MICHALSKA, Martyna, WINIAREK, Karolina, WARDYN, Wiktor, TOKARCZYK, Elżbieta, ZIEMIŃSKA, Daria, GUZOWSKI, Cezary, BURCZYK, Rafal and MURAWSKA, Joanna. Colostrum: The Golden Elixir of Health – Unveiling Its Multifaceted Benefits in Modern Medicine. Quality in Sport. 2024;32:56082. eISSN 2450-3118.
https://dx.doi.org/10.12775/QS.2024.32.56082
https://apcz.umk.pl/QS/article/view/56082

The journal has been 20 points in the Ministry of Higher Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024. No. 32553.
Has a Journal's Unique Identifier: 201398. Scientific disciplines assig589 ned: Economics and finance (Field of social sciences); Management and Quality Sciences (Field of social sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 r. Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398.
Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 09.10.2024. Revised: 13.11.2024. Accepted: 14.11.2024. Published: 15.11.2024.

Colostrum: The Golden Elixir of Health – Unveiling Its Multifaceted Benefits in Modern Medicine

1. Karolina Winiarek
Wojewódzki Szpital Zespolony im. Ludwika Rydygiera w Toruniu, ul. Św. Józefa 53-59, 87-100 Toruń
ORCID: 0000-0001-7305-0613
https://orcid.org/0000-0001-7305-0613
karolinawiniarek97@gmail.com

2. Martyna Michalska
Szpital św. Wincentego a Paulo, ul. Wójta Radtkego 1, 81-348 Gdynia
ORCID: 0009-0002-3467-4364
https://orcid.org/0009-0002-3467-4364
martynamichalska1997@gmail.com

3. Wiktor Wardyn
Wojewódzki Szpital Zespolony im. Ludwika Rydygiera w Toruniu, ul. Św. Józefa 53-59, 87-100 Toruń
ORCID: 0009-0002-6133-2220
https://orcid.org/0009-0002-6133-2220
wiktor12398@gmail.com

4. Elżbieta Tokarczyk
Szpital św. Wincentego a Paulo, ul. Wójta Radtkego 1, 81-348 Gdynia
ORCID: 0009-0003-9683-7699
https://orcid.org/0009-0003-9683-7699
elzbieta.tokarczyk96@wp.pl

5. Daria Ziemińska
Szpital św. Wincentego a Paulo, ul. Wójta Radtkego 1, 81-348 Gdynia
ORCID: 0009-0001-8240-2593
https://orcid.org/0009-0001-8240-2593
dziemin98@wp.pl

6. Cezary Guzowski
Wojewódzki Szpital Zespolony im. Ludwika Rydygiera w Toruniu, ul. Św. Józefa 53-59, 87-100 Toruń
ORCID: 0000-0002-0022-9943
https://orcid.org/0000-0002-0022-9943
cezary.guzowski@gmail.com

7. Joanna Murawska
Szpital Uniwersytecki nr 1 im. dr Antoniego Jurasza, ul. Marii Skłodowskiej- Curie 9, 85-094 Bydgoszcz
ORCID: 0000-0001-7564-938X
https://orcid.org/0000-0002-0022-9943
Joanna.murawska94@wp.pl

8. Rafał Burczyk
Szpital Uniwersytecki nr 2 im. dr Jana Biziela, ul. Ujejskiego 75, 85-168 Bydgoszcz
ORCID: 0000-0002-1650-1534
https://orcid.org/0000-0002-1650-1534
raimer001@gmail.com

Abstract

Introduction: Colostrum is uniquely rich in immunoglobulins, growth factors, antibacterial peptides, probiotics, prebiotics, and essential vitamins and minerals. Available as a supplement, BC is used to prevent gastrointestinal infections, boost immune support, and aid in managing chronic inflammation, autoimmune diseases, and even athletic recovery.

Aim: The aim of this article is to assess the potential benefits of colostrum across various health areas, including gastrointestinal health, immune system support, respiratory diseases, dermatology, autoimmune conditions and the development of preterm infants. The article will also present a critical analysis of current scientific data and examine future research directions and therapeutic advancements.

Review methods: This article is based on a comprehensive, non-systematic review of the scientific literature. A thorough search of the PubMed database was conducted, and 45 sources published up to 2024 were analyzed to ensure that the information presented is current and relevant.
Abbreviated description of the state of knowledge: Analysis of the literature suggests that colostrum may provide passive protection, reduce inflammation and support gut integrity in preterm infants. Inflammatory bowel disease may benefit from colostrum, though results for IBS are mixed. It aids wound healing, has anti-aging effects, and shows potential in autoimmune disease management. It also boosts respiratory immunity and aids athletes' recovery and performance.
Conclusions: Colostrum contains bioactive components like immunoglobulins, lactoferrin, and growth factors. While current studies highlight its benefits in enhancing immunity, supporting gut health, and managing inflammatory conditions, more comprehensive clinical trials are required to confirm its efficacy and safety across various populations and health conditions.

