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PRACTICAL USE OF GOAT MILK AND COLOSTRUM

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This review presents the protein and amino acid composition of both goat colostrums and milk and describes the properties of goat colostrums and milk components. In addition, the prospects of use of goat milk and colostrum in the food and cosmetics industry and the feasibility of use of goat milk for baby feeding are shown. Functional foods produced from goat milk have antioxidant, anti-inflammatory, cardioprotective, antihypertensive and antiatherogenic activities in the human body. Goat milk cosmetics are very useful for maintaining a healthy skin and are effective in treatment of various skin diseases. Infant formula based on goat milk provides comfortable digestion for babies and are better at absorbing proteins, fats and other nutrients than infant formula based on cow's milk.

Key words: goat colostrum, goat milk, proteins, amino acids, cosmetology, baby feeding.

Goat colostrum is a pure natural product containing a large amount of biologically active substances such as proteins, vitamins, minerals, antimicrobial peptides, immunoglobulins [1]. Therefore it is promising to create therapeutic and cosmetic products based on goat milk and colostrum, which protect the skin from aging, dermatological problems, harmful effects of the environment. Additionally, the nutritional value of goat colostrum and its lower allergenicity in comparison with bovine colostrum provoke interest to goat's milk and colostrum as functional products. Moreover, the creation of infant formula and fermented dairy products from goat's milk supposes significant advantagesduetoitsprobiotic and antioxidant properties.

Protein and amino acid composition of goat's milk and colostrum,the components' properties. Protein plays a fundamental role in the functional and technological value of goat colostrum. The total protein content in goat colostrum ranges from 2.6 to 4.1 g/l.

The protein composition of goat's milk is presented in the Table 1 [2].

Among these proteins, whey proteins have the highest biological activity. Thus, β-lactoglobulin has antitumor functions, participates in the regulation of enzyme activity, and is able to bind hydrophobic molecules such as retinol, fatty acids, steroids, etc. [3]. β-lactoalbumin promotes the growth of bifidobacteria, as well as assimilation of calcium and zinc [4].

Lactoferrin is an iron-binding glycoprotein, which plays an important role in iron homeostasis and cell proliferation; it has antibacterial, antifungal, antiviral, antioxidant, immunomodulatory and anticancer activities [5].

Ig A protects the intestinal mucosa against *E. coli*, it protects also the mucous membranes of the throat, lungs and intestines of infants. Ig M is an immunoglobulin, which is the first to be formed in response to antigen and is highly effective in boosting immunity by the complement fixation, agglutination and opsonic activity [6]. Ig G is involved in the formation of antibacterial immunity [7].

The amino acid composition of goat's milk [7] is presented in the Table. 2.

Table 1. **Protein composition of goat colostrum**

No.	Protein	Concentration,%
1	Total casein	2.33–4.63
2	α_{S1}-Casein	0–28
3	α_{S2}-Casein	10–25
4	β-Casein	0.6–64
5	κ-Casein	15–29
6	Whey proteins	0.37–0.7
7	β-Lactoglobulin	39.2–72.1
8	α-Lactalbumin	17.8–33.3
9	Lactoferrin	5.1–21.5
10	Immunoglobulins	4.6–21.4

Table 2. **Amino acid composition of goat's milk**

No.	Amino acid	Content, mg/100 g of milk
1	Threonine	138.67
2	Isoleucine	160.54
3	Leucine	341.01
4	Lysine	342.86
5	Methionine	77.95
6	Valine	210.23
7	Arginine	135.65
8	Cysteine	30.62
9	Phenylalanine	175.45
10	Tyrosine	162.51
11	Histidine	122.73
12	Asparagine	117.95
13	Alanine	250.15
14	Glutamine	694.58
15	Glycine	55.83
16	Proline	310.61
17	Serine	152.65

From the data presented, the conclusion can be made that leucine, lysine and valine predominate among the essential amino acids in goat's milk proteins, whereas glutamine, alanine and proline are found in the largest amounts among the nonessential amino acids.

Amino acids in goat's milk and colostrum are not only substrates for biosynthetic and energy processes, but also important regulators of physiological functions, including hormone secretion, nerve impulse conduction, and modulation of the immune response.

Glutamic and aspartic acids, tryptophan, lysine and arginine have the highest immuno- and phagocytosis-stimulating activity.

