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Does a Diet of Colostrum Improve Athletic Performance?

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ABSTRACT: The purpose of the studies described here was to determine the effects of supplementation with concentrated bovine colostrum protein powder (intact™) on plasma insulin-like growth factor I (IGF-I) concentrations, athletic performance and recovery during training. Randomised, double-blind, placebo controlled, parallel designs were used in which volunteers trained whilst consuming 60 g·day^{-1} of either intact™ powder or a placebo (concentrated whey protein powder). Plasma IGF-I concentrations and changes in exercise performance or recovery were determined prior to, sometimes during, and after training and supplementation. Supplementation with intact™ powder had no effect on plasma IGF-I concentration ($P>0.50$), but resulted in significantly greater improvements in muscular power (vertical jump; $P=0.004$), endurance exercise performance (rowing; $P=0.004$), and recovery from exhaustive treadmill running exercise ($P=0.05$). It was concluded that intact™ powder is an effective product for enhancing athletic performance and recovery.

Key Words: Bovine Colostrum, IGF-1, Athletic Performance, Exercise

INTRODUCTION

Bovine colostrum is the milk secreted by cows during the first few days after calving and is a rich source of proteins, carbohydrates, fat, minerals and vitamins. Bovine colostrum also contains significant concentrations of biologically active molecules such as antimicrobial factors, hormones and growth factors. Antimicrobial factors provide passive immunity and protection against infection during the first few weeks of life, which is vital for calves since, unlike human babies, calves do not acquire any immunity from their mother during fetal life. Quantitatively, the major antimicrobial factors in bovine colostrum are immunoglobulins (antibodies), but lactoferrin, lysozyme and lactoperoxidase are also present. The hormones and growth factors present in colostrum include bovine growth hormone (bGH), epidermal growth factor (EGF), transforming growth factor (TGF) and insulin-like growth factors I and II (IGF-I and -II), which are important for promoting the growth and development of the newborn calf.

Colostrum is a finite resource, and only available during calving seasons. Typically the first four milkings are collected, yielding 20-50 litres/cow. High immunoglobulin levels depend on collecting colostrum from the first 24 hours after parturition (Figure 1). IGF-1 concentrations fall in a pattern similar to immunoglobulin, as do a number of other components that rely on cell transport mechanisms to leave the circulation and enter the udder.

Colostrum must be collected separately from milk, requiring storage and refrigeration on a smaller scale than the dairy farmer normally employs. This equipment will typically be needed only 8 weeks/year on most farms. Colostrum is also difficult to process as the high concentrations of whey proteins make it particularly susceptible to heat, coagulation or gelling at temperatures over 64° C, easily fouling heat exchangers and evaporators. Dairy facilities strictly exclude colostrum from the milk supply to avoid negative effects on processing efficiency and dairy product quality. Heat also destroys immunoglobulins and complement.

The therapeutic potential for bovine colostrum in humans has been the subject of considerable international research. Until recently, the research focus has been on the hyperimmunisation of cows with pathogens of the human gut to develop specifically targeted antibodies shown to be effective in the prevention and treatment of infectious gastroenteritis in various populations (Davidson, 1996; Davidson *et al*., 1994; Davidson *et al*., 1989; Ebina *et al*., 1992; Ebina *et al*., 1983; Tacket *et al*., 1992; Tzipori *et al*., 1986; Tzipori *et al*., 1987)

The mode of action of hyperimmune colostrum products is not fully understood, but the primary factor is for enough bovine IgG with activity against the targeted pathogen to survive in the gastrointestinal tract (GIT) and specifically bind virus, bacteria, or protozoa. Despite human studies, and studies in animals clearly demonstrating the dose response effect of hyperimmune colostrum in prevention of rotavirus and suppression of H. pylori and other pathogens, only one hyperimmune colostrum product is available commercially (GASTROGARD-R™; hyperimmune bovine colostrum – antirotavirus, NorthField Laboratories Pty Ltd).

Many other medical indications for the use of bovine colostrum have been postulated, with varying levels of evidence in support of the claims. A number of animal studies point to the role of bovine colostrum in development of the neonatal gut in mammals (Playford *et al*., 1993; Xu, 1996; Xu *et al*., 1994; Xu and Wang, 1996). Human studies of the effects of bovine colostrum on gut diseases such as colonic cancer, inflammatory bowel, or on gut development, growth and repair have not yet been published, despite promising results with products from milk and colostrum in animals(Howarth *et al*., 1998; Howarth *et al*., 1996; Playford *et al*., 1999).