Keywords: colostrum, bovine colostrum, inflammatory bowel disease, acute diarrhea, irritable bowel syndrome, wound healing, skin regeneration, skin aging prevention, immune system, athletes, neonates

Introduction

Colostrum, also known as colostrum, is the first fluid secreted by the mammary glands of mammals shortly after birth. Its unique composition distinguishes it from later milk – colostrum is rich in immunoglobulins, growth factors, antibacterial peptides, probiotics, prebiotics, and various vitamins and minerals. Thanks to these components, colostrum plays a key role in protecting newborns from infections and supporting their immature immune system [1].

The immunoglobulins contained in colostrum, especially IgG, IgA, and IgM, provide a natural barrier against pathogens, which is essential during the neonatal period. Growth factors such as insulin-like growth factor (IGF-1) and transforming growth factor (TGF-β), support tissue development and wound healing, which is particularly important in the regeneration of the digestive and respiratory tracts. It is these bioactive properties that have made colostrum interesting not only in the context of neonatal health, but also in adults, as a component with a wide range of potential health applications.

Recent studies suggest that bovine colostrum (BC), or bovine colostrum, has similar properties to human colostrum and may be a valuable supplementary source for humans. BC is available in the form of dietary supplements and is used to prevent gastrointestinal infections, support the immune system, and support the treatment of chronic diseases and inflammation [2, 3]. In addition, colostrum is used to prevent diarrhea, especially in children, and to protect athletes from infections caused by exhaustive training and physical stress, making it an interesting tool in sports medicine [4].

Some studies indicate anti-cancer properties of colostrum, resulting from its ability to inhibit the growth of cancer cells, which may have potential importance in the treatment of some types of gastrointestinal cancers.
Regenerative and immunomodulatory properties mean that colostrum is also increasingly used in the treatment of autoimmune diseases and in supporting the immune system in patients weakened by disease or treatment [5].
Both human and bovine colostrum are being intensively studied in the context of their potential applications in medicine and public health. Activities aimed at processing and stabilizing colostrum enable its introduction as a component of functional foods and supplements, which opens up new possibilities for its commercialization and implementation in the food and health market.

Effects of colostrum on the immune system

Colostrum contains numerous bioactive components that support the immune system and are particularly beneficial for newborns whose immune systems are not fully developed. A review of contemporary scientific studies shows that colostrum enhances the immune response in many ways, from passive protection against infections to supporting the maturation of key immune cells.
Passive immunity through immunoglobulins Colostrum is rich in immunoglobulins, in particular IgA, IgG and IgM, which play a key role in the passive transfer of immunity from mother to child. These immunoglobulins form a protective layer on the mucous membranes of the gastrointestinal tract, which is the first line of defense against pathogens [6,7]. Thanks to this, newborns who do not yet fully produce their own antibodies receive immediate protection against bacteria and viruses present in the environment.
Active support for the immune system thanks to lactoferrin and cytokines Lactoferrin, present in high concentrations in colostrum, has strong antibacterial, antiviral and immunomodulatory properties. By binding iron ions, lactoferrin limits the availability of this element for pathogens, which inhibits their growth. Lactoferrin also supports the activation of immune cells, such as neutrophils, which are key in the fight against infections [7]. Cytokines, such as interleukins and growth factors, support inflammatory processes and modulate the immune response, stimulating the maturation of T and B cells, which is essential for long-term immunity [8].
Colostrum supports the development of a healthy gut microbiota, which plays a key role in the functioning of the immune system. A healthy gut microbiota affects the maturation of the immune system, protecting against pathogen invasion and supporting immune responses against infections. Studies indicate that colostrum proteins, such as defensins and lysozyme, support the integrity of the intestinal mucosa, which reduces the risk of inflammation and intestinal infections [9,10].
Colostrum components can modulate the inflammatory response, which is especially important in newborns with an immature immune system. Animal studies have shown that colostrum reduces the activity of inflammatory markers while supporting the production of antibodies and cytokines that control the immune response [11]. Such modulation helps

maintain the balance between pro- and anti-inflammatory responses, which is essential for health.

Colostrum, thanks to the presence of bioactive components, also stimulates the development of regulatory T cells (Tregs), which play a key role in maintaining immune homeostasis. Tregs prevent excessive immune responses, which is important in preventing autoimmune reactions and in food tolerance [12].