Among amino acids, a special place is occupied by leucine, which regulates the processes of protein breakdown and synthesis *in vivo*. The experiments on peritoneal neutrophils have shown that leucine enhances phagocytosis of staphylococci by neutrophils.

The effect of leucine on the phagocytic activity of neutrophils in the umbilical cord blood of newborns was investigated in the work of Russian scientists [8]. It was found that, depending on the concentration, leucine has a different effect on the ability of neutrophils to phagocytosis. The dose of 0.1 mg/ml is optimal, which stimulates the completion of phagocytosis – the index of phagocytosis completion increases twice, the phagocytic index increases from 53.2 to 63.9%, and the phagocytic number from 7.5 to 9.33, compared with the control.

The branched-chain amino acids valine, leucine and isoleucine are important amino acids in the immune system. In [9] De Simone et al. evaluated the effect of these amino acids on microglia, the main immune cells of the brain. It was found that the interleukin IL-10 expression and phagocytic activity increase under the influence of these amino acids.

Studies by Chinese scientists [10] have shown that valine enhances the phagocytosis of macrophages, thereby inhibiting the growth of infectious agents *Klebsiella pneumoniae*, *Escherichia coli* in infected tissues. Two mechanisms are involved in this acivity: valine activates the PI3K/Akt1 pathway and promotes NO production through inhibition of arginase activity. The valine-arginine combination effectively kills *K. pneumoniae* and other gram-negative (*Escherichia coli* and *Pseudomonas aeruginosa*) and gram-positive (*Staphylococcus aureus*) bacteria.

L-arginine also plays an important role in the immune system functioning. First of all, nitric oxide, formed from arginine, has a specific immunomodulatory effect and act as one of the main effectors of cellular immunity, causing antimicrobial, antitumor and antiproliferative effects.

Some studies demonstrate that arginine plays an important role in the ability of macrophages to produce NO, which has many physiological functions, including enhancing the cytotoxicity of macrophages.

The absence of L-arginine blocks the re-expression of T-cell receptors in response to

antigenic stimulation, and is accompanied by a decrease in cell proliferative activity [11].

Arginine is also known to be important for the normal proliferation and functioning of T-cells. The maximum proliferation of T-lymphocytes is achieved at the arginine level in the environment of 100 μmol/l, and no further increase in the proliferation rate is observed at higher concentrations. At arginine deficiency, a progressive decrease in the number of T-cell receptors on the cell membrane occurs.

Additionally, arginine is required for the killing of tumor cells by activated macrophages. Besides, arginine in high concentrations increases the cytotoxicity of monocytes *in vitro*.

Thus, arginine stimulates immunity due to the action on lymphocytes, macrophages and dendritic cells [12].

Kurtseva et al. presented the results of studying the reparative and immunotropic action of a combination of amino acids (glycine + histidine + *lysine*) with *lysine* [13]. It was found that the combination of amino acids – lysine and glycine – enhanced the functions of neutrophils.

When studying the immunotropic effects of amino acids separately, it was found that histidine did not influence the neutrophils function whereas glycine and lysine had a stimulating effect. An addition of glycine resulted in an increase of phagocytic index (PhI) by 1.5 times, and phagocytic number (PhN) — by 1.6 times. An increase in the level of stimulated reaction of the NBT-test by 1.3 times was also observed. An addition of lysine was accompanied by an increase in the absorption capacity of neutrophils, as evidenced by an increase in (PhN) by 1.8 times compared with the control.

It can be assumed that an increase in the absorption capacity of phagocytosis under the influence of lysine is associated with its stress-limiting effect.

According to some data, lysine has a stimulating effect on the phagocytic activity of neutrophils whereas no significant changes in specific indicators of the immune response were detected.

Researches of a number of virologists have revealed that L-lysine is able to inhibit the replication of the herpes simplex virus in cells and thus to reduce the disease duration [14].

Threonine is a major component of intestinal mucins and IgA, which are secreted during lipopolysaccharide (LPS)-induced inflammation. The results of the *in vivo* study in chickens [15] showed that threonine deficiency causes a violation of the inflammatory and secretory immune response.

The need for threonine during lymphocyte proliferation and immunoglobulin A production was established *in vitro* and *in vivo*.Therefore, threonine is a key element involved in the production of mucins and IgA to maintain the intestinal secretory immune system.

