FITNESS 2.0

CONGRESO INTERNACIONAL
ACADEMIA & FITNESS

presented by: EXPOFITNESS

Emerging Sports Ingredients

Richard B. Kreider, PhD, FACSM, FASEP, FISSN, FACN, FNAK

ExerciseAndSportNutritionLab.com | hcrf.tamu.edu

Overview

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Plant Proteins
- Botanical Bioactives
  - Nitrates
  - Tart Cherry
  - Quercetin
  - Grape Seeds
  - Betaine
- Pre-Workout Supplements
- Planned Studies

Emerging Sport Ingredients

Plant-Derived Proteins

- **Animal Protein**
  - Whey Protein
  - Casein
  - Gelatin
  - Beef
  - Egg
- **Plant Protein**
  - Soy
  - Rice
  - Pea
  - Hemp
  - Flax
  - Digestive Enzymes
  - Priobiotics

Adapted from Jäger R. *Role & Rise of Plant Protein.* **Emerging Sports Ingredients**. SupplySide West, Las Vegas, NV, October 7, 2016.

Complete and Incomplete Proteins

Essential Amino Acids

*Isoleucine	Phenylalanine
*Leucine	Threonine
Lysine	Tryptophan
Methionine	*Valine

Conditionally Essential Amino Acids

Arginine	Proline
Cysteine	Taurine
Glutamine	Tyrosine
Histidine	

Nonessential Amino Acids

Alanine	Glutamic Acid
Asparagine	Glycine
Aspartic Acid	Serine
Citrulline	

* Branched Chain Amino Acid

Adapted from Kreider, Leutholtz, Katch & Katch (2009)

- ***Complete proteins***
  - Containing all essential amino acids
  - Generally, complete proteins have higher protein quality
- ***Incomplete proteins***
  - Missing some of the essential amino acids
- The type of protein determines the availability of amino acids necessary to repair tissue and promote growth.
- ***The greater the content or EAA, the higher the quality of the protein***.

Plant versus Animal Proteins

- Plant protein viewed as lower "quality"
  - Not complete protein (must blend)
    - Rice
    - Pea
    - Hemp
    - Flax
  - Inferior absorption
    - Whey (99%), Casein (97%)
    - Rice (87%), Pea (93.5%)
  - Lower leucine content
    - plant proteins 6-8%
    - animal proteins 9-11%
- Digestion kinetics
  - Fast (post-exercise: e.g. whey)
  - Intermediate (e.g. rice)
  - Slow (before bedtime: e.g. casein)
- Less scientific evidence on efficacy in athletes
- Other concerns
  - GMO (soy)
  - Allergen (milk, soy)
  - Hormones (soy)

Table 1: Protein Quality

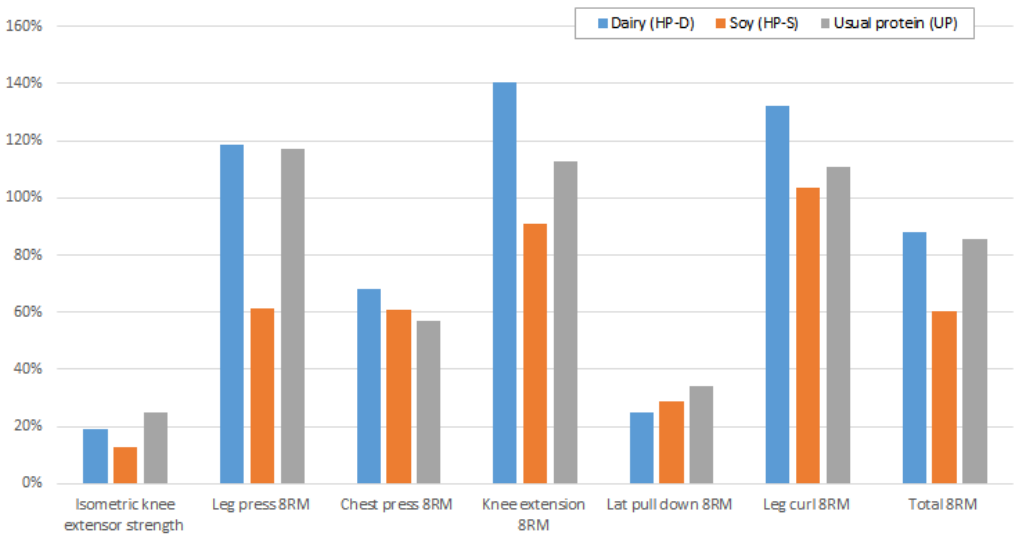
Protein Source	NPU	PDCAA
Whey	92*	1.00
Casein	78*	1.00
Egg	72*	1.00
Soy		1.00
Beef		0.92
Soybeans		0.91
Vegetable proteins		0.70 – 0.78
Cereals		0.59
Gelatin		0.08

