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POSTER PRESENTATIONS

P1

The effect of three different energy drinks on oxygen consumption and perceived exertion during treadmill exercise

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Background: Some energy drink manufacturers claim that their products can increase athletic performance. However, there are no studies to assess the effect of these energy drinks on oxygen consumption (VO_2) or ratings of perceived exertion (RPE) during exercise. If these energy drinks improve performance, VO_2 and RPE would likely be reduced during any given exercise intensity.
Methods: Fifteen (22.1 ± 2.7 years old) participants completed the study. Maximal oxygen consumption (VO_2 max) was initially measured to establish each participant's exercise for the 70% treadmill exercise protocol after ingesting an energy drink. Following VO_2 max testing, all participants completed a total of four conditions. Each condition required a participant to ingest an energy drink then rest in a seated position for one hour. Following one hour of rest, participants exercised for a total of 15 minutes on a treadmill at 70% of their VO_2 max. For each condition, participants blindly ingested one of four price-matched beverages (12 oz. placebo (Squirt), 8.4 oz. Red Bull®, 16 oz. Monster Energy ®, 2 oz. 5-hour ENERGY®). Relative VO_2 ($ml.kg^{-1}.min^{-1}$) and RPE (6-20 Borg Scale) were recorded each minute during the treadmill exercise and averaged in five-minute increments and as an average for each 15-minute condition.
Results: Analysis of variance revealed there was no significant main effect of energy drinks on average VO_2 (placebo 35.8 ± 2.3 $ml.kg^{-1}.min^{-1}$; Red Bull 35.4 ± 2.3 $ml.kg^{-1}.min^{-1}$; Monster 35.8 ± 2.2 $ml.kg^{-1}.min^{-1}$; 5-hour 36.5 ± 2.4 $ml.kg^{-1}.min^{-1}$; $p \geq .482$) and RPE (placebo 12.2 ± 0.6; Red Bull 12.6 ± 0.5; Monster 12.0 ± 0.5; 5-hour 11.7 ± 0.5; $p \geq .179$) during 15 minutes of treadmill exercise.
Conclusions: Energy drinks do not appear to improve perceived treadmill exercise performance nor running economy assessed via oxygen consumption at 70% treadmill exercise. Given that no significant reductions were found in VO_2 and RPE post energy drink consumption, results do not support manufacturers' claims regarding their product's ability to boost performance. Additional research is needed to assess time trial or time to exhaustion sprint and endurance performance. Time trials and time to exhaustion may better assess if these energy drinks can, in fact, improve exercise performance.

P2

Effects of a traditionally-dosed creatine supplementation protocol and resistance training on the skeletal muscle uptake and whole-body metabolism and retention of creatine in males

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Background: A typical oral creatine supplementation regimen involving a 5-7 day "loading phase" of 20-25 grams/day followed by a "maintenance phase" of 5-7 grams/day is typically considered as necessary to adequately saturate skeletal muscle as a lesser dose of creatine is insufficient in doing so. This rationale also assumes that the majority, if not all, of the creatine ingested at this dosage is fully utilized by skeletal muscle as a phosphate reservoir in which to re-synthesize ATP during high-intensity, short-term exercise. The purpose of this study was simply to determine the effects of this "typical" creatine dosing strategy previously mentioned on skeletal muscle creatine uptake as well as the whole-body metabolism and retention of creatine in males while engaged in resistance training.
Methods: In a double-blind manner, fourteen (Cr = 7, Pl = 7) non-resistance-trained (i.e. < thrice weekly, 1 year prior) men between the ages of 18-30 were randomly assigned by age and body weight to orally ingest a powdered dextrose placebo or creatine monohydrate. After baseline strength and body composition testing procedures, participants ingested creatine or placebo at a dose of 0.3g/kg lean body mass/day (≈ 20-25g/day) for a 5 day loading phase immediately followed by a 42-day maintenance phase at a dose of 0.075g/kg lean body mass/day (≈ 5-7g/day). The participants followed a periodized 4 day per week resistance-training program split into two upper body and two lower body workouts per week, for a total of 7 weeks. Blood and muscle samples were obtained at Day 0, 6, 27, and 48. Statistical analyses were performed utilizing separate two-way ANOVA for each criterion variable employing a probability level of ≤ 0.05.
Results: Creatine supplementation preferentially induced significant increments in total body mass ($p = 0.03$) and lean body mass ($p = 0.01$). Creatine did not significantly decrease fat mass ($p = 0.29$); however, fat mass was significantly decreased in both groups with resistance training ($p = 0.001$). Muscle strength significantly increased with resistance training ($p = 0.001$) for both groups, but was not preferentially increased with creatine supplementation. Creatine supplementation significantly increased muscle total creatine ($p = 0.043$), serum creatine ($p = 0.003$), urinary creatine ($p = 0.036$), and urinary creatinine ($p = 0.01$) in the creatine group compared to placebo.

Conclusion: A typically-dosed creatine supplementation regimen produced increases in total and lean body mass, despite the inability to preferentially increase muscle strength in conjunction with resistance training. This regimen was also able to effectively increase muscle total creatine content; however, this dosing strategy for creatine supplementation also led to excess amounts of serum and urinary creatine and urinary creatinine content. Despite increases in body mass and muscle creatine uptake with this regimen, a similar response may likely occur with a lesser creatine dose in non-resistance trained males.

P3

Exercise and calorie information on menus is not enough to improve food choices in Hispanic adults

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Background: Hispanics are a fast growing population in the U.S. with a high prevalence of obesity or overweight. Eating out frequently in restaurants is linked with weight gain, and several strategies to improve food choices from menus have been studied. Some of the strategies that may be effective include displaying the amount of exercise needed to burn the food calories, rank ordering the food items by calorie content, and showing both calorie content of foods and the recommended calories together. However, most of the participants in the previous studies were non-Hispanic. Hispanics engage in sports activities and eat out in restaurants just like non-Hispanics and whether the exercise and calorie labels will affect their food choices needs to be determined.
Methods: Three-hundred and seventy-two Hispanic adults (18-65 years) were randomized to a menu with no labels (NL) (n = 127), a menu with rank ordered calorie labels plus a statement on the number of calories recommended per meal (CL) (n = 123), or a menu with rank ordered exercise labels showing the duration of brisk walking necessary to burn the food calories (EL) (n = 122). Food and drink choices were identical on each menu. Participants were given the assigned menu and instructed to circle the food and drink items they would order, as if having lunch in a fast-food restaurant. The menus were developed in both English and Spanish and the participants decided which language version they preferred. Participants were not informed about the study purpose and were paid $10 for completing the study. The effects of menu condition on the number of calories and percent energy from fat ordered were assessed by analysis of variance.
Results: There were no differences in calories ordered (mean ± standard deviation: NL: 792 ± 378 kcal; CL: 829 ± 415 kcal; EL: 867 ± 528 kcal; p = 0.41) or percent energy from fat ordered (NL: 35.0 ± 7.3%; CL: 34.4 ± 8.3%; EL: 35.4 ± 8.2%; p = 0.64) by menu condition. Adjustment for age, weight status, gender, hunger level, price, education, and whether or not they used the English or Spanish version of the menus did not affect the number of calories ordered.
Conclusions: The EL and CL menus did not affect the number of calories or percent energy from fat ordered by Hispanic adults. This study indicates that it is not enough to just provide information on menus. Coaches, fitness trainers, and nutritionists also need to educate their Hispanic clients about the importance of controlling calorie intake when eating out.

P4

Effects of 8 weeks pre-workout dietary supplement ingestion with and without synephrine on blood chemistry panel

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Background: A number of nutritional strategies have been developed to optimize nutrient delivery prior to exercise. As a result, a number of pre-workout supplements have been developed to increase energy availability, promote vasodilation, and/or positively affect exercise capacity. The purpose of this study was to examine the effects of 8 weeks pre-workout dietary supplement ingestion with and without synephrine on blood chemistry panel.
Methods: In a double-blind, randomized and placebo-controlled manner; 80 apparently healthy and resistance-trained men (21.76 ± 3.59 yr, 15.29 ± 6.19% fat, 25.60 ± 4.03kg/m^2) ingested in a randomized and counterbalanced manner a dextrose flavored placebo (P); a pre-workout supplement (PWS) containing 3.0 g beta alanine, 2 g creatine nitrate, 2g arginine AKG, 300mg N-acetyl tyrosine, 270mg caffeine, 15mg Mucuna pruriens; or, the PWS with 20mg synephrine (PWS+S), and then had blood donation at week 0, week 4, and week 8. The participants had resistance training 4 times per week during 8 weeks supplementation. Data were analyzed by repeated measure ANOVA and presented as mean (95% CI) delta change from baseline.
Results: Repeated MANOVA revealed no significant differences among groups in blood urea nitrogen (BUN) (p = 0.62) and creatinine (CRE) (p = 0.27), and the ratio of BUN/CRE (BCr) (p = 0.20). An overall Wilks' Lambda analysis showed significant time effects (p < 0.01) in mean changes in BUN (unit conversion to mg/dl by mmol/l × 2.8011) (2.79mg/dl; 1.58, 4.00) at week 8, CRE (unit conversion to mg/dl by μmol/l × 0.0113) (-0.35mg/dl; -0.49, -0.21) at week 4 and (-0.16mg/dl; -0.28, -0.05), and BCr: (8.17; 4.01, 12.33) at week 4 and (7.02; 3.02, 11.02) at week 8. Greenhouse-Geisser univariate analysis revealed no time × group interaction of BUN (p = 0.54), CRE (p = 0.78), and BCr (p = 0.62). In liver enzymes, there were no significant differences among groups in alkaline phosphatase (ALP) (p = 0.24), alanine amino transferase (ALT) (p = 0.74), and aspartate amino transferase (AST) (p = 0.47). Delta analysis revealed significant difference in ALP: (-11.23 U/L; -13.93, -8.5) at week 4 and (-5.44 U/L; -8.48, -2.4) at week 8. LSD Post hoc analysis revealed no significant mean changes in liver enzymes; however, there was a significant difference (p = 0.04) of ALP between PWS+S (-3.44 U/L; -6.52, -0.36) and PWS (-7.86 U/L; -10.88, -4.84) compared with P (-5.36 U/L; -8.388, -2.34). However, the range of both groups PWS+S: (68.14 ± 17.39 U/L) at week 4 and (74.44 ± 19.64 U/L) at week 8 and PWS: (87.20 ± 24.72 U/L) at week 4 and (78.49 ± 24.96 U/L) at week 8 were within safe clinical range (30-92 U/L). There were no significant time (p = 0.23) and time × group interaction (p = 0.78) of creatine kinase (CK) and lactate dehydrogenase (LDH), no significant time × group interaction (p = 0.78) of total cholesterol, LDL-C, HDL-C and triglyceride, and a significant time effect (p < 0.01) but no time × group effect (p = 0.083) of glucose levels.
Conclusion: Ingesting a dietary PWS or PWS+S for 8 weeks had no adverse effect on kidney function, liver enzymes, blood lipid levels, muscle enzymes, and blood sugar levels. These findings are in agreement with other studies testing similar ingredients.
Acknowledgements: Supported by Nutrabolt International, Inc. (Bryan, TX)

P5

Safety and efficacy of a pre-wrkout dietary supplement with and without synephrine

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Background: A number of nutritional strategies have been developed to optimize nutrient delivery prior to exercise. As a result, a number of pre-workout supplements have been developed to increase energy availability, promote vasodilation, and/or positively affect exercise capacity. The purpose of this study was to examine the safety and efficacy of a pre-workout dietary supplement with and without synephrine.
Methods: In a double-blind, crossover, randomized and placebo-controlled manner; 25 apparently healthy and recreationally active men and women (21.76 ± 3.00 yr, 15.24 ± 5.26% fat, 25.09 ± 3.03kg/m^2) had the first blood donation after 10-12 hours fasting, and then after 2 hours of a pre-workout supplement ingestion, participants had the second

blood donation. Participants ingested in a randomized and counterbalanced manner a dextrose flavored placebo (P); a pre-workout supplement (PWS) containing 3g beta alanine, 2g creatine nitrate, 2g arginine AKG, 300mg N-acetyl tyrosine, 270mg caffeine, 15mg *Mucuna pruriens*; or, the PWS with 20mg synephrine (PWS+S). Participants repeated the experiment after a one week washout period with the alternate supplements in a randomized and counterbalanced manner. Data were analyzed by repeated measure ANOVA and presented as means (95% CI) delta change from baseline.
Results: Delta analysis revealed significant differences among groups in mean change in blood urea nitrogen (BUN) (unit conversion to mg/dl by mmol/l × 2.8011): P (-1.51mg/dl; -2.26, -0.78), PWS (-2.26mg/dl; -2.99, -1.54), and PWS+S (-0.56mg/dl; -1.28, 0.14), creatinine (CRE) (unit conversion to mg/dl by μmol/L × 0.0113): P (0.05mg/dl; 0.01, 0.10), PWS (0.14mg/dl; 0.09, 0.19), and PWS+S (0.14mg/dl; 0.09, 0.18). An overall Wilks' Lambda time ($p < 0.01$) and time × group ($p < 0.01$) interactions for BUN, CRE and the ratio of BUN/CRE (BCr), and Greenhouse-Geisser univariate analysis for BUN, CRE and BCr ($p < 0.01$) were found. Wilks' Lambda analysis revealed a significant time effect ($p < 0.05$) of alkaline phosphatase (ALP), aspartate amino transferase (ALT), and alanine amino transferase (AST), and of creatine kinase (CK) and lactate dehydrogenase (LDH), with no time × group interactions ($p > 0.05$). MANOVA Greenhouse-Geisser univariate analysis revealed significant changes over time for ALP, ALT and AST ($p < 0.01$), and CK and LDH ($p < 0.01$). Delta analysis revealed significant differences among groups in mean change in total cholesterol (CHOL): P (0.31mmol/L; 0.12, 0.50), PWS (-0.16mmol/L; -0.35, 0.02), and PWS+S (0.31mmol/L; 0.12, 0.50). An overall Wilks' Lambda time ($p < 0.01$) and time × group ($p < 0.01$) interactions for CHO, HDL-C, LDL-C and triglyceride (TAG), and Greenhouse'Geisser univariate analysis for CHO, HDL-C, and LDL-C ($p < 0.01$) were found. Delta analysis revealed significant differences among groups in mean change in glucose: P (0.60mmol/L; 0.21, 0.99), PWS (0.77mmol/L; 0.39, 1.15), and PWS+S (1.29mmol/L; 0.90, 1.68). A significant time × group interactions ($p < 0.03$) of glucose was found.
Conclusion: Ingesting a dietary PWS or PWS+S had minor affects within 3 hours, similar to P, on kidney function, liver enzymes, blood lipid levels, muscle enzymes, and blood sugar levels. These findings are in agreement with other studies testing similar ingredients.
Acknowledgements: Supported by Nutrabolt International, Inc. (Bryan, TX)

P6

A comparison of citrulline and arginine for increasing exercise-induced vasodilation and blood flow

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Background: One goal of supplementation has been to increase blood flow to skeletal muscle during exercise. Raw L-citrulline (RC) and raw L-arginine (RA) has often been used for its vasodilatory effects, and recently, citrulline and arginine have been bound to a whey peptide (CP and AP, respectively) to increase bioavailability. The purpose of the present study was to compare the acute hemodynamic effects of RC, CP, RA, and AP following resistance exercise in healthy, men when administered at a common, commercial dose.
Methods: In a double-blind, crossover, placebo-controlled design, 11 recreationally-active males (28.2 ± 5.0y, 182.4 ± 5.7cm, 87.1 ± 10.3kg) ingested either 1.87g of RC, 3.67g of CP (citrulline content 1.87g), 1.87g of RA, or 3.07g of AP (arginine content 1.87g) and performed 3 sets of 15 arm curls at 30 and 120 minutes post-supplementation. Brachial artery vessel diameter (VD) and blood flow volume (BFV) were measured via Doppler ultrasound at 0, 3, and 6 minutes post-exercise, corresponding to 30 (30P), 33 (33P), 36 (36P), 120 (120P), 123 (123P), and 126 (126P) minutes post-supplementation. Measurements were compared with both resting baseline (no treatment, no exercise) and active control (no treatment, exercise) values. Raw data were analyzed for all group, time, and group × time interactions using 2-way repeated-measures ANOVA. Delta values were analyzed using dependent T-tests. Alpha was predetermined at $p < 0.05$.
Results: A significant ($p < 0.05$) group × time effect was present for VD, which significantly increased in CP versus RA from active baseline to 33P (CP: 0.57 ± 0.05; RA: 0.55 ± 0.05cm). Although, no effects for BFV were observed ($p > 0.05$). No differences were found between delta values for CP and AP nor between delta values for RC and RA or AP for VD ($p > 0.05$). However, VD delta values for CP were significantly ($p < 0.05$) greater than for RA at 33P (CP: +0.04 ± 0.03; RA: +0.02 ± 0.02cm) and 36P (CP: +0.04 ± 0.02; +0.02 ± 0.02cm) compared to active controls. A significantly ($p < 0.05$) greater change in BFV for the CP and RC treatments versus the RA treatment were observed at 33P (CP: +62.6 ± 155.8; RC: +57.6 ± 145.3; RA: -26.4 ± 137.4mL/min) compared to active control values. Conversely, significantly ($p < 0.05$) greater delta values for BFV were observed for AP over CP at 126P (AP: -5.6 ± 90.8; CP: -50.2 ± 74.7mL/min) compared to active controls.
Conclusions: Collectively, citrulline-based ingredients appear to be more effective than arginine-based ingredients for modulating vasodilation and blood flow. The whey peptide bound state may positively influence the effects of supplementation.

P7

Short-term powdered tart cherry supplementation encircling an acute endurance challenge potentially increases running performance and attenuates post-race markers of inflammation

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Background: Consumption of tart cherry juice has been reported to increase endurance aerobic performance and attenuate perceptions of muscle soreness by reducing inflammation and oxidative stress that cause secondary muscle damage following endurance exercise. The purpose of this study was to determine if consumption of a powdered form of tart cherries derived from tart cherry skins (CherryPURE® Freeze Dried Tart Cherry Powder) prior to and following strenuous endurance exercise increases performance while attenuating markers of inflammation and oxidative stress.
Methods: 27 endurance trained or triathlete (21.8 ± 3.9 yr, 15.0 ± 6.0% body fat, 67.4 ± 11.8kg) men (n = 18) and women (n = 9) were matched based on average reported race pace, age, body weight, and fat free mass. Subjects were randomly assigned to ingest in a double blind manner capsules containing a placebo (P, n = 16) or powdered tart cherries [CherryPURE®] (TC, n = 11). The runners ingested the supplements one time daily (480mg/d) for 10-d: 7-d pre-exercise, day of exercise, and 48-hr post-exercise. Subjects participated in a study-organized half-marathon race (13.1mi/21.1km) at competition-pace with a 2-h (111.98 ± 11.9 min) maximum finish time. Official race splits and finish times were recorded using a standard stopwatch timing system and analyzed by a one-way ANOVA. Blood samples were drawn pre-run, 60-min post-run as well as after 24-h and 48-h of recovery and analyzed by MANOVA with repeated measures.
Results: Significantly faster half-marathon split ($p = 0.002$) and race finish ($p = 0.001$) times were reported for subjects in the TC group versus P. The overall MANOVA analyses revealed significant Wilks' Lambda time ($p < 0.001$) interactions, but no significant group × time pro-inflammatory ($p = 0.90$) and anti-inflammatory ($p = 0.73$) effects. All of the univariate measures for pro- and anti-inflammatory makers reported main time effects. The mean TC IL-1β result ($p = 0.059$) tended to be greater than P, but no between group change over time. A trend toward a significant group × time interaction was shown in IL-2 ($p = 0.079$) and IL-5 ($p = 0.076$) with a significantly greater TC IL-2 pre-run response and a greater TC IL-5 level over all five study time points compared to P. A significant group × time interaction was shown for IL-6 ($p = 0.038$) and IL-12p70 ($p = 0.050$) with a significantly greater TC IL-6 response at baseline,

pre-run, and 60-min post-run compared to P. Post-hoc analysis indicated a significantly attenuated TC IL-12p70 response across all three post-run recovery time points compared to P. The overall delta MANOVA analyses revealed significant Wilks' Lambda time ($p < 0.001$) interactions, but no significant group × time pro-inflammatory ($p = 0.77$) and anti-inflammatory ($p = 0.64$) effects. Within the univariate analysis, changes in IL-2 ($p = 0.10$), IL-5 ($p = 0.067$), IL-12p70 ($p = 0.036$), and IL-13 ($p = 0.096$) from pre-run tended to be more significantly attenuated in TC over P coupled with a tendency for IL-2 ($p = 0.098$), IL-12p70 ($p = 0.098$), and IL-13 ($p = 0.087$) levels to be more greatly attenuated in TC compared to P. The 48-h recovery NT response from pre-run tended to be greater in TC compared to P. Post-hoc analysis revealed significantly attenuated changes in IL-2 and IL-5 from pre-run values at both 24-h and 48-h post-run in TC compared to P. These results were paired with significantly attenuated IL-13 levels from pre-run at 60-min and 48-h post-run, while the NT TC response was significantly greater and the IL-12p70 TC levels were significantly attenuated compared to P at 48-h post-run. While a main delta time effect was shown for IL-6 ($p < 0.001$), no significant delta changes between groups over time were observed ($p = 0.16$).