Thus, among the essential amino acids, leucine, valine, arginine and lysine have the greatest influence on immune responses. These amino acids enhance the phagocytic activity of macrophages and stimulate the formation of NO in the body, which in turn is able to have a specific immunomodulatory effect and act as one of the main effectors of cellular immunity.

The nonessential amino acids perform also many important functions in the body.

Scientists [16] have found that glutamic acid plays an important role in maintaining lymphocyte homeostasis. It is known that in a medium devoid of glutamic acid or glutamine, lymphocytes completely lose the ability to proliferate.

The ability of glutamic acid to modulate the functional state of lymphocytes by receptor mechanisms was also established.

In [17], the scientists studied experimentally the immunocorrective properties of the composition phenotropil + L-glutamic acid in the models of cyclophosphamide immunodepression and LPS-induced immune stress. It was found that this composition restores cellular and humoral parts of immunity as well as lymphoproliferative processes in immunocompetent organs.

It was found that glutamic acid has a stimulating effect on the activity of the immune system due to increasing the number of antibody- and rosette-forming cells in the spleen of laboratory animals with immunosuppression.

There is growing evidence that some amino acids play a role in the regulation of key metabolic pathways required for maintenance, growth, reproduction, and immunity.

The scientists [18] evaluated the modulating functions of several amino acids in protective immunity against herpes simplex virus type 1 (HSV-1). It was found that glutamine and leucine show increased immune protection against HSV-1 with double administration of glutamine and a single injection of leucine per day. Here, an increased formation of interferon IFNγ in the vaginal tract was observed on the 2^{nd} and 4^{th} days

after infection. The activity of *NK*- and *Th1*-type *CD4 + T* cells, which increases under the influence of glutamine and leucine, is thought to play a crucial role in providing effective protective immunity against HSV-1 infections.

Additionally, glutamine and arginine increase the expression of antioxidant genes and decrease the expression of pro-inflammatory genes in the small intestine and adipose tissue.

It has been shown that glutamine affects the growth of immune cells, the functioning of T cells, as well as the immunoglobulin A (IgA) synthesis [19].

Chinese scientists [20] show also that arginine and glutamine affect the immune responses and intestinal morphology of striped perch. Arginine and glutamine tend to improve the production of neutrophil oxidative radicals. They increase the activity of lysozyme as well. Glutamine is the main source of energy of enterocytes and immune cells. Both arginine and glutamine have been shown to modulate the immune functions in pathological conditions in mammals. Additionally, some studies show that glutamine may be a precursor to arginine for the synthesis of nitric oxide (NO) in immune cells.

Glutamine as the main energy substrate for leukocytes and a key modulator of the cytokine and NO production plays a crucial role in the immune response.

Aspartic acid is also important for the immune system. Scientists from Russia have found [19] that the inclusion of 10% L-aspartic acid to the mineral complex in the diets of piglets is sufficient to provide higher protective properties in animals. Under the influence of this amino acid, the highest phagocytic activity was observed.

Since aminoacids are absorbed in large quantities and the body's need for the mishigh, a so-called «deception» of the body's absorption system occurs, and most likely a change in the phagocytic activity of the blood serum of guinea pigs in the experimental groups towards higher values indicates the intensity of the phagocytosis process, which is most pronounced in animals of the group receiving 10% aspartic acid.

Proline is a key regulator of several biochemical and physiological processes in cells. For example, proline is a signaling molecule, a cellular energy sensor, and a source of superoxide-anion, a free radical involved in redox reactions in humans and animals. Additionally, proline takes part in protecting lymphocytes against apoptosis by stimulating cell growth and antibody synthesis. Proline-enriched polypeptide complex can affect not only adaptive immunity, but also innate immunity, thereby regulating the secretion of inflammatory mediators. In general, proline plays an important role in physiological and immunological functions [21].

One more study was performed to determine the immunostimulatory effect of proline on vaccine-inactivated immunized mice. The survival of mice, the diet of which was supplemented with 0.4% L-proline was higher, indicating an immunostimulatory effect.

Thus, nonessential amino acids also significantly affect the immune response in the body. The leading role is played by glutamic acid, aspartic acid, proline and serine, which are present in high concentrations in goat milk and colostrum. The mechanism of the immunostimulating action of these amino acids consists in maintenance of homeostasis of lymphocytes, stimulation of the development of antibody- and rosette-forming cells in the spleen, enhancementof the interferon formation, an increase of the expression of antioxidant genes and a decrease of the expression of pro-inflammatory genes. Amino acids also enhance phagocytic activity, protect lymphocytes against apoptosis by stimulating antibody synthesisand control T-cell proliferation.

