should be replaced daily and it needs to be as clean and dry as possible to

reduce the bacteria number and the risk of mastitis (DeLaval, 2006). The coliform bacteria in the milk indicate that it had been contaminated with feces, which can be found in the milk as a result of the low milking hygiene (USAID).

In order to have a satisfactory milk quality and to reduce the hazards which can affect it, it is necessary to pay attention to the good hygienic practices. To reduce the microorganisms on their hands, the milkers need to wash their hands correctly, to use a disinfection liquid and to have a contact time of at least 30 seconds (Tofant A., 2005). Every milker must wear gloves during milking. Gloves will reduce the risk of bacteria that comes from the milkers hands. A dairy farmers hand can be a primary source of *Staphylococcus aureus* and various environmental bacteria (Johnson A., 2004).

According to Bell J.R.M., Gallagher S.J., (2006), the water used for cleaning of the equipment should contain a total number of bacteria which amounts less than 1 000 bacteria/ ml, excluding the *E.coli*, and not more than 10 Coliforms in 100 ml. If there are *E.coli* and over 10 Coliforms present, it is necessary that the water is disinfected.

For production of safe and high quality milk, the cows should be healthy (Hampton T., 2010). This can be accomplished only by good stock-breeding, safe and responsible use of veterinary medications and control and monitoring of the animals' health and well-being as the sick animals can cause milk contamination. In this respect, it is of a highest importance that enough attention is paid to the sanitation before and after the milking, as that is when the contamination happens. As very important contamination factors are listed the following: the equipment, the udder infection, dirty udder or teats, hands or clothes.

The key principles in the course of the cleaning are as follows: the high water quality (low number of bacteria and low water hardness), adequate amount of solution so all the areas are cleaned, the dosage, the solution temperature, contact time of the detergent and the surfaces, active effect time. There are two types of detergents that can be used to clean the milking equipment: alkaline group, which removes the milk fats, the proteins and the fat remaining and acidic group, which remove the milk stone, the minerals and the hard water residue. The two groups must never be mixed and it is necessary to use them both (Bell J.R.M., Gallagher S.J., 2005).

When it comes to the combined cleaning of the milking equipment (detergent and disinfectant), it is conducted in three phases: initial cleaning with lukewarm water to remove the milk residues after the milking and it should be done until the water is clear; then the circulatory cleaning with a solution and a water temperature of usually 70°C to 90°C in the beginning and 40-50°C at the end of the cycle. The last temperature must not be under 40°C, as the fats can coagulate. At the end there is cold water cleaning, in order to remove any cleaning solution residues (DeLaval, 2001).

Conclusion

On the basis of this research, it can be concluded that the hygiene is on a very low level on the farms. The milking protocol is not implemented consistently and as a result there can be a lot of risks which can affect the bacteriological status of the farms. Because of that, it is inevitable that the milking protocol is followed correctly before, during and after the milking, as well as implementation of the positive practices. All of that is necessary in order to reduce the raw milk bacteria number as in the Republic of Macedonia the total raw milk bacteria number is regulated by a Rulebook (The Official Gazette of the Republic of Macedonia).

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