Conclusion: The results of the current study involving the consumption of a Montmorency powdered TC supplement for 10-d surrounding an endurance running challenge demonstrated faster race completion and a similar effect on oxidative stress and inflammation reported in previous tart cherry juice supplementation literature. Coupled with the dampening of the post-run immune and inflammatory response, the powdered tart cherry runners seemed to maintain better post run redox balance compared to placebo-supplemented runners. Further research is necessary to determine active fruit phytochemical-related inflammatory and oxidative stress mechanisms in relation to high volume endurance challenges.

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P8

Effects of MSM on exercise-induced muscle and joint pain: a pilot study

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Background: Participants in organized running commonly experience muscle and joint pain while training for and competing in distance events. Many runners report pain as a major influence on changes or breaks in training regimens, and as a common deterrent for returning to exercise after a break. Methylsulfonylmethane (MSM) is a sulfur-based nutritional supplement shown through several clinical trials to be effective in reducing pain associated with osteoarthritis, and to exhibit anti-inflammatory properties. To further investigate the role of MSM in pain management, this randomized, double-blind, placebo-controlled study evaluated the effects of MSM supplementation on exercise-induced muscle and joint pain.

Methods: Twenty-two healthy females (n = 17) and males (n = 5) (33.7 ± 6.9 yrs.) were recruited from the 2014 Portland Half-Marathon registrant pool. Participants were randomized to take either MSM (OptiMSM®) (n = 11), or a placebo (n = 11) at 3g/day for 21 days prior to the race and two days after (23 total). Pain was recorded using a 100 mm Visual Analogue Scale (VAS) for both muscle pain (MP) and joint pain (JP) on a single questionnaire. Participants completed the questionnaire at five time points. Baseline levels (T_0) were recorded approximately one month prior to the race. Post-race pain levels were recorded at 15 minutes (T_1), 90 minutes (T_2), 1 Day (T_3), and 2 days (T_4) after race finish. Data were analyzed using linear mixed models controlled for baseline, with time point as a repeated factor. Simple contrasts compared post-race time points to baseline, and Student's t-tests assessed between-group time point comparisons.

Results: Half-marathon completion resulted in significant time effects for increased pain in both MP ($p < 0.001$) and JP ($p < 0.001$). Mean MP at T_0 (14.7mm) significantly increased at T_1 (38.4mm; $p < 0.001$), T_2 (33.5mm; $p = 0.001$), and T_3 (36.3mm; $p = 0.001$), and fell to non-significant levels at T_4 (20.9mm; $p = 0.330$). Mean JP at T_0 (8.4mm) significantly increased at T_1 (33.5mm; $p < 0.001$), T_2 (31.5mm; $p < 0.001$), and T_3 (24.8mm; $p = 0.004$), and fell to non-significant levels at T_4 (16.1 mm; $p = 0.198$). The results showed a trend of lower pain levels in the MSM group. However, time-by-treatment effects did not reach significance in either MP or JP. Compared to placebo, MSM supplementation resulted in nearly significantly lower MP at T_1 (MSM = 27.3mm vs. placebo = 49.8mm, $p = 0.063$), and lower MP at T_2 (27.1mm vs. 40.0mm; $p = 0.300$), and T_3 (30.0mm vs. 41.9mm; $p = 0.306$). Similar results were seen for JP at T_1 (24.2mm vs. 42.4mm; $p = 0.156$), T_2 (22.7mm vs 39.3mm; $p = 0.204$), and T_3 (15.4mm vs. 32.2mm; $p = 0.152$).

Conclusion: Exercise-induced muscle pain and joint pain increase within 15 minutes of completing a half-marathon, continue through the following day, and diminish approximately two days post-race. Three weeks of MSM supplementation at 3g/day attenuated post-exercise muscle and joint pain at clinically significant levels compared to placebo. However, the pain reductions did not reach statistical significance, warranting further research on MSM and post-exercise pain among larger samples.

Acknowledgements: Eric D Withee is employed part-time at Bergstrom Nutrition (Vancouver, WA), manufacturers of MSM (OptiMSM™)

P9

Effects of 8 weeks of Stealth® supplementation on body composition, muscle strength and mass, markers of satellite cell activation, and clinical safety markers in males

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Purposes: This study determined the effect of 8 weeks of heavy resistance exercise combined with oral ingestion of either a placebo or Stealth® dietary supplement on body composition, muscle strength and mass, hemodynamics, myofibrillar protein content, serum (IGF-1, HGF, GH), muscle total DNA content, c-Met, and the myogenic regulatory factors (Myo-D, Myogenin, MRF-4).

Methods: Twenty non-resistance-trained males were randomly matched by age and body mass in a double-blind fashion being assigned to either a placebo (maltodextrose) or Stealth® group. Testing was conducted at baseline (day 0) followed by 8 weeks of a periodized 4-day per week resistance training program of 3 × 10 reps at 70-80% of their 1-RM. The program was split into two upper and two lower extremity workouts per week with post testing occurring at (day 57). Both groups consumed 2 servings (312g) (1248 kcals) per day. During exercise sessions the placebo group consumed (156g) of maltodextrose 30 min before and after exercise. The Stealth® group consumed (22g fat, 158g carbohydrates, 94g protein). During non-training days both groups consumed the 2 servings in the morning upon waking. Both the placebo and Stealth® groups consumed an isocaloric diet (~2500 kcals) and the additional (1,248 kcals) for a total of (~3750 kcals) each day. Data were analyzed with separate 2 × 2 factorial analyses of variance (ANOVA) with repeated measures ($p < 0.05$).

Results: For dietary intake, there were no significant differences in total calories ($p = 0.346$), protein ($p = 0.689$), and fat ($p = 0.275$) between testing sessions. A significant difference in carbohydrate ($p = 0.003$) between testing session was shown, but no difference ($p = 0.737$) between groups was observed. Hemodynamic measurement between testing session for resting heart rate ($p = 0.208$) and SBP ($p = 0.192$) were not significant between testing sessions. However, DBP ($p = 0.047$) was significant but no differences ($p = 0.686$) between groups were observed. A significant increase in body mass ($p = 0.001$), body water ($p = 0.001$), body fat % ($p = 0.001$), and fat mass ($p = 0.001$) were shown between testing sessions. Only body water was significantly ($p = 0.030$) greater within the stealth® group. No significant difference in fat free mass ($p = 0.068$) was shown between testing session for either group. A significant difference in upper body strength ($p = 0.024$) and lower body strength ($p = 0.001$) was shown between testing sessions for both groups. However, no significant difference between upper body ($p = 0.989$) and lower body ($p = 0.097$) strength was observed between the supplement groups. Serum IGF-1 ($p = 0.270$), HGF ($p = 0.070$), and GH ($p = 0.397$) were not

significantly different between testing sessions. No significant difference between testing sessions for myofibrillar protein (p = 0.108), total DNA (p = 0.217), Myo-D (p = 0.093), and Myogenin (p = 0.070) were observed. A significant difference between testing session in c-MET (p = 0.023) and MRF-4 (p = 0.044) were shown. Only the placebo (p = 0.047) group was < Stealth® for c-Met.
Conclusions: Heavy resistance training with a high caloric proprietary blend weight gain dietary supplement does not improve markers for skeletal muscle hypertrophy. Significant increases in body mass, fat mass and body fat % were shown for both placebo and Stealth®.
Acknowledgements: This study was supported by a research grant from VPX, awarded to Baylor University

P10

Acute hemodynamic effects of L-arginine, arginine nitrate, and arginine peptide on exercise-induced vasodilation and blood flow in healthy men

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Background: Increasing blood flow to skeletal muscle during exercise may benefit both recreational and elite athletes. Raw arginine (RA) is a commonly used supplement for increasing blood flow via nitric oxide production. Arginine has been also been bound to a whey peptide (AP) and to nitrate (AN) to increase bioavailability. The purpose of the present study was to determine the acute hemodynamic effects of RA, AP, AN, and placebo (PLA) following resistance exercise in healthy, recreationally-active men at doses commonly used in the marketplace.
Methods: In a double-blind, crossover, placebo-controlled design, 11 recreationally-active males (28.2 ± 5.0y, 182.4 ± 5.7cm, 87.1 ± 10.3kg) consumed either 1.87 g of RA, 3.07 g of AP (arginine content 1.87g), 2.55g of AN (arginine content 1.87g), or a flavor-matched, visually identical placebo (PLA), and performed 3 sets of 15 arm curls at 30 and 120 minutes post-supplementation. Vessel diameter of the brachial artery (VD) and blood flow volume (BFV) were measured via Doppler ultrasound at 0, 3, and 6 minutes post-exercise, corresponding to 30 (30P), 33 (33P), 36 (36P), 120 (120P), 123 (123P), and 126 (126P) minutes post-supplementation. Measurements were compared with active control (no treatment, exercise) values. Raw data were analyzed for all group, time, and group × time interactions using 2-way repeated-measures ANOVA. Percent change values were analyzed using dependent t-tests. Alpha was set at $p < 0.05$.
Results: A significant ($p < 0.05$) group × time interaction was observed for RA compared to PLA, and post hoc analyses revealed that RA increased VD versus PLA at 30P (RA: 0.56 ± 0.17; PLA: 0.55 ± 0.17cm) compared to control. Significantly greater percent change values were observed for VD when comparing RA and PLA at 30P versus active (RA: 7.87 ± 4.09; PLA: 3.90 ± 3.75cm). Significantly greater percent change values were observed for BFV when comparing AP and PLA at 33P, AP and RA at 33P, AP and PLA at 36P, and AP and AN at 123P and 126P versus active baselines ([AP 33P: 25.7 ± 39.1; 36P: 22.0 ± 41.6; 123P: 21.5 ± 47.6; 126P: 3.02 ± 31.7mL/min], [PLA 33P: 3.27 ± 30.6; 36P: 5.71 ± 33.6mL/min], [RA 33P: -0.71 ± 34.5mL/min], [AN 123P: -2.58 ± 29.6; 126P: -21.8 ± 27.6mL/min]).
Conclusions: Though raw arginine may significantly increase vessel diameter compared to placebo at 30 minutes post-exercise, arginine peptide induced significantly higher percent change values for blood flow volume compared to raw arginine, placebo and arginine nitrate at specific time points, and therefore may be the best option for increased blood flow.

P11

The effects of beef protein isolate and whey protein isolate supplementation on lean mass and strength in resistance trained individuals - a double blind, placebo controlled study

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Background: Consumption of moderate amounts of whey and animal derived protein has been demonstrated to enhance short and long-term protein balance over a placebo matched control. However, to date no study has comprehensively compared high quality beef based protein supplementation with whey based protein sources following a resistance training protocol. The purpose of this study was to determine the effects of post-exercise consumption of two servings of beef protein isolate (BeefISO) or whey, compared to a maltodextrin control on lean mass and strength during 8 weeks of resistance training.
Methods: Thirty college-aged, resistance-trained males and females were randomly assigned to one of three treatment groups. Subjects consumed two servings (46g) of Beef Protein Isolate (BeefISO™), Whey Protein isolate or maltodextrin. Subjects trained 5 days per week (3 resistance training, 2 cardio) for 8 weeks as a part of a daily undulating periodized resistance-training program. Two servings of protein were consumed immediately following exercise or at a similar time of day on off days. Dual emission x-ray absorptiometry (DXA) was used to determine changes in body composition. Maximum strength were assessed by one-rep-max (1RM) for bench press (upper body) and deadlift (lower body). A two-way ANOVA with repeated measures model was used to identify group, time, and group by time interactions. The significance level was set at $p < 0.05$.
Results: Both beef protein isolate (↑5.7%) and whey protein isolate (↑4.7%) each lead to a significant increase in lean body mass compared with baseline ($p < 0.0001$). Fat loss was also significantly decreased at 8 weeks compared to baseline for beef protein isolate and whey, 10.8% and 8.3% respectively ($p < 0.0001$). 1RM both deadlift and bench-press were both significantly increased for all treatment groups when compared to baseline. However, no significant differences in increased strength as measured by deadlift (↑11.6%-19.3 %) or bench-press (↑11.4%-17.6%) were observed between beef protein isolate, whey, or maltodextrin groups over the 8 week training regimen ($p < 0.0001$).
Conclusion: The results of this study further support the benefits of protein supplementation following resistance training. Specifically, in this study consumption of two-servings of beef protein isolate or whey resulted in significant gains in lean body mass over time, which outpaced gains resultant from resistance training alone (maltodextrin supplementation). However, all experimental groups increased strength equally. It is plausible that the uniform strength gains were explained by both increases in neural and morphological adaptations negating the effect of protein supplementation. Overall, the results of this study demonstrate that consuming two servings of either beef protein isolate or whey protein isolate following resistance training lead to significant increases in lean body mass and strength.

P12

The effect of meal composition on postprandial glucagon-like peptide-1 response in overweight/obese participants

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Background: Glucagon-like peptide-1 (GLP-1) is an incretin hormone secreted in the intestine in response to food intake. GLP-1 may be responsible for nearly 50% of insulin secretion. Postprandial GLP-1 secretion

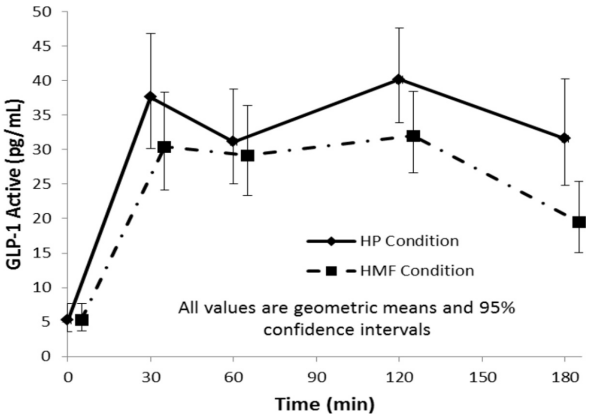

Figure 1(abstract P12)

may be impaired in overweight/obese (OW/O) individuals and in patients with type-2 diabetes (T2D). Meals high in protein (HP) or high in monounsaturated fat (HMF) may increase GLP-1 response. However, there are no studies directly comparing HP with HMF meals on postprandial GLP-1 response.

Methods: Twenty-four OW/O participants (male/female: 12/12; age: 38.7 ± 15.3 (mean ± standard deviation) years; BMI: 31.6 ± 4.0kg/m^2) were studied. Participants consumed a HMF and a HP meal in a random order at least 4 days apart. The HMF meal contained 35.2% energy from fat and 20.7% from monounsaturated fat and the HP meal contained 31.9% energy from protein. Energy and carbohydrate content were similar across meals. Blood samples were collected in the fasting and postprandial (30, 60, 120, and 180 min) states and analyzed for GLP-1 (active and total), insulin, glucagon, C-peptide, and glucose. A mixed effects repeated measures analysis model was used to examine the effect of meal composition on the outcome variables.

Results: There were statistically significant ($p < 0.01$) time and time by meal composition interaction effects on active GLP-1 (see figure). Also found were statistically significant ($p < 0.01$) time, meal composition, and time by meal composition interaction effects on total GLP-1, insulin, C-peptide, and glucagon. The responses were higher on the HP compared to the HMF meal ($p < 0.05$) for active and total GLP-1 and C-peptide at 120 and 180 min, insulin at 60, 120, and 180 min, and glucagon at 30, 60, 120, and 180 min. There was a significant time ($p < 0.0001$) but not meal composition ($p = 0.14$) or time by meal composition interaction ($p = 0.83$) effect on blood glucose.

Conclusions: Postprandial GLP-1, insulin, C-peptide, and glucagon responses were higher on the HP compared to the HMF meal but there was no difference in blood glucose response by meal composition. Future studies comparing meal composition on GLP-1 need to be longer in duration and in participants with T2D.

P13

Safety and efficacy of a proprietary thermogenic and cutting agent on measures of muscular strength and endurance, body composition, fat metabolism, and hormone levels

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Purpose: The purpose of this study was to conduct a clinical trial on the commercially available thermogenic supplement (Iron Cuts®) and its effects on various markers of performance, metabolism, body composition, and hormone levels. The supplement evaluated in this study contains several ingredients (caffeine, green tea extract, fenugreek, etc.) that have been shown to promote positive adaptations of some of the dependent variables of interest.

Methods: Twenty resistance-trained male subjects (21.10 ± 2.5 yrs, 177.4 ± 5.2cm, 87.2 ± 15.4kg, 14.8 ± 5.4 BF%) participated in a four-day per week split body resistance program. Participants were matched based on lean mass and randomly assigned to consume either a placebo (PL) or the dietary supplement Iron Cuts (IC). At baseline (PRE), subjects were assessed on body composition via DEXA, circumference measurements, 1 repetition maximum (1RM) and repetitions to failure on bench press and leg press. After concurrent training and supplementation for six weeks, all testing at baseline was repeated (POST). Subjects performed 3 consecutive supine resting energy expenditures and heart rate/blood pressure assessments before (0MIN), 30 minutes after (30MIN), and 60 minutes after (60MIN) ingesting an acute dose of the either PL or IC. Data were analyzed via ANOVA with repeated measures and statistical significance was accepted at $p \leq 0.05$.

Results: Significant time effects were observed for leg press (PRE: 925.0 ± 139.86; POST: 1089.1 ± 159.04lbs; $p = 0.005$) and bench press (PRE: 274.5 ± 73.8; POST: 290.9 ± 70.1lbs; $p = 0.005$) 1RM indicating the resistance training program was sufficient to induce changes in strength. A significant group by time interaction was observed for leg press 1RM ($p = 0.05$) indicating that strength gains were greater in the IC (Δ 1RM: 164.1lbs) versus PL (Δ 1RM: 88.9lbs) groups. Both groups improved lean muscle mass and percent body fat, but no significant effects were observed. A significant group by time interaction was observed with serum cortisol ($p = 0.032$), however, these changes observed were within normal clinical values. REE increased 6.8% and 12.34% in IC group and 5.7% and 5.2% in PL group at 30M and 60M, respectively. A significant time effect for REE ($p = 0.005$) and RQ ($p = 0.017$) was observed with no differences between groups. No significant changes were observed in circumference measurements of the biceps, thigh, chest, and waist.

Conclusions: Based upon outcomes of this study, the supplement is apparently safe for both acute and chronic supplementation from a hemodynamic and blood analysis (CMP and CBC) perspective. Despite differential changes between groups in variables such as REE, lean muscle mass, and percent body fat, only lower body strength was shown to be improved via supplementation during resistance training. The reduction in serum cortisol in the IC group should be noted and evaluated with further research, but likely has little clinical significance.

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P14

The benefits of inositol-stabilized arginine silicate as a workout ingredient

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Background: The purpose of this study was to examine the benefits of inositol-stabilized arginine silicate (ASI; Nitrosigine®) as a workout ingredient in healthy adults. ASI has been previously shown to significantly enhance blood levels of arginine up to six hours post-dose and increase nitric oxide levels. To investigate reports of enhanced energy, increased muscle pump and stamina during workouts, and faster muscle recovery post-workout, ASI (1,500mg/day) was tested in a double-blind placebo-controlled crossover-design (DBPC-X) study using the POMS vigor-activity and fatigue-inertia sub-scores, blood flow measurements, leg circumference measurements, and biomarkers of muscle recovery (creatine kinase (CK) and lactate dehydrogenase (LDH)) as outcome measures.

Methods: The DBPC-X study was conducted in male subjects (N = 16 per group) who had limited exercise routines prior to participating in the study. These subjects took ASI daily for 4 days. Subjects had baseline measurements drawn at the hour 0 visit, took the study product, and completed an intense leg extension exercise protocol to induce muscle soreness. Subjects returned after 24, 48, and 72 hours for additional study measurements. After 72 hours, subjects repeated the leg extension exercise protocol. There was a seven-day washout between test products.

Between-product assessments were primary endpoints and within-product assessments secondary endpoints.

Results: Sixteen (16) healthy male subjects (19-33 years of age) completed the study. Perceived energy, measured using the POMS vigor-activity sub-scores, significantly increased after 72 hours compared to placebo ($p = 0.039$). At 72 hours, perceived fatigue, measured using the POMS fatigue-inertia sub-scores, significantly decreased in the ASI group ($p = 0.041$) from pre-dose, compared to a non-significant change in the placebo group ($p = 0.580$); $p = 0.055$ between groups.

Hyperemia, measured using leg circumference, increased significantly in the ASI group by 1.8cm ($p = 0.001$) at 72 hours from pre-dose, compared to a non-significant increase in the placebo group by 0.8cm ($p = 0.091$); $p = 0.070$ between groups.

Blood flow, measured by blood velocity through the femoral artery using a Doppler Ultrasound, increased 59.9 cm/s in the ASI group ($p < 0.005$) and 49.9cm/s in the placebo group ($p < 0.005$) after exercise on Day 3; $p = 0.2$ between groups.