The effect of goat's milk on the skin and its use in cosmetology. Recently, variety of cosmetics are produced in the world from goat's milk, including soaps, creams, body lotions, shampoos, hair conditioners and aftershave lotions. Large cosmetic companies show increasing interest in colostrum-based nutraceutical creams, which help to restore and accelerate the recovery of aging skin [22].

Scientists performed a comparative analysis of goat's and cow's milk and found that the substances of goat's milk more easily penetrate into the deep layers of the skin, since they contain oleic or caprylic fatty acid, and more quickly saturate the skin with vitamins, phospholipids, and fatty acids. This property of goat's milk is associated with high content of fatty acids.

Goat milk replenishes the deficiency of fats and linolenic acid (its content in goat milk is 1.5 times higher than in cow's milk) and provides other fatty acids, linoleic and arachidonic, which are necessary for the skin but not synthesized by the body. Thanks to the fatty acids in goat milk, the skin becomes smooth and healthy.

Essential fatty acids are the precursors of pharmacologically active substances involved in cell division and epidermal differentiation. They are able to change the inflammatory and immunological reactions, which modify the functions of leukocytes and accelerate the process of tissue granulation. Goat's milk acts as a good skin regenerator because it contains caprylic acid. Additionally, the fat globules due to their small size penetrate into the middle layer of the skin (dermis), moisturizing and rejuvenating it [23].

Unsaturated fatty acids are involved in the regeneration of epidermal cells. In goat's milk, they are absorbed into the skin faster due to lower melting point. For comparison, fatty acids in cow's milk melt at the temperature 29–42 °C, i.e. higher than the human body' stemperature, which greatly complicates their absorption by the skin. The fatty acids of goat's milk begin to be actively absorbed and work already at a temperature of 26–28 °C.

Addition, unsaturated fatty acids enhance the anti-aging effect of the components of goat milk – vitamins and phospholipids.

With age, the amount of skin phospholipids decreases significantly, which is associated with lower rates of their formation and self-healing processes in the epidermis. Lack of phospholipids leads to metabolic disorders and impaired blood circulation, which resulted in rapid aging of the skin. Goat milk's phospholipids supplement the skin's phospholipid deficiency, improve blood microcirculation, restore the activity of epidermal cell membranes and slow down the aging process [24].

It has been established that milk lactoferrin shows a significant improvement in dermatological symptoms in the treatment of fungal skin infections [25].

Peptides isolated from goat's milk are often used in the manufacture of cosmetics. For example, hydrolyzed milk protein is used in 200 formulations.

Sodium caseinate is most often used in production of bath salts and oils, in concentrations up to 0.1% — in the facial and neck care products.

Whey protein is used in face and neck skin care products.

Some of these peptides can be used in products that may come into contact with mucous membranes and eyes. For example, milk proteins in concentrations up to 0.5% are used in eye makeup.

Additionally, some milk peptides have been reported in deodorants, hair sprays, face powders, face and neck sprays, body and hand sprays, perfumes. For example, casein was used in deodorant. Milk peptides at a concentration of 0.0002% are also used in face powders [26].

Another advantage of goat milk's proteins is a higher content of amino acidsleucine, glutamine and asparagine as compared with cow's milk. These amino acids help to quickly heal wounds, microcracks on the skin, have an anti-inflammatory effect [27].

Goat milk contains also a large amount of zinc. Zinc is an important element for maintaining healthy skin, wound healing and is directly involved in both innate and adaptive immunity. Zinc has antioxidant activity and helps to eliminate oxygen reactive species due to its role as a cofactor of the antioxidant enzyme superoxide dismutase [28].

Goat milk is an essential source of vitamins: vitamin A, thiamine, riboflavin and niacin. However, compared to cow's milk, goat's milk has less vitamin E, folate and vitamin B12 [29].

Vitamin A enhances the processes of collagen and elastin synthesis in the skin. Thanks to vitamin A, the skin becomes smooth and elastic, as this vitamin regulates the growth of epidermal cells [24, 29]. Vitamin B1 (thiamin) has a positive effect at seborrhea, alopecia, dermatitis and other skin problems. Vitamin B2 (riboflavin) promotes wound healing. Niacin improves cellular respiration, gives a healthy tone and smoothness to the skin [24].