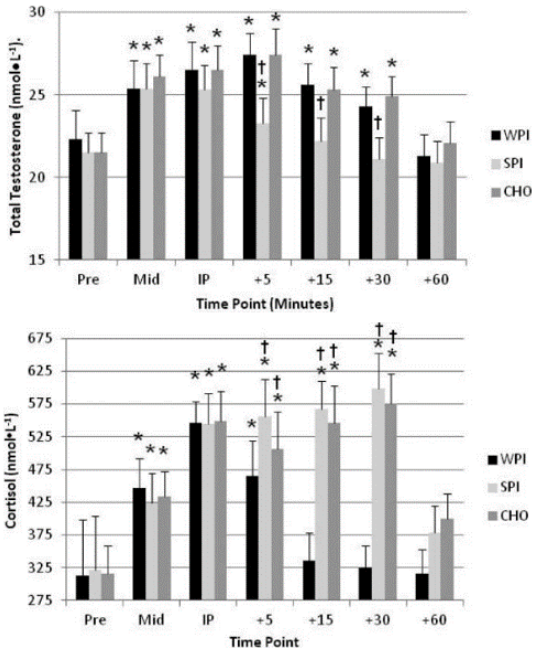
* Phillips and Tang 2009 [8]

Beginning to see more dietary supplements use plant sources of protein

Soy Protein vs. Whey Protein

- ***Soy protein promotes smaller increases in MPS*** in young and elderly in comparison to milk protein (Phillips et al., 2009).
- ***Soy protein negatively effects acute hormonal responses*** to RE in comparison to whey protein (Kraemer et al., 2013).
- Soy protein intake ***attenuates gains in muscle strength during resistance training*** in older adults compared with increased intake of dairy protein (Thomson et al., 2016).





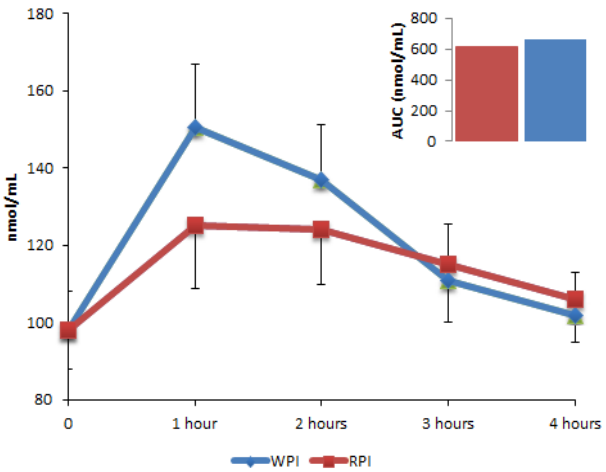
S.M. Phillips, *et al. J Am Coll Nutr* **2009**, 28(4):343-354.
W.J. Kraemer, *et al. J Am Coll Nutr* **2013**, 32(1):66-74.
R.L. Thomson, *et al. Clin Nutr* **2016**, 35(1):27-33.

A Comparison of Blood Amino Acid Concentrations Following Ingestion of Rice and Whey Protein Isolate: A Double-Blind Crossover Study

Purpura et al., J Nutr Health Sci 2014, 1(3): 306.

- 10 trained male subjects were randomly assigned to receive ***either 48 grams of RPI or WPI in a double-blind, crossover design***, separated by a washout period of 7 days.
- Blood draws were taken immediately prior to and at 1, 2, 3, and 4 hours following consumption of WPI or RPI.
- ***RPI elicited a non-significant 6.8% lower total amino acid concentration*** in the blood based on AUC compared to WPI.
- WPI was faster or equal for all amino acids with the exception of ***leucine, which reached C_{max} faster in the RPI group***.

