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Effects of bovine colostrum supplementation on athletic performance – literature review

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Abstract

Background: Colostrum is the first milk produced by mammals after birth and is characterized by a high concentration of bioactive compounds, including immunoglobulins, growth factors such as insulin-like growth factor-1 (IGF-1) and transforming growth factor-β (TGF-β), lactoferrin, cytokines, and antimicrobial peptides. Bovine colostrum shares several functional components with human colostrum and is widely used as a dietary supplement. Its bioactive constituents have been associated with immunomodulatory, anti-inflammatory, antimicrobial, and regenerative properties. In sports nutrition, bovine colostrum has been investigated for its potential role in supporting immune function, post-exercise recovery, gastrointestinal barrier integrity, and adaptation to exercise-induced physiological stress. However, the consistency of its effects on athletic performance and the mechanisms underlying its action remain a subject of scientific debate.

Aim: This review evaluates evidence on the effects of bovine colostrum supplementation on performance, recovery, gastrointestinal integrity, and selected immune parameters in athletes and physically active individuals.

Material and methods: A narrative review of randomized controlled trials, experimental studies, systematic reviews, and meta-analyses was conducted using PubMed, Scopus, and Web of Science.

Results: Current evidence suggests modest and context-dependent benefits, mainly for mucosal immunity, intestinal barrier function, inflammatory responses, and post-exercise recovery. Some studies reported favorable effects on salivary secretory IgA, intestinal permeability or injury markers, and selected biochemical indicators. However, direct effects on strength, endurance, body composition, and sport-specific performance remain inconsistent.

Conclusions: Bovine colostrum may be considered a supportive nutritional strategy for selected athletes exposed to intensive training, endurance exercise, or immune and

gastrointestinal stress. Further randomized controlled trials are needed to define optimal dose, duration, timing, and target populations.

Key words: bovine colostrum, supplementation, athletes, sports performance, immunity, recovery, gastrointestinal barrier

Introduction

Colostrum is the first milk produced postpartum by mammals and its composition differs significantly from mature milk. Its main role is to support the newborn's immune system at the very beginning of life. It contains a high concentration of nutrients such as proteins, fats, carbohydrates, vitamins, and minerals, as well as important bioactive substances, including immunoglobulins, lactoferrin, and growth factors. (1,2) These components support the development and regulation of the immune system, contributing to survival and overall health. Its physicochemical composition undergoes rapid changes in the first days after birth, which reflects its distinct biological functions compared to mature milk (1). While the consumption of human colostrum by infants has long been recognized as a source of critical bioactive proteins, the potential use of bovine colostrum as a supplement in humans has been increasingly investigated in recent years. Bovine colostrum has long been used in traditional diets and in various cultural practices.(3,4) In many regions, it has been consumed in different forms and appreciated for its medicinal purposes, based on the belief that it promotes healthy development in children and provides benefits for both healthy and weakened adults. (5) Although these practices originate from cultural traditions, the presence of well-described bioactive compounds and prebiotic components may offer scientific support for these beliefs. It has also been associated with beneficial effects on the development of healthy children and supportive of healthy or infirm adults.(3,4) In recent years, bovine colostrum has increasingly been processed into powdered forms and used as a dietary supplement, reflecting growing interest in its potential role in human health and nutrition. (6) Bovine colostrum is used for immune support (6,7), improvement of gut health (8,9), prevention or reduction of diarrhoea(10) , and support of athletes during periods of intense training and physical stress (8,11). It has also been investigated as a supportive supplement in inflammatory conditions and selected chronic disorders (9), as well as in tissue repair and wound-healing applications (12,13).

Composition of bovine colostrum

Bovine colostrum (BC) differs substantially from human colostrum, due to species-specific needs and developmental strategies. Unlike in humans, immunoglobulins are not transferred across the placenta in cows during gestation. Therefore, to ensure adequate immune protection, newborn calves must ingest colostrum shortly after birth, as it is rich in immunoglobulins and other components essential for the development of the immune system.(1) Human colostrum contains immunoglobulins mainly in the form of secretory IgA (sIgA), which is the predominant immunoglobulin in human milk.(14,15) Reported IgA concentrations in human colostrum vary considerably, but they are generally higher than in mature milk and may reach several g/L, with values around 7.5 g/L reported in review data.(15) In contrast, bovine colostrum contains much higher concentrations of immunoglobulins, predominantly IgG, which commonly reaches or exceeds 50 g/L and may approach approximately 100 g/L in first-milking colostrum. (16,17)