Effects of colostrum on the development of preterm infants

Preterm infants have an immature immune system, making them more susceptible to infections. Colostrum supports the immune response by providing immunoglobulins, mainly IgA, which are the first line of defense against pathogens in the digestive system [13]. Immunoglobulins contained in colostrum help protect the intestinal mucosa and prevent pathogens from entering the body [14]. Colostrum supplementation has been shown to reduce the risk of infections, which may contribute to improved health outcomes in preterm infants [15].

The digestive system of preterm infants is also immature and prone to inflammation and conditions such as necrotizing enterocolitis (NEC). Studies suggest that colostrum supports the development of intestinal epithelial cells, improving their barrier function and accelerating repair processes [16]. Colostrum is also a source of growth factors, such as epidermal growth factor (EGF), which support the regeneration of the intestinal mucosa [17]. Furthermore, colostrum supports the development of a beneficial gut microbiota, which is crucial for the intestinal health of preterm infants [18].

Clinical studies have shown that oropharyngeal colostrum (OPC) supplementation can significantly reduce the incidence of necrotizing enterocolitis and respiratory tract infections. In a randomized controlled trial conducted by Nasuf et al. (2018), preterm infants fed colostrum had significantly fewer cases of NEC and fewer infections compared to the control group. Additionally, in the study by Sangild et al. (2021) showed that colostrum supplementation before formula feeding improved gut function and reduced inflammatory markers [19,17]

Another meta-analysis of clinical trials found that preterm infants fed colostrum had higher levels of immune cells, such as regulatory T cells, which modulate immune responses, reducing the risk of excessive inflammatory responses [15].

Use of Colostrum in Gastroenterology

Inflammatory bowel disease (IBD) encompasses a group of inflammatory disorders affecting the small intestine and colon, primarily categorized into ulcerative colitis (UC) and Crohn's disease (CD). While these conditions share certain symptoms, they are distinct diseases influenced by a combination of genetic, environmental, and immunologic factors [20]. Crohn's disease can affect any part of the digestive tract, from the mouth to the anus, involving all layers of the intestinal wall. In contrast, ulcerative colitis is limited to the mucosal layer of the colon, with lesions typically found in the rectum and extending through the intestine. Symptoms vary from mild to severe and, in some cases, can be life-threatening [21].

Bovine colostrum has demonstrated promising results in alleviating inflammation and symptoms in both animals and humans. In murine models of colitis, bovine colostrum and its components have been effective in preventing or reducing chemically induced colitis [3]. Studies indicate that bovine colostrum may primarily counteract the increase in pro-inflammatory cytokines; however, the complex cytokine storm observed in IBD patients suggests that its beneficial effects likely arise from multiple mechanisms. Further research is essential to clarify these effects, such as investigating whether colostrum-induced modulation of monocyte or macrophage activity can reduce the pro-inflammatory state throughout the gastrointestinal tract in human IBD [22].

Irritable bowel syndrome (IBS) is a functional gastrointestinal disorder characterized by abdominal pain linked to changes in stool form or frequency.

Although its pathophysiology is not fully understood, it is well established that IBS involves disrupted communication between the gut and brain, resulting in motility disturbances, visceral hypersensitivity, and altered central nervous system processing. Additional, less consistent mechanisms may include genetic predispositions, changes in gastrointestinal microbiota, and disturbances in mucosal and immune function [23]. Prospective, double-blind, randomized, placebo-controlled trial found that colostrum did not provide benefits in alleviating symptoms or enhancing mucosal immunity in patients with IBS. Therefore, further large-scale studies are necessary to assess the potential effectiveness of colostrum in IBS patients [24].

Infectious inflammatory diarrhea is a severe form of diarrhea, typically caused by invasive or toxin-producing bacteria, though viral and parasitic pathogens can also be responsible. Symptoms such as bloody stools, high fever, significant abdominal pain, or a duration exceeding three days suggest an inflammatory infection. In North America, the most commonly identified inflammatory pathogens include *Salmonella*, *Campylobacter*, *Clostridioides difficile*, *Shigella*, and Shiga toxin–producing *Escherichia coli* [25]. Bovine colostrum (BC) products have proven effective in managing clinical symptoms and reducing pathogenic agents in cases of infectious diarrhea in children, showing improvements in stool frequency, diarrhea occurrence, and pathogen detection [26]. Lactoferrin in bovine colostrum can stimulate the secretion of anti-inflammatory cytokines and promote T helper lymphocyte polarization, potentially aiding in the prevention of enteric infections and sepsis [4]. Studies have indicated that bovine colostrum supplementation can reduce the frequency of diarrhea and improve stool consistency, though it does not impact the duration of diarrhea. Additionally, colostrum was effective in lowering the rate of hospital admissions due to diarrhea in children but did not shorten the length of hospital stay [27].