CK levels significantly decreased in the ASI group at 24 ($p = 0.040$), 48 ($p = 0.017$) and 72 ($p = 0.034$) hours post-exercise compared to the placebo group. Immediately post-exercise at the hour 0 visit, ASI supplementation led to 44% less muscle damage, measured by CK levels, than placebo ($p = 0.057$). LDH levels significantly increased from baseline immediately after exercise in the placebo group ($p = 0.015$), but not in the ASI group ($p = 0.366$); $p = 0.133$ between groups. No safety concerns were raised by this study.

Conclusion: Both primary and secondary endpoints show that daily doses of ASI prior to workout significantly increased pre-workout energy levels, increased muscle pump immediately following a workout, and decreased biomarkers of muscle damage immediately after a workout and during recovery. These results demonstrate multiple benefits of ASI as a functional workout ingredient.

P16

Effects of matching diet type to obesity-related genotype on body composition changes in women during a six-month resistance-exercise training and walking program

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Background: We recently reported [1] that correctly matching diet type to some obesity-related genes promoted greater fat loss during the first 3 months of a diet and exercise intervention. This study examined whether these changes were observed following a 6-month diet and exercise training program.

Methods: Fifty sedentary, obese women (41.6 ± 12 yrs, 35.4 ± 8 kg/m^2) were assigned to diet groups based on five obesity-related genetic variants from four genes prominently associated with obesity (FABP2, PPARG, ADRB2, ADRB3). Participants were either truly matched (T) to their diet group based on genotype (n = 28) or falsely matched (F) based on genotype (n = 22). Prescribed diets consisted of 1,500 kcal/d and included carbohydrate:fat:protein percentages of 30:25:45 (H) or 20:35:45 (L). Participants performed a supervised circuit-style resistance-exercise program four days/week and a walking program consisting of 10,000 steps/day, three days/week. Body weight and duel energy X-ray absorptiometry (DXA) body composition measures were obtained at baseline, 4, 8, 12, 16, 20, and 24 weeks. Data were analyzed by MANOVA, with baseline body weight and body composition values used as covariates to normalize baseline differences between groups. Data are presented as changes from baseline at each time point, respectively.

Results: MANOVA revealed an overall Wilks' Lamda time effect ($p < 0.001$) with no significant time by diet ($p = 0.51$), time × gene type (0.84), or time × diet × gene type (0.81) effects observed. Univariate analysis revealed that the exercise and diet interventions promoted significant reductions in weight (-5.36 ± 5.0 kg, $p < 0.001$), fat mass (-4.53 ± 3.6 kg, $p < 0.001$), and body fat (-2.88 ± 2.7 %, $p < 0.001$) with a trend toward a reduction in fat free mass (-0.65 ± 2.3 kg, $p < 0.071$). When baseline body weight and DXA body composition variables were used as covariates, Wilks' Lambda time × diet ($p = 0.098$) tended to differ, a time × gene type interaction was observed ($p = 0.011$), while no differences were seen in time × diet × gene type ($p = 0.18$). Univariate analyses revealed some trends in time × diet changes in weight (H -2.03 ± 1.7, -3.13 ± 2.6, -4.17 ± 3.3, -4.62 ± 4.0, -4.75 ± 4.6, -4.41 ± 5.1; L -2.47 ± 1.8, -3.66 ± 2.4, -4.56 ± 3.1, -5.49 ± 3.9, -5.89 ± 4.5, -6.17 ± 4.8 kg, $p_q = 0.02$), fat mass (H -1.53 ± 1.4, -2.67 ± 2.3, -3.63 ± 2.5, -3.73 ± 2.8, -4.14 ± 3.6, -3.95 ± 3.6; L -1.31 ± 1.6, -2.66 ± 2.2, -3.22 ± 2.5, -4.32 ± 2.9, -4.60 ± 3.0, -5.03 ± 3.7 kg, $p_q = 0.10$), FFM (H -0.49 ± 1.2, -0.58 ± 1.5, -0.52 ± 1.8, -0.68 ± 2.4, -0.51 ± 2.2, -0.31 ± 2.3; L -0.95 ± 1.5, -0.73 ± 1.9, -1.20 ± 1.9, -0.86 ± 2.0, -1.03 ± 2.6, -0.94 ± 2.4 kg, $p = 0.14$), or body fat (H -0.50 ± 1.9, -1.51 ± 1.8, -2.32 ± 2.2, -2.22 ± 2.0, -2.68 ± 2.5, -2.65 ± 2.3; L -0.46 ± 1.5, -1.55 ± 2.1, -1.67 ± 2.4, -2.56 ± 2.5, -2.78 ± 2.7, -3.08 ± 3.0 %, $p_q = 0.13$) generally in favor of the more carbohydrate restricted diet. Some trends were also seen in time × gene type changes in weight (T -2.06 ± 1.8, -2.91 ± 2.6, -3.99 ± 3.3, -4.83 ± 4.0, -5.07 ± 4.6, -5.15 ± 5.1; F -2.54 ± 1.7, -4.05 ± 2.2, -4.88 ± 2.9, -5.43 ± 3.8, -5.73 ± 4.6, -5.62 ± 5.0 kg, $p = 0.20$), fat mass (T -1.39 ± 1.6, -2.42 ± 2.2, -3.15 ± 2.4, -3.74 ± 2.8, -4.27 ± 3.3, -4.18 ± 3.3; F -1.45 ± 1.3, -2.98 ± 2.1, -3.74 ± 2.6, -4.45 ± 2.9, -4.54 ± 3.3, -4.98 ± 4.0 kg, $p_q = 0.19$), FFM (T -0.50 ± 1.6, -0.40 ± 1.5, -0.78 ± 1.8, -0.78 ± 2.0, -0.60 ± 1.9, -0.81 ± 2.3; F -1.04 ± 1.1, -0.99 ± 2.0, -1.02 ± 1.9, -0.76 ± 2.4, -1.04 ± 3.0, -0.45 ± 2.3 kg, $p = 0.01$), and body fat (T -0.76 ± 1.6, -1.58 ± 2.0, -1.98 ± 2.3, -2.26 ± 2.1, -2.84 ± 2.2, -2.70 ± 2.4; F -0.12 ± 1.8, -1.47 ± 2.0, -1.96 ± 2.3, -2.60 ± 2.5, -2.60 ± 3.1, -3.12 ± 3.0 %, $p_q = 0.05$) with those in the false match group observing generally greater changes.

Conclusion: Results revealed that participants following a more carbohydrate restricted diet experienced significantly greater weight loss and slightly greater body composition changes. Matching diet based on gene-type exhibited better retention of fat free mass, with no significant differences between groups in changes in weight or fat mass. While changes in body fat percentage were similar between groups throughout the intervention, by week 24 individuals in the false match group experienced slightly greater loss.

Acknowledgements: Supported by Curves International (Waco, TX) & Interleukin Genetics (Waltham, MA)

Reference

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P17

Effects of 28 days of two creatine nitrate based dietary supplements on bench press power in recreationally active males

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Journal of the International Society of Sports Nutrition 2015, **12(Suppl 1):**P17

Background: Athletes use ergogenic aids in an attempt to increase training-adaptations, which serves to enhance their performance during competition. Creatine monohydrate is one of the most studied ergogenic aids. Although many studies have reported the efficacy and effectiveness of creatine monohydrate supplement manufacturers continually introduce newer forms of creatine into the marketplace. The newer forms of creatine purport to be more effective than creatine monohydrate alone. However, there is little evidence to support most manufacturers' claims.

Methods: We examined 28d of randomly assigned (1) placebo (PL), (2) Creatine monohydrate (CrM; 3 g), (3) creatine nitrate (CrN; 1 g CrM; 0.5 g N) and (4) CrN2X (2 g CrM; 1.0 g N) on bench press performance. Participants (N = 48; 21 ± 3 yrs) presented for fasting (12 h) testing after abstaining from exercise and alcohol for 48 h. Performance (reps at 70% of bench press 1 RM) was measured using a Tendo Fitrodyne at 0 & 28d and analyzed by MANOVA or one-way ANOVA. Mean changes (95% CI) were reported.

Results: We previously reported (*FASEB J, 29(1):LB248, 2015*) that all treatment groups increased bench press repetitions after 28d of

supplementation; however, total work (reps × weight lifted) during bench press was greater at 28d for CrN2X (294.6 lbs; 95% CI, 196, 393) vs. CrN (164.2 lbs; 95% CI, 25, 304) and PL (187.1 lbs; 95% CI, 37, 336, both p = 0.02). MANOVA univariate analysis of power data indicated a significant time effect with all power output variables (i.e., peak power (PP), average power (AP), and average velocity (AV)). No significant group by time effects were observed among groups. One-way ANOVA of the 3rd set of exercise performed to exhaustion revealed no significant differences among groups in changes from baseline after 28d of supplementation. However, pairwise comparison of 95% CIs revealed a significant difference in peak power and average power between CrN2X (522.8 W; 95% CI, 473.5, 572.2) and PL (422.9 W; 95% CI, 386.6, 499.1, p = 0.037) and CrN2X (470.3 W; 95% CI 422.1, 518.5) and PL (386.1 W; 95% CI, 331.1, 441.0, p = 0.025), respectively. Average power was also significantly different between CrN2X (470.3 W; 95% CI 422.1, 518.5) and CrN (384.0 W; 95% CI, 335.8, 432.2, p = 0.014). Average velocity during bench press test was also significantly different between CrN (0.629 m/s; 95% CI, 0.572, 0.686) and PL (0.525 m/s; 95%, 0.460, 0.590, p = 0.02).

Conclusion: Results suggest some ergogenic value of consuming these types of creatine containing pre-workout supplements on bench press power adaptations during training in comparison to PL responses.

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P18

A comparison of raw citrulline and citrulline peptide for increasing exercise-induced vasodilation and blood flow

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Background: One goal of supplementation has been to increase blood flow to skeletal muscle during exercise. Raw L-citrulline (RC) has often been used for its vasodilatory effects, and recently, RC has been bound to a whey peptide (CP) to increase bioavailability. The purpose of the present study was to determine the acute hemodynamic effects of RC, CP, and placebo (PLA) following resistance exercise in healthy men when administered at a common, commercial dose.

Methods: In a double-blind, crossover, placebo-controlled design, 11 recreationally-active males (28.2 ± 5.0y, 182.4 ± 5.7cm, 87.1 ± 10.3kg) ingested either 1.87 g of RC, 3.67 g of CP (citrulline content 1.87 g), or a flavor-matched, visually identical placebo (PLA) and performed 3 sets of 15 arm curls at 30 and 120 minutes post-supplementation. Brachial artery vessel diameter (VD) and blood flow volume (BFV) were measured via Doppler ultrasound at 0, 3, and 6 minutes post-exercise, corresponding to 30 (30P), 33 (33P), 36 (36P), 120 (120P), 123 (123P), and 126 (126P) minutes post-supplementation. Measurements were compared with both resting baseline (no treatment, no exercise) and active control (no treatment, exercise) values. Raw data were analyzed for all group, time, and group × time interactions using 2-way repeated-measures ANOVA. Delta values were analyzed using dependent T-tests. Alpha was predetermined at $p < 0.05$.

Results: A significant ($p < 0.05$) group × time interaction was present for VD, which increased in CP versus PLA from resting baseline to 30P (CP: 0.58 ± 0.05; PLA: 0.55 ± 0.06cm) and 33P (CP: 0.57 ± 0.05; PLA: 0.54 ± 0.05cm). VD also significantly ($p < 0.05$) increased in CP versus PLA from active baseline to 30P, 33P, and 120P (CP: 0.58 ± 0.05; PLA: 0.55 ± 0.05cm). Moreover, CP significantly ($p < 0.05$) increased VD versus RC at 30P (RC: 0.56 ± 0.06cm), 33P (RC: 0.55 ± 0.06cm), and 36P (CP: 0.55 ± 0.05; RC: 0.53 ± 0.06cm) compared to active baselines. A significant ($p < 0.05$) group × time interaction existed for BFV, which increased in CP versus PLA from active baseline to 30P (CP: 686.3 ± 214.7; PLA: 554.8 ± 124.2mL/min). Additionally, significantly greater delta values were observed for VD when comparing CP and PLA at 30P, 33P, 36P, and 120P and for BFV at 30P versus active ([CP VD 30P: +0.06 ± 0.03cm; 33P: +0.04 ± 0.02; 36P: +0.03 ± 0.03cm], [PLA VD 30P: +0.02 ± 0.02; 33P: +0.02 ± 0.01; 36P: +0.01 ± 0.03cm], [CP BFV: +198.0 ± 179.6; PLA BFV: +48.2 ± 104.1mL/min]) and resting ([CP VD 30P: +0.10 ± 0.03cm; 33P: +0.08 ± 0.03; 36P: +0.07 ± 0.03cm], [PLA VD 30P: +0.06 ± 0.03; 33P: +0.06 ± 0.02; 36P: +0.05 ± 0.02cm], [CP BFV: +608.9 ± 179.6; PLA BFV: +477.4 ± 130.0mL/min]) baselines. VD and BFV delta values were significantly ($p < 0.05$) greater for CP than RC at 30P, and VD changes remained greater at 33P and 36P versus both active ([RC VD 30P: +0.03 ± 0.02; 33P: +0.02 ± 0.02; 36P:+ 0.01 ± 0.02cm], [RC BFV: +99.5 ± 152.2mL/min]) and resting ([RC VD 30P: +0.07 ± 0.04; 33P: +0.06 ± 0.04; 36P: +0.04 ± 0.04cm], [RC BFV: +510.5 ± 157.7mL/min]) baselines.

Conclusions: Citrulline peptide can significantly increase vasodilation and the volume of blood flow compared to raw citrulline and placebo. Citrulline peptide may be a preferred choice over raw citrulline for athletes seeking enhanced vasodilation or blood flow.

P20

Ten weeks of branched chain amino acid supplementation improves select performance and immunological variables in trained cyclists

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Background: We examined if supplementing trained cyclists (32 ± 2 yr, 77.8 ± 2.6 kg, and 7.4 ± 1.2 yr training) with 12g/d (6g/d L-Leucine, 2g/d L-Isoleucine and 4g/d L-Valine) of either branched chain amino acids (BCAAs, n = 9) or a maltodextrin placebo (PLA, n = 9) over a 10-week training season affected select body composition, performance, and/or immune variables.

Methods: Before and after the 10-week study, the following was assessed: a) 4-h fasting blood draws; b) dual X-ray absorptiometry body composition; c) Wingate peak power tests; and d) 4km time-trials.

Results: No group*time interactions existed for total lean mass (p = 0.27) or dual-leg lean mass (p = 0.96). A significant interaction existed for body mass-normalized relative peak power (19% increase in the BCAA group pre- to post-study, p = 0.01), and relative mean power (4% increase in the BCAA group pre- to post-study, p = 0.01). 4km time-trial time to completion approached a significant interaction (p = 0.08), as the BCAA group improved in this measure by 11% pre- to post-study, though this was not significant (p = 0.15). There was a tendency for the BCAA group to present a greater post-study serum BCAA: L-Tryptophan ratio compared to the PLA group (p = 0.08). A significant interaction for neutrophil number existed (p = 0.04), as there was a significant 18% increase within the PLA group from the pre- to post-study time point (p = 0.01).

Conclusions: Chronic BCAA supplementation improves sprint performance variables in endurance cyclists. Additionally, given that BCAA supplementation blunted the neutrophil response to intense cycling training, BCAAs may benefit immune function during a prolonged cycling season.

P21

Ketogenic versus Western and standard chow diets favorably alters fat deposition and serum biomarkers in rats

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Background: Very low-carbohydrate (ketogenic) diets are becoming increasingly popular as weight loss interventions. This study examined the effects of ketogenic (KD), Western (WD), and standard chow (StdChow) control diets on fat deposition and serum health-related biomarkers.
Methods: Male Sprague-Dawley rats (~9-10 weeks of age) were provided isocaloric amounts of either a KD (5.2 kcal/g, 20.2% protein, 10.3% carbohydrate, 69.5% fat; n = 50), WD (4.5 kcal/g, 15.2% protein, 42.7% carbohydrate, 42.0% fat; n = 66), or StdChow (3.1 kcal/g, 24.0% protein, 58.0% carbohydrate, 18.0% fat n = 10) for 6 weeks with daily food intake and body weights recorded. After the animals were sacrificed, 4 different fat depots were weighed and serum was collected in subsets of each diet for further investigation.
Results: Over the 6-week period, KD rats consumed 3,540 ± 74 (mean±SD) total kcal, WD rats consumed 3,638 ± 83 total kcal, and StdChow rats consumed 3,025 ± 145 total kcal (WD>KD>StdChow; $p < 0.001$). Remarkably, however, 6-week feed efficiency (g bodyweight gained/kcal consumed) was greater in the WD and (0.042 ± 0.007g/kcal) StdChow (0.045 ± 0.012g/kcal) compared to the KD rats (0.018 ± 0.006g/kcal) ($p < 0.001$). Total body mass at sacrifice was also significantly less in KD compared to WD and StdChow groups (397 ± 26,494 ± 36 and 472 ± 49g, respectively; $p < 0.001$). KD and StdChow had significantly less absolute and relative omental (absolute omental: 0.8 ± 0.3g and 1.2 ± 0.4g vs 1.6 ± 0.6g, respectively, $p < 0.05$; relative omental: 2.1 ± 0.7 and 2.4 ± 0.7 vs 3.2 ± 1.2g/kg, respectively, $p < 0.05$) compared to WD rats. KD and StdChow also had significantly less perirenal adipose tissue compared to WD (absolute perirenal: 4.2 ± 1.3 and 5.4 ± 1.4 vs 7.8 ± 1.8g, respectively, $p < 0.05$; relative perirenal: 10.6 ± 2.8 and 11.4 ± 2.4 vs 15.6 ± 3.0g/kg, respectively, $p < 0.05$). KD had significantly less absolute inguinal subcutaneous (SQ) and scapular brown fat than WD (absolute SQ: 4.3 ± 1.5 vs 6.6 ± 2.4g/kg; absolute brown fat: 0.6 ± 0.2 vs 0.8 ± 0.3g) but similar relative SQ and brown fat weights. Serum triglyceride levels were greater in WD (319.7 ± 109.8mg/dL) versus StdChow rats (163.0 ± 67.0mg/dL; $p < 0.05$), and both groups presented greater levels versus KD rats (69.9 ± 21.2mg/dL; $p < 0.05$). Serum cholesterol and glucose levels were significantly less in the KD compared to WD and StdChow rats (cholesterol: 67.7 ± 6.8 vs 89.9 ± 10.8 and 87.0 ± 16.9mg/dL, respectively, $p < 0.05$; glucose: 166.1 ± 49.6 vs 278.3 ± 99.9 and 256.6 ± 86.9mg/dL, respectively, $p < 0.05$). White blood cell counts were greater in the WD compared to KD and StdChow groups (15.3 ± 2.6 vs 7.9 ± 2.8 and 9.5 ± 4.3 $x10^3$ cells/μL, $p < 0.05$), and white blood cell differentials between groups are discussed herein.
Conclusions: These rodent data suggest that KD is favorable for fat loss and improvements in serum health-related biomarkers compared to WD and even hypocaloric amounts of StdChow.

P22

The anabolic skeletal muscle response to acute resistance exercise is not impaired in rats fed a ketogenic diet

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Background: Many individuals that resistance train consume a typical Western diet (WD) comprised of protein, carbohydrates (many of which are sugar), and fat. Recent enthusiasm has surrounded the use of a ketogenic diet for weight loss and muscle sparing, although it is uncertain as to whether low carbohydrate diets can optimize the anabolic response to resistance training.
Methods: This study examined the effects of KD versus WD on the anabolic response to resistance exercise using a rodent leg-kicking resistance exercise model. Male Sprague-Dawley rats (~9-10 weeks of age) were provided isocaloric amounts of either a KD (5.2 kcal/g, 20.2% protein, 10.3% carbohydrate, 69.5% fat; n = 30) or WD (4.5 kcal/g, 15.2% protein, 42.7% carbohydrate, 42.0% fat; n = 32) for 6 weeks. During week 7, the right-leg plantarflexor muscles of each rat were acutely exercised under isoflurane anesthesia using high-frequency electrical stimulations (4 sets of 8 repetitions with 2 min recovery between sets). Rats were then sacrificed at 90 min (n = 8 per group), 180 min (n = 8 per group), or 270 min (n = 8 per group) following exercise and intraperitoneal puromycin injections were provided 30 min prior to each sacrifices as a tracer for muscle protein synthesis (MPS). A subset of unexercised limbs from WD (n = 8) and KD (n = 8) were used as a non-exercise (non-EX) control comparison.
Results: There was a main time effect for MPS, as it was significantly greater at 90, 180 and 270 min in both groups versus the non-EX condition ($p < 0.001$), although there was no between group effect ($p = 0.59$) or group*time interaction ($p = 0.87$). There was a main time effect for phosphorylated (p)-4E-BP1 (Thr37/46), as it was significantly greater at 90, 180 and 270 min in both groups versus the non-EX condition ($p = 0.001$), although there was no between group effect ($p = 0.85$) or group*time interaction ($p = 0.93$). There was a main time effect for p-rps6 (Ser235/236), as it was significantly greater at 90, 180 and 270 min in both groups versus the non-EX condition ($p = 0.002$), although there was no between group effect ($p = 0.99$) or group*time interaction ($p = 0.79$). There was no time effect ($p = 0.31$), between group effect ($p = 0.42$) or group*time interaction ($p = 0.22$) for p-AMPKα (Thr172).
Conclusions: These data demonstrate that rats fed a ketogenic diet present a similar anabolic response to resistance exercise compared to rats fed a Western diet.