Human colostrum is richer in lactose and oligosaccharides that support the development of infant gut microbiota,(14,18) while bovine colostrum contains higher levels of protein and growth factors.(3,16) On the other hand, bovine colostrum, produced during the first hours after calving, also differs markedly from mature milk in both composition and function.(3,16) It contains significantly more protein (approximately 140–149 g/L vs. 36 g/L in mature milk) and a wide range of bioactive compounds, including lactoferrin (0,82 g/L), growth factors such as IGF-1, and fat-soluble vitamins (especially vitamins A and E), while its lactose content is lower (around 24,9–37 g/L vs. 49 g/L), reflecting its primary role in immune protection rather than energy supply. (3)

Lactoferrin, one of the key bioactive proteins present in colostrum, plays a crucial role in host defense due to its ability to bind iron, thereby limiting its availability to pathogenic microorganisms and exerting antimicrobial effects.(12) Moreover, it demonstrates antiviral and anti-inflammatory properties, modulates both innate and adaptive immune responses, and supports gut health by promoting beneficial microbiota and enhancing intestinal barrier integrity,(19) which is particularly relevant in athletes exposed to exercise-induced gastrointestinal stress. (8,17)

Importantly, the composition of bovine colostrum is highly dynamic and changes rapidly within the first 48–72 hours after calving, with immunoglobulin levels decreasing by up to 70–80% and lactose levels gradually increasing as the secretion transitions toward mature milk.(5,16,20) In addition, its composition may vary depending on several factors, including breed, parity,

maternal nutrition, health status, and especially the timing of collection.(21) For supplementation purposes, colostrum is typically collected within the first 12–24 hours after calving, when the concentration of bioactive compounds is highest, and subsequently processed using low-temperature techniques such as freeze-drying or spray-drying to preserve biological activity while ensuring microbiological safety.(22) The final product is usually standardized based on IgG content, although processing and storage conditions may influence its overall composition and biological effectiveness.(22)

Supplementation with bovine colostrum (BC) has been reported to exert immunomodulatory effects and may support immune homeostasis under selected conditions. There is also increasing evidence that BC may be a valuable supplement for athletes to aid in exercise performance and recovery. Colostrum is generally regarded as a safe substance for humans.(2) However, some individuals may experience mild side effects, including nausea or bloating. It is important for those who are allergic to cow's milk protein to avoid using colostrum. (23)

Bovine colostrum and sports benefits

Moderate and recreational physical activity has been shown to enhance immune system function and reduce the risk of infections.(24,25) However, athletes, particularly those engaged in high-intensity and prolonged training, are exposed to an increased risk of infections due to transient disturbances in immune function.(24) It is well established that excessive training loads, inadequate recovery, and periods of overreaching or overtraining may lead to immunosuppression, manifested by alterations in both innate and adaptive immune responses.(26) In addition prolonged and intensive exercise is associated with physiological stress, including elevated cortisol levels, oxidative stress, and inflammation all of which may lower immunity. At the cellular level, immune cells require a continuous supply of energy and specific substrates, such as amino acids, to support their proliferation, differentiation, and functional activity.(27) During periods of intensified training, the demand for these substrates may increase, which could potentially contribute to alterations in immune function. For instance, reductions in salivary immunoglobulin A (IgA), impaired mucosal immunity, and changes in circulating immune cells have been associated with a higher incidence of upper respiratory tract infections (URTIs) in athletes.(26) This phenomenon is often described within the framework of the “open window” theory, which suggests that following intense exercise there is a temporary period of increased susceptibility to pathogens.(28)

The potential effects of bovine colostrum in athletes are closely related to its influence on key mechanisms underlying exercise-induced immune disturbances. One of the most important

targets is mucosal immunity, particularly the regulation of salivary immunoglobulin A (IgA), which constitutes a primary defense against pathogens at mucosal surfaces. Since intense and prolonged exercise is associated with reductions in IgA levels, bovine colostrum supplementation may help attenuate this decline, thereby supporting the first line of immune defense and potentially reducing susceptibility to upper respiratory tract infections (URTIs). (26,29,30)