The use of colostrum in dermatology, wound healing and skin aging prevention

Colostrum has numerous applications in dermatology and is becoming an increasingly popular cosmetic ingredient. It is rich in bioactive components that support and stimulate wound healing and skin regeneration processes, while also providing anti-aging benefits [28,29]. The non-casein bioactive peptides found in colostrum may contribute to its anti-inflammatory properties, indicating its potential usefulness in treating inflammatory skin conditions [30].

Studies compare colostrum to mature milk produced during lactation, generally concluding that colostrum is richer in immune and bioactive factors [31].

The positive effect of colostrum on skin wound healing may result from the presence of growth factors and other immune-regulating components [29]. Growth factors are essential for key metabolic activities, such as cell proliferation. Bovine colostrum contains growth factors like Epidermal Growth Factor (EGF), Transforming Growth Factor Beta (TGF-β), and Platelet-Derived Growth Factor (PDGF). EGF promotes granulation tissue formation, reduces inflammation, and supports re-epithelialization, accelerating wound closure. During the healing process, TGF-β1 shifts from acting as a pro-inflammatory mediator to an anti-inflammatory role, which is essential for tissue repair and inflammation resolution.

PDGF serves as a potent chemoattractant, drawing fibroblasts, neutrophils, monocytes, and smooth muscle cells to the wound site. It also activates macrophages and stimulates fibroblast proliferation, contributing to extracellular matrix production and playing a critical role in new tissue formation and the restoration of tissue integrity [32].

Colostrum-derived extracellular vesicles contain a range of anti-inflammatory factors that aid in transitioning from the inflammatory to the proliferative phase, as well as components that promote tissue remodeling and angiogenesis [33].

Colostrum offers substantial potential as a natural anti-aging agent and in repairing UV-induced skin damage [31]. Its amino acids deliver multiple benefits: proline helps reduce wrinkles and sagging, supports collagen formation, and promotes tissue healing; threonine boosts collagen and elastin production; and methionine provides antioxidant protection [29]. Colostrum-derived exosome treatment has been shown to prevent UV-induced formation of intracellular reactive oxygen species in epidermal keratinocytes. In UV-stimulated melanocytes, these exosomes also significantly reduce melanin production, potentially lowering the risk of excessive melanin accumulation linked to hyperpigmentation disorders [31].

The Use of Colostrum in Autoimmune Diseases

In recent years, research on colostrum has provided increasing evidence of its effectiveness in the context of treating and preventing autoimmune diseases. These diseases, such as rheumatoid arthritis (RA), inflammatory bowel diseases, or type 1 diabetes, represent a significant health problem that requires new therapeutic approaches. Below is a detailed review of studies that particularly focus on the impact of colostrum on various aspects of the immune system.

Research has shown that proline-rich polypeptides (PRP) present in colostrum have the ability to regulate immune responses, which is particularly important for patients with autoimmune diseases. These polypeptides can act as both stimulatory and suppressive agents depending on the immune state of the body. PRPs may reduce the activity of hyperactive immune cells, which can lead to a decrease in inflammation and symptoms of autoimmune diseases, such as rheumatoid arthritis (RA) [34]. A study conducted on an animal model utilized hyperimmune colostrum for the treatment of rheumatoid arthritis (RA). In this study, mice were given colostrum with elevated levels of antibodies directed against specific antigens. The results

showed that mice receiving hyperimmune colostrum exhibited significant reductions in inflammatory symptoms and milder joint changes compared to the control group [35].
The ability of colostrum to reduce intestinal permeability is crucial in the prevention and treatment of diseases associated with leaky gut syndrome. High intestinal permeability, known as "leaky gut syndrome," is commonly associated with autoimmune diseases, such as inflammatory bowel diseases.
Colostrum, due to its content of proteins and growth factors like immunoglobulins and lactoferrin, can strengthen the intestinal barrier, limiting the passage of harmful particles and bacteria into the bloodstream. It has been demonstrated that colostrum supplementation improves gut integrity and reduces inflammation in patients with inflammatory bowel diseases, making it a promising support in the treatment of autoimmune intestinal diseases [36]. The effect of colostrum was studied in patients suffering from inflammatory bowel diseases, including Crohn's disease (CD) and ulcerative colitis (UC).
The research showed that regular colostrum supplementation alleviates symptoms such as abdominal pain and diarrhea and improves the overall well-being of patients. The findings suggest that colostrum may act as a complementary therapy supporting traditional pharmacological treatment. Furthermore, the low risk of side effects makes colostrum a safe option for individuals with gut-related issues [22].
The versatility of colostrum as a therapeutic agent is also emphasized, showing beneficial effects in cases of autoimmune diseases, gastrointestinal disorders, and even certain types of cancer. Scientific studies have presented the mechanisms of colostrum's action in terms of modulating gut microbiota and reducing inflammation, which play a crucial role in the course of autoimmune diseases. These studies highlight the potential of colostrum as a therapeutic support with minimal risk of adverse effects [37].