In 1997, Mero *et al*. (Mero *et al*., 1997) showed that 8 days of oral supplementation with bovine colostrum during speed-strength training resulted in a dose-dependent increase in circulating IGF-I concentrations. Mero *et al*. (Mero *et al*., 1997) were unable to determine whether the increased circulating

IGF-I resulted from absorption of IGF-I from the colostrum, or whether something in the colostrum stimulated an increase in endogenous IGF-I production. For orally administered IGF-I to be directly absorbed it must survive digestion, and then be transported across the intestinal wall. There is evidence that IGF-I in milk may retain bioactivity within the gastrointestinal tracts of neonatal calves (Baumrucker *et al*., 1992) and rats (Philipps *et al*., 1995), but the IGF-I molecule has a molecular weight of 7.5 kDa and, even if it survived digestion, it is unlikely that such a large molecule would be absorbed in significant quantities in the adult gastrointestinal tract. Orally administered ^{125}I-IGF-I has been shown to be transported into the circulation in neonatal animals (Donovan *et al*., 1997; Xu and Wang, 1996), but absorption of IGF-I can occur in neonates because the gut epithelium is permeable to macromolecular transmission. Gut closure occurs during the first two days after birth and, although transmission of certain macromolecules can still continue for some time after the onset of gut closure via receptor mediated processes (Weaver and Walker, 1989), such transport does not occur indefinitely. It would therefore seem unlikely that significant quantities of IGF-I would be absorbed directly in the adult gut. Nevertheless, colostrum has been shown to increase the fractional rate of protein synthesis in a number of tissues, including skeletal muscle, in the absence of any change in circulating IGF-I concentration (Burrin *et al*., 1992), suggesting that colostrum feeding may exert positive effects on muscle, and therefore on athletic performance, independently of IGF-I.

Table 1. Major bioactive components in colostrum and milk

Values expressed as weight of protein per litre.	Colostrum	Milk
IgA	3.2 – 6.2 g	0.2 g
IgG1	48 – 87 g	0.4 g
IgG2	1.6 – 2.9 g	0.05 g
IgM	3.7 – 6.1 g	0.05 g
IGF-1	0.1 – 2 mg	25 μg
IGF-11	0.1 – 2 mg	2 μg
TGF-β	20 – 40 μg	1 – 2 μg
EGF	4 – 8 μg	2 μg
Lactoferrin	1.5 – 2 g	0.1 g
Lysozyme	0.1 – 0.7 mg	0.1 - 0.3 mg
Lactoperoxidase	30 mg	20 mg
Growth hormone	3 – 10 ng	nd
Insulin	20 – 50 μg	nd

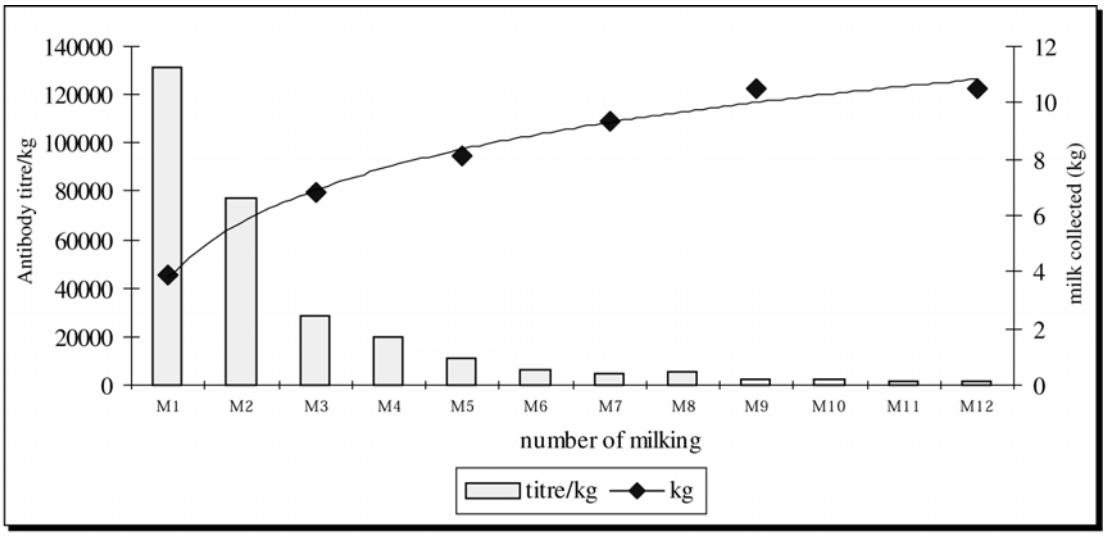

Figure 1. Volume of colostrum and antibody titre by milking

Composition of colostrum varies between cows and milkings, nd = not determined.

METHODS AND RESULTS

In a study recently conducted in our laboratory we assessed the effect of supplementation with 60 g·day^{-1} of concentrated bovine colostrum protein powder (intact™, NorthField Laboratories Pty Ltd) on plasma IGF-1 concentrations and vertical jump performance during 8 weeks of resistance and plyometric training using a double-blind, placebo controlled, parallel, randomised design. Vertical jump height was assessed prior to, and after 4 and 8 weeks of supplementation and training. We found that plasma IGF-1 concentrations did not change (P=0.58) in either the intact™ group (n=26) or a group taking a placebo (concentrated whey protein powder, n=25). Vertical jump height had improved similarly in both groups after 4 weeks of supplementation and training (P=1.0), but the intact™ group had improved their vertical jump significantly more than the placebo group after 8 weeks (colostrum 3.0 ± 0.6 cm, placebo 1.3 ± 0.7 cm; P=0.004; Figure 2). These results indicated that oral supplementation with intact™ bovine colostrum facilitated a greater improvement in vertical jump performance independently of any systemic effect of IGF-I, and that the supplement must be taken for up to 8 weeks before any performance benefit becomes apparent.