In addition, bovine colostrum may counteract exercise-induced increases in intestinal permeability. Strenuous exercise has been shown to disrupt tight junction function within the intestinal epithelium, leading to increased translocation of endotoxins such as lipopolysaccharides (LPS) into the circulation, which can trigger systemic inflammation and further impair immune function. (31) Bioactive components of colostrum, including growth factors such as insulin-like growth factor-1 (IGF-1) and transforming growth factor-β (TGF-β), may promote epithelial repair and enhance barrier integrity, thereby limiting endotoxin leakage and reducing inflammatory responses.(32,33)

Furthermore, bovine colostrum may influence immune responses at the cellular level by providing bioactive peptides and proteins that interact with immune cells. For example, lactoferrin has been shown to modulate cytokine production and exhibit antimicrobial activity, while colostral immunoglobulins may bind pathogens within the gut lumen, reducing their interaction with the host immune system.(34) These effects may be particularly relevant during periods of intensified training, when immune function is compromised due to increased physiological stress and metabolic demands.(29)

Taken together, these mechanisms suggest that bovine colostrum may act on multiple levels—mucosal immunity, gut barrier function, and systemic immune responses—thereby potentially mitigating the immunosuppressive effects of intense exercise.

Colostrum and athletic performance

Early studies on bovine colostrum supplementation in athletes and physically active individuals focused mainly on its potential ergogenic effects, particularly changes in body composition, strength, and exercise performance. Antonio reported that 8 weeks of bovine colostrum supplementation increased lean body mass in active men and women, although improvements in strength or exercise performance were not clearly demonstrated.(35) Similarly, Brinkworth investigated bovine colostrum supplementation during resistance training and observed changes in tissue composition, but without consistent evidence of improved muscle strength or performance outcomes.(36) These early findings contributed to the growing interest in bovine

colostrum as a potential ergogenic aid; however, the evidence for direct performance enhancement has remained inconsistent.

More recent studies suggest that the potential benefits of bovine colostrum may be more closely related to immune function, mucosal defense, gastrointestinal integrity, and post-exercise recovery than to direct improvements in physical performance. In soccer players, low-dose bovine colostrum supplementation helped maintain performance and attenuated selected inflammatory and muscle-damage-related responses following intermittent exercise.(37) In female athletes and football players, long-term supplementation was associated with changes in oxidative stress, inflammation, iron-homeostasis-related markers, and selected immune parameters, although performance outcomes were not consistently improved.(38,39)

Several studies have also examined the immunomodulatory effects of bovine colostrum in athletes. Jones showed that supplementation may attenuate the reduction in in vivo immune responsiveness following prolonged exercise, while Durkalec-Michalski demonstrated that 12-week high-dose Colostrum Bovinum supplementation increased post-exercise salivary SIgA concentration in endurance-trained males, suggesting a potential role in supporting local mucosal immune defense.(27,32) However, effects on systemic immunoglobulins and other hematological or biochemical markers were limited. Most recent acute supplementation trial performed by Jones et al. further indicated that bovine colostrum may modify selected innate immune responses to prolonged cycling, although not all mucosal immune markers were affected.(11) Studies focused on gastrointestinal integrity have also indicated that bovine colostrum may help limit selected markers of intestinal permeability or intestinal injury after exercise-induced stress, although the results are not fully consistent across different protocols. (40–42)

Overall, current evidence indicates that bovine colostrum supplementation may provide modest benefits for athletes, particularly in relation to mucosal immunity, gastrointestinal barrier function, inflammatory responses, and recovery from exercise-induced physiological stress. In contrast, its direct ergogenic effects on strength, endurance, or sport-specific performance appear less consistent and may depend on the training status of participants, dose, duration of supplementation, and type of exercise protocol used.