Colostrum in the Prevention and Treatment of Respiratory Diseases

Colostrum, or the initial milk produced by mammals after birth, has gained increasing recognition in scientific literature for its potential benefits in immune support and as an adjunctive measure in the prevention and treatment of respiratory diseases. This chapter provides a review of the latest research on the impact of colostrum on respiratory health, exploring its immunological properties and applications in various respiratory conditions.
One of the primary mechanisms through which colostrum supports respiratory health is its ability to modulate immunity. Studies have shown that colostrum strengthens mucosal immunity by providing immunoglobulins, mainly IgG, which act as a first line of defense, neutralizing pathogens and preventing their adhesion to the respiratory epithelium, thereby reducing the risk of infection. Additionally, colostrum contains large amounts of lactoferrin, a protein that binds iron and has direct antiviral and antibacterial properties. Lactoferrin has been shown to inhibit the replication of certain viruses and plays a role in enhancing the host's immune defense [38]. Bagwe and colleagues demonstrated that individuals supplementing with colostrum experienced a lower frequency of respiratory infections. These mechanisms include the improvement of macrophage function and the increased activity of natural killer (NK) cells, highlighting colostrum's potential in preventing respiratory diseases [10].

The effects of regular use are particularly significant in children, where frequent infections can have long-term impacts on respiratory health. Studies have included children who received bovine colostrum supplementation. It was observed that the duration of respiratory illnesses was shortened, and overall immunity improved [39]. Similar results were obtained by researchers Loss, G., Depner, M., Ulfman et al., who compared the effects of raw and processed cow's milk in infants. It was confirmed that infants consuming raw milk had a lower risk of respiratory infections [40].

Colostrum as a Dietary Supplement for Athletes

Athletes subjected to intense physical effort are often at risk of inflammation, immune dysfunction, and muscle damage**.** With the growing popularity of natural supplements, bovine colostrum has become a subject of research for its impact on athlete health and post-exercise recovery.

Colostrum, the first milk secreted by cows after giving birth, contains high concentrations of growth factors, immunoglobulins, and bioactive proteins, which may support the body's regenerative processes and enhance physical performance.

In 2016, Mizelman conducted a study on the effects of colostrum supplementation on physical performance, muscle mass, inflammation, and immune function during the regular season for rugby players. The results suggest that colostrum supplementation can reduce inflammation levels and support immunity, allowing athletes to recover faster from intense training [41]. Similar results were obtained by researchers observing the impact of long-term colostrum supplementation on the immune system of young female basketball players. The findings indicated an improved immune response and shortened recovery time after physical exertion [42]. A randomized study conducted in 2024 also examined the effects of colostrum supplementation on the endurance of trained swimmers, showing that colostrum contributes to improved endurance parameters and faster recovery time after intense workouts [43].

A crucial component of physical effort is recovery, which is impossible without a proper diet and a healthy and functional digestive system. In 2017, Hałasa and colleagues investigated how oral colostrum supplementation affects intestinal permeability and fecal zonulin levels in athletes. The results indicate that colostrum reduces intestinal permeability and improves gut health, which is particularly important for athletes exposed to physical stress [44]. In 2022, Cieślicka and colleagues examined the long-term effects of colostrum supplementation on iron homeostasis, which is essential for maintaining proper hemoglobin levels and, consequently, physical endurance, oxidative stress, and inflammation in female athletes. A placebo-controlled study found that colostrum improves iron balance and reduces markers of oxidative stress, which is crucial for long-term physical performance [45].

Summary

Colostrum contains bioactive components like immunoglobulins, lactoferrin, and growth factors, enhancing newborn immunity and gut health. It offers passive protection through immunoglobulins and actively boosts immune cells and reduces inflammation. In preterm infants, colostrum prevents infections and supports gut barrier function, lowering risks of

conditions like necrotizing enterocolitis. In gastroenterology, bovine colostrum helps reduce inflammation in inflammatory bowel diseases, though results are mixed for irritable bowel syndrome. Colostrum aids wound healing and has anti-aging skin benefits. It shows promise in autoimmune disease management by regulating immune responses and enhancing gut integrity. In respiratory health, colostrum reduces infection risk and boosts mucosal immunity. For athletes, it aids recovery, reduces inflammation, and improves gut health, enhancing performance and endurance. Further research is needed to fully understand the mechanisms and potential therapeutic applications of colostrum. While current studies highlight its benefits in enhancing immunity, supporting gut health, and managing inflammatory conditions, more comprehensive clinical trials are required to confirm its efficacy and safety across various populations and health conditions.