Goat's milk also contains a significant number of growth factors. Goat colostrum growth factors help in building and regenerating the skin.

Epidermal growth factors (EGF) help to prevent the destruction of skin cells that can occur at autoimmune disorders. Transforming growth factor (TGF) and insulin-like growth factor (IGF-1) stimulate skin growth and cell growth and restore it by direct action on DNA and RNA, improving wound healing [30]. Transforming growth factor β (TGF-β), acidic and alkaline fibroblast growth factors (FGF), milk growth factor (MGF) have a protective and regenerating effect on the skin.

Considering this, it is advisable to use goat's milk in regenerating cosmetics.

The main task of regenerating cosmetics is to stimulate cell division of the basal layer of the epidermis. Almost all the means, which are combined with the concept of "regenerating", to some extent affect the rate of cell division. However, most often they play secondary role. They only create certain conditions for better

cells division but do not stimulate division themselves.

Goat milk effectively promotes immune defense of the skin and slows down its aging by the influence on cellular immunomodulation. Goat milk is a source of a complex of antioxidants: amino acids of glutathione, vitamins E, C, A, selenium, Q-enzyme, proteins — lactoperoxidase, lactoferrin, alpha-lactoalbumin. These substances strengthen cell membranes, keeping cells healthy [24].

Many cosmetics are made from goat milk — soaps, creams, lotions, facemasks. Goat milk soap does not contain harsh chemicals and is therefore ideal for sensitive skin. This soap prevents irritation and damage to the skin. It is often recommended by dermatologists and is successfully used to heal people with skin conditions such as psoriasis, eczema, acne, xerodermia and itch [31].

Goat milk is used to produce antibacterial soap, which can inhibit the growth of *S. aureus, B. subtilis, Candida albicans, Micrococcus, Enterococcus, Staphylococcus epidermidis*. Therefore it is effective in treating acne and skin infections, as it inhibits the growth of pathogens [32].

A face mask was developed on the basis of fermented goat milk. Its whey peptides and lactic acid were shown to reduce skin pigmentation; besides, lactic acid inhibits the growth of the causative agent of acne *Propionibacterium acnes* [33].

A cosmetic product containng goat milk and sweet orange extract has been also developed. This product has moisturizing and anti-allergic properties and is effective in the prevention and treatment of eczema [34].

So, considering the significant content of various biologically active substances in goat milk and colostrum, they are used to create the cosmetics effective in combating skin diseases such as psoriasis, eczema, acne, etc.

The use of goat's milk in food. Another promising area of use of goat's milk and colostrum is the production of food products.

Goat milk triggers innate and adaptive immune responses in the human body. Consumption of goat's milk increases the production of NO in the body, which has a cardioprotective and antiatherogenic effect. Additionally, the induction of proinflammatory (TNF- and IL-6) and anti-inflammatory (IL-10) cytokines indicates the ability of goat's milk to maintain immune homeostasis in humans, especially aged people, since they have a reduced immune response, and as a result the elderly demonstrate an increase in infections, cancer and autoimmune diseases. That is why dietary products based on goat's milk can be useful in strengthening age-related immunity [35].

Goat milk has a specific "goat" smell, which restrictsits consumption. The specific smell of goat's milk is associated primarily with the composition of fatty acids. The content of capronic, caprylic and capric acids in goat's milk is slightly higher than in cow's milk. During fermentation, goat's milk loses its odor whereas the nutritional value of goat's milk may increase. Therefore, the production of fermented dairy foodstuffs, such as cheese, kefir, yoghurt, is of great impotance.

Recent studies focused on the natural antioxidant components of milk and dairy products. For example, consumption of goat's milk cheese produced with *Lactobacillus fermentum* CRL1446 affects the activity of intestinal feruloyl esterase, which increases by 1.5 folds. Therefore, goat's milk cheese can be used as a functional product with the activity of feruloyl esterase, which is responsible for an increase of intestinal activity and bioavailability of the antioxidant of ferulic acid in the intestine, thereby providing protection against oxidative stress [36].

The antioxidant properties of kefir from goat milk were also investigated for the absorption of radicals, such as 2,2-diphenyl-1-picrylhydrazyl, 2,2'-azino-bis-(3-ethylbenzthiazoline-6-sulfonicacid). It was found that the antioxidant activity increases during the first 8–12 hours of fermentation, and then gradually decreases. When stored for 21 days, the antioxidant activity of kefir increases also [37].