Table 1. Summary of studies on bovine colostrum supplementation in athletes and physically active participants

Participants	Supplementation protocol	Outcomes	Reference
8 healthy volunteers exposed to a heavy exercise protocol	20 g/day (alone or combined with Zn), 14 days, crossover RCT	Reduced exercise-induced gut permeability; stronger effect with zinc carnosine..	(42)
10 male participants exercising in a hot and humid environment	20 g/day for 14 days, randomized placebo-controlled study	No effect on plasma I-FABP after exercise in hot and humid conditions.	(41)
25 soccer players	3.2 g/day for 6 weeks, RCT	Helped maintain performance and attenuated selected inflammatory responses.	(37)
12 healthy males exercising in the heat	20 g/day for 14 days, crossover RCT	Reduced exercise-induced increase in I-FABP; no clear effect on bacterial DNA response.	(40)
31 healthy men exposed to prolonged running exercise	20 g/day for 58 days, RCT	Attenuated exercise-induced reduction in in vivo immune responsiveness.	(32)
Healthy adults; short- and long-term administration protocols	40 g in an acute protocol; 20 g/day for 4 or 12 weeks in longer protocols	Did not increase circulating IGF-1.	(43)
27 elite female basketball players aged 16–19 years; 20 completed the study	3.2 g twice daily for 24 weeks, RCT	No significant effect on most immune parameters.	(44)

20 trained female athletes	3.2 g/day for 6 months, placebo-controlled trial	Reduced oxidative stress and influenced selected inflammatory and iron-related markers.	(39)
28 male football players	3.2 g/day for 6 months, crossover study	Increased IgG and reduced selected inflammatory markers; no performance effect.	(38)
28 endurance-trained males	25 g/day for 12 weeks, crossover RCT	Increased post-exercise salivary SIgA; no effect on blood immunoglobulins.	(27)
28 male triathletes and swimmers	25 g/day for 12 weeks, crossover RCT	No significant improvement in swimming performance versus placebo.	(45)
28 endurance-trained males	25 g/day for 12 weeks, crossover RCT	Improved selected aerobic-capacity indicators; no effect on body composition or time to exhaustion.	(46)
16 healthy recreationally active males	Acute supplementation: 30 g 1 h before exercise, 5 g immediately before exercise, and 5 g during exercise; total 40 g, crossover RCT	Modified selected innate immune responses after cycling; no effect on SIgA or salivary lactoferrin.	(11)

Who should supplement colostrum and how?

From a practical point of view, bovine colostrum supplementation should be regarded as a supportive nutritional strategy rather than a primary performance-enhancing supplement. Current evidence suggests that it may be most relevant for athletes exposed to prolonged, repeated, or high-intensity exercise, particularly during periods of intensified training, frequent competitions, or insufficient recovery.(23,29) In such conditions, athletes may experience transient disturbances in immune function, increased inflammatory responses, and gastrointestinal barrier stress; therefore, bovine colostrum may be considered as a strategy to support mucosal immunity, recovery, and gastrointestinal integrity.(8,24,26,31)

The groups that may potentially benefit most include endurance athletes, such as long-distance runners, cyclists, triathletes, and swimmers, as well as team-sport athletes exposed to repeated high-intensity efforts, including soccer, football, and basketball players. In endurance athletes, bovine colostrum has been investigated mainly in relation to mucosal immune defense, aerobic-capacity indicators, and responses to prolonged exercise.(27,32,46) In team-sport athletes, available studies suggest possible effects on selected inflammatory, oxidative stress, muscle-damage-related, or immune markers, although improvements in sport-specific performance are not consistent.(37–39,44)

Bovine colostrum may also be useful for athletes who frequently experience gastrointestinal symptoms or are exposed to exercise-induced gut barrier stress, especially during prolonged exercise or training in hot environments. Studies using exercise-heat or heavy-exercise protocols suggest that supplementation may help limit selected markers of intestinal permeability or intestinal injury, although findings are not fully consistent across all protocols. (33,40–42) Therefore, this application may be particularly relevant for endurance athletes, ultra-endurance athletes, and athletes who report gastrointestinal discomfort during long-duration events.(8,31)

In terms of dosage, the most commonly studied strategies differ depending on the intended outcome. For mucosal immune support and endurance-related outcomes, studies have often used approximately 20–25 g/day for several weeks, with 25 g/day for 12 weeks being investigated in endurance-trained males.(27,32,46) For gastrointestinal barrier support, short-term protocols of approximately 20 g/day for about 14 days have been used. (40–42) Lower doses, such as 3.2 g/day, have been applied in longer interventions in team-sport athletes, including soccer, football, and basketball players; however, these lower-dose protocols appear to produce more variable effects and should not be interpreted as consistently performance-enhancing.(37–39,44)