Author's contribution

Conceptualization: Martyna Michalska, Karolina Winiarek, Elżbieta Tokarczyk, Wiktor Wardyn, Rafał Burczyk, Joanna Murawska, Daria Ziemińska
Methodology: Wiktor Wardyn;
Software: not applicable;
Verification: Rafał Burczyk, Karolina Winiarek;
Formal analysis: Elżbieta Tokarczyk, Wiktor Wardyn;
Research: Martyna Michalska, Joanna Murawska, Daria Ziemińska, Wiktor Wardyn, Rafał Burczyk, Joanna Murawska, Elżbieta Tokarczyk, Cezary Guzowski;
Resources: Karolina Winiarek, Martyna Michalska, Elżbieta Tokarczyk;
Writing - rough preparation: Daria Ziemińska;
Writing - review and editing, Martyna Michalska, Karolina Winiarek, Elżbieta Tokarczyk, Wiktor Wardyn;
Visualization: Joanna Murawska;
Supervision: Martyna Michalska;
Project administration: Karolina Winiarek;

All authors have read and agreed with the published version of the manuscript.

Funding statement:
The study did not receive special funding

Informed Consent Statement:
Not applicable

Acknowledgments:
Not applicable

Conflict of Interest Statement:

The authors report no conflict of interest.

References:

1. El-Loly MM. Colostrum ingredients, its nutritional and health benefits - an overview. Clinical Nutrition Open Science. 2022;44:126-143. doi:10.1016/j.nutos.2022.07.001
2. Guberti M, Botti S, Capuzzo MT, et al. Bovine Colostrum Applications in Sick and Healthy People: A Systematic Review. Nutrients. 2021; 13(7):2194. https://doi.org/10.3390/nu13072194
3. Chandwe K, Kelly P. Colostrum Therapy for Human Gastrointestinal Health and Disease. Nutrients. 2021; 13(6):1956. https://doi.org/10.3390/nu13061956
4. Ghosh S, Iacucci M. Diverse Immune Effects of Bovine Colostrum and Benefits in Human Health and Disease. Nutrients. 2021; 13(11):3798. https://doi.org/10.3390/nu13113798
5. Mehra R, Garhwal R, Sangwan K, et al. Insights into the Research Trends on Bovine Colostrum: Beneficial Health Perspectives with Special Reference to Manufacturing of Functional Foods and Feed Supplements. Nutrients. 2022;14(3):659. Published 2022 Feb 4. doi:10.3390/nu14030659
6. Kim YJ. Immunomodulatory Effects of Human Colostrum and Milk. Pediatr Gastroenterol Hepatol Nutr. 2021;24(4):337-345. doi:10.5223/pghn.2021.24.4.337
7. Ulfman LH, Leusen JHW, Savelkoul HFJ, et al. Effects of Bovine Immunoglobulins on Immune Function, Allergy, and Infection. Frontiers in Nutrition. 2018;5. doi:https://doi.org/10.3389/fnut.2018.00052
8. Batista da Silva Galdino A, do Nascimento Rangel AH, Buttar HS, et al. Bovine colostrum: benefits for the human respiratory system and potential contributions for clinical management of COVID-19. Food and Agricultural Immunology. 2021;32(1):143-162. doi:https://doi.org/10.1080/09540105.2021.1892594
9. Matsukawa S, Ueno K, Sugino T, et al. Effects of colostrum whey on immune function in the digestive tract of goats. Animal Science Journal. 2018;89(8):1152-1160. doi:https://doi.org/10.1111/asj.13027
10. Bagwe S, Tharappel LJP, Kaur G, et al. Bovine colostrum: an emerging nutraceutical. Journal of Complementary and Integrative Medicine. 2015;12(3). doi:https://doi.org/10.1515/jcim-2014-0039
11. Duan H, Sun Q, Chen C, et al. A Review: The Effect of Bovine Colostrum on Immunity in People of All Ages. Nutrients. 2024; 16(13):2007. https://doi.org/10.3390/nu16132007
12. Colonetti T, de Carvalho Florêncio I, Figueiredo P, et al. Colostrum Use and the Immune System of Premature Newborns: A Systematic Review and Meta-Analysis. Journal of Human Lactation. 2022;38(3):487-500. doi:10.1177/08903344221087967
13. Demers-Mathieu V, Underwood M, Beverly R, et al. Comparison of Human Milk Immunoglobulin Survival during Gastric Digestion between Preterm and Term Infants. Nutrients. 2018;10(5):631. doi:https://doi.org/10.3390/nu10050631

