APPLIED NUTRITIONAL INVESTIGATION

The Effects of Bovine Colostrum Supplementation on Body Composition and Exercise Performance in Active Men and Women

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The purpose of this study was to determine the effect of 8 wk of bovine colostrum supplementation on body composition and exercise performance in active men and women. Subjects were randomly assigned to a placebo (whey protein) and colostrum group (20 g/d in powder form). Each subject participated in aerobic and heavy-resistance training at least three times per wk. Body composition was assessed via dual x-ray absorptiometry analysis. Treadmill time to exhaustion, one repetition maximum strength (bench press), and the total number of repetitions performed during one set to exhaustion at a submaximal load for the bench press (50% and 100% of body weight for women and men, respectively) were ascertained. The whey protein group experienced a significant increase ($P < 0.05$) in body weight (mean increase of 2.11 kg), whereas the colostrum group experienced a significant ($P < 0.05$) increase in bone-free lean body mass (mean increase of 1.49 kg). There were no changes in any of the other parameters measured. Thus, supplementation with bovine colostrum (20 g/d) in combination with exercise training for 8 wk may increase bone-free lean body mass in active men and women. *Nutrition* 2001;17:243–247. ©Elsevier Science Inc. 2001

Key words: supplement, whey protein, diet, exercise

INTRODUCTION

Bovine colostrum is the initial milk secreted by cows during parturition and the first few days postparturition.[1,2] There is evidence to suggest that bovine colostrum contains growth factors that stimulate cellular growth and DNA synthesis.[1,2] In neonatal piglets acutely fed colostrum, the fractional rates of protein synthesis in the liver, kidney, spleen, and skeletal muscle, as well as the absolute rate of protein synthesis in the liver and spleen, was greater than in pigs fed mature milk or water.[3] Oral supplementation with bovine colostrum by humans has been shown to significantly enhance plasma insulinlike growth factor 1 (IGF-1) concentrations but to have no effect on vertical jump performance.[4]

Although bovine colostrum is not typically thought of as a food supplement, it should be noted that strength-power athletes (i.e., bodybuilders) have known of its availability for many years. However, there is no evidence that supports an anabolic effect of bovine colostrum supplementation in humans. Thus, the purpose of this investigation was to assess the effects of bovine colostrum supplementation on body composition, muscular strength, and muscular endurance in active adult men and women.

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METHODS

Subjects

Healthy, trained men and women (14 men, 8 women) were recruited from the university population via posted advertisement. To participate in the study, subjects had to meet the following inclusion criteria: 1) 18–35 y; 2) in good health as determined by self-reporting (free from diabetes, cancer, heart disease, or orthopedic impairment); 3) not currently taking a dietary supplement that contained colostrum; and 4) already performing resistance training at least three times per wk for the last 6 mo. Informed consent was obtained from each subject, and the experimental procedures were approved by the institutional review board of the university. For completing the study, subjects were compensated with dietary supplements (i.e., bovine colostrum) worth approximately 75 U.S. dollars.

Dietary Supplement

This study was a double-blind, placebo-controlled trial in which subjects were matched for sex. Subjects orally ingested either whole colostrum in the form of bovine colostrum powder (Symbiotics, Sedona, AZ, USA) or whey protein concentrate (placebo) at a mean daily dose of 20 g for an 8-wk duration. The 20 g of colostrum contained 71 kcal, and 15.8, 4.0, and 0.2 g of protein, carbohydrate, and fat, respectively. However, the concentrations of various bioactive components of the colostrum (e.g., lactoferrin, immunoglobulins, epidermal growth factor, transforming growth factor, etc.) was not determined. Whey was chosen as the placebo because of its similar taste and texture. Previously whey has been used as a placebo in studies that have examined the effects of colostrum on body composition and exercise performance.[5,6] Subjects mixed the colostrum or whey protein powder with water using a premeasured scooper. All subjects were instructed not to change their dietary habits. Twenty-four–hour dietary recalls were

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TABLE I.

PHYSICAL CHARACTERISTICS*

	Age	Height (cm)	Weight (kg)	Body fat (%)
Colostrum (n = 9)	22.4 ± 1.4	178.2 ± 10.0	80.57 ± 15.94	18.8 ± 8.3
Placebo (n = 11)	21.5 ± 1.9	173.0 ± 5.6	77.71 ± 18.91	18.7 ± 10.1

* Values are means ± standard deviations. There were no significant differences between groups. The colostrum group had two women, seven men; the placebo had four women, seven men.

obtained from all subjects on a random day during the first, fourth, and last week of the study. The average of the three measurements was used to ascertain the caloric and macronutrient intake of each subject via computerized analyses (Nutribase '98, Phoenix, AZ, USA). It should be noted that subjects were not screened for the use of androgens (legal or illegal), dehydroepiandrosterone (DHEA), 7-keto-DHEA, or other potentially anabolic compounds. However, via personal self-disclosure, no subject admitted to the use of legal or illegal androgens.