P23

The effects of a bodybuilding thermogenic supplement in conjunction with a periodized resistance training program in resistance trained males

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Background: Males looking to improve their body composition may ingest thermogenic supplements for the purpose of losing body fat. The purpose of this study was to examine the effects of a commercially available dietary supplement (Arnold Iron Cuts™, which contains ingredients that promote thermogenesis) on body composition and maximal strength in a randomized, double-blind, placebo-controlled parallel groups design.
Methods: 34 resistance trained male subjects (21 ± 3.8 years; 177 ± 6.2cm; 79 ± 11.2kg) participated in this investigation. At baseline and following 8-weeks of a periodized resistance-training program, participants were assessed for body composition (fat mass, body fat %, and lean body mass) and maximal strength (back squat and bench press 1RM). After baseline testing, participants were matched according to total fat mass and randomized to the thermogenic supplement group (n = 18) or the placebo group (n = 16). Body composition was assessed via ultrasound and measurements were made using an A mode, 2.5-MHz transmitter (BodyMetrix, Intelametrix). The periodized resistance-training program consisted of whole body workouts conducted three times per week (for 7 weeks) and one week in which two whole-body workouts were conducted. Data were analyzed via a 2-factor [2x2] between-subjects repeated measures analysis of variance (ANOVA) using SPSS version 22.0. The criterion for significance was set at $p \leq 0.05$.
Results: No differences existed between the two groups for any strength or body composition measures at baseline. The repeated measures ANOVA revealed a significant group × time interaction for body fat % ($p = 0.044$) favoring the thermogenic supplement treatment. Specifically, body fat percentage decreased from 11.9% to 11.0% and 11.8% to 11.7% in the thermogenic and placebo treatments, respectively. There were also changes in total fat mass that resulted in a significant group × time interaction ($p = 0.032$). Fat mass decreased from 9.6 to 8.9 kg in the thermogenic supplement group and remained stable in the placebo group (slightly increasing from 9.6 to 9.8kg). Lean body mass increased in both groups,

increasing from 68.8 to 69.9kg in the thermogenic supplement group and from 69.7 to 70.8kg in the placebo group. These changes resulted in a significant main effect for time ($p < 0.001$), but no group × time interaction was observed ($p = 0.947$). Relative to maximal strength, the repeated measures ANOVA revealed a significant main effect for time relative to bench press 1RM ($p < 0.001$), but no group × time interaction was observed ($p = 0.303$). Similarly, a main effect for time was observed for squat 1RM ($p < 0.001$), but no group × time interaction was observed ($p = 0.299$).
Conclusions: Resistance trained males engaging in an 8-week periodized resistance training program and consuming a commercially available thermogenic dietary supplement (Arnold Iron Cuts™) can lose a significant amount of fat mass as compared to a placebo treatment. The loss of fat mass can occur while the participants are maintaining normal dietary intakes (i.e., without embarking on a hypoenergetic diet). The thermogenic dietary supplement did not augment gains in lean body mass and offered no advantages related to maximal upper and lower-body strength.
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P24

The effect of a pre-workout supplement on power performance

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Background: Product specific research is necessary for determining the efficacy of dietary supplements comprised of different ingredients. Recently, the pre-workout supplement Assault™ (MusclePharm, Denver, CO, USA) was investigated and demonstrated an ergogenic effect through improved lower body muscular endurance and agility choice reaction. However, continued product specific research is necessary for identifying further potential benefits Assault™ has to offer. The purpose of this study was to determine the impact of Assault™ on anaerobic power measured on a Wingate Cycle Test (WAnT), upper body power via medicine ball put (MBP), and lower body power during a countermovement vertical jump (CMJ).
Methods: 13 male adults (24.3 ± 6.4 years; 179.3 ± 5cm; 83.3 ± 13.1kg) volunteered to participate in this investigation. Each participant was required to visit the laboratory on 4 different occasions separated by approximately 7 days. On the first visit, participants underwent a familiarization session in which they practiced a dynamic warm-up, MBP, CMJ and the WAnT. During their second visit, participants were assessed for height, weight and resting blood pressure, and then performed a dynamic warm-up followed by baseline testing for the performance variables MBP, CMJ, and WAnT. On the third visit, approximately 25 minutes prior to the physical assessments, participants ingested either Assault™ or a placebo and repeated testing of all performance variables following a dynamic warm-up. Approximately 1-week later, participants ingested the alternative supplement and repeated all performance testing in the exact same manner as the prior session. Data were analyzed via a 1-factor [1x3] within-subjects repeated measures analysis of variance (ANOVA) using SPSS version 22.0. Post-hoc tests were analyzed via paired samples t-tests. The criterion for significance was set at $p \leq 0.05$.
Results: The repeated measures ANOVA revealed a significant within-subjects effect for peak ($p = 0.003$) and mean ($p = 0.007$) anaerobic power relative to the WAnT. Post-hoc analyses revealed that Assault™ provided a significant increase in anaerobic peak power (782 ± 191W) and mean power (569 ± 133W) in comparison to the placebo ($p = 0.003$; 722 ± 208W), ($p = 0.006$; 535 ± 149W) and baseline trials ($p = 0.011$; 723 ± 205W), ($p = 0.020$; 538 ± 148W), respectively. Table 1 demonstrates the raw data (mean ± SD) in anaerobic peak, mean, and minimum power for each treatment group. No main effects were observed for the MBP ($p = 0.314$) or the CMJ ($p = 0.150$).
Conclusions: Ingestion of the a pre-workout supplement (Assault™) lead to significant improvements in anaerobic peak and mean power values as compared to the placebo treatment and baseline measures. These elevations came with no adverse effects relative to blood pressure values. Taken prior to exercise, Assault™ supplementation may improve anaerobic power values, thus leading to enhanced performance.

P25

Powdered tart cherry supplementation surrounding a single bout of intense resistance exercise demonstrates potential attenuation of recovery strength decrement with no definitive oxidative or inflammatory effect

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Background: Consumption of tart cherry juice has been reported to increase subsequent resistance exercise performance by reducing inflammation and oxidative stress that cause secondary muscle damage following initial bouts of resistance exercise. The purpose of this study was to determine if consumption of a powdered form of tart cherries derived from tart cherry skins (CherryPURE® Freeze Dried Tart Cherry Powder) prior to and following intense resistance exercise increases subsequent performance while attenuating markers of inflammation and oxidative stress.
Methods: 23 resistance trained men (20.9 ± 2.6 yr, 14.2 ± 5.4% body fat, 63.9 ± 8.6kg FFM) were matched based on relative maximal back squat strength, age, body weight, and fat free mass. Subjects were randomly assigned to ingest in a double blind manner capsules containing a placebo (P, n = 12) or powdered tart cherries [CherryPURE®] (TC, n = 11). The lifters ingested the supplements one time daily (480 mg/d) for 10-d: 7-d pre-exercise, day of exercise, and 48-hr post-exercise. Subjects performed 10 sets of 10 repetitions at 70% of 1RM back squat exercises with 3-min recovery between sets, maintaining equivalent total work performed ($p = 0.80$) and average daily caloric consumption ($p = 0.61$) between groups. Isokinetic knee extension/flexion maximal voluntary contractions (MVCs) and fasting blood samples were taken pre-squat workout, 60-min following squat workout as well as after 24-h and 48-h of recovery and analyzed by MANOVA with repeated measures.
Results: Powdered tart cherry supplementation seemed to attenuate the drop from pre-lift measures in 3-repetition summation of isokinetic flexion work ($p = 0.21$; $d = 0.45, 0.28$), extension work ($p = 0.23$; $d = 0.45, 0.36$), and all work ($p = 0.15$; $d = 0.55, 0.37$) through 60-min and 24-h of recovery compared to placebo as reported above by Cohen's d effect size, despite not being statistically significant. The overall MANOVA analysis revealed a significant Wilks' Lambda time ($p < 0.001$) interaction for all inflammatory markers, but no significant group × time pro-inflammatory ($p = 0.30$) and anti-inflammatory ($p = 0.45$) effects. Univariate measures for pro-inflammatory markers reported significant main time effects for TNF-α ($p = 0.001$), IL-1β ($p = 0.30$), IL-6 ($p = 0.023$), and IL-8 ($p = 0.018$). Univariate measures for anti-inflammatory markers reported significant main time effects for IL-4 ($p = 0.001$) and IL-7 ($p = 0.033$) with IL-13 trending toward significance ($p = 0.055$). No significant group × time effects were observed for any of the inflammatory markers,

Table 1(abstract P24) Anaerobic Power and Power Drop in Watts (mean ± SD) for each group

	Peak Power Watts	Mean Power Watts	Minimum Power Watts	Power Drop Watts
Assault™	782 ± 191#*	569 ± 133#*	356 ± 83	426 ± 145#
Placebo	722 ± 208	535 ± 149	336 ± 87	387 ± 135
Baseline	723 ± 205	538 ± 148	331 ± 90	391 ± 148

- Post-hoc statistical difference compared to baseline values ($p \leq 0.05$)
* - Post-hoc statistical difference compared to placebo values ($p \leq 0.05$)

NT, or TBARS. Serum IL-1β levels were significantly lower in TC compared to P (p = 0.048). Delta changes were assessed at all three recovery time points from the pre-lift marker measures. The overall delta MANOVA analysis revealed a significant Wilks' Lambda pro-inflammatory interaction across time (p = 0.001) and an anti-inflammatory time interaction trending toward significance (p = 0.070), but no significant group × time pro-inflammatory (p = 0.44) or anti-inflammatory (p = 0.30) effects. TNF-α (p = 0.010), IFN-γ (p = 0.042), IL-1β (p = 0.031), IL-6 (p = 0.001), IL-8 (p = 0.025), IL-10 (p = 0.019), and NT (p = 0.018) demonstrated significant main effects on time, while IL-7 approached significance across time (p = 0.095). Serum IL-2 TC (p = 0.074) and IL-10 (p = 0.10) changes from pre-lift tended to be greater across the recovery time coupled with a tendency for IL-10 (p = 0.063) TC levels to also be greater compared to P. Contrarily, serum IFN-γ (p = 0.021) TC changes from pre-lift values were significantly smaller compared to P with specific differences at 24-h and 48-h post-lift.

Conclusion: In accordance with previous TC juice supplementation research, the isokinetic performance results of this study indicate that short-term powdered TC consumption 7 days prior to, day of, and 2 days after a single bout of intense resistance exercise may help to attenuate the strength decrement over a 48-h recovery period. The seemingly better maintenance of strength during recovery with short-term powdered TC supplementation surrounding a single bout of resistance exercise did not, however, coincide with any definitive effect on markers of oxidative damage or inflammation. This may be due to the differences in resistance exercise metabolic demands, thus indicating the need for further mechanistic research.

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P26

Digestive enzymes reduce quality differences between plant and animal proteins: a double-blind crossover study

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Background: Whey protein is considered to be the optimal protein source to support muscle protein synthesis (MPS) with resistance training, based on its amino acid content (high in leucine), rapid digestibility, and high bioavailability within the muscle tissue [1]. Athletes can choose from different plant protein sources (e.g. soy, rice, pea, hemp), which differ in numerous ways, such as the presence of allergens (milk, soy), cholesterol, saturated fats, digestion rate (fast, intermediate, or slow absorption of amino acids), or the relative amount of individual amino acids. Rice protein has been shown to promote muscle hypertrophy with resistance training comparable to whey protein [2]. 48g of rice or whey protein isolate immediately post-exercise during an 8-week progressive, non-linear resistance-training protocol increased lean body mass, muscle thickness, and strength with no differences between groups. The findings are likely due to the high dose of protein used in the study, providing amounts of leucine greater than the 1.7 to 3.5g that has been proposed to be the range for optimal MPS. Rice protein, compared to whey (fast) and casein (slow), is an intermediate digesting protein and shows a 6.8% lower total amino acid appearance in the blood [3]. While dairy protein sources contain simple sugars, mainly lactose, plant proteins contain more complex carbohydrates, including fibers and glycoproteins. This study sought to investigate if co-ingestion of a plant protein specific digestive enzyme blend (Digest-All® VP, a proprietary enzyme blend consisting of protease 6.0, protease 4.5, peptidase, bromelain and alpha-galactosidase, Chemi-Source, Inc., Oceanside, CA) can reduce the significant differences in amino acid appearance in the blood between plant and animal proteins.

Methods: After a 12 hour overnight fast, 11 resistance-trained male subjects (age: 21.4 ± 1.5 years, body weight: 82.5 ± 3.9kg, height: 177.3cm ± 6.1cm, and average training status of 2.3 years ± 1.9 years) were randomly assigned to receive either 60 grams of whey protein concentrate ("WPC", Milk Specialties Global, Eden Prairie, MN), or a 70:30 blend of pea protein (VegOtein® P80, Axiom Foods, Los Angeles, CA) and rice protein (Oryzatein® Silk 80, Axiom Foods, Los Angeles, CA) concentrate ("PRPC"), or PRPC plus Digest-All® VP ("PRPC+DA", Veggie Elite®, MRM, Oceanside, CA) in a double-blind, crossover design, separated by a washout period of 7 days. Blood draws were taken immediately prior to, and at 30 minutes, 1, 2, 3, and 4 hours following consumption of WPC, PRPC or PRPC+DA.

Results: Time to peak (Tmax (min)) for total amino acid (TAA) was faster in the WPC group in comparison to PRPC. However, the addition of digestive enzymes to the plant protein blend increased Tmax of PRPC +DA over WPC (TAA: WPC 62.7 ± 31.3, PRPC 73.6 ± 33.6, PRPC+DA 57.3 ± 24.9). Tmax for the sum of non-essential amino acids (NEAA) showed the same trend: WPC 62.7 ± 31.3, PRPC 73.6 ± 31.1, PRPC+DA 51.8 ± 24.9, while for essential amino acids (EAA) WPC was fastest: WPC 57.3 ± 9.0, PRPC 76.4 ± 28.0, PRPC+DA 70.9 ± 24.3. There were no differences between conditions for Tmax (p = 0.10). Significant differences were detected for AUC (AUC × 10^3 [nmol/ml]) whereas the EAA for PRPC 384.5 ± 79.3 was significant lower than WPC 447.1 ± 69.9 (p = 0.002). There were no differences for the AUC between WPC and PRPC+DA 404.9 ± 80.5 (p = 0.16). In addition, no significant differences between conditions were detected for NEAA: WPC 677.5 ± 145.0, PRPC 650.3 ± 192.1, PRPC +DA 643.2 ± 139.8, p = 0.59 and for TAA: WPC 1,187.2 ± 228.3, PRPC 1,071.0 ± 241.0, PRPC+DA 1,083.7 ± 223.0, p = 0.09. There were significant differences between conditions for peak values (Cmax [nmol/ml]) for EAA, whereas WPC (2,261.1 ± 437.2) demonstrated higher values than PRPC (1,797.1 ± 333.4), p = 0.01. There no differences between WPC and PRPC+DA (1,881.4 ± 352.9), p = 0.07. No significance differences in Cmax were found for NEAA (WPC 3,103.4 ± 769.8, PRPC 2,978.2 ± 663.8, PRPC+DA 2,904.8 ± 726.7, p = 0.94) and TAA (WPC 5,694.1 ± 1,317.7, PRPC 4,940.5 ± 951.9, PRPC+DA 4,936.6 ± 1,231.0, p = 0.62).

Conclusion: Co-ingestion of a plant protein specific digestive enzyme blend (Digest-All® VP) and a pea/rice protein blend increases time to peak, peak concentrations, and amount of amino acid appearance in the blood (AUC) in comparison to pea/rice protein alone, and reduces previously significant differences between WPC and PRPC.

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P27

Effects of shift type, job position and a rigorous work period on physical- and performance-related attributes in female nursing workers

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Background: Healthcare workers exhibit among the highest injury rates of all occupations, with musculoskeletal injuries predominating. Anthropometric attributes and demanding work schedules may contribute to enhanced injury risks. Specifically, physical characteristics and performance capacities as well as accumulating fatigue from multiple work shifts may predispose workers to job-related injuries. Given the unique demands of day versus night shift work and varying job positions within the healthcare sector, it remains to be determined if these job characteristics may differentially impact nursing workers' physical and performance attributes. Therefore, the purpose of this study was to compare physical and performance attributes of both day and night shift nursing workers, and registered nurses (RNs) and nurses' aides (CNAs).

Methods: Thirty-four full time female nurses (age = 32.9 ± 10.5 yrs, height = 163.4 ± 8.1 cm, mass = 73.8 ± 18.7 kg) working 12 h shifts

participated in this study. Nurses were stratified by shift (day and night shift) and job position (RN and CNA). All groups were matched for age, and shift workers and job positions were matched across each category. Nurses visited the lab on three occasions with the first visit consisting of anthropometric assessments and familiarization on all performance tests. Visits two and three were within 24 h prior to, and 24 h following a four-day period that involved the nurses working three, 12 h shifts (36 h of work). Tests consisted of a computer-based psychomotor vigilance test (PVT) to assess reaction time and motivation, unipedal balance for 30 s, and isometric maximal strength (peak torque, PT; Nm) and rate of torque development (RTD, $Nm \cdot s^{-1}$) of the leg extensors and leg flexors. Subjects also completed a multidimensional fatigue questionnaire from which general and physical fatigue components were scored. Independent t-tests were used to assess differences between shifts and job positions.
Results: CNAs (n = 10) were heavier compared to RNs (n = 24) (P = 0.05, 81.3 ± 21.0 and 68.8 ± 14.5 kgs, respectively), but no differences were shown for height (P = 0.28), nor for height or weight between night and day shift workers (p > 0.09). There were no differences for PVT, balance, leg extensors or flexors strength, or RTD variables for either shift or job position categories. There was however, a significant difference (P = 0.02) for work-induced change scores in leg flexors RTD with the night shift exhibiting greater declines (-46.2 ± 60.9 $Nm \cdot s^{-1}$) compared to the day shift (1.8 ± 58.7 $Nm \cdot s^{-1}$) workers. Also, CNAs exhibited greater (p < 0.03) general and physical fatigue scores compared to RNs (11.0 and 9.5 vs. 8.9 and 7.4, respectively) at baseline.
Conclusion: These findings showed CNAs had greater body mass and subjective fatigue perception while night shift workers had greater work-induced declines in leg flexors explosive strength capacities. Thus, nutritional strategies may be tailored towards specific healthcare worker vulnerabilities, where weight management approaches may be pertinent for CNAs and improved explosive strength-endurance capacities for night shift workers. Also, nutritional aids designed for improving subjective mood and fatigue perception (i.e., stimulants, mood boosting nutritionals etc.) may be useful for enhancing recovery and reducing general and physical fatigue perception specifically in CNAs.
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Acute hemodynamic effects of a multi-ingredient performance supplement on brachial artery vasodilation and blood flow volume following elbow flexion exercise in healthy young men

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Background: Nutritional supplements have received attention for increasing blood flow to skeletal muscle during exercise. L-arginine is often used for its vasodilatory effects, and supplementation with nitrates has recently become more popular for the same reason. The purpose of the present study was to determine the acute hemodynamic effects of a multi-ingredient performance supplement (MIPS) containing arginine and nitrates as compared to placebo following resistance exercise in healthy young men.
Methods: In a randomized double-blind, crossover, placebo-controlled design, 11 recreationally-active males (28.2 ± 5.0 y, 182.4 ± 5.7cm, 87.1 ± 10.3kg) ingested either 1 serving (14.5 g) of a MIPS (SUPP; Assault™, Musclepharm, Denver, CO) or a flavor-matched, visually identical placebo (PLA) and performed 3 sets of 15 arm curls at 30 minutes (30P) and 120 minutes (120P) post-supplementation. Brachial artery vessel diameter (VD) and blood flow volume (BFV) were measured via Doppler ultrasound at 0, 3, and 6 minutes post-exercise. Additionally, BP, HR, and BIA-determined extracellular water (ECW) and intracellular water (ICW) were assessed. Measurements taken following 30P and 120P were compared with both resting baseline (no treatment, no exercise) and active control (no treatment, exercise) values. Data were analyzed for all group, time, and group × time interactions using 2-way repeated-measures ANOVA. Alpha was predetermined at $p < 0.05$.
Results: A significant ($p < 0.05$) group × time interaction was present for brachial artery VD, wherein SUPP increased to a greater extent than PLA at 0 minutes following 30P compared to both resting baseline (SUPP +0.09 ± 0.03cm; PLA +0.06 ± 0.03cm) and active control (SUPP +0.05 ± 0.04cm; PLA +0.02 ± 0.02cm) values. However, the increase in BFV at 0 minutes following 30P did not vary significantly between treatments from either resting baseline (p = 0.49) or active control (p = 0.27) values. No other variables had significant ($p < 0.05$) group × time interactions between any other time points.
Conclusion: Acute supplementation with a multi-ingredient performance supplement containing arginine and nitrates may increase vasodilation synergistically with resistance exercise 30 minutes post-ingestion. However, it remains to be seen if increased vasodilation necessarily results in increased blood flow volume to working musculature.
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Effects of sub-chronic branched chain amino acid supplementation on markers of muscle damage and performance variables following 1 week of rigorous weight training

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Background: We investigated the efficacy of supplementing a branched chain amino acid (BCAA- 3g/d L-Leucine, 1g/d L-Isoleucine and 2g/d L-Valine) supplement compared to a carbohydrate (CHO) control drink in terms of attenuating markers of muscle damage in addition to preserving performance markers following 3 days of intense weight training.
Methods: Apparently healthy resistance trained males (n = 30) were randomized to either a BCAA group or the CHO control group. Participants performed preliminary testing (T1) to derive peak quadriceps isometric torque, peak quadriceps isokinetic torque (60º and 120º per second), and a 1RM barbell back squat. The following week, the participants performed 10x5 repetitions at 80% of their 1RM barbell back squat for 3 consecutive days. During this experimental intervention antecubital blood was drawn to assess serum myoglobin concentrations, in addition a visual analog scale was utilized in order to measure subjective perceptions of muscular soreness. 48 hours following the third bout of exercise, participants performed post testing (T2) like T1 testing and donated a final blood draw.
Results: The BCAA group maintained 95% of their peak isometric torque compared to 86% for the CHO group (p = 0.12). Regarding isokinetic measures at T2, there was a 92% and 88% maintenance for the BCAA and CHO group, respectively (p = 0.39), compared to their respective T1 values. T2 performance at 120º/s was maintained by 93% and 96% of T1 measurements for the BCAA and CHO group, respectively (p = 0.40). The BCAA group actually enhanced squat 1RM by 1%, whereas the CHO group experienced a 3% decrement; however, this difference failed to reach significance (p = 0.92). Serum myoglobin concentrations increased as a function of time, and there was no difference between groups (p = 0.31). Lastly, perceptions of muscular soreness were also not differentially altered between groups (p = 0.09).
Conclusions: In conclusion, while a BCAA supplement did not appear to enhance recovery benefits compared to a CHO control, a few areas of performance were bolstered to a point of practical importance regarding high level competition.