14. Lee J, Kim HS, Jung YH, et al. Oropharyngeal colostrum administration in extremely premature infants: an RCT. Pediatrics. 2015;135(2):e357-366. doi:https://doi.org/10.1542/peds.2014-2004
15. Ismail RIH, Awad HA, Imam SS, et al. Gut priming with bovine colostrum and T regulatory cells in preterm neonates: a randomized controlled trial. Pediatric Research. 2021;90(3):650-656. doi:https://doi.org/10.1038/s41390-020-01344-y
16. Hossain Z, Qasem WA, Friel JK, et al. Effects of Total Enteral Nutrition on Early Growth, Immunity, and Neuronal Development of Preterm Infants. Nutrients. 2021; 13(8):2755. https://doi.org/10.3390/nu13082755
17. Sangild PT, Vonderohe C, Melendez Hebib V, et al. Potential Benefits of Bovine Colostrum in Pediatric Nutrition and Health. Nutrients. 2021; 13(8):2551. https://doi.org/10.3390/nu13082551
18. Collado MC, Cernada M, Neu J, et al. Factors influencing gastrointestinal tract and microbiota immune interaction in preterm infants. Pediatric Research. 2015;77(6):726-731. doi:10.1038/pr.2015.54
19. Nasuf AWA, Ojha S, Dorling J. Oropharyngeal colostrum in preventing mortality and morbidity in preterm infants. Cochrane Library. 2018;2019(7). doi:10.1002/14651858.cd011921.pub2
20. Bruner LP, White AM, Proksell S. Inflammatory Bowel Disease. Prim Care. 2023 Sep;50(3):411-427. Epub 2023 May 10. PMID: 37516511. https://doi.org/10.1016/j.pop.2023.03.009
21. Seyedian SS, Nokhostin F, Malamir MD. A review of the diagnosis, prevention, and treatment methods of inflammatory bowel disease. J Med Life. 2019 Apr-Jun;12(2):113-122. PMID: 31406511; PMCID: PMC6685307. https://doi.org/10.25122/jml-2018-0075
22. Sienkiewicz M, Szymańska P, Fichna J. Supplementation of Bovine Colostrum in Inflammatory Bowel Disease: Benefits and Contraindications. Adv Nutr. 2021 Mar 31;12(2):533-545. PMID: 33070186; PMCID: PMC8009748. https://doi.org/10.1093/advances/nmaa120
23. Ford AC, Sperber AD, Corsetti M, et al. Irritable bowel syndrome. Lancet. 2020 Nov 21;396(10263):1675-1688. Epub 2020 Oct 10. PMID: 33049223. https://doi.org/10.1016/S0140-6736(20)31548-8
24. Yoon JY, Park SJ, Cheon JH. Effect of Colostrum on the Symptoms and Mucosal Permeability in Patients with Irritable Bowel Syndrome: A Randomized Placebo-controlled Study. Intest Res. 2014 Jan;12(1):80-2. Epub 2014 Jan 28. PMID: 25349570; PMCID: PMC4204680. https://doi.org/10.5217/ir.2014.12.1.80
25. Meisenheimer ES MD, MBA, Epstein C DO, Thiel D MD, MPH. Acute Diarrhea in Adults. Am Fam Physician. 2022 Jul;106(1):72-80. PMID: 35839362.
26. Li J, Xu YW, Jiang JJ, Song QK. Bovine colostrum and product intervention associated with relief of childhood infectious diarrhea. Sci Rep. 2019 Feb 28;9(1):3093. PMID: 30816291; PMCID: PMC6395637. https://doi.org/10.1038/s41598-019-39644-x