Training

All subjects were instructed to maintain current levels of exercise for the 8-wk study. Subjects provided a training log of a typical week of training. They were instructed to not substantially alter their training for the 8-wk treatment duration (i.e., the number of sets, repetitions, and weight utilized did not change during the 8-wk treatment period). We chose to monitor training rather than impose a training regimen because many trained individuals are reluctant to alter their training program. Thus, any changes seen in the treatment group (versus the placebo) would be due ostensibly to the dietary supplement. The primary change that was imposed on each subject was the regular consumption of colostrum or whey protein.

Exercise Testing

After three warm-up sets, subjects were instructed to perform a one-repetition maximum (1-RM) on the supine free-weight bench press. Also, the maximal number of full repetitions for the bench press at 50% (women) and 100% (men) of body weight was assessed; the assistant strength and conditioning coach performed all strength testing. During the test, subjects had their feet fully planted on the floor, their hips and scapula maintained contact with the bench at all times, and a slight lumbar lordosis was allowed. Repetitions were performed such that the concentric phase was performed as quickly as possible and the eccentric phase was performed with a controlled descent. Hand position was slightly greater than shoulder width. Treadmill time to exhaustion was ascertained using the Bruce protocol.[7] All subjects were given precise instructions on the nature of the test. Subjects were asked to run on the treadmill until volitional exhaustion. Subjects would terminate the test by pressing an emergency stop button. The number of minutes each subject lasted was recorded.

Body Composition

Body composition was assessed via whole-body scans using dual-energy x-ray absorptiometry (DEXA; Lunar DPX-IQ, Madison, WI, USA). Subjects lay supine on the DEXA with their body centered along the midline of the table. Their upper extremities were held against their torso and their feet were approximately 15 cm apart. Subjects lay completely motionless during the scan. Each scan lasted approximately 25 min. A single pretest and posttest scan was performed in a fasted state before performance testing. The use of DEXA as a method for estimating body composition has been validated previously.[8,9] In addition, the coefficient of variation for fat mass and lean body mass (LBM) has been estimated to be in the range of 1.8–6.4 and 0.6–3.1%, respectively.[9–11] Unpublished data from our lab has shown DEXA measures to have a coefficient of variation of 1.49 and 1.00% for fat mass and bone-free LBM, respectively. To ensure quality control, the DEXA unit was calibrated daily using the standard calibration block provided by the manufacturer.

Statistics

Because there are no human data that have examined the effects of bovine colostrum supplementation on body composition, we in essence had to speculate on the possible changes that we might observe with regard to fat and LBM. Hence, we made a conservative estimate of the change to be detected (in fat loss or LBM gain). Based on a 1.0 kg change to be detected (after an 8-wk treatment), an expected standard deviation of change of 1.0 kg, a

TABLE II.

BODY COMPOSITION*

		Weight (kg)	Fat (%)	LBM (kg)	Fat mass (kg)
Colostrum	Pre	80.57 ± 15.94	18.8 ± 8.3	63.59 ± 15.97	14.91 ± 6.76
	Post	81.67 ± 16.36	17.6 ± 7.9	65.08 ± 16.19†	14.19 ± 7.11
Placebo	Pre	77.71 ± 18.91	18.7 ± 10.1	58.48 ± 13.97	14.32 ± 8.81
	Post	79.82 ± 19.04‡	20.2 ± 10.1	58.37 ± 13.71	15.77 ± 8.62

* Values are means ± standard deviations. There were no between-group differences at baseline for any of the measures.
† $P = 0.001$ pre versus post.
‡ $P = 0.043$ pre versus post.
LBM, bone-free lean body mass.

TABLE III.

EXERCISE PERFORMANCE*

		1-RM BP (kg)	Max reps	TTE (min)
Colostrum	Pre	97.2 ± 39.0	13.1 ± 7.2	13.44 ± 1.56
	Post	100.9 ± 41.7	14.1 ± 7.9	13.50 ± 1.40
Placebo	Pre	97.1 ± 49.6	10.4 ± 4.9	13.06 ± 2.18
	Post	102.1 ± 53.3	11.6 ± 6.0	12.82 ± 1.87

* Values are means ± standard deviations. There were no between-group or within-group differences for any of the performance measures.
1-RM, one repetition maximum; BP, bench press; Max, maximal; Reps, repetitions; TTE, treadmill time to exhaustion.

power of 0.800 and an α level equal to 0.050, we determined that a sample size of 10 was needed (SigmaStat, SPSS Inc., Chicago IL, USA). Pre- and postdifferences for total weight lifted on the bench press, body composition, and treadmill time to exhaustion were analyzed by a paired *t* test. An unpaired *t* test was used to assess between-group differences in bench press, body composition, treadmill time to exhaustion, and dietary intake. Statistical significance was set at $P < 0.05$; data are shown as means ± standard deviation. Data were analyzed using SigmaStat (SPSS Inc.).