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Effect of post-exercise ingestion of different molecular weight carbohydrate solutions. Part 1: The glucose and insulin response

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Background: Post-exercise ingestion of a high molecular weight (HMW) carbohydrate (CHO) solution has been shown to result in greater rates of muscle glycogen synthesis, attributed, in part, to the higher rates of gastric emptying compared to a low molecular weight (LMW) CHO solution. Given the higher rate of gastric emptying, a more rapid rise of glucose and insulin would be expected. However, differences have been reported in the pattern and time course of the subsequent insulin and glucose responses following ingestion. These differences have been attributed to timing and technique (venous vs. arterialized venous) of blood sampling. Thus, the current study sought to examine differences in the glucose, insulin, and glucagon response to post-exercise ingestion of a HMW and LMW CHO solution.
Methods: Sixteen resistance trained men (mean±SD; 23 ± 3 years; 176.7 ± 9.8cm; 88.2 ± 8.6kg; 12.1 ± 5.6% fat) participated in this double-blind, placebo-controlled, randomized crossover study, which consisted of three testing sessions, each separated by one week. VO_2 max (37.4 ± 4.3 ml·kg·min^{-1}) was determined prior to testing session 1. In sessions 1-3, subjects completed a glycogen depleting cycling bout of 60 minutes at 70% VO_2 max, followed by six, one-minute sprints at 120% VO_2 max. Immediately post-exercise subjects ingested a placebo (PLA), or a LMW or HMW CHO solution (10%) providing 1.2kg· bw^{-1} CHO; assigned randomly. Blood was sampled prior to ingestion and every ten minutes for 120 minutes post-ingestion. A two-factor repeated measures ANOVA was used to determine differences among treatments ($p \leq 0.05$).
Results: Post-exercise ingestion of the LMW and HMW CHO solutions caused an increase in plasma glucose and insulin at 10 minutes. Glucose remained elevated in LMW until 60 minutes; and 70 minutes in HMW. The difference between HMW and LMW at that time approached significance (LMW, 4.7 ± 0.3mmol · L^{-1}; HMW, 5.2 ± 0.3mmol · L^{-1}; $p = 0.086$). Insulin remained elevated throughout blood sampling. Peak plasma insulin occurred at 40 minutes (LMW, 50.0 ± 7.1 μIU· L^{-1}; HMW, 49.8 ± 8.3 μIU · L^{-1}). Plasma glucagon declined following CHO ingestion with a more rapid difference following LMW (20 minutes) than HMW (30 minutes) CHO solution. However, no differences were noted between CHO treatments. Glucagon achieved a peak value of 38.7 ± 5.5ng·L-1 after ingestion of the PLA, while the lowest values observed following ingestion of the LMW and HMW CHO solutions were 12.0 ± 1.7ng·L^{-1} and 11.5 ± 1.4ng·L^{-1}, respectively.
Conclusions: These data suggest that when venous blood is sampled, ingestion of HMW and LMW CHO solutions providing 1.2kg· bw^{-1} CHO result in similar responses in glucose, insulin, and glucagon. Further study is needed to determine the effect on subsequent performance.
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Effect of post-exercise ingestion of different molecular weight carbohydrate solutions. Part II: The incretin response

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Background: Gastric inhibitory peptide (GIP) and glucagon like peptide-1 (GLP-1), incretin hormones of the small intestine, are secreted in response to the presence of food in the lumen. Once released into circulation, these incretins stimulate beta cells to increase insulin secretion, accounting for at least 50% of total insulin secreted after glucose ingestion. Post-exercise ingestion of a high molecular weight (HMW) carbohydrate (CHO) solution has been shown to result in greater rates of muscle glycogen synthesis, which are attributed to the higher rates of gastric emptying, compared to a low molecular weight (LMW) CHO solution. However, no studies have examined the effect of post-exercise ingestion of CHO's of differing molecular weights on incretin response. Therefore, we sought to examine the difference in GIP and GLP-1 secretion after ingestion of HMW and LMW CHO solutions following a glycogen depleting exercise bout.
Methods: Sixteen resistance trained men (mean ± SD; 23 ± 3 years; 176.7 ± 9.8 cm; 88.2 ± 8.6 kg; 12.1 ± 5.6 % fat) participated in this double-blind, placebo-controlled, randomized cross over study, which consisted of three testing sessions, each separated by one week. VO_2 max (37.4 ± 4.3 ml·kg·min^{-1}) was determined prior to testing session 1. In sessions 1-3, subjects completed a glycogen depleting cycling bout of 60 minutes at 70% VO_2 max, followed by six, one-minute sprints at 120% VO_2 max. Immediately post-exercise, subjects ingested a placebo (PLA), or a LMW or HMW CHO solution (10%) providing 1.2 kg· bw^{-1} CHO, assigned randomly. Blood was sampled prior to ingestion and every ten minutes for 120 minutes post-ingestion. A two-factor repeated measures ANOVA was used to determine differences among treatments ($p \leq 0.05$).
Results: A time × treatment effect was observed in both GIP ($p < 0.001$) and GLP-1 ($p < 0.001$). Ingestion of both HMW and LMW solutions caused a sharp increase in GLP-1 and GIP, resulting in significantly higher values compared to those observed following ingestion of PLA. By 10 minutes both GIP (LMW, 146.7 ± 6.5 pg·mL^{-1}; HMW, 129.7 ± 23.7 pg·mL^{-1}) and GLP-1 (LMW, 13.1 ± 3.3 pg·mL^{-1}; HMW, 13.2 ± 3.3 pg·mL^{-1}) were higher following ingestion of LMW and HMW compared to PLA (GIP, 35.1 ± 6.1 pg·mL^{-1}; $p \leq 0.004$; GLP-1, 2.1 ± 0.5 pg·mL^{-1}; $p \leq 0.001$). GIP increased progressively and remained elevated for the entirety of blood sampling (120 minutes) in both CHO conditions. Changes in GLP-1 were almost immediate, resulting in a trend, whereby GLP-1 values were elevated above PLA immediately post-ingestion in both LMW and HMW ($p = 0.089$ and $p = 0.087$, respectively). GLP-1 peaked at 40 minutes following ingestion of LMW (27.9 ± 3.5 pg·mL^{-1}) and HMW (28.5 ± 5.1 pg·mL^{-1}), then began to decline, remaining above PLA until 120 minutes. No differences were observed between HMW and LMW GIP or GLP-1 at any time point.
Conclusions: These data suggest ingestion of HMW and LMW solutions providing 1.2 kg· bw^{-1} CHO result in similar responses in the gut hormones GIP and GLP-1. Further study is needed to determine incretin's effect on subsequent insulin secretion and glucose disposal.
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Effect of post-exercise ingestion of different molecular weight carbohydrate solutions. Part III: Power output during a subsequent resistance training bout

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Background: To maximize power adaptations, resistance training (RT) should be performed at maximal power output. In sports where more than one training bout is necessary in a day, subsequent RT may be limited by muscle glycogen, resulting in lower power output. High molecular weight (HMW) carbohydrate (CHO) solutions have been shown to result in greater glycogen re-synthesis rates, and greater work output during a subsequent cycling time trial compared to a low molecular weight (LMW) CHO solution. However, the effect of a HMW CHO on RT power output following exhaustive exercise is unknown.

Methods: Sixteen resistance trained men (mean ± SD; 23 ± 3 years; 176.7 ± 9.8 cm; 88.2 ± 8.6 kg; 12.1 ± 5.6% fat) participated in this study. One-repetition maximum (1RM) back squat (153.3 ± 53.6 kg; 1.7 ± 0.2 1RM: body mass), and VO_2 max (37.4 ± 4.3 ml·kg·min^{-1}) were initially assessed in order to prescribe exercise intensities during experimental trials. In a double-blind, placebo-controlled, randomized cross over design consisting of three testing sessions separated by one week, subjects completed a glycogen depleting exercise bout on a cycle ergometer. Immediately post-exercise, subjects ingested a placebo (PLA), or a LMW or HMW CHO solution (10%) providing 1.2 kg· bw^{-1} CHO, assigned randomly. Two hours post-ingestion, subjects performed 5 sets of 10 repetitions back squat (75% 1RM) "as explosively as possible". If subjects paused for more than 2 seconds or were unable to complete a rep, resistance was lowered by 13.6 kg. Kinematic and kinetic measurements were sampled at 1000 Hz via force plate and two linear position transducers.
Results: Average power following ingestion did not differ between CHO solutions until Set 4 (p = 0.108) and Set 5 (p = 0.083). Average power collapsed across the latter Sets was greater following ingestion of the HMW solution (Set 4, 1216 ± 97 W; Set 5, 1143 ± 102 W) compared to PLA (Set 4, 1066 ± 80 W: p = 0.037; Set 5, 1019 ± 89 W: p = 0.048), but not compared to ingestion of LMW (Set 4, 1160 ± 79 W: p = 0.355; Set 5, 1131 ± 92 W: p = 0.852). No difference was observed between LMW and PLA (Set 4, p = 0.275; Set 5, p = 0.077). The difference in average power was driven by velocity, as similar trends were observed in Set 4 and 5 (p = 0.100 and p = 0.066, respectively). Average velocity was higher following ingestion of HMW (Set 4, 0.63 ± 0.03 m·s^{-1}; Set 5, 0.62 ± 0.03 m·s^{-1}) compared to PLA (Set 4, 0.56 ± 0.04 m·s^{-1}: p = 0.050; Set 5, 0.56 ± 0.04 m·s^{-1}: p = 0.032), but not LMW (Set 4, 0.61 ± 0.03 m·s^{-1}; p = 0.422; Set 5, 0.61 ± 0.03 m·s^{-1}: p = 0.074), with no difference between LMW and PLA (Set 4, p = 0.220; Set 5, p = 0.769). HMW conferred a likely beneficial effect in Sets 4 and 5 (92.5% and 88.7% likelihood, respectively), compared to PLA; while ingestion of LMW conferred only a possibly beneficial effect (68.7%) and likely beneficial effect (83.9%) in Sets 4 and 5, respectively.
Conclusions: These data suggest post-exercise ingestion of a HMW CHO solution providing 1.2 kg· bw^{-1} CHO may allow athletes to sustain power output in a subsequent resistance training session when time between training sessions is limited.
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Nutrient timing habits of Division I NCAA athletes

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Background: It has been suggested that nutrient timing strategies may augment training adaptations in active populations. However, collegiate athletes are often restricted by practice schedules, class times and training sessions and, as a result, may not follow recommendations on optimal feeding strategies. Therefore, a survey questionnaire, which examined the nutrient timing habits of athletes, was designed and administered at selected Division I Institutions within the United States.
Methods: A total of 481 (240 women, 241 men) NCAA Division I athletes representing eleven intercollegiate sports from three universities in three athletic conferences (i.e., Atlantic 10, Atlantic Coast Conference, Conference USA) volunteered to participate as subjects. There were 18 multiple choice questions that addressed nutrient timing habits. The surveys were administered to all athletes during a scheduled training time.
Results: When asked about breakfast habits 2% (9/398) reported eating breakfast ≤ once per week, while 51% (204/398) reported consuming breakfast 7 days per week. 79% of all athletes reported feeling hungry prior to training, practice or competition. However, 77% of all athletes surveyed reported that it was "*easy*" to eat 1-2 hours prior to competition. A summary of the amount of time prior to practice, training or competition that athletes consumed a full meal is presented in Table 1. When asked if they "snacked" during practice, 24% of men and 23% women responded positively. Only 51% percent of all athletes reported that their athletic department provides post workout or game day nutrition. When asked how soon after practice, training and competition they consumed a full meal, 2% responded 15 min, 15% responded 30 min, 22% responded 45 min, 44% responded 1 hr and 17% responded 2 hr. In regard to nutritional periodization, 43% of men reported that they consume the same number of calories during off-season and in-season with 36% reporting that they were unsure. Similarly, 22% of women reported that they eat the same amount of calories during off-season and in-season with 38% reporting they were unsure.

Table 1(abstract P33) Summary of meal consumption prior to training or competition

Hours Before	Men	Women	Totals
6 hrs	5	7	12
5 hrs	2	2	4
4 hrs	16	22	38
3 hrs	62	57	119
2 hrs	91	86	177
1 hr	24	28	50
Totals	200	200	400
Total % Responses	100%	97%	99%

Conclusions: It appears as though most athletes consumed breakfast regularly throughout the week. In addition the results suggest that athletes are consuming a meal or snack after training and competition despite the fact that only 51% of athletes reported their athletic departments provide post-workout nutrition. However, the majority of athletes also reported feeling hungry prior to training. It is suggested that more proactive strategies may need to be employed to optimize training adaptations.

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A multi-ingredient containing, proteins, carbohydrate and creatine does not attenuate humoral immune response or performance decrease compared to carbohydrate during resistance training

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Background: Nowadays, only carbohydrate has shown to be an effective countermeasure to exercise-induced immune dysfunction while the effect of protein remains controversial. The purpose of this study was to investigate the acute effects of a commercially available multi-nutrient supplement on performance and salivary markers of humoral immunity, following a bout of circuit resistance training in young athletes.
Methods: Twelve recreationally resistance-trained males (age: 22 ± 1.4 years; body mass 79 ±9.78 kg; 1.81 ± 0.07 m height) volunteered to participate in the study completing 2 randomised controlled circuit resistance training sessions (CT). Participants ingested 2 doses of 500ml of water mixed 60g of a multi-ingredient (MTN) containing whey proteins, carbohydrate, creatine, HMB and sodium bicarbonate or maltodextrin (PL). Beverages were consumed (3 doses of ~166ml) during and after the workout (1 × 500ml). Both MTN and PL looks the same colour and flavour and provide a similar amount of calories (~230 per serving). CT involved three rounds of 7 resistance exercises (CMJs, Bench Press, Parallel-Squat, Upright row, Alternate Lunges, Dead Lift, Push-press, Abdominals) followed by 1 min rest. Participants performed 12 repetitions at 70% 1RM in each of

the exercises with no rest in between (only the time to change from one exercise to the next).
Measurements included pre and post (30 min and 60 min) salivary markers of humoral immune response: Antimicrobial Peptide, Alpha Defensins (HNP 1-3). The total kg lifted per exercise and in the overall workout was considered as indicator of performance. ANOVA design and Cohen d effect sizes (ES) were used to analyse potential differences between times and treatment conditions.
Results: No significant differences were observed between the total weight (kg) lifted per exercise or for the entire session ($p > 0.05$). HNP 1-3 showed a strong trend ($p = 0.06$) with a moderate effect size ($d = 0.53$) at 30 min for the CHO condition [2.001 (1.95) vs 3.037 (2.49) ng/mL], nevertheless, no significant differences were observed at 60 min with respect to the values measured at both pre [3.825 (3.21) vs 2.001 (1.95) ng/mL] and 30 min [3.825 (3.21) vs 3.037 (2.49) ng/mL]. On the other side, HNP 1-3 did not increase at either 30 min [2.464 (3.31) vs 3.656 (3.22) ng/mL] or 60 min [2.464(3.31) vs 2.387 (2.46) ng/mL] post workout for the MTN treatment condition. No differences were observed between the two tested treatment conditions for the three analysed times points (pre, post 30 min and post 60 min).
Conclusion: Ingesting both MTN and CHO supplements during and after a circuit resistance-training workout, resulted in no impact on performance. However, even when both nutritional interventions were effective to attenuate the increase of antimicrobial peptide alpha-defensins, MTN showed a stronger effect to blunt exercise-induced immune-dysfunction. These results did not support the notion that only carbohydrate with no added proteins is the only effective nutritional countermeasure against the transient post exercise immunosuppression.
Acknowledgements: The authors would like to thank all participants and Kelly Cooper for their help and support during the collection data process

P35

Functional animal proteins activate mTOR and bind pro-inflammatory compounds

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Background: Protein supplementation in addition to resistance training has been shown to increase muscle hypertrophy and lean mass. Supplemental protein sources differ in amino acid composition, size, structure, and functionality. Animal derived proteins sources such as Beef Protein Isolate (BeefISO), Serum Albumin Concentrate (SuperSerum), Serum Protein Concentrate (SerumPro), whey protein isolate (WPI), and hydrolyzed Chicken Protein Isolate (MyoCHX) each have high-quality amino acid profiles. The mammalian target of rapamycin (mTOR) signal pathway is a nutrient sensor whose activation is associated with muscle protein synthesis. In this work, mTOR pathway activation was shown by Western blot to demonstrate bioavailability of protein preparations. Protein functionality was demonstrated by lipopolysaccharide (LPS) binding to prevent antigen induced inflammatory signaling. Systemic inflammation has been shown to negatively impact athletic performance, suggesting protein preparations which can stimulate muscle protein synthesis and reduce inflammation may be advantageous following resistance training.
Methods: HEK293 cells were stimulated by protein preparations and probed for activation of the mTOR signaling pathway. Briefly, cells were serum starved for 24 hours followed by addition of protein stimulants normalized in protein content. Cells were exposed to 5% proteins solutions for 2, 10, 30, and 60 min after which cellular proteins were harvested for Western blot analysis. Activation of mTOR was monitored at the Ser2448 phosphorylation site. The housekeeping protein β-actin was used to normalize protein loading conditions for comparison between protein preparations. Endotoxin neutralization experiments were conducted by measuring the inflammatory response of THP-1 monocytes to lipopolysaccharide (LPS). Protein solutions (1.25% w/v) were mixed with 10 ng/mL LPS for 1 hour prior to THP-1 exposure. THP-1 and protein mixture were incubated for 24 hours followed by analysis of IL-8 inflammatory cytokine production by Bio-Plex® MAGPIX™ Multiplex Reader and Bio-Plex Pro™ Assays (Bio-Rad, Hercules, CA). IL-8 inhibition was determined by comparison with a standard curve of THP-1 responses to varying concentrations of LPS.
Results: Each of the animal protein supplements tested activated the mTOR pathway as evidenced by increased phosphorylation of mTOR compared with controls. BioBeef, BeefISO, SerumPro, WPI and MyoCHX stimulated the highest phosphorylation of mTOR at 10 min post-stimulation while SuperSerum resulted in earlier maximal stimulation at 2 min. Serum derived protein supplements (BioBeef, SerumPro, and SuperSerum) were each capable of neutralizing endotoxin as shown by a significant ($p < 0.05$) decrease in IL-8 inflammatory cytokine production by THP-1 monocytes when compared to addition of LPS alone. Blending of high-quality protein sources with functional serum protein supplements (SuperSerum and SerumPro) resulted in the effective inhibition of LPS-induced inflammation at an inclusion rate of SuperSerum or SerumPro as low as 5% of the total protein.
Conclusion: Animal derived protein supplements are quickly absorbed by cells *in vitro* and efficiently activate the mTOR signaling pathway, which is associated with increased MPS. High-intensity exercise has been shown to increase inflammation in the body in part from responses to inflammatory antigens. Functional serum proteins provide high quality amino acids yet have a unique impact on immune exclusion through protein binding to inflammatory antigens resulting in anti-inflammatory benefits.