Supplementation is usually administered in powder form, dissolved in water or another beverage. Current evidence does not allow for precise timing recommendations, although regular daily intake over several weeks appears more justified than single or occasional use when the aim is to support immune or recovery-related outcomes. Acute supplementation protocols have also been tested, but these should be interpreted cautiously, as they do not yet provide a basis for general practical recommendations.(11)

An additional practical consideration is the presence of insulin-like growth factor-1 (IGF-1) and other growth factors in bovine colostrum. Available evidence indicates that standard bovine colostrum supplementation does not significantly increase circulating IGF-1 concentrations in healthy adults.(43) Nevertheless, competitive athletes should use caution and choose only high-quality supplements tested for contaminants, because supplement composition may vary and anti-doping responsibility remains with the athlete.

Overall, bovine colostrum supplementation should not be recommended universally to all athletes. It appears most justified in athletes exposed to high physiological stress, prolonged endurance exercise, repeated high-intensity efforts, frequent competitions, recurrent upper respiratory symptoms, or gastrointestinal complaints associated with exercise. Supplementation

strategies should be individualized according to sport discipline, training load, recovery status, gastrointestinal tolerance, and the quality of the colostrum product.

Limitations of current evidence

The available evidence on bovine colostrum supplementation in athletes has several limitations. Many studies include relatively small sample sizes and differ substantially in terms of participant characteristics, training status, supplementation dose, intervention duration, and exercise protocols. In addition, immune, gastrointestinal, inflammatory, and performance-related outcomes are assessed using different markers and methods, which makes direct comparison between studies difficult. Another important limitation is the lack of standardization of bovine colostrum products, including differences in IgG content, bioactive compound concentration, processing methods, and storage conditions. These factors may partly explain the inconsistent findings reported across studies. Therefore, further well-designed randomized controlled trials are needed to determine the optimal dose, duration, target populations, and most relevant outcome measures for bovine colostrum supplementation in athletes.

Conclusions

In conclusion, bovine colostrum supplementation may represent a valuable supportive nutritional strategy for selected groups of athletes, particularly those exposed to prolonged endurance exercise, repeated high-intensity efforts, intensive training blocks, or congested competition schedules. Current evidence suggests that its effects are not primarily related to direct improvements in strength, power, or sport-specific performance, but rather to the modulation of physiological responses that may indirectly influence athletic capacity and recovery.

The most consistent findings concern mucosal immune defense, gastrointestinal barrier integrity, inflammatory responses, and selected recovery-related markers. These effects may be especially relevant for endurance athletes, such as runners, cyclists, triathletes, and swimmers, who are frequently exposed to prolonged physiological stress, as well as for team-sport athletes who experience repeated bouts of high-intensity exercise and limited recovery time. In these groups, bovine colostrum may help support immune homeostasis, reduce exercise-induced disturbances in gut barrier function, and attenuate selected inflammatory or muscle-damage-related responses.

However, the available evidence remains heterogeneous. Differences in study design, participant characteristics, training status, supplementation dose, intervention duration, product composition, and outcome measures make it difficult to establish universal recommendations. While some studies have reported favorable effects on salivary SIgA, intestinal permeability, inflammatory markers, or selected aerobic-capacity indicators, others have shown limited or no significant effects on systemic immune markers, body composition, time to exhaustion, strength, or sport-specific performance.

Therefore, bovine colostrum should not be regarded as a supplement with clearly established ergogenic effects, nor should it be recommended universally to all athletes. Its use appears most justified in athletes experiencing high physiological stress, recurrent upper respiratory symptoms, gastrointestinal complaints during exercise, or increased recovery demands. Practical supplementation strategies should be individualized according to the athlete's discipline, training load, competition schedule, gastrointestinal tolerance, and overall nutritional status.

Further well-designed randomized controlled trials are needed to clarify the optimal dose, duration, timing, and target populations for bovine colostrum supplementation. Future research should also standardize product composition and outcome measures, particularly in relation to immune function, gut barrier integrity, recovery, and performance. This would allow for more precise, evidence-based recommendations regarding the use of bovine colostrum in sports nutrition.

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