RESULTS

There were no significant baseline differences between groups for age, height, weight (Table I), body composition, or performance measures (Tables II and III). There were no significant differences between groups for training frequency per week (aerobic and weight-training), number of exercises, sets, and repetitions or in the total estimated volume (sets × reps) of weight-training exercises performed (Table IV). The only significant pre- versus post-differences were for body weight (placebo group) and LBM (colostrum group) ($P < 0.05$). Reported dietary intakes (which included the colostrum and whey protein supplements for each group) did not differ between groups (Table V). Two women dropped out from the study because of unknown personal reasons.

DISCUSSION

There are numerous macro- and micronutrients present in milk. The two primary proteins found in milk are whey and casein, albeit both have several different types of protein subfractions. Whey is the fluid portion of milk that is obtained by coagulating and removing the curd (i.e., casein) during cheese production.[12] The whey protein component of milk contains the majority of vitamins and minerals and 20–24% of the milk proteins.[13] Bovine colostrum is the initial lacteal secretion of cows during parturition and the first few days postparturition.[1,2] Bovine colostrum contains growth factors that stimulate protein synthesis with its highest activity occurring during the first 24 h of colostrum sampling. These growth factors include epidermal growth factor, IGF-I, transforming growth factors a and b, tumor necrosis factor, basic fibroblast growth factor, and platelet-derived growth factor.[14,15] However, there is no detectable colostrum 3 d postparturition.[1,16]

There is an abundance of data that indicates that porcine colostrum feeding augments protein synthesis in organs and skeletal muscle of newborn pigs.[3,17] It is not clear if a similar anabolic effect is found in adult animals or humans. However, work by Mero et al.[4] found that bovine colostrum supplementation increased IGF-1 concentrations in nine male sprinters. However, these investigators did not assess body composition changes to determine if the measured increase in IGF-1 can produce subsequent gains in LBM.

Ours is the first study to assess the effects of chronic supplementation of bovine colostrum on body composition and exercise performance in active men and women. After 8 wk of exercise training and colostrum consumption (20 g/d), subjects had a mean gain of 1.5 kilograms (kg) of bone-free LBM. In contrast, the placebo (whey protein) group did not change in LBM. The coefficient of variation for estimated LBM using DEXA (unpublished observations from our laboratory) is approximately 1%. This would be equal to a 0.64 kg change in LBM. Thus, it might be surmised that the 1.5-kg increase in LBM in the colostrum-supplemented group may in fact be a true increase. However, one must be cautious with this interpretation because other investigators have found the coefficient of variation for LBM estimates via DEXA to be as high as 3.1%.[9–11] Certainly, this is as large as the difference in LBM reported for the colostrum-supplemented group.

It is not known what underlying mechanism(s) is responsible for the purported gains in LBM as a result of colostrum supplementation. Some have surmised that the gain in LBM may be due to an increase in circulating IGF-1 concentration. Bovine colostrum given to human athletes[4] and porcine colostrum fed to newborn piglets produces a significant rise in plasma IGF-1.[18] On the other hand, Buckley et al.[5] did not find a change in plasma IGF-1 concentrations after 8 wk of bovine colostrum supplementation (60 g/d). Moreover, work by Burrin et al.[17,19] indicate that even though the primary stimulus for protein anabolism is the

TABLE IV.

REPORTED TRAINING REGIMEN*

	Aerobic freq/wk	Weights freq/wk	No. of exerc.	No. of sets	No. of reps	Sets × reps
Colostrum	3.3 ± 1.8	4.3 ± 1.2	6.4 ± 3.2	3.4 ± 0.5	9.1 ± 1.2	208 ± 144
Placebo	3.5 ± 2.0	3.6 ± 0.8	6.8 ± 2.2	3.2 ± 0.3	9.2 ± 0.8	231 ± 78

* Values are means ± standard deviations. There were no between-group differences in reported exercise training.
freq, frequency; exerc, exercises; reps, repetitions.

TABLE V.