P36

Effects of probiotic supplementation on markers of skeletal muscle damage, perceived recovery and athletic performance after an intense single leg training bout

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Introduction: The probiotic GanedenBC^{30} (*Bacillus coagulans* GBI-30, 6086; Ganeden Biotech Inc., Maryfield Heights, OH) has been shown to support healthy digestive and immune function, including increased protein absorption. In a pilot study, daily co-administration of GanedenBC^{30} and protein in resistance-trained subjects performing full body workouts 4 times per week for 8 weeks has shown a trend to increase vertical jump power and might have a beneficial effect on peak power and fat mass. We speculate that the beneficial effects might be based on aiding muscle recovery through gut microbial modulation. Thus, the purpose of this investigation was to determine if the co-administration of GanedenBC^{30} with protein has a beneficial effect on muscle damage, recovery and athletic performance following a damaging exercise bout.
Methods: 30 healthy recreationally-trained males participated in this study (mean+/-SD; age: 21.5 ± 2.8 years; height: 177.4 ± 8.0 cm; weight: 89.7 ± 28.2 kg). Subjects were randomly assigned to consume either 20 g of casein (Control = CON) or 20 g of casein plus probiotic (500M CFU GanedenBC^{30}, = BC30) twice daily in a crossover, diet-controlled design for a two-week time period. Subjects performed a damaging exercise bout consisting of 10 sets × 10 repetitions unilateral leg press at 70% 1 RM with 1 minute rest, one legged - leg extension (5 sets × 12 reps), and rear foot elevated split squat 5 sets × 12 reps with one minute rest at baseline and after two weeks of supplementation. Athletic performance consisting of peak power (Wingate 10 sec Peak Power Assessment at 7.5% BW at 175RPM threshold loaded drop), vertical jump power (Tendo unit, single-leg jump), and 1-RM single-leg press; and muscle damage was analyzed by muscle swelling (ultrasonography) and blood draws (creatine kinase (CK), blood urea nitrogen (BUN)) were taken at baseline (pre-supplementation) and 48 hours after damaging exercise bout. Perceptual measures (perceived recovery, soreness) were taken before, 24, 48 and 72 hours after exercise.
Results: The damaging exercise bout significantly increased muscle soreness ($p < 0.001$), reduced perceived recovery ($p < 0.001$), however, BC30 significantly increased recovery at 24 and 72 hours, and decreased soreness at 72 hours post exercise in comparison to CON. Perceptual measures were confirmed by increases in CK (CON: +266.8%, $p = 0.0002$; BC30: +137.7%, $p = 0.01$), with BC30 showing a trend towards reduced

indices of muscle damage (p = 0.08). The strenuous exercise significantly reduced athletic performance in CON (Wingate Peak Power; CON: (-39.8 watts, - 5.3%, p = 0.03)), whereas BC30 maintained performance by (+10.1 watts, +1.7%). There were no differences between groups for strength responses (CON: +7.2 kg, +2.6%, p = 0.15; and BC30: +3.4 kg, +1.2%, p = 0.79).
Conclusions: This study indicated that probiotic supplementation in form of GanedenBC^{30} in combination with protein (casein) reduces indices of muscle damage, increases recovery and may maintain athletic performance after muscle damaging exercise.
Acknowledgements: Supported by Ganeden Biotech Inc., Maryfield Heights, OH

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The effects of heavy resistance training and a high protein diet (3.4g/kg/d) on body composition, exercise performance and indices of health in resistance-trained individuals - a follow-up investigation

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Background: The consumption of a high protein diet (> 4g/kg/d) in trained men and women who did not alter their training program has been previously shown to have no significant effect on body composition. Thus, the purpose of this investigation was to determine if a high protein diet in conjunction with a body part, split-routine heavy resistance training program would affect indices of body composition, performance and health.
Methods: Forty-eight healthy resistance-trained men and women completed this study (mean ± SD; Normal Protein group [NP n = 17 four female and 13 male]: 24.8 ± 6.9 yr; 174.0 ± 9.5 cm height; 74.7 ± 9.6 kg body weight; 2.4 ± 1.7 yr of training. High Protein group [HP n = 31 seven female and 24 male]: 22.9 ± 3.1 yr; 172.3 ± 7.7 cm; 74.3 ± 12.4 kg; 4.9 ± 4.1 yr of training). Subjects in the NP and HP groups consumed 2.3 and 3.4g/kg/day of dietary protein during the treatment period. Moreover, all subjects participated in a split-routine, body part heavy resistance-training program. Training and diet (everyday) logs were kept by each subject.
Results: A two-time point (Pre, Post) by two-group (NP, HP) repeated-measures analysis of variance (ANOVA) was utilized to examine body composition measures. There were significant time by group ($p \leq 0.05$) changes in body weight (1.3 ± 1.3 kg NP, -0.7 ± 4.0 HP), fat mass (-0.3 ± 2.2 kg NP, -1.7 ± 2.3 HP), and % BF (-0.7 ± 2.8 NP, -2.4 ± 2.9 HP) in the HP group. There was a significant time effect for FFM for both groups; however, the time by group effect FFM (1.5 ± 1.8 NP, 1.5 ± 2.2 HP) was not significant. Furthermore, a significant time effect ($p \leq 0.05$) was seen in both groups vis a vis improvements in maximal strength (i.e., 1-RM squat and bench) vertical jump and pull-ups; however, there were no significant time by group effects ($p \geq 0.05$) for all exercise performance measures. Additionally, there were no changes in any health parameters (i.e., basic metabolic panel).
Conclusion: Consuming a very high protein diet (3.4g per kg daily) in conjunction with a heavy resistance-training program may confer benefits with regards to body composition. Furthermore, there is no evidence that consuming a high protein diet causes any adverse effects.

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Intermittent fasting combined with resistance training: effects on body composition, muscular performance, and dietary intake

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Background: Intermittent fasting (IF) is a dietary strategy that has recently gained popularity due to a number of potential health benefits. One form of IF, termed time-restricted feeding (TRF), only allows caloric intake during a limited window of time each day (often 4 to 8 hours in duration). One concern of IF is the potential loss of lean mass due to the fasting periods. Resistance training is known to help mitigate loss of lean mass during hypocaloric diets. The purpose of this experiment was to examine the effects of TRF in combination with resistance training on body composition, muscular performance, and dietary intake in young untrained males.
Methods: Adult males (n = 18) were recruited and randomized into one of two groups: resistance training alone (RT) or resistance training plus TRF (RT+TRF). Both groups followed a 3-days-per-week resistance training program for 8 weeks. The TRF program was implemented on non-workout days (i.e. 4 days per week) and consisted of consuming all calories within any 4-hour period between 4 PM and midnight. Both groups were allowed unrestricted food intake during feeding periods. Research visits were conducted at baseline, 4 weeks, and 8 weeks after beginning the study and consisted of body composition assessment via dual-energy x-ray absorptiometry (DXA), 1-repetition maximum (1-RM) strength testing and muscular endurance testing on bench press and leg press exercises, and subjective measures of program difficulty. Diet records, workout logs, and compliance forms were used to track and encourage program adherence, as well as examine dietary differences. One-way and factorial ANOVAs were conducted using R (version 3.1.1).
Results: No group*time interactions were found for any measures of body composition (lean mass, fat mass, and body fat percentage), muscular performance, or dietary intake. A time main effect for increased leg press 1-RM (p = 0.011) and a group main effect for higher leg press 1-RM in the RT+TRF group (p = 0.011) were seen. A group main effect was present for higher bench press endurance in the RT+TRF group (p = 0.013). Within the RT+TRF group, participants consumed fewer calories (p = 0.008), less protein (p = 0.017), less carbohydrate (p = 0.007), and less fat (p = 0.050) on fasting days compared to non-fasting days. However, there was no difference in the percent of total calories from any macronutrient. There were no differences in total calories, protein, or fat consumed between the non-fasting days of the RT+TRF group and the RT group, but the RT group consumed more carbohydrate (p = 0.018). Noticeable differences in individual responses to the programs were noted.
Conclusions: In the absence of any other dietary guidance, restricting caloric consumption to a 4-hour window on 4 days per week was not sufficient to elicit body composition improvements in 8 weeks, although lean mass was maintained in both groups. This form of IF was sufficient to reduce caloric intake on fasting days, but this did not translate to body fat reductions in many subjects. Untrained young men experience similar strength adaptations whether they eat normally or perform this form of IF. Protein intake may be of particular concern for individuals implementing IF and young men beginning a resistance training program.

P39

Effects of macronutrient intake on fuel utilization: potential sex differences

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Background: Evidence suggests that women oxidize more fat for fuel at rest than males. Potential sex differences in fuel utilization during exercise remain unclear. Alterations in diet may influence substrate utilization by altering substrate availability and metabolic enzyme activity. Reduced carbohydrate (CHO) intake has been shown to lower respiratory exchange ratio (RER) over time, which may improve aerobic endurance. The purpose of this study was to explore potential sex differences in the relationship between habitual macronutrient distribution and substrate utilization during exercise.
Methods: Twenty-eight recreationally active college-aged participants (12 females, 16 males; mean ± SD; Age = 22.7 ± 4.1 yrs, BMI = 23.3 ± 2.7 kg·m^2) completed a three-day food log. Participants were provided with detailed instructions for accurately logging food intake and portion sizes. Logs were analyzed using The Food Processor software (ESHA Research, Salem, OR, USA) for total calories, estimated energy requirements (EER), CHO (g/kg), fat (g/kg); and protein (PRO; g/kg). RER was analyzed via indirect calorimetry (Parvomedics TrueOne 2400) during a maximal oxygen consumption (VO_2 max) test to exhaustion on a cycle ergometer and during

a submaximal, six-minute cycling test. The six-minute cycling test was completed at a workload between 60% of ventilatory threshold and VO_2 max. RER was collected throughout and averaged every minute.
Results: For men, there was a significant positive correlation between CHO and RER at both 1 min ($p = 0.012$; $R = 0.613$) and 3 min ($p = 0.013$; $R = 0.608$) of high-intensity exercise, with no significant relationships with PRO or FAT. For women, there was a significant positive correlation with CHO and RER at 2 min ($p = 0.008$; $R = 0.724$); as well as a significant correlation between PRO and RER at 3 min ($p = 0.010$; $R = 0.708$). During high-intensity exercise, women demonstrated a significantly higher RER ($p = 0.016$) compared to men. Macronutrient intake analysis revealed a significant positive correlation between PRO and FAT ($p = 0.007$; $R = 0.496$) in both groups. For men, both CHO and PRO positively correlated with FAT ($p = 0.040$; $R = 0.518$; $p = 0.010$; $R = 0.623$) but only PRO and FAT were correlated in women ($p = 0.009$, $R = 0.712$). When energy intakes were below EER in the total group, PRO and FAT demonstrated a positive relationship.
Conclusions: Contrary to the expected relationship, a positive correlation between RER and PRO intake was seen in women, with no relationship to fat intake. In contrast, higher CHO intake resulted in higher RER for men. Future studies should evaluate long-term effects of dietary changes on exercise fuel utilization. The ability to maximize fat utilization during exercise may be beneficial for longer aerobic events, as well as for weight loss. CHO and PRO correlated with FAT intake in men, but only PRO and FAT correlated in women, possibly suggesting women who consciously consume higher relative amounts of protein are aware of the health benefits of dietary fat.

P40

The effects of a botanical anti-inflammatory nutritional supplement while participating in a resistance training program on indices of body composition and metabolic, cardiovascular, muscular, and hemodynamic function in obese females

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Background: Botanical supplements with flavonoids possess the ability to reduce inflammatory markers such as CRP, IL-6, and TNF-α. Also, they could potentially help reduce sugar-induced weight gain and facilitate weight loss. Diafin is a non-stimulant, botanical, weight loss product created from a blend of standardized Free-B-ring flavonoids and flavans from two plant extracts isolated from the *Scutellaria* genus of plants and the *Acacia* genus of plants. Flavonoids, specifically from the *Scutellaria* genus, have been used previously for anti-inflammatory and cardiovascular applications, and have been suggested to inhibit eicosanoid generating enzymes such as phospholipase A_2, cyclooxygenases, and lipoxygenases, while concomitantly reducing prostanoids and leukotrienes. However, the exact mechanism in which flavonoids induce an anti-inflammatory effect is unclear.
Purpose: The purpose of this study was to determine the effects of eight weeks of daily ingestion of a botanical, anti-inflammatory, nutritional supplement combined with resistance training and an energy-controlled diet on body composition, muscular performance, and serum lipids, obesity hormones, and inflammatory markers.
Methods: Sedentary, obese women (n = 40) participated in a full-body resistance training program 3 days/week for 8 weeks while following an energy-restricted, low-glycemic diet and also ingested either 125 mg of a botanical, anti-inflammatory product (Diafin, Unigen Pharmaceuticals, Lacey, WA) or 125 mg of a cellulose placebo in a randomized, double blind, placebo-controlled fashion. Body composition, muscle performance, serum lipids, and inflammation and obesity markers were obtained at week 0 and after weeks 4 and 8. Data were analyzed by repeated measures ANOVA and are presented as means ± SD.
Results: For body composition, there was a significant time main effect for body mass, BMI, and fat mass. Body mass ($p < 0.001$), BMI ($p < 0.001$), and fat mass ($p = 0.034$) all decreased significantly for both groups between weeks 0 and 8. For muscle performance, there was a significant time main effect for leg press and bench press strength as both strength variables increased in both groups between weeks 0 and 8 ($p < 0.001$). For serum lipids, there was a significant time main effect for TCHOL, LDL, and HDL. TCHOL ($p = 0.004$), LDL ($p = 0.048$), and HDL ($p = 0.009$) decreased between weeks 0 and 8. There was also a significant time main effect for leptin, which decreased significantly between week 0 and 8 ($p = 0.019$).
Conclusion: It is concluded that a full-body resistance training program, in combination with an energy-restricted, low glycemic diet: 1) promotes weight loss and strength gains, 2) improves total and LDL cholesterol, and 3) decreases circulating leptin levels in previously-sedentary, obese women.

P41

The effects of alpha-glycerylphosphorylcholine, caffeine or placebo on markers of mood, cognitive function, power, speed, and agility

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Background: Alpha-glycerylphosphorylcholine (Alpha-GPC) and caffeine supplementation have been shown to improve mental and physical performance. Alpha-GPC administration increases the release of the neurotransmitter acetylcholine and facilitates learning and memory. In athletes, Alpha-GPC supplementation prevents exercise-induced reductions in choline levels, increases endurance performance and growth hormone secretion. Caffeine has been shown to increase mental focus, acuity and athletic performance, however, contributes to a nervous or anxious feeling. The purpose of this study was to measure the acute effects of Alpha-GPC supplementation in comparison to caffeine or placebo on mood, cognitive function, and physiological performance.
Methods: Twenty participants [10 males, 10 females; 22.0 ± 3.4 years of age; height 171.9 ± 7.4 cm; weight 56.8 ± 8.6 kg] consumed 200 mg of Alpha-GPC (aGPC-L, AlphaSize®, Chemi Nutra, Austin, TX, USA), 400 mg of Alpha-GPC (aGPC-H), 200 mg of caffeine (CA), and a placebo (PL) in a randomized, double-blind, placebo-controlled, crossover design. Participants performed the following measurements 30 minutes after supplementation: visual analog scales (VAS) for six different moods, a serial subtraction test (SST), and tests for reaction time, hand-eye coordination, power, speed, and agility.
Results: SST scores were 18.1% and 10.5% faster in the aGPC-L (6.19 ± 2.21 s) group compared to CA (7.32 ± 5.67 s) and PL (6.85 ± 2.52 s), respectively. Vertical Jump Peak Power was 8.5% higher in the aGPC-L (2,041.3 ± 547.2 W), 7.5% higher in the aGPC-H (2,023.1 ± 942.8 W) and 2.0% higher in the CA group (1,920.4 ± 689.6 W) in comparison to PL (1,881.9 ± 576.9 W).
The group consuming CA had significantly higher scores on the VAS for jitteriness compared to aGPC-H ($p = 0.019$), but not aGPC-L ($p = 0.849$) or PL ($p = 0.086$). There were no other statistically significant differences between supplement groups for any of the dependent variables.
Conclusion: Acute supplementation with caffeine or Alpha-GPC had no statistically significant beneficial effect on measures of mood, cognitive function, or physiological performance, in part due to large individual variability between subjects. As Alpha-GPC seemed to be beneficial for certain physical and mental performance tasks, future research should focus on dosage, timing of consumption before testing measurement, bioavailability, longer term supplementation, and subject selection, in order to reduce individual variability.
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P42

Effectiveness of multi-ingredient supplement on substrate utilisation, perception of hunger, mood state and rate of perceived exertion (RPE) at rest and during exercise

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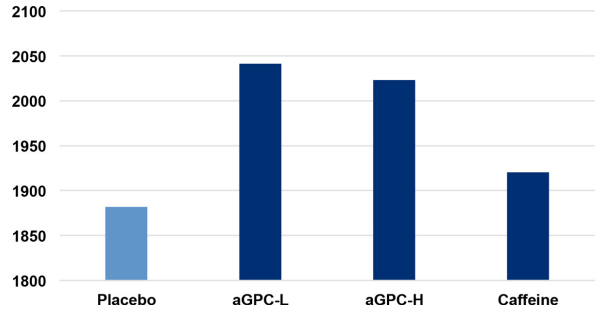

Figure 1(abstract P41) The effects of aGPC-L (+8.5%), aGPC-H (+7.5%), and caffeine (+2.0%), in comparison to placebo, on vertical jump peak power (in watts)

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Background: Enhancing the ability to utilize fatty acids at rest and during exercise is a known important factor for weight loss and endurance performance outcomes. The aim of this study was to determine the acute effect of a multi-ingredient supplement (Shred-Matrix®), containing green tea extract, yerba mate, guarana seed extract, anhydrous caffeine, saw palmetto, fo-ti, eleuthero root, cayenne pepper, and yohimbine HCI, on fatty acid oxidation (FAO), perception of hunger, mood state and rate of perceived exertion (RPE) at rest and during 30 min of submaximal exercise.
Methods: Following the ethical institutional approval and after performing an incremental test to exhaustion to determine both their peak oxygen uptake (VO_2 peak) and the exercise intensity where fat oxidation becomes maximal (Fmax), twelve healthy recreationally active participants, 5 females and 7 males (MS ± SD age: 24 ± 3.8; Body Mass 69 ± 17.0 kg, stature 174 ± 0.09 cm) performed two experimental ergometry cycling trials 72 h apart. Following an overnight fast, participants were randomised to ingest 1.5 g (3 × capsules) of either a multi-ingredient supplement (SHRED) or placebo (PL). On both occasions, participants rested for 3 hours and then performed a constant 30-min cycling exercise test corresponding to their individually-determined Fmax intensity.
Expired gasses and stoichiometric indirect calorimetry were used to analyse fatty acid oxidation (FAO) at rest and during exercise. The rate of perceived exertion (RPE) using the Borg scale (6-20) was measured every 3 min during the 30-min exercise. Additionally both mood state and perception of hunger were assessed just after the ingestion (-3h before exercise), immediately pre and post exercise. A repeated measures ANOVA design and Cohen d effect sizes were used to analyse potential differences between times and treatment conditions.
Results: Perception of hunger and mood state were not different between conditions. With the exception of the first 3 min time point, all RPE values were significantly lower in SHRED compared to Pl ($p < 0.001$). FAO increased in SHRED from -3 h to pre [0.56 (0.26) to 0.96 (0.37), $p = 0.003$ d 1.34] but not in PL [0.67 (0.25) to 0.74 (0.19) $p = 0.334$ d = 0.49]. Both conditions showed a significant increase in FAO from pre to post exercise [SHRED 0.96 (0.37) to 3.80 (1.92) $p < 0.01$ d = 1.72; Pl 0.74 (0.19) to 2.80 (2.02) $p = 0.009$ d = 1.09] with no differences between them ($p = 0.12$ d = 0.49).
Conclusion: Acute ingestion of SHRED increases FAO significantly at rest, and appears to have a moderate effect size on FAO during exercise compared with PL. Those effects were combined with a significant decrease in the perception of effort during Fmax exercise intensity, but did not affect mood state and perception of hunger. The results suggest an acute effectiveness of the multi-ingredient supplement (Shred-Matrix®) in augmenting the weight-loss benefits at rest and during exercise.