Fermented goat's milk, influencing antioxidant activity, plays a positive role in the treatment of iron deficiency anemia. After consumption of fermented goat's milk, a significant increase of some antioxidant endogenous enzymes was found, along with an increase in total level of antioxidants. Thereby milk protects the main cellular components (lipids, proteins, DNA) from oxidative damages occuring during anemia [38].

Probiotic lactobacilli are able to release bioactive peptides during milk fermentation. The antihypertensive effect of fermented goat's milk due to inhibiting angiotensin-converting enzyme (ACE) was investigated. Extremely high activity with regard to ACE inhibition was found in the goat's milk fermented with *Lactobacillus reuteri, Lactobacillus bulgaricus, Lactobacillus rhamnosus, Lactobacillus helveticus* [39].

Additionaly, goat's milk and yoghurtmade using a *Lactobacillus acidophilus* culture, have a protective effect against the intestinal lesions, so they can be used in functional foods at the inflammatory bowel diseases, such as Crohn's disease and ulcerative colitis, which are consumptive and immunologically mediated diseases, at which the excessive inflammatory reactions of the intestinal mucosa and destruction of the gastrointestinal tracttissues take place.

It has been proven that when goat's milk or yogurt is consumed, the activity of myeloperoxidase, the level of leukotriene B4, interleukin-1β and tumor necrosis factor-α significantly improved. Goat milk intake also contributes to a significant reduction in oxidative stress, which is manifested in a decrease of malodialdehyde and an increase of glutathione. This preserves the colon cytoarchitecture and reduces the expression of cyclooxygenase-2 and nitric oxide synthase [40].

Yoghurt is also made from goat's milk. Quality yogurt is produced by fermentation at a ratio of lactic acid bacteria – *Lactobacillus delbrueckii* ssp. *bulgaricus, Streptococcus thermophilus* and *L. rhamnosus* GG — 1:1:3 [41].

Cottage cheese is one more functional product made from goat milk. In its production, a starter culture containing *Lactobacillus acidophilus, Streptococcusthermophilus, Bifidobacteriumlongum, B. bifidum, B. infantis*is used.The nutritional and biological value of cottage cheese lies in alarge amount of proteins, lactose, calcium, phosphorus, and valuable probiotic cultures [42].

Recently, the production of functional fermented goat milk products supplemented with synbiotics has attracted attention in terms of health promotion. It has been shown that the most effective prebiotics regarding the antioxidant activity of fermented dairy products are inulin and fructo-oligosaccharide [43].

Also, a high-protein dessert for sports nutrition is made on the basis of goat's milk. Whey protein isolate and micellar casein in a ratio of 30/70 are used as protein sources with a complete amino acid composition, which makes it possible to obtain a dessert with a harmonious milk taste and a homogeneous structure [44].

Goat's milk and colostrum are natural protein bases for creating instant food mixtures with immunomodulatory properties and reduced, compared to cow lactation products, allergenicity. Thus, goat's milk and colostrum can be used as components of a healthy diet for the prevention and treatment of chronic diseases of the cardiovascular system — coronary insufficiency, atherosclerosis, hypertension.

To stabilize the biologically active substances of goat's milk and colostrum in the produced mixtures, the technologyis proposed, which includes preliminary removal of moisture by baromembrane methods, freezing with cryogenic liquids (liquid nitrogen),and sublimation drying [45].

Goat's milk is also used to make cheese and sweet cheese products containing caramel, cocoa and walnuts. Goat cheese is a high-quality protein product because it contains a large number of essential amino acids such as methionine, cysteine and tryptophan. Also, sweet cheese samplesare stable against bacteria and other microorganisms during storage. Thus, goat cheese can be considered as a useful product, especially for feeding children, because it is easily digested [46].

Thus, goat's milk and dairy products provide positive effect on the body due to their antioxidant, anti-inflammatory, cardioprotective, antihypertensive, antiatherogenic properties; they are functionalat iron deficiency anemia, inflammatory bowel disease.

Use of goat milk and colostrum for baby feeding. Good quality infant nutrition is essential for normal growth and development. Infant formula is used as supplement during breastfeeding, or if breast milk is insufficient or breastfeeding is not possible. Cow's milk is most commonly used in infant formula, but recent research shows that using goat's milk for infant feeding has many benefits.