REPORTED DIETARY INTAKE*

	Kcals†	CHO (g)	PRO‡ (g)	Fat (g)	Ratio (C:P:F)
Colostrum	2412 ± 717	339 ± 143	123 ± 46	61 ± 28	57:20:23
Placebo	2352 ± 879	333 ± 128	120 ± 60	70 ± 38	55:20:25

* Values are means ± standard deviations. Each figure is the mean from three 24-hour dietary recalls. There were no significant between-group differences.

† Conversion factor: 1 kilocalorie (kcal) = 4.1840 kilojoule (kJ).

‡ Protein intake for both groups includes the 20 g/d of whey protein or colostrum.

CHO, carbohydrate; PRO, protein; (C:P:F), carbohydrate:protein:fat ratio (kcal).

intake of nutrients, it is likely that there is a non-nutritive component of colostrum that is anabolic with respect to skeletal muscle. It is not known if this component is insulin, IGF-1 or some other yet to be identified growth factor.[17] The current study did not measure plasma concentrations of anabolic hormones or factors; thus, it is not known if the LBM gains observed in the colostrum-fed subjects are related to changes in plasma hormone concentrations.

Even though LBM increased, body weight did not change significantly in the colostrum-supplemented group. This may have been owing to the slight decrease in fat mass.

Thus, the small sample size may have precluded seeing significant gains in body weight. On the other hand, the whey protein-supplemented (placebo) group had a significant increase in body weight. The increase in body weight may be due to the increased fat mass observed in the whey protein group; however, the change in fat mass was not significant. Also, changes in hydration status might affect body weight measures.

Fat mass did not change significantly for either group in the current study. This is in contrast with work by Lands et al.[20] These investigators found that 3 mo of whey protein supplementation produced a significant decrease in body fat. However, the subjects in the Lands et al. study were untrained individuals who did not participate in an exercise training regimen per se. Instead, they were asked to monitor their activity levels. Subjects in the whey-supplemented group ostensibly had an increase in activity level in comparison to the placebo (casein-supplemented) group. It is not clear if changes in activity level are related to the consumption of whey. Nor is it clear if it was the whey protein, increased activity level, or both that might have contributed to the decrement in body fat.

The subjects in our study did not have a significant change in body fat. One might speculate that possible changes in the colostrum-supplemented group (e.g., decrease in fat mass) might be masked by a similar effect from the whey placebo. However, it is clear from our sample of trained men and women that whey protein supplementation had no significant effect on body composition.

Our data show that there were no significant differences in macronutrient (i.e., total calories, carbohydrate, protein, fat) intake between groups. Thus, the changes in LBM (colostrum-supplemented group) and body weight (whey protein-supplemented group) may not be due to changes in eating habits. However, one should be cautious of dietary intake data derived from personal disclosure in that some individuals may consistently underestimate their food consumption.[21] We examined an average of three 24-h dietary recalls during our study; certainly, an increase in the number of observations might improve the accuracy of such data.[21]

Preliminary work by Buckley et al.[5,6] has demonstrated that bovine colostrum supplementation might augment exercise performance. These investigators examined a group of eight female elite rowers in which subjects consumed either 60 g daily of bovine colostrum ($n = 3$) or whey protein power (placebo) ($n = 5$). The distance covered and work performed during a 4-min maximal rowing effort was significantly greater in the colostrum-supplemented group.[6] Similarly, oral supplementation of bovine colostrum (60 g/d for 8 wk) improved treadmill performance in moderately fit men.[5]

On the other hand, our investigation did not reveal a performance-enhancing effect of colostrum supplementation. The exercise training regimen of the subjects in our study were not prescribed by the investigators. Instead, subjects in our study were required to have consistently resistance-trained three times per week for the last 6 mo. Moreover, subjects were instructed to not change their exercise training regimen for the duration of the study. Our data indicates that there were not any significant differences in the reported exercise training regimen between groups. This may explain, in part, the lack of change in exercise performance for either group. Also, because these subjects were already resistance and aerobically trained, it would be more difficult to improve muscular strength and endurance without systematic changes in their training scheme. On the other hand, one might expect an improvement in bench press performance in the colostrum-supplemented group because of their significant gains in LBM. In trained individuals, however, neural factors might play a greater role in improved performance.[22] Furthermore, the colostrum dosage in the current study was one third that used by Buckley et al.[5,6] Thus, one might speculate that with regard to performance changes, a larger dose (>20 g/d) is necessary. Future work should examine this possibility.

In summary, active men and women might experience a significant increase in bone-free LBM as a result of daily bovine colostrum consumption (20 g/d) for an 8-wk duration. Future work should examine if this anabolic effect is due to an increase in plasma growth factors or hormones (e.g., insulin, IGF-1) or if bovine colostrum mediates cellular events (e.g., increased muscle protein synthesis, increased cellular volume, etc.) related to skeletal muscle hypertrophy.

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