

Microorganisms present in cow's, sheep's and goat's colostrum

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Abstract

Colostrum is a substance, very often called „the first milk“, since in it produced 72 hours after delivery. The consumption of colostrum has increased recently due to its health beneficial composition. The health beneficial properties of colostrum are mainly connected with the content of bioactive colostrum proteins (IgG1, IgG2, IgM, IgA). These biologically active substances can be adversely affected by pasteurization temperatures. The studies are revealing that temperatures around 60 °C are not affecting bioactive colostrum proteins, but pathogens such as *Mycoplasma bovis*, *L. monocytogenes*, *E. coli* O157:H7, *S. enteritidis* and *Mycobacterium avium* subsp. *paratuberculosis* are effectively eliminated.

Bioactive acolostrum proteins, temperature, pH, pathogens

Introduction

The mammary glands of female mammals produce “first milk” within the first 72 hours after delivery. It is a substance called colostrum. The importance of colostrum is that it contains all essential ingredients necessary to protect the health of the newborn (Božanić, 2004). It is a vital source of proteins, and the highest content of protein in colostrum is on the first day of lactation. Although the protein content is decreasing in relation with time and the biggest drop of protein content is between the 1st and 3rd day of lactation (Csapo et al., 2012).

The popularity and consumption of colostrum have been increasing recently among humans because people are starting to consume colostrum as a functional food, which can in some cases replace the usage of certain remedies. Certain consideration should be focused on the fact that many bioactive colostrum proteins can be denatured by pasteurization and other methods should be considered for the production of colostrum as a final product (Houser et. al., 2008).

At the same time, lactose content and casein content in colostrum are lower than in milk. Colostrum has nutritive value and also immunologic function for suckling calves. Calves are born with very weak immune system probably because the placenta of ruminants is not permeable for macromolecules such as immunoglobulins (IgG₁, IgG₂, IgM, IgA). These immunoglobulins are present in higher concentration during the first day of lactation and due to this fact, it is very important for calves to receive colostrum immediately after birth (Georgiev, 2008).

Although colostrum is very important for the health condition of newborn due to the content of substances supporting the immune system, the presence of pathogen bacteria in it can represent the source of infection and contamination (Stewart et al., 2005).

Bacteriological quality of colostrum

The colostrum of best quality has high content of active biological substances which can be very beneficial for consumers against some virus, bacteria, mycetes, and protozoa. Oppositely, if good production practice is not satisfied colostrum can also be a source of pathogens for animals and human health. Bacteriological quality of colostrum is highly

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influenced by the production method, equipment used for colostrum collection and by storage conditions. These bacteria were found in colostrum: *Salmonella Dublin*, *Salmonella typhimurium*, *Mycobacterium bovis*, *Mycobacterium avium* subsp. *paratuberculosis*, *Mycobacterium coliformicum*, *Escherichia coli*, *Salmonella* spp., *Listeria monocytogenes* and many others can be contaminants of colostrum (Conte and Scarantino, 2013, Trujillo et al., 2007).

Some bacteria present in milk and colostrum can produce proteases which are capable to denature bioactive beneficial proteins. They come from udder or farm environment and bacteriological quality of colostrum is in correlation with correctly applied hygiene practices. Therefore, it is very important for raw, unprocessed colostrum to have a low number of bacteria and to be without pathogenic organisms (Houser et al., 2008).

Houser et al. (2008) carried out the microbiological survey on 55 samples of cow colostrum in Canada. Their results showed how it is very hard to produce colostrum of high microbiological quality. Only 9% samples satisfied all requirements for high microbiological quality. *Salmonella* was present in colostrum samples and 15% of samples were positive on this pathogenic bacterium. 69% of samples had more than 5000 CFU/ml aerobic bacteria, while 82% of samples had more than 10 000 CFU/ml psychotrophic bacteria. *Staphylococcus aureus* were present in 42% of samples and 70% of samples exceeded the standard value for coagulase negative staphylococci and streptococci (<500 CFU/ml). More than half of the samples had excessive counts of coliforms and non-coliforms bacteria. Researchers in this study tried to find a correlation between microbiological quality and the size of the herd, as it had been found in previous studies, but they didn't find it.

In another study (Conte and Scarantino, 2013) 30 samples of cow colostrum in Italy were investigated. Oppositely from above mentioned study, in their study *Salmonella* was not present in the samples of cow colostrum. Also the presence of aerobic, psyhotrophic and *Staphylococcus aureus* were present in a smaller number of samples, 23%, 20% and 10%, respectively. Trujillo et al. (2007) also didn't find the presence of *Salmonella* spp. and *Listeria monocytogenes* in the samples of goat colostrum.

In the research conducted by Pandey et al. (2011) the presence of *Lactobacillus bifidus acidophilus* was found in the bovine colostrum. This bacterium has an impact on the normal food digestion and can decrease the growth of harmful bacteria in the digestive system.