First, whey proteins are often added to infant formulas as a source of main essential amino acids. The infant formulas made from goat's milk contain a sufficient amount of all essential and nonessential amino acids without any addition of whey proteins [47].

Second, comparing the breastfed infants and those fed by formulas with cow and goat milk, it was found that babies who consumed goat milk formulas gain better weight and height. This is likely due to higher protein content in goat's milk formulas than in breast milk and cow's milk formulas.

Also, when children are fed with goat milk formulas, there is a significant decrease in the frequency of colic, which indicates an improvement of the process of food digestion. Additionally, an improvement of

the fatty acids absorption in the intestine was found, which once again confirms the easier assimilation of the fatty components of the goat milk formula [48].

Based on the evaluation of clinical efficacy of the adapted goat milk-based formula, it was found that it meets the physiological needs of infants for basic nutrients and energy, and supports their normal physical development. Moreover, the majority of infants (95%) who consumed goat milk-based formulas showed good tolerance to the product and a high degree of the protein assimilation and utilization [49].

Goat's milk proteins in infant formula are absorbed faster in the gastrointestinal tract of infants than cow's milk proteins. The assimilation of essential amino acids in goat milk in infants does not differ in comparison with human milk [50].

The assimilation of goat milk proteins and the kinetics of their digestion are similar to those of breast milk proteins. Casein from goat milk is generally more efficiently absorbed than casein from cow's milk [51].

Additionally, goat milk contains smaller fat globules, which results in a more uniform distribution of fat in the milk and makes the digestion of goat milk easier.

Thus, feeding babies with goat milk-based formulas is close in efficiency to breastfeeding and has a number of advantages regarding the cow's milk-based formulas. Therefore, the use of goat milk-based formulas for feeding children provides comfortable digestion, prevention of functional disorders of the gastrointestinal tract, reduces the risk of inflammation of the intestinal mucosa.

Thus, goat's milk and colostrum are unique products that can be used to create cosmetics for maintaining healthy skin and treating skin diseases, as well as toproduce functional foods with antioxidant and anti-inflammatory properties and infant formulas, which are very useful due to good digestibility and the content of all substances necessary for the babies.

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ПРАКТИЧНЕ ВИКОРИСТАННЯ КОЗИНОГО МОЛОКА ТА МОЛОЗИВА

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В огляді наведено інформацію стосовно протеїнового й амінокислотного складу козиного молозива та молока, проаналізовано властивості компонентів молозива та молока кіз. Окрім цього, показано перспективи застосування козиного молока та молозива у харчовій і косметичній промисловості, доцільність використання козиного молока для дитячого вигодовування. Функціональні харчові продукти з козиного молока виявляють антиоксидантні, протизапальні, кардіопротекторні, антигіпертензивні та антиатерогенні властивості в організмі людини. Косметичні засоби на основі козиного молока є дуже корисними для підтримання здорового вигляду шкіри і ефективними у лікуванні різних захворювань шкіри. Дитячі суміші на основі козиного молока забезпечують комфортне травлення у немовлят і є кращими у засвоюванні протеїнів, жирів та інших поживних речовин порівняно із сумішами з коров'ячого молока.

Ключові слова: козине молозиво, козине молоко, протеїни, амінокислоти, косметологія, дитяче харчування.

ПРАКТИЧЕСКОЕ ИСПОЛЬЗОВАНИЕ КОЗЬЕГО МОЛОКА И МОЛОЗИВА

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В обзоре представлена информация о протеиновом и аминокислотном составе козьего молозива, проанализированы свойства компонентов молозива коз. Кроме того, показаны перспективы применения козьего молока и молозива в пищевой и косметической промышленности, целесообразность использования козьего молока для детского вскармливания. Функциональные пищевые продукты из козьего молока оказывают антиоксидантный, противовоспалительный, кардиопротекторный, антигипертензивный и антиатерогенный эффект в организме человека. Косметические средства на основе козьего молока очень полезны для поддержания здорового вида кожи и эффективности в лечении различных заболеваний кожи. Детские смеси на основе козьего молока обеспечивают комфортное пищеварение младенцев и являются лучшими в усвоении протеинов, жиров и других питательных веществ по сравнению со смесями из коровьего молока.

Ключевые слова: козье молозиво, козье молоко, протеины, аминокислоты, косметология, детское питание.