27. Hajihashemi P, Haghighatdoost F, Kassaian N, et al. Therapeutics effects of bovine colostrum applications on gastrointestinal diseases: a systematic review. Syst Rev. 2024 Feb 26;13(1):76. PMID: 38409162; PMCID: PMC10898101. https://doi.org/10.1186/s13643-024-02489-1
28. Kazimierska K, Szabłowska-Gadomska I, Rudziński S, et al. Biologically Active Sheep Colostrum for Topical Treatment and Skin Care. Int J Mol Sci. 2024 Jul 25;25(15):8091. https://doi.org/10.3390/ijms25158091
29. Kazimierska K, Kalinowska-Lis U. Milk Proteins-Their Biological Activities and Use in Cosmetics and Dermatology. Molecules. 2021 May 28;26(11):3253. https://doi.org/10.3390/molecules26113253
30. Kocic H, Langerholc T, Kostic M, et al. The Regenerative Potential of Donkey and Human Milk on the Redox-Sensitive and Proliferative Signaling Pathways of Skin Fibroblasts. Oxid Med Cell Longev. 2020 Nov 11;2020:5618127. https://doi.org/10.1155/2020/5618127
31. Han G, Kim H, Kim DE et al. The Potential of Bovine Colostrum-Derived Exosomes to Repair Aged and Damaged Skin Cells. Pharmaceutics. 2022 Jan 27;14(2):307. https://doi.org/10.3390/pharmaceutics14020307
32. Yalçıntaş YM, Duman H, López JMM et al. Revealing the Potency of Growth Factors in Bovine Colostrum. Nutrients. 2024 Jul 21;16(14):2359. https://doi.org/10.3390/nu16142359
33. Kim H, Kim DE, Han G et al. Harnessing the Natural Healing Power of Colostrum: Bovine Milk-Derived Extracellular Vesicles from Colostrum Facilitating the Transition from Inflammation to Tissue Regeneration for Accelerating Cutaneous Wound Healing. Adv Healthc Mater. 2022 Mar;11(6):e2102027. https://doi.org/10.1002/adhm.202102027
34. Borba VV, Lerner A, Matthias T et al. Bovine Milk Proteins as a Trigger for Autoimmune Diseases: Myth or Reality? International Journal of Celiac Disease. 2020;8(1):10-21. https://doi.org/10.12691/ijcd-8-1-3
35. Hung LH, Wu CH, Lin BF et al. Hyperimmune colostrum alleviates rheumatoid arthritis in a collagen-induced arthritis murine model. Journal of Dairy Science. 2018;101(5):3778-3787. https://doi.org/10.3168/jds.2017-13572
36. Gomes RDS, Anaya K, Galdino ABS, et al. Bovine colostrum: A source of bioactive compounds for prevention and treatment of gastrointestinal disorders. NFS Journal. 2021;25:1-11. https://doi.org/10.1016/j.nfs.2021.10.001
37. Bagwe-Parab S, Yadav P, Kaur G et al. Therapeutic Applications of Human and Bovine Colostrum in the Treatment of Gastrointestinal Diseases and Distinctive Cancer Types: The Current Evidence. Frontiers in Pharmacology. 2020;11.https://doi.org/10.3389/fphar.2020.01100
38. Jasiński K, Oleksa P, Żuraw D, et al. THE EFFECTIVENESS OF THE IMMUNE-BOOSTING PREPARATIONS IN PREVENTION AND TREATMENT OF

RESPIRATORY INFECTIONS. Prospects in Pharmaceutical Sciences. 2024;22(3):186-197. https://doi.org/10.56782/pps.190
39. Playford RJ, Weiser MJ. Bovine Colostrum: Its Constituents and Uses. Nutrients. 2021;13(1). https://doi.org/10.3390/nu13010265
40. 1.Loss G, Depner M, Ulfman LH, et al. Consumption of unprocessed cow's milk protects infants from common respiratory infections. The Journal of Allergy and Clinical Immunology. 2015;135(1):56-62.https://doi.org/10.1016/j.jaci.2014.08.044
41. Mizelman, E. (2016). The Effect of Bovine Colostrum Supplementation on Fitness, Muscle Mass, Inflammation, and Immune Function in Rugby Players
42. Skarpańska-Stejnborn A, Cieślicka M, Dziewiecka H, et al. Effects of Long-Term Supplementation of Bovine Colostrum on the Immune System in Young Female Basketball Players. Randomized Trial. Nutrients. 2020;13(1):118. https://doi.org/10.3390/nu13010118
43. Krzysztof Durkalec-Michalski, Główka N, Tomasz Podgórski, et al. Does Colostrum Bovinum Supplementation Affect Swimming Performance in Endurance-Trained Males? A Randomized Placebo-Controlled Crossover Study. Nutrients. 2024;16(18):3204-3204. https://doi.org/10.3390/nu16183204
44. Hałasa M, Maciejewska D, Baśkiewicz-Hałasa M, et al. Oral Supplementation with Bovine Colostrum Decreases Intestinal Permeability and Stool Concentrations of Zonulin in Athletes. Nutrients. 2017;9(4):370. https://doi.org/10.3390/nu9040370
45. 1.Cieślicka M, Ostapiuk-Karolczuk J, Buttar HS, et al. Effects of Long-Term Supplementation of Bovine Colostrum on Iron Homeostasis, Oxidative Stress, and Inflammation in Female Athletes: A Placebo-Controlled Clinical Trial. Nutrients. 2022;15(1):186. https://doi.org/10.3390/nu15010186