The best storage conditions for bovine colostrum were analyzed by Cummins et al. (2016). The colostrum was stored at 4, 13 and 20 °C for 72 hours and there were found that the total bacteria count significantly increased in warmer conditions as well as the pH significantly decreased. The best storage condition is at ≤ 4 °C.

As mentioned by Roostita et al. (2015), *Enterococcus* bacteria were isolated from bovine colostrum. These microorganisms belong to probiotics and its advantage is resistance to gastric acid and bile salts. It was found that *Eneteroccus* bacteria are resistant to pH of around 4 (the normal pH in the stomach is 4 to 5) and to the bile salt concentration of around 0.5% (normal bile salt concentration in human intestine – 0.3 %).

Foster et al. (2016) found that high-pressure processing of colostrum effectively decreases a presence of microorganisms *E. coli* and *Salmonella Dublin*, the side effect was decreasing of IgG too, but the colostrum was still evaluated as suitable for calf feeding.

Goat samples were analyzed how the heat treatment influence viability of *Mycoplasma agalactiae* and *Mycoplasma mycoides* in the research of Paterna et al. (2013). The research showed that pasteurization at 56°C for 60 minutes reduced but, did not totally inactivate *Mycoplasma agalactiae* and *Mycoplasma mycoides*, while pasteurization at 60°C eliminate all viable *Mycoplasma mycoides*, though there were still the presence of viable *Mycoplasma agalactiae*.

In research conducted by Bogdanovicova et al. (2015), there was determined a difference between microbial composition in native and lyophilized goat colostrum

in the Czech Republic. There were found pathogenic microorganisms in these samples, namely *Listeria monocytogenes* in 6.1 % of samples, *Escherichia coli* in 2.6 % of samples and *Staphylococcus aureus* in 18.3 % of samples from of the total quantity of samples 460. There were also found that lyophilization is not perfect for the elimination of *L. monocytogenes*. These findings emphasized that the consumption of goat colostrum can be hazardous for small children, pregnant women and older people.

There are differences between cow, goat and sheep colostrum composition in physico-chemical characteristics. Goat colostrum has higher content of caproic, caprylic and capric fatty acid in comparison with cow colostrum. Fatty acid composition of colostrum can also influence its bacteriological quality due to the fact that fatty acids with 8 to 12 carbon atoms (medium chain fatty acids) are effective antimicrobials (Marounek et al., 2012).

Sheep milk contains more total solids and basic nutrients in comparison with goat and cow milk. In the same manner sheep colostrum in the early postnatal period contains higher fat and protein contents than milk colostrum (Park et al., 2007).

Correlation between bacteriological quality of colostrum and the content of active biological substances

One of the most effective methods to reduce the number of viable pathogens in colostrum is pasteurization. Therefore, following treatments are sufficient for the reduction or elimination of particular microorganisms in colostrum:

- 65.5 °C during 30 minute period is sufficient to remove *Mycobacterium avium* ssp. *paratuberculosis*,
- 60 °C during 30 minute period is sufficient for the elimination of viable *Mycoplasma bovis*, *L. monocytogenes*, *E. coli* and *Salmonella enteritidis*,
- 60°C during 60 minute period, sufficient to remove viable *M. avium* ssp. *paratuberculosis* (Trujilo et al., 2007).

Earlier studies revealed that high-temperature short-time (HTST) pasteurization at 72°C during 15 seconds reduces the concentration of IgG for 25% to 30%. The same reduction (25% - 30%) of IgG was noticed during pasteurization at 63°C for 30 minutes, but pasteurization at 60°C for at least 120 minutes doesn't affect IgG concentration. Pasteurization at 60°C for 30 minutes eliminates all viable *Mycoplasma bovis*, *L. monocytogenes*, *E. coli* O157:H7 and *S. enteritidis*, while the pasteurization at 60°C for 60 minutes is enough for the elimination of *Mycobacterium avium* subsp. *paratuberculosis* (Godden et al., 2006).

Conclusion

Colostrum is very health beneficial for newborn, but because of possible microbial contamination it can also contribute to certain diseases. Producers should pay attention to hygiene practices during all steps of colostrum production, including: colostrum harvest, storage and feeding processes. They should strive to produce raw colostrum of best possible bacteriological quality. In that way that can minimize further processing of colostrum, and as a consequence of good manufacturing praxis protect all beneficial substances in it. If colostrum undergoes pasteurization procedure, temperature should not exceed 60°C and in that way IgG concentration would not be effected but bacteria such as *Mycoplasma bovis*, *L. monocytogenes*, *E. coli* O157:H7, *S. enteritidis* and *Mycobacterium avium* subsp. *paratuberculosis* would be eliminated. Further research should investigate more how different temperature and period of pasteurization influence bacteriological quality of colostrum and its IgG concentration. The correlation between present microorganisms

and colostrum source (cow, sheep, and goat) should be analyzed more deeply due to the different physical-chemical properties of colostrum from these animals.

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