P43

The effects of creatine monohydrate supplementation on creatine transporter activity and creatine metabolism in resistance trained males

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Background: Oral creatine supplementation is known to provide numerous benefits, including increases in lean muscle mass, muscular strength, and enhanced performance in various athletic capacities. The creatine transporter is a transmembrane protein that mediates the entry of creatine from the circulation into the muscle cell. Little is understood about the importance of the creatine transporter in controlling the uptake and regulation of creatine within human skeletal muscle. The purpose of this study was to conduct a preliminary examination of the effects of a typical creatine monohydrate supplementation regimen on the activity of the creatine transporter at the transcriptional and translational levels in resistance-trained males.
Methods: In a double blind manner, nineteen (creatine = 9, placebo = 10) resistance-trained (i.e. thrice weekly, > 1 year prior) men between the ages of 18-30 were randomly assigned by age and body weight to orally ingest packets containing a powdered dextrose placebo (AST Sports Science; Golden, CO) or micronized creatine monohydrate (AST Sports Science; Golden, CO). After baseline strength and body composition testing procedures, participants ingested creatine or placebo at a dose of 0.3 g/kg lean body mass/day (≈ 17-20 g/day) for one week in the loading phase and, immediately post loading phase, a dose of 0.075 g/kg lean body mass/day (≈ 5-7 g/day) during the four week maintenance phase. A four week wash out phase followed the supplementation protocol. The participants followed a periodized 4-day per week resistance-training program split into two upper body and two lower body workouts per week, for a total of nine weeks. A total of five muscle samples were collected: Day 1, 8, 22, 36, and 64; six blood samples were obtained: Day 1, 4, 8, 22, 36, and 64; and nine 24-hour urine samples: Day 1, 4, 8, 15, 22, 29, 36, 50 and 64. Statistical analyses were performed utilizing separate two-way ANOVA for each criterion variable employing a probability level of ≤ 0.05.
Results: Creatine supplementation induced significant increments in total body mass ($p = 0.03$) and lean body mass ($p = 0.01$). A moderate effect size (d = 0.51) was found for strength increase. Significant group × time interactions were found for the elevated levels of urinary creatine ($p = 0.01$), serum creatine ($p = 0.003$), and muscle total creatine ($p = 0.043$) in the creatine group compared to placebo. However, no statistical difference was observed for creatine transporter mRNA ($p = 0.78$) or protein content ($p = 0.36$).
Conclusion: Despite detectable differences in levels of urinary, serum, and muscle total creatine content, a standard creatine supplementation protocol had no apparent effect on creatine transporter mRNA or protein expression following a loading, maintenance, and washout phase. Further investigation is warranted to fully elucidate the regulation of creatine transporter activity.

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The effects of a sports nutrition education intervention on nutritional status, sport nutrition knowledge, body composition, and performance in NCAA Division I baseball players

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Background: Maintaining energy balance by consuming the required distribution of macronutrients (nutritional status) is important to support performance and health in collegiate athletes; however, less than 10% of NCAA athletes possess adequate sports nutrition knowledge or maintain

nutritional status (Torres-McGehee et al., 2012). A recent study demonstrated that a sports nutrition education intervention (SNEI) improved nutritional knowledge and nutritional status in Division I volleyball players. This study investigated the effects of an SNEI on nutritional status, knowledge, body composition, and performance in NCAA Division I baseball players.
Methods: Thirty resistance trained NCAA Division I baseball players (82.4 ± 8.2 kg; 183 ± 6.3 cm; 13.7 ± 5% bodyfat) participated in the 12-week study. Fifteen players volunteered for the SNEI while 15 players matched for position served as controls (C). All players participated in a monitored, periodized strength (4 hr/wk), conditioning 3 hr/wk), and skills (20 hr/wk) training program. The nutrition intervention group (N) received a 90 min SNEI encompassing the following topics: energy intake (Kcal), carbohydrate (CHO), protein (PRO), fat, food sources, and hydration. Thereafter, N met once every three weeks with the primary researcher for educational reinforcement in groups of 5. Sport nutrition knowledge questionnaires (Reilly & Maughan, 2007) were administered to N at baseline (t-0) and following 12 weeks (t-12). Food intake was determined by three-day dietary logs administered to N at t-0 and t-12. Energy and macronutrient intake was calculated using Diet Analysis Plus (Cengage), and compared to nutritional requirements (Kcal: 45 kcal/kg; PRO: 2 g/kg; CHO 6 g/kg; Fat 1.5 g/kg). Body composition (BodPod), 1 RM back squat, vertical jump, and broad jump were measured at t-0 and t-12 for C and N. Pre and post nutritional status and knowledge were analyzed using paired samples t-test for N. Changes in body composition and performance were compared between C and N using an independent groups t-test with an alpha level of 0.05 for all tests.
Results: Knowledge significantly ($p < 0.05$) increased from t-0 to t-12 (56 ± 11% vs. 70 ± 9%). Energy consumption was significantly ($p < 0.05$) less than requirements at t-0 (35.5 ± 6.6 kcal/kg) and significantly ($p < 0.05$) increased to meet requirements at t-12 (41.2 ± 5.2 kcal/kg). CHO was significantly ($p < 0.05$) less than requirements at t-0 (3.6 ± 1.1 g/kg) and t-12 (3.8 ± 0.8 g/kg). PRO was significantly ($p < 0.05$) less than requirements at t-0 (1.7 ± 0.4 g/kg) and significantly increased ($p < 0.05$) at t-12 (2.2 ± 0.4 g/kg). Fat was not significantly ($p > 0.05$) different than requirements at t-0 (1.6 ± 0.3 g/kg) and significantly ($p < 0.05$) increased above requirements at t-12 (2.0 ± 0.4 g/kg). Fat free mass and body mass significantly ($p < 0.05$) increased (Δ = 3.7 ± 3.6 kg; 3.3 ± 4.8 kg, respectively) with no difference between groups. Percent body fat decreased significantly ($p < 0.05$) in N (Δ= -1.2 ± 2.3%) but not C (Δ = 0.3 ± 1.7%). Squat, vertical, and broad jump significantly ($p < 0.05$) increased (Δ = 25.5 ± 15.9 kg; .144 ± 0.09 m; .135 ± 0.1 m, respectively) with no difference between groups.
Conclusion: Our findings indicate that an off season SNEI is effective at improving sport nutrition knowledge and some, but not all nutrient intakes in Division I baseball players. Improvements in nutritional status were associated with decreases in body fat percentage, possibly attributable to increased protein consumption.

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Chronic supplementation of a mushroom blend on oxygen kinetics, peak power, and time to exhaustion

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Background: *Cordyceps militaris* has been used in pre-workout supplement blends intended to improve aerobic performance. Mushroom blends containing *Cordyceps* may serve as an ergogenic aid by improving oxygen kinetics and delaying fatigue, but there is limited data on the effects of this ingredient during exercise. The purpose of this study was to determine the effects of 3 weeks of supplementation with a mushroom blend on oxygen kinetics, aerobic power, time to exhaustion, and lactate levels during high-intensity exercise.
Methods: In a double-blind placebo controlled design, recreationally active subjects (n = 10; mean ± SD; age = 21.4 ± 2.4 yrs; height = 175.8 ± 78 cm; weight = 75.0 ± 10.6 kg) were randomly assigned to a mushroom (MR; n = 6) or placebo (PL; n = 5) treatment group. All subjects completed a maximal graded exercise test, 6 min sub-maximal cycle test, and 3 min all-out cycle test, each separated by at least 24 hrs. Maximal oxygen consumption (VO_2 max), time to exhaustion (TTE), and ventilatory threshold (VT) were determined via respiratory gas analysis during the maximal graded exercise test performed on a cycle ergometer. Lactate and oxygen saturation (SPO_2) were measured at 0, 2, 3 and 6 min during the 6 min sub-max cycle test at a workload of 60% between VT and VO_2 max. Peak power output (PP) was recorded during the 3 min all-out cycle test with a resistance of 4.5% of body weight. Subjects were given capsules containing either 1.3 grams of mushroom blend or 1.3 grams of maltodextrin (PL) to be taken 3 times per day (4 grams daily) for 3 weeks. The same 3 exercise tests were repeated after 3 weeks.
Results: There was a significant increase in VO_2 max (44.0 ± 10.5 to 48.8 ± 11.1 ml/kg/min^{-1}; $p = 0.042$) for MR. There was also an increase in TTE (+69.8 sec; 851.7 ± 170.0 to 921.5 ± 146.2 sec) for MR as determined by 95% confidence intervals. No changes in VO_2 max or TTE were observed for PL ($p > 0.05$). Though not statistically significant ($p > 0.05$), there was a greater increase in VT for MR (+0.9 L/min; 1.7 ± 0.3 to 2.4 ± 1.0 L/min) compared to PL (+0.2 L/min; 2.3 ± 0.9 to 2.5 ± 0.7 L/min). Lactate increased significantly over the 6 min test in both groups with no significant difference between groups ($p = 0.369$). There was also a non-significant increase ($p > 0.05$) in PP in MR (51 ± 113 W) and a decrease in PP in PL (- 48 ± 50 W).
Conclusion: Chronic, 3 week supplementation of a mushroom blend at 4 grams per day may improve VO_2 max, increase TTE and augment PP during high-intensity aerobic exercise. A blend containing *Cordyceps militaris* may be an effective method for enhancing aerobic performance and delaying fatigue by improving oxygen kinetics. This could have positive implications for maintaining and improving training volume, especially in endurance athletes.
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Safety and organ health with 8 weeks use of commercially available bio-active peptide supplement: A prospective, double-blind, placebo controlled randomized trial

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Background: It has been established that bio-active peptides may provide improved health, muscular performance and immune function. Enhancements in athletic performance and gains in lean muscle mass have also been reported with training. While the safety of bio-active peptides has been previously reported, it was the purpose of this investigation to examine the specific effects of a commercial bio-peptide product, Bio-Gro™, on blood markers of health and organ function and resting hemodynamic measures in men engaged in intense resistance training as indications of safety.
Methods: Twenty recreationally resistance trained men voluntarily participated in this prospective, randomized, double-blind, placebo-controlled research investigation. Study participants were randomly assigned to receive two servings of either Bio-Gro™ bio-active peptides or placebo daily for an eight week study period. All study participants completed four intense weight training sessions weekly for the first four weeks and five intense weight training sessions performed per week for the final four weeks. Before and after the eight week program, assessment sessions were performed including standard complete blood counts, comprehensive metabolic panels, and resting hemodynamics. Measures were examined using two-way ANOVAs for repeated measures. Statistical significance was accepted at the $p < 0.05$ level.
Results: Analyses of the blood chemistry count measures indicated significant main effects of group for RBC and significant main effects of time for values of MCV and MCHC (p values < 0.05). There were no statistically significant interaction effects (group × time) for any blood chemistry count measures indicating no specific effects of supplementation on these variables (p values > 0.05).
Results of the analyses of comprehensive metabolic panel measurements revealed significant effects of group for creatinine, eGFR, and BUN/creatinine (p values < 0.05). There were numerous significant main effects of time including BUN, BUN/creatinine, sodium, chloride, CO2, calcium, albumin, and alka phosphate (p values < 0.05). Analyses also showed no statistically significant interaction effects (group × time) for any comprehensive

metabolic panel measures which indicated that Bio-Gro™ had not specific effects on the measures of the metabolic panels (p values > 0.05).
The analyses of resting hemodynamic measurements revealed significant time effects for HR ($p < 0.05$) with no significant effects of group or significant group × time interactions for HR, SBP, or DBP (p values < 0.05) again indicating that the supplementation had no specific effects on these variables.
Conclusion: The results of the present study indicate that 56 days ingestion of a commercial bio-active peptide supplement, Bio-Gro™, produced no significant effects on complete blood count measures, values from comprehensive metabolic panels, or on resting hemodynamic measures in men participating in intense resistance training. These findings indicate that short-term supplementation of this bio-active peptide product is safe in apparently healthy, recreationally trained men when ingested at recommended dosages.

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Significant enhancement in the rate of body mass and lean body mass gains with supplementation of a bio-active peptide in conjunction with eight weeks of resistance training: a prospective, double-blind, placebo controlled randomized trial

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Background: It has been previously shown that supplementation with a commercial food-based bio-active peptide product (Bio-Gro™) may improve resistance training capacity and enhance recovery between repeated bouts of strenuous exercise. It has been suggested that enhanced workout capacity during training sessions and improved recovery from exercise may enhance chronic training adaptions, such as superior gains in muscular mass, compared with training without supplementation. The purpose of the present investigation was to examine the changes in body mass and lean body mass of young men engaging in eight weeks of resistance training and ingesting a commercial bio-active product compared with training without supplementation.
Methods: This study utilized a prospective, randomized, double-blind, placebo-controlled research design. Twenty recreationally resistance trained men voluntarily participated in this study. Each research participant agreed to participate in four intense weight training sessions per week for four weeks and five intense weight training sessions per week for weeks five through eight over an eight week study period. Study participants were randomly assigned to receive either Bio-Gro™ or placebo for the eight week period and were directed to take two servings per day. Test sessions were performed prior to initiation of the study and following the eight weeks of training. Body composition was assessed using the BodPod system, which utilizes air displacement. Body composition was also calculated based on skinfold measurements that were taken at the chest, abdomen, thigh, triceps, and suprailiac. Circumferential measurements were taken at standard sites using a Gulick tape and included chest, shoulders, abdomen, mid-thigh, mid-arm relaxed, and mid-arm flexed. Pre- and post-study measurements were used to establish change scores which were compared between the Bio-Gro™ and placebo groups using one way ANOVAs. Statistical significance was accepted at the $p < 0.05$ level.
Results: Analyses revealed no significant differences between groups in baseline measures of body composition or circumferential measures (p's > 0.05). Analyses of change scores between groups indicated that Bio-Gro™ produced significantly greater ($p < 0.05$) changes in total body mass as assessed with BodPod (+6.3 pounds) than the placebo condition (+2.8 pounds). Lean body mass changes were also significantly greater with Bio-Gro™ (+5.8 pounds) compared with placebo (+3.7 pounds) ($p < 0.05$).
While there were significant main effects of time detected for change scores of total body mass and lean body mass as calculated from the skinfold measurements, there were no significant group × time interactions indicating no significant differences in changes scores between groups.
Analyses of change scores between groups indicated that Bio-Gro™ produced significantly greater changes in mid-arm flexed measurements (+0.74 inches) than the placebo condition (+0.31 inches) ($p < 0.05$). There were no other significant differences detected between groups in circumferential change scores.
Conclusion: The findings of this prospective, randomized, double-blind, placebo-controlled research investigation indicate that when applied in conjunction with an intense eight week resistance training program, Bio-Gro™, a bio-active peptide supplement, produced significantly greater gains in total body mass (125% greater) and significantly greater increases in lean body mass compared with placebo with significantly greater changes in flexed mid-arm circumference ($p < 0.05$).

P48

MSM enhances LPS-induced inflammatory response after exercise

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Background: Methylsulfonylmethane (MSM) has been reported to positively influence markers of inflammation and exercise recovery, including decreasing muscle soreness and fatigue. Acute exercise induces tissue damage that results in sterile inflammation that is propagated by secreted mediators such as IL-6 and TNF-α. Regulation of the inflammatory response is critical as chronic inflammation is associated with a plethora of diseases. In addition to the exercise recovery, MSM has also been reported to reduce inflammation associated with osteoarthritis and allergy. Based on these data we designed a pilot study to determine the effect of MSM on Lipopolysaccharide (LPS) - induced inflammatory mediators after a single bout of acute eccentric exercise.
Methods: Blood was collected from five recreationally active, healthy men after 28 days of supplementation with MSM (OptiMSM®; Bergstrom Nutrition, Vancouver, WA) or placebo (rice flour) indicated by "Base". Subjects #19 and #20 received placebo, while #36, #39 and #40 received 3 g of MSM per day. A single bout of acute exercise (10 sets of 10 repetitions of eccentric knee extensions) was performed and additional blood samples were collected immediately (0 h) and 24 h, 48 h and 72 h post exercise. 250 μl of whole blood was plated in a 96-well U bottom plate containing 50 μl of tissue culture media (RPMI1640, antibiotics, 10% FBS) with or without LPS (final concentrations = 0.2 ug/ml). The samples were then incubated at 37°C for 24 h and plasma collected by centrifugation and stored at -80°C until analysis. Plasma cytokine concentrations were determined using a MILLIPLEX MAP human custom cytokine magnetic bead panel that included analytes for IL-1β, IL-6, IL-10, IL-17a and TNF-α. Analytes were quantified using a MAGPIX® and xPONENT software.
Results: The supplementation of MSM blunted the increase in the systemic levels of inflammatory cytokines (IL-6 and IL-1β) immediately after exercise. *Ex vivo* incubation of blood from various time points with LPS, caused a dramatic increase in inflammatory cytokine secretion (IL-6, IL-1β and TNF-α) only after exercise for samples that was exposed to MSM. This response is specific to the stimulation with LPS as secretion of LPS-non responsive proteins is not increased, as evident by the stable levels of IL-17a. There is also a 2-3 fold increase in IL-10 production after LPS stimulation for the MSM group despite having lower IL-10 levels before exercise.
Conclusion: MSM is able to reduce the initial cytokine surge that is induced by acute exercise, while allowing for an efficient response to infectious stimuli after a single bout of acute exercise.

P49

Effects of acute ingestion of a multi-ingredient pre-workout supplement on lower body power and anaerobic sprint performance

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Background: Multi-ingredient pre-workout supplements (MIPS) are becoming popular dietary supplements among strength and power athletes. These products frequently include caffeine, creatine, beta-alanine, and branched-chain amino acids as the primary ingredients. When studied on an

Table 1(abstract P49)

Variable	SUP	PLA	p value
Peak Power (W)	1934 ± 379	1918 ± 376	0.719
Mean Power (W)	1468 ± 304	1397 ± 257	0.034*
Total Work (m)	107.1 ± 4.8	106.7 ±5.3	0.384
CMVJ (cm)	65.2 ± 7.0	65.8 ± 8	0.584
Peak Power (W)	6470 ± 895	6513 ± 898	0.584
Mean Power (W)	3415 ± 487	3438 ± 483	0.584

Values are presented as Mean±SD

*Significant difference between treatment conditions ($p < 0.05$)

individual basis, several of these ingredients have been shown to increase muscular power following acute ingestion; however, little is known in regard to a synergistic effect when said ingredients are combined. The purpose of this study was to determine if short-term, MIPS ingestion influences muscular power and anaerobic sprint performance.

Methods: In a double-blind, randomized, and crossover design; 12 Division III male, football players (18.8 ± 1.2 yrs; 180 ± 12 cm; 89.3 ± 11 kg; 13.6 ± 4.9% BF) completed one baseline session and two subsequent testing sessions to determine the efficacy of acute ingestion of a MIPS. The initial baseline session consisted of body composition assessment and familiarization with the jump mat and non-motorized force treadmill. In testing Session 1, participants ingested either 1 serving of a commercially available MIPS (SUP) that contained 4g of carbohydrates, 2g of creatine hydrochloride, 3g of beta-alanine, 1.5g of betaine, 1g of taurine, 600mg of N-acetyl L-Cysteine, 150mg of Alpha-Glyceryl Phoshporyl Choline, 6g of citruline malate, 500mg of beet extract, 6g of BCAA's, 1.5g of L-tyrosine, 300mg of caffeine anhydrous, 50mcg of huperzine A and 5mg of BioPerine; or a placebo (PLA). Following a post-consumption 30-minute waiting period, participants completed a warm-up of 10 body weight exercises. Next, they completed a counter-movement vertical jump (CMVJ) test on a jump mat (*Just Jump System, Probotics, AL, USA*), which consisted of three attempts with the highest CMVJ being recorded for analysis and converted to power (W) using previously described methods [1]. Following the CMVJ, participants completed a 25-second maximal effort sprint test on a non-motorized force treadmill with the resistance set at 18% of their bodyweight. Session 2 followed a week later in which participants repeated the testing protocol under the opposite treatment condition (SUP or PLA).

Results: Mean values for CMVJ power and treadmill performance work under each treatment are included in Table 1. There were no significant differences in lower body peak ($p = 0.584$) or mean power ($p = 0.584$) as determined by CMVJ. A significant increase in mean power was observed in the MIPS condition ($p = 0.034$) during the anaerobic sprint test. No significant differences were observed for any of the remaining anaerobic sprint performance variables.

Conclusions: Results suggest that acute ingestion of a MIPS 30 minutes pre-exercise has no impact on lower body muscular power, but improves mean power output during a maximal-effort anaerobic sprint. Based upon the results of the current study, ingesting a MIPS prior to a training session may improve anaerobic capacity during bouts of exercise lasting < 30 seconds.

Reference

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P50

A comparison of resting energy prediction equations in young recreationally active women

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Table 1(abstract P50) Comparison of REE prediction equations

	REE (kcal) Mean ± SD	t-test p value	r value	p value
Indirect Calorimetry	1646 ± 204.6			
Nelson Equation	1301.3 ± 155.9	$p < 0.001$	0.687	$p < 0.001$
Mifflin-St. Jeor Equation	1426.2 ± 118.5	$p < 0.001$	0.630	$p < 0.001$
Harris-Benedict Equation	1919.2 ± 137.2	$p < 0.001$	0.682	$p < 0.001$

Values are × ± SD; r represents Pearson correlations; P values represent 2-tailed testing

Background: The estimation of resting energy expenditure (REE) can be a valuable tool in developing programs for weight loss interventions and body composition management. REE prediction equations are a low-cost alternative to assess REE versus directly measuring REE, which typically requires expensive laboratory equipment. Though often used to estimate REE in active populations, the majority of REE equations have been developed in overweight or sedentary populations. This study sought to examine the accuracy of three commonly used REE estimation equations in a recreationally active population.

