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Review article

Properties of bovine colostrum and the possibilities of use

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ABSTRACT

Introduction: Food manufacturers compete on the market, introducing innovative products. Functional products, which show a beneficial impact on human health over the one which comes from the basic product component, are becoming increasingly important. Since a few years researchers underline a huge importance of colostrum in this trade. 'First milk' is significantly richer in biologically active peptides, immunologic components and growth factors than later milk.

Aim: In the article an overview of literature concerning the meaning of bovine colostrum in human nutrition and its therapeutic properties was performed.

Discussion: A vast research which was conducted on animals, as well as in strict laboratory conditions (in vitro, in vivo) confirm clinical benefits of colostrum. A number of analyses is still conducted, which additionally refer to the design of the appropriate dose and time of treatment with colostrum. Colostrum is considered a fully safe substance. To this moment, even with very high doses, very few side effects were noted. The main functions of the colostrum are supplying the organism with essential nutrients which strengthen the immune system, stimulation of the immune system response, maintaining the intestinal microflora and tissue regeneration acceleration.

Conclusions: Summing up, further use of products based on colostrum both in healthy individuals – prevention, as well as with some diseases is justified. The interest in questioned substance is rising due to vast scientific and clinical research underlining the

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significance of colostrum in feeding of human beings. Scientists predict that products based on colostrum may play a significant role on the functional products market in the future.

1. Introduction

The last decade brought a dynamic development in the functional food market.[1] The production of functional products is a main direction of food industry development.[2,3] This is due to the major attractiveness of such products.[4,5] The list of functional products is gradually rising.[6,7] In recent years, the use of colostrum in human food products is gaining popularity.[8]

The colostrum is produced by milking glands of cows in the first four days after calving. In subsequent days it changes into standard milk.[9] It is characterized by a unique composition.[10] The research proved that the colostrum from cows contains over ninety various biologically active substances.[11,12] Bovine colostrum (BC) is rich in growth factors, immunologically active compounds and nutrients, which appear in a highly digestible form.[8,13]

The quality of colostrum depends on the race of cows, number of calvings and calves which were born alive as well as health on animals, proper production practices and knowledge of a breeder.[14,15] The colostrum is the most valuable during the first 24–48 h after calving. The dependence between time after calving and the quality of colostrum is directly proportional – as time progresses the number of biologically active components in colostrum decreases.[16]

2. Aim

The aim of the article is to highlight the significance of BC use in human nutrition, the therapeutic characteristics of colostrum and the influence of its most important, immunologically active components on human organism.

3. Discussion

3.1. *BC and colostral preparations*

In recent years, milk derivatives have become a subject of scientific research.[17–19] A significant popularity, as a product appropriate for consumption was gained by the BC. This is due to the fact that it is a perfect source of biologically active proteins which are not only antibacterial and antiviral but also improve peristalsis and regulate work of the digestive tract.[20–22] Nowadays, colostrum can be obtained in a clear form as well as a product based on it or colostrum mixed with other components in a lyophilized or liquid form. A line of products based on BC is available on the market. Consumers can also buy products based on the goat colostrums.[7] Li and Aluko[23] underline that there is no possibility of introduction of human colostrum to the market. Therefore an alternative is a BC.

3.2. *Potential benefits of BC*

As Conte and Scarantino[7] report the healing properties of colostrum were known for centuries. In India, where cows are considered saint, colostrum is distributed together with milk to houses. Its positive therapeutic effect in elder individual flu symptoms treatment was noticed. Doctors, the so called 'saint healers' or 'rishi', gave their patients milk with an addition of colostrum, what had a positive healing effect. It was the first step to application of colostrum in human nutrition. In parallel, near the end of XVIII century, research concerning use of colostrum in animal feeding was started.[24]

The antibacterial properties and enhancing passive immunity against infection are crucial, particularly in the first weeks of the infant's life.[25] The antibacterial activity of colostrum can influence pathogens directly or indirectly by stimulating the development of intestinal microbiota, rich in *Bifidobacteria* and *Lactobacillus*.[26,27] The immune system receives signals from colostrum based food[28,29] and the transmitted information is associated with the non-invasiveness of these food antigens. This prevents from abnormal immune response, while supporting the immune response against pathogens.[30,31] Growth factors play an essential role in the repair and maturation of different tissues.[32] They accelerate the regeneration of muscles, skin, bones or nerve tissue. In addition, growth factors stimulate the body to burn fat. They are often applied to local burns or skin injuries.[33]

3.3. *Usefulness of BC for humans*

Colostrum has been used in the feeding of infants and adults, mainly for preventive purposes. BC based food is also used in treating gastrointestinal and immune system diseases, cancer, allergies and various infections.[7] There are colostrum based dietary supplements, drinks and chewing gums available on the market.[34]

The analysis conducted by Rak and Bronkowska[8] shows the significance of lactoferrin and secretory IgA form (sIgA) present in colostrum in fighting infections of gastrointestinal, respiratory and urogenital system in infants. Bovine colostrum contains significant amounts of sIgA which blocks the adhesion of pathogens to mucous membranes and inhibits their colonization.[35] In addition, sIgA effectively protects

infants against enterotoxigenic strains of *Escherichia coli*, the main cause of acute diarrhea.[36] IgA is resistant to stomach and intestinal enzymes, which allows adherence of these antibodies to the gastrointestinal mucosa, thus creating a protective coat. Immune cells are capable of releasing lactoferrin (LF), which inhibits the growth of pathogenic microorganisms. The selective action of LF allows simultaneous growth of desirable bacteria of the genus *Bifidobacterium*.