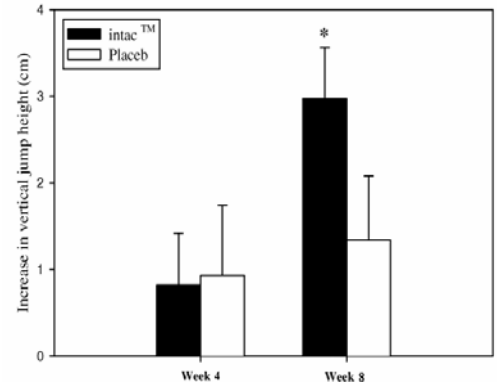

Figure 2. Changes in vertical jump height after 4 and 8 weeks of supplementation with intact™ powder or placebo during training.

In another study, we examined the effect of 8 weeks of supplementation with intact™ powder on plasma IGF-1 concentrations and recovery from treadmill running to exhaustion. Recovery was assessed prior to, and after 4 and 8 weeks of supplementation and training by having subjects perform two treadmill runs to exhaustion and determining how much less work could be done during the second treadmill run after being allowed only 20 min to recover from the first run. A larger decrement in work done during the second run indicated a slower recovery, whilst a lesser decrement indicated a faster recovery. Again we found no effect of the intact™ powder on plasma IGF-I concentrations (P=0.90), but the intact™ group recovered significantly better than the placebo group after 8 weeks of supplementation and training (P=0.05; Figure 3).

Since the results of these first two studies became public, a growing number of athletes, in particular elite athletes, have been taking intact™ powder in an effort to improve their performances. In many cases the physiology of elite athletes differs from that of moderately trained individuals and, although a nutritional supplement may prove effective in eliciting performance improvements in moderately trained individuals, it does not necessarily follow that the supplement will be effective in elite performers.

The subjects used in the first two studies were moderately trained male recreational athletes and it was felt necessary therefore to obtain some data from athletes competing at a higher level. With this in mind, a study was conducted in early 1999 using volunteers from the high performance rowing program at the South Australian Sports Institute.

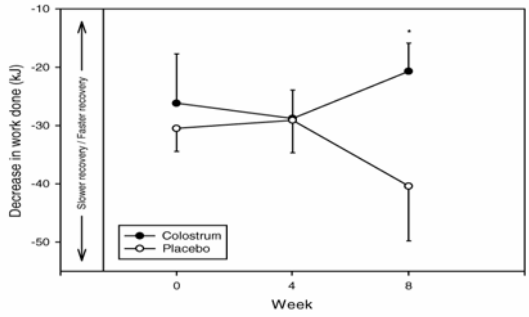

Figure 3. Changes in recovery from exercise after 4 and 8 weeks of supplementation with intact™ powder or placebo.

This study employed a double-blind, placebo controlled, parallel, randomised design to determine the effect of supplementation with concentrated bovine colostrum protein powder (intact™, NorthField Laboratories Pty Ltd) on rowing performance in 8 elite female rowers during 9 weeks of training. Changes in the distances rowed and work done during a 4 minute maximal rowing test were assessed and it was found that there were greater increases in the distance covered (CP, 33.7 ± 2.3 m, WP, 23.2 ± 2.3 m; P=0.05) and work done (CP, 6.3 ± 0.1 kJ, WP, 4.2 ± 0.4 kJ; P=0.004; Figure 4) in the group taking the intact™ supplement.

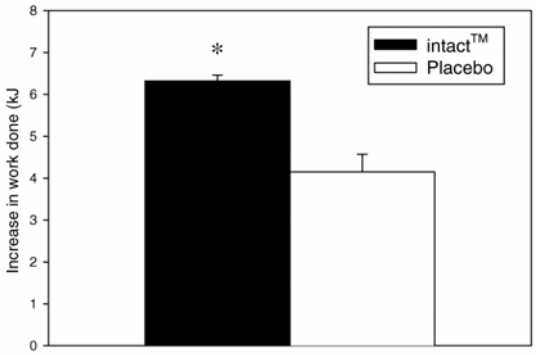

Figure 4. Changes in work done during 4 min of maximal rowing exercise following 9 weeks of supplementation with intact™ powder or placebo.

We also found that the intact™ group had a higher buffer capacity (P=0.02) and were able to tolerate a greater increase in plasma lactate accumulation (P=0.04) by the end of the study, suggesting that the greater improvements in performance were due to an increased ability to derive energy from anaerobic metabolism.

CONCLUSIONS

Taken together, the results of the studies completed so far indicate that oral supplementation with intact™ concentrated bovine colostrum protein powder can improve both muscular power (vertical jump) and endurance (rowing) exercise performance, and may also enhance recovery from exercise. Based on these findings, it would appear that intact™ powder is an effective product for enhancing athletic performance and recovery.

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