Methods: Twenty-five recreationally active, college-aged women (20.72 ± 0.97 yrs; 163.04 ± 5.67 cm; 67.08 ± 10.40 kg; 29.04 ± 5.80% BF) were recruited to participate in this observational study. Participants underwent a single day of testing, consisting of determination of REE by indirect calorimetry (*TrueOne® 2400 Metabolic Measurement system, ParvoMedics, Sandy, UT*) followed by body composition assessment. Participants were instructed to refrain from strenuous exercise 48 hrs prior to testing in addition to fasting >8 hrs prior. Participants laid motionless without falling asleep for 15-20 minutes during REE determination. Data were recorded during a period of time in which criterion variables (e.g., VO_2 L/min) changed less than 5% every 5 minutes. Body composition was assessed using air displacement plethysmography (*BODPOD, Cosmed, USA*). Fat and fat-free mass were determined based upon the body densities obtained from the BODPOD and the Siri equation. Independent sample t-test was used to determine the difference between indirect calorimetry and each of the following REE prediction equations: 1) Nelson Equation; 2) Mifflin-St. Jeor Equation; and 3) Harris-Benedict Equation (with a moderate activity factor). Bivariate Pearson correlations were also used to determine the relationship between methods of REE assessment. A criterion alpha level of $p < 0.05$ was selected to determine statistical significance.

Results: All three REE equations were significantly different than indirect calorimetry ($p < 0.001$; Table 1). The Nelson and Mifflin-St. Jeor equations underestimated REE when compared to indirect calorimetry by 345.5 ± 51.5 and 220.6 ± 47.3 kcals, respectively; while the Harris Benedict overestimated REE by 272.4 ± 49.3 kcals. All three equations were moderately correlated with REE as determined by indirect calorimetry.

Conclusions: Results of the current study suggest that REE prediction equations differ from directly assessed REE using indirect calorimetry. Practitioners should exercise caution when providing dietary recommendations based upon predicted REE values as certain equations may over or underestimate energy requirements by several hundred kilocalories.

P51

Muscle proportionality: The proportionality of skeletal muscle before and after intervention

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Background: There are many types of intervention that can lead to a change in lean body mass including: hormone replacement therapy, aging, menopause, strength training, aerobic exercise, extreme weight loss interventions (gastric bypass surgery), and starvation. Lean body mass is a metabolically active tissue which is involved in several key functions in the body, including: locomotion, basal metabolic rate, and strength. The purpose of this study was to assess the proportionality of changes of regional lean body mass (arms, trunk and legs) before and after intervention.
Methods: A systematic search was conducted utilizing these key phrases, "muscle proportionality", "regional muscle proportionality", and "DXA regional muscle studies". Also, each study had to fit within the search criteria which included; DXA regional lean body mass before and after intervention randomized controlled studies. After the preliminary search was conducted, a total of 10 studies fit the search criteria for this study. Initial versus final regional lean body mass was plotted and linear regression R^2 for total as well as, regional lean body mass (LBM) changes was determined.
Results: Muscle proportionality was linearly correlated in three specific regions of the body including: arms ($r^2 = 0.94$, $p < 0.0001$), legs ($r^2 = 0.97$, $p < 0.0001$), and trunk ($r^2 = 0.89$, $p < 0.0001$). Total body muscle proportionality was also linearly correlated ($r^2 = 0.99$, $p < 0.0001$).
Conclusion: In studies utilizing no or whole body weight training, muscle change - gain or loss - appears to occur proportionately to where it was before the intervention. This data could prove beneficial for healthcare professionals when designing nutrition protocols and assessing lean body mass change over time.

P52

Oral L-citrulline supplementation enhances cycling time trial performance in healthy well-trained males

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Background: L-citrulline is an amino acid that is an endogenous precursor of L-arginine and contributes to generating nitric oxide (NO). L-citrulline is known for increasing plasma L-arginine and NO more effectively than equivalent doses of L-arginine. NO plays an important role in sport performance but it is presently unknown whether L-citrulline enhances sport performance during rowing ergometer competition in humans. The aim of this study is to investigate the effect of oral supplementation of L-citrulline on cycling time trial performance.
Methods: A randomized double-blind crossover study design was used. Twenty two well-trained males, aged between 20 and 39, consumed 2.4 g / day of L-citrulline or placebo for 7 days and they took 2.4 g of L-citrulline or placebo 1 hour before 4 km cycling time trial on day 8. Completion time of 4 km cycling, power output / VO_2 ratio (PO / VO_2), plasma NOx, amino acids, Visual Analog Scale (VAS) were evaluated.
Results: L-citrulline supplementation significantly improved cycling time trial performance by 1.5% ($p < 0.05$) and increased PO / VO_2 during performance ($p < 0.1$). Moreover there was a correlation between plasma NOx and PO / VO_2 ($r = 0.47$, $p < 0.01$) in L-citrulline group. L-citrulline significantly increased plasma L-citrulline and L-arginine, and improved the subjective feeling of muscular fatigue and concentration ($p < 0.05$).
Conclusion: Oral L-citrulline supplementation enhances cycling time trial performance by improving PO / VO_2 through up-regulation of plasma NO availability.

P53

Genetic variation related to caffeine metabolism or response during exercise

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Background: Caffeine use for improved athletic performance has variable effects. Caffeine can exert a wide variety of physiologic effects that range from adverse (e.g., anxiety, increased heart rate, nervousness) to pleasurable (e.g., alertness, elevated mood, increased energy), which could be associated with individual genetic differences.
Methods: We examined whether a panel of 25 SNPs in 19 genes that might be related to caffeine metabolism or response modified exercise performance, or were associated with any physiologic outcomes during exercise. Subjects were trained male cyclists (n = 33) who underwent a double-blind placebo-controlled crossover trial to test the effects of caffeine (6 mg/kg) on various performance parameters during a computer-simulated 40 km time trial. The 25 SNPs were genotyped using the Sequenom MassARRAY® system, and caffeine-genotype interactions on time trial time, VO_2 max, heart rate, respiratory exchange ratio and rate of perceived exertion were assessed using repeated measures analysis of variance.
Results: There was a significant interaction between caffeine and rs4410790, a SNP located near the aryl hydrocarbon receptor (*AHR*) gene, on heart rate during the time trial ($p = 0.007$). Compared with placebo, caffeine supplementation increased heart rate (HR) to a greater extent in carriers of the T allele (n = 19; placebo = 155 ± 12 bpm; caffeine = 165 ± 11 bpm $p = < 0.0001$) compared with CC homozygotes (n = 14; placebo = 164 ± 15 bpm; caffeine 167 ± 14 bpm $p = 0.11$).
Conclusion: Our findings show that a polymorphism near the *AHR* gene was associated with a greater elevation in HR during a 40-kilometer time trial after caffeine ingestion, but had no effect on performance.

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A randomized, double-blind, placebo controlled, parallel group, efficacy study of alpha BRAIN® administered orally

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Background: Nutritional supplements that purport cognitive enhancing properties are widely available and are being consumed by athletes with increasing prevalence. The goal of this study was to investigate the efficacy of a self-described cognitive enhancing nutraceutical on cognitive functioning in a group of healthy adults by utilizing a randomized, double-blind, placebo controlled design.
Methods: A total of 63-treatment naïve individuals participated in this randomized, double-blind, placebo controlled trial. All participants completed a two-week placebo run in before receiving either active product, Alpha BRAIN® or new placebo. Participants then followed the manufactures recommended instructions for use for six weeks. Following their placebo run in, participants undertook a battery of neuropsychological tests before being randomized, and again approximately six weeks later at study completion. Primary outcome measures included neuropsychological tests from the WMS-IV, DKEFS, CVLT-II, Trails A & B and PSAT as well as measures of sleep.
Results: Bivariate analysis indicated no significant differences between groups on any demographic variables and both groups demonstrated excellent supplement adherence (> 90%). Following the two-week placebo run in, no significant differences were found between groups on any cognitive measure. At six weeks, significant improvement was noted in tasks of delayed verbal recall and executive functioning for the Alpha BRAIN® group compared to placebo ($p < 0.05$). Both groups demonstrated overall improvement on neuropsychological tests between time points. Analysis of variance (ANOVA) was utilized to assess the impact of randomization on neuropsychological outcome measures across time points. Results indicated significant interaction effects for improvement in delayed verbal recall for the AlphaBrain$^{(TM)}$ group, $F(1.61) = 4.07$, $p < 0.05$, partial eta squared =0.06.
Conclusions: The use of Alpha BRAIN® for 6-weeks significantly improved recent verbal memory and executive function when compared with controls, in a group of healthy adults aged 18-35. Results of this trial merit

further study toward the application of cognitive enhancing supplements in athletic performance.

P55

Observational case study - Vitamin 25(OH)D status of professional basketball players and its impact on athletic performance and recovery

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Background: The rate of vitamin D insufficiency is estimated at greater than three-quarters of the general population and therefore it's likely many athletes fall into this same category. Vitamin D's role in calcium regulation and bone health is well documented, however new research highlights vitamin D's potential role in athletic performance and recovery via its potential impact on protein synthesis, muscle function, hormone synthesis, immune response, inflammation and regulation of lean muscle.
Objective: To highlight the prevalence of insufficient serum vitamin 25 (OH)D levels in professional basketball players training at high-intensity and its potential impact on performance and recovery.
Methods: Serum vitamin 25(OH)D levels were collected at pre-training camp medicals for 7 of the 12 players on the Canadian Men's Olympic Basketball team. Collection was done via blood draw the day before training camp started (mid-July 2014), after the conclusion of the athlete's competitive season.
Results: The serum vitamin 25(OH)D levels for the seven players measured in nmol/L at training were as follows; 31, 56, 59, 61, 63, 70, and 144 nmol/L. The mean serum vitamin 25(OH)D results for the seven players tested was 69 nmol/L, while the median score was 61 nmol/L.
Discussion: The optimal serum level of vitamin 25(OH) D has not been established, however vitamin D deficiency is typically defined as < 50 nmol/L (< 20 ng/mL), insufficiency defined as 50-80 nmol/L (20-32 ng/mL), and optimal levels 100 nmol/L (> 40 ng/mL). It has been noted that at levels < 40 ng/mL (100 nmol/L), the body relies on daily replenishment of vitamin 25(OH)D to meet its requirements and it's difficult to obtain this amount in the average diet.
The research available to support vitamin D's ability to increase performance is very limited, showing possible benefit in muscular strength, sprinting capacity, and VO_2 max. Increased levels of inflammation from intense training (aerobic) have also been associated with low vitamin D levels. Vitamin D plays a key role in active muscle, as well as preventing stress fractures, supporting the notion that correcting vitamin D insufficiency may improve future performance. The direct cause of low or insufficient vitamin status in athletes training a high intensity is not clear and is most likely multi-factorial, due to inflammatory processes, muscular damage, increased protein synthesis requirements, increased immune activity, race, genetics or other unknown causes. Athletes competing in indoor sports may be at higher risk. (Note - player 'G' whose levels were 144 nmol/L was supplementing with vitamin D at the time of the assessment. He was the only player supplementing at the time of assessment).
Conclusion: Athletes training at high-intensity seem more likely to have insufficient levels of vitamin 25(OH)D. The research in this area recommends athletes achieve > 40 ng/mL (100 nmol/L) to support overall health and athletic performance. These levels seem difficult to achieve without supplementation.
Limitations & Future Considerations: In the future, obtaining values for all players on the roster and correcting for race, gender, disease, etc would help in further understanding the role of vitamin D in athletic performance and recovery.

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The effects of pomegranate extract on anaerobic exercise performance & cardiovascular responses

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Background: During exercise, there is an increased demand for oxygen. Increasing blood flow may provide an ergogenic effect. Dietary nitrate supplementation, such as pomegranate extract (PE), has been linked to reduced vascular resistance, enhanced vasodilation, and increased blood flow to possibly improve exercise efficiency. The purpose of this study was to evaluate the effects of acute PE supplementation on anaerobic exercise, flow mediated dilation (FMD), oxygen saturation ($SP0_2$), heart rate (HR), and blood pressure (BP).
Methods: Nineteen recreationally active individuals (mean ± SD; Age: 22.1 ± 1.9 yrs; Height: 170.4 ± 12.4 cm; Weight: 68.7 ± 15.9 kg) participated in this crossover design study. In a double-blind fashion, participants were randomized to either 1000 mg of PE (True Pomegranate Extract, Stiebs Nature Elevated, Madera, CA) or placebo (PL; 95% maltodextrin, 5% purple carrot and hibiscus for color), ingested in capsule form 30 min prior to a repeated sprint ability (RSA) test. Peak and average power were identified from the RSA on a friction-loaded cycle ergometer (Monark 894E, Stockholm, Sweden), which consisted of ten six-second maximal sprints with a load of 65 g/kg of body weight with 30 seconds of passive recovery. Brachial artery FMD was assessed by ultrasound (GE logiq-e B-mode, GE Healthcare, WI) with vascular, pulse wave, and color flow settings to determine blood flow and vessel diameter. FMD, HR, SPO_2, and BP were assessed at baseline, 30 min post ingestion (30minPI), immediately post exercise (IPost), and 30 min

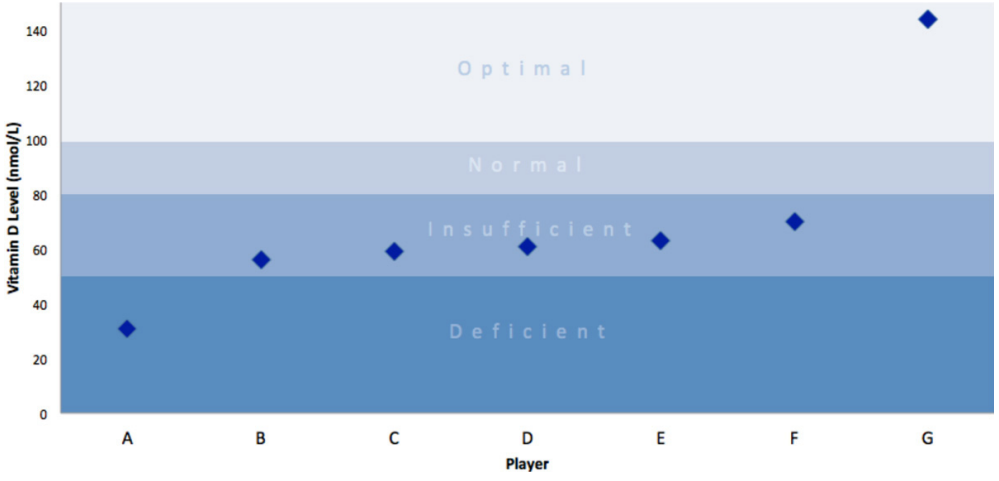

Figure 1(abstract P55)

post exercise (30minPostEx). After a seven-day washout period, participants completed the RSA test with the opposite treatment. Separate two-way mixed factorial ANOVAs (treatment × time) were used to assess peak power, average power, FMD, BP, HR, and SPO_2, with Bonferroni post hoc comparisons. Change scores from PE to PL were calculated and 95% confidence intervals (CI) were placed around the mean change score.
Results: Peak power was significantly higher for sprint number 5 when supplementing with PE versus PL (mean difference [MD]= 31.81 Watts; p = 0.046) and sprint 7 trended towards significance (MD = 35.34 Watts; p = 0.063). When 95% CI were employed for peak power, sprints 5 and 7 were significantly higher when PE was consumed. Confidence intervals demonstrated average power was significantly higher for sprint 5 wth PE. Vessel diameter was significantly greater at 30minPostEx and blood flow was significantly higher IPost when PE was consumed. There were no significant differences in $SP0_2$, HR, or BP.
Conclusions: Acute supplementation of PE resulted in enhanced vessel diameter, blood flow, and repeated sprint ability halfway through the test. Results suggest the possibility of enhanced exercise performance due to increased delivery of oxygen and substrates to working skeletal muscle with the use of PE.
Practical Applications: The acute timing and capsule form of PE may be preferable to the athletic population due to ergogenic effects, taste, and convenience. Combining PE with other ergogenic aids may be advantageous as a pre-workout supplement to further augment performance.

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Effects of coffee and caffeine anhydrous on strength and sprint performance

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Background: Caffeine is a commonly used ergogenic aid and is included in many pre-workout formulations marketed towards athletes engaged in high-intensity exercise. Previous studies have directly compared the effects of coffee (COF) and anhydrous caffeine (CAF) on endurance performance, with equivocal results reported. To our knowledge, COF and CAF have not yet been directly compared in the context of strength and sprint performance. The purpose of the current randomized, double-blind study was to compare the effects of acute COF and CAF intake on strength and sprint performance.
Methods: Fifty-four resistance-trained male participants (mean ± SD; age = 20.1 ± 2.1 yrs; height = 177.3 ± 5.6cm; weight = 78.8 ± 8.8 kg; habitual caffeine intake = 32.9 ± 59.6mg/day) completed baseline strength testing, consisting of both one-rep max (1RM) and repetitions to fatigue (RTF) for leg press (LP) and bench press (BP). Following strength testing, a friction-loaded cycle ergometer was loaded with a resistance of 95g/kg of bodyweight and participants completed a repeated sprint protocol consisting of five, ten-second sprints separated by one minute of passive rest. Peak power (PP) and total work (TW) were recorded for each sprint, along with average PP and TW values for the entire protocol (all five sprints). At least 48 hours later, participants returned for post-testing and ingested a beverage containing either CAF (300mg), a caffeine-matched dose of instant COF (8.9g, yielding 303mg of caffeine), or a flavored placebo (PLA) 30 minutes prior to exercise. Prior to each visit, participants were instructed to maintain similar dietary habits, abstain from strenuous exercise for at least 24 hours, and avoid caffeine intake for at least 48 hours. Change scores were compared using one-way ANOVAs, and 95% confidence intervals (mean ± 1.96 × SEM) were constructed for each dependent variable.
Results: Leg press 1RM was improved more by COF compared to CAF (Δ = 32.2 ± 18.6 vs 15.3 ± 16.9lb, p = 0.04), but not to PLA (p = 0.99). Significant interactions were not observed for BP 1RM, BP RTF, or LP RTF (p > 0.05). There were no significant sprint × treatment interactions for changes in PP or TW (p > 0.05). For TW, a main effect for sprint was observed (p = 0.02). 95% confidence intervals revealed a significant improvement in sprint 1 TW for CAF [81.4, 623.9J], but not COF [-121.0, 376.2J] or PLA [-239.9, 180.1J]. Reductions were observed in sprint 4 PP [-64.9, -2.5W], sprint 2 TW [-321.2, -66.1J], sprint 4 TW [-403.1, -57.6J], and average TW [-219.0, -40.2J] in PLA, but not in CAF or COF.
Conclusion: Neither COF nor CAF improved strength outcomes to a greater degree than PLA. Repeated sprint results suggest that both COF and CAF attenuated power reductions to a similar degree. Considering the potential health benefits associated with regular COF consumption, COF may be considered a suitable source of pre-exercise caffeine for high-intensity exercise.
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Differential effects of rapid or slow body weight loss on muscle weight and protein degradation pathways in rat skeletal muscle

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Background: Many athletes restrict energy intake to achieve a certain body mass category, aesthetic benefits or to attain a better force-to-mass ratio to improve performance. This rapid weight loss, also known as "weight cutting", usually involves several-day fasting until a target weight is achieved. However, fasting is a well-known stimulus to activate two major protein degradation pathways, the autophagy-lysosome and ubiquitin-proteasome systems, resulting in skeletal muscle atrophy. An alternative dietary weight loss approach commonly practiced by athletes is daily caloric restriction, which consists of decreasing energy intake by 10-30% every day, resulting in slower body weight loss compared with fasting. The caloric restriction-induced slower body weight loss has also been shown to induce skeletal muscle atrophy. Since no study has directly compared the effects of rapid vs. slow body weight loss on muscle weight and the major protein degradation pathways during an equivalent body weight loss, it still remains unclear which rapid or slow weight loss approach is effective in maintaining skeletal muscle mass. The purpose of this study was thus to assess the effects of rapid or slow body weight loss on muscle weight and the protein degradation pathways in skeletal muscle.
Methods: Twenty-week-old male Fischer rats were divided into the following 3 groups; fed ad libitum for 2 weeks (Control); subjected to 30% calorie restriction to decrease body weight slowly (Slow); or fasted for the last 3 days to rapidly decrease body weight comparable to that of the Slow group (Rapid). Fast-twitch plantaris and slow-twitch soleus muscles were dissected out and the expression ratio of autophagosomal membrane protein LC3-II to LC3-I and poly-ubiquitinated protein concentration were determined as biomarkers of the autophagy-lysosome and ubiquitin-proteasome activities, respectively.
Results: Body weight and total intra-abdominal fat mass in the Slow and Rapid groups decreased to the same extent, although food intake was significantly higher in the Rapid than Slow group. Although muscle weight and muscle protein content of soleus muscle did not differ among the 3 groups, those of plantaris muscle were significantly lower in the Rapid but not in Slow group, compared with the Control group. Substantial increases in LC3-II protein expression, the ratio of LC3-II/-I and poly-ubiquitinated protein concentration were observed in plantaris muscle of the Rapid group. Moreover, the LC3-II/-I ratio or poly-ubiquitinated protein concentration was highly negatively correlated with the muscle weight or muscle protein content of plantaris muscle.
Conclusion: These results suggest that rapid body weight loss by short-term fasting may induce muscle atrophy in fast-twitch muscle, at least in part through enhanced protein degradation by the autophagy-lysosome and ubiquitin-proteasome systems.