Research conducted by Marnila et al.[37] and Tran et al.[38] confirms that colostrum based products can inhibit the growth of *Helicobacter pylori*, responsible for stomach ailments. Daily administration of colostrum to adult mice reduced the severity of the gastritis. Complete elimination of the bacteria was only observed in a few test subjects, however in all cases, gastric mucosa showed significant improvement. Researchers proved that two components of BC played a vital part in reducing the negative impact of the disease. The first is LF, which is attributed to have a destructive effect on *H. pylori* (destruction of the pathogen's cell wall, causing the death of bacteria). Moreover, it was observed that LF boosted immunity and increased bacterial susceptibility to the antibiotic. The second immune-modulating component is lysozyme. The researchers noted that LF and lysozyme showed antibacterial response to the pathogenic microorganism and reduced the degree of its colonization. LF prevents bacterial biofilm development by binding free iron, necessary for growth of pathogens.[39]

The positive effect of colostrum on the human body is manifested during antibiotic therapy. Wong et al.[40] emphasize the significance during antibiotic therapy. The researchers claim that the administration of colostrum at the beginning of therapy will reduce the risk of diarrhea. Moreover, the 'first milk' may have a beneficial effect on the intestinal microbiota, thereby enhancing immunity. LF contained in colostrum leads to an increase in the degrees of bacterial susceptibility to the antibiotic. This may result in a reduction of the drug dose, while increasing its antimicrobial activity.[41]

Research conducted by Pontoppidan et al.[42] on piglets during chemotherapy showed that administration of colostrum reduced the toxicity of chemical compounds used in the intestine treatment. Strengthening of tissues and their faster repair enables an increase in the duration of chemotherapy. The researchers report that colostrum contains high concentrations of a number of growth factors, which allow restoration of the intestinal mucosa. These include transforming growth factor (TGF-β), epidermal growth factor (EGF), and somatomedin C (IGF-1). The authors confirmed that these growth factors acted as stimulators of cellular proliferation. Moreover, they had a beneficial effect in reducing oral ulcerations induced by the chemotherapy. The authors also noticed that preparations based on colostrum regulated body weight of the treated animals. In vitro and in vivo studies carried out by Eliassen et al.[43] confirmed the cytotoxic action of the BC (LF to be more exact) on colon cancer and melanoma. In effect, the size of the tumors is reduced and the risk of metastasis lowers. Colostrum also contains a complex of α-lactalbumin and oleic acid. Laboratory tests carried out by Fischer et al.[44] showed that the compound has anti-tumor activity by inducing apoptosis in cancer cells. The synergistic action of α-lactalbumin and oleic acid kills carcinogenic cells without damaging the healthy ones. In an experiment on mice suffering from inflammatory bowel disease (IBD) Bodammer et al.[45] found that the administration of colostrum reduced their body weight loss and slowed down the shortening of the colon. In addition, the large intestine showed histologic improvement. Therapeutic agents used in IBD effectively decreased the immunity of the animals participating in the experiment. Regular administration of colostrum reversed the side effects of drugs, and thus improved immune system and restored the balance of the intestinal microbiota. Stool consistency improved and the presence of occult blood in the stool was not detected. In 2013, research on piglets suffering from necrotizing enterocolitis (NEC) was conducted.[46] It was noted that active BC components added to food rations significantly improved the animals' medical results. Animals fed with BC showed higher daily weight gain compared to piglets fed with infant formulas.[47] It was observed that the concentration of pro-inflammatory NEC causing compounds significantly decreased and the activity of intestinal enzymes increased considerably. The histologic severity of the intestine inflammation improved. Piglets fed with infant formulas were more susceptible to NEC and substantial structural damage to the gut, as well as decreased activity of digestive enzymes.[47] This study was subsequently confirmed by in vitro studies, which emphasizes the importance of colostrum in reducing fecal bacteria. According to the current state of knowledge on the dangers of colostrum and its derivatives, BC is considered a safe substance and can be used in human nutrition (and animal), even at high doses. However Struff and Sprotte[48] and Tsabouri et al.[49] stress that BC, as well as milk contains casein, α-lactalbumin and β-lactoglobulin, which are considered allergenic.[18,50,51] For this reason it is not recommended to consume colostrum-based products by people who are allergic to milk proteins.

4. Conclusions

1. BC is a substance rich in nutrients and biologically active components. These components are important for human organism. It is due to the immune system response modulation, immunity strengthening, balancing of intestinal microflora as well as tissue regeneration.
2. Components contained in colostrum have a synergistic effect, which leads to an improvement in symptoms of many diseases (especially digestive tract).
3. A review of the literature shows that BC can be used not only in prevention but also to overcome side effects during antibiotic therapy or chemotherapy. Sick individuals using colostrum-based products can count on faster health improvement and maintain body weight.
4. In the age of rising resistance to antibiotics of microorganisms, rising numbers of irregular immune system functioning and drastic rise in oncogenic cases it is wise to use the alternative prevention and treatment methods, which products made on the BC basis seem to be.
5. It can be foreseen that in the near future 'first milk' may play a significant role on the functional products market.

Conflict of interest

None declared.

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