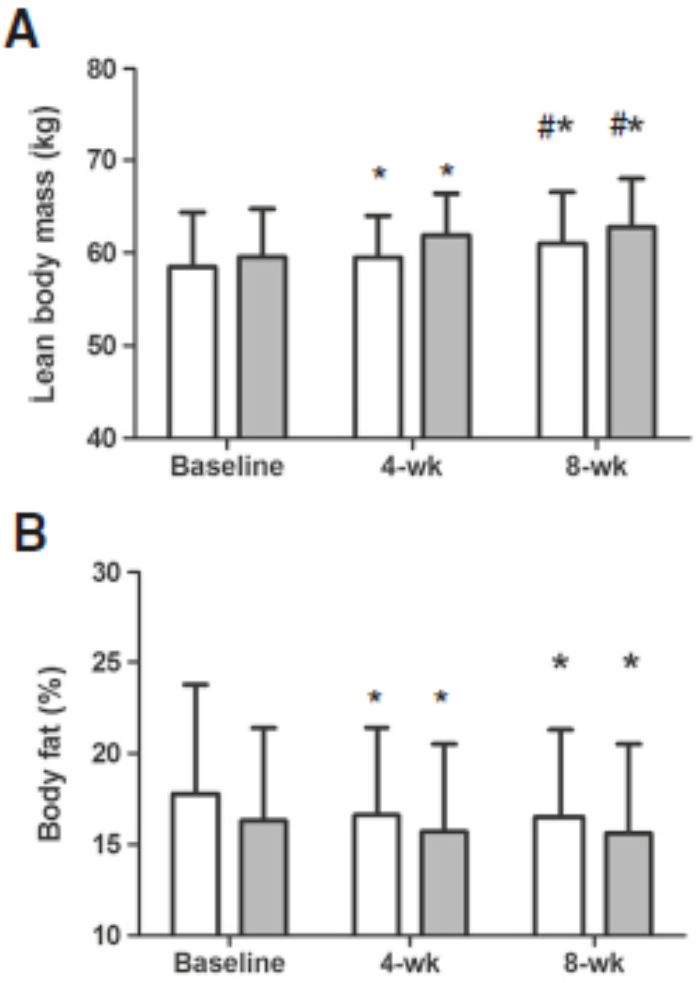
	Rice	Whey	P-Value
EAA			
AUC [nmol/ml]	649.5 ± 140.9	754.2 ± 169.9	0.64
C_{max} [nmol/ml]	176.1± 37.6	229.5± 51.2	0.41
T_{max} [min]	87± 7	67± 4	*0.03
NEAA			
AUC [nmol/ml]	592.7 ± 118.2	596.6 ± 121.2	0.98
C_{max} [nmol/ml]	160.0± 31.1	178.4± 34.0	0.69
T_{max} [min]	97±4	69±3	*0.00
TAA			
AUC [nmol/ml]	615.9± 88.6	661.1± 98.7	0.74
C_{max} [nmol/ml]	166.6± 23.4	199.3± 28.8	0.39
T_{max} [min]	93± 4	69± 3	*0.00



The effects of 8 weeks of whey or rice protein supplementation on body composition and exercise performance

Joy et al., Nutr J, 12:86, 2013

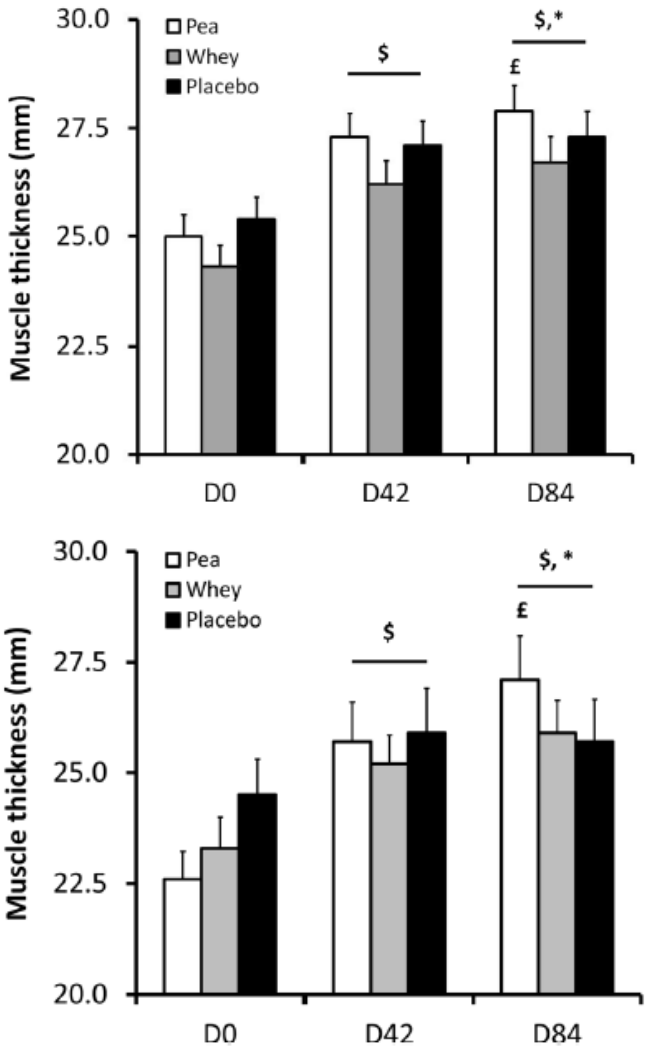
- 24 college-aged, RT males participated in this study.
- Subjects were randomly and equally divided into ***rice (RPI) or whey protein (WPI) isolate groups***.
- Subjects trained ***3 days/wk for 8 wks***
- The RPI and WPI supplements (***48 g***) were ***consumed immediately following exercise***.
- No differences were seen in perceived recovery, soreness, or readiness to train ($p > 0.05$).
- Significant time effects were observed in LBM, FFM, strength and power in all groups while FM decreased with no interactions observed ($p > 0.05$).
- ***WPI and RPI ingestion after RT improved indices of body composition and exercise performance with no differences between the two groups***.
- Results suggest that ***RPI may serve as a viable source of protein for RT athletes***.



Pea proteins oral supplementation promotes muscle thickness gains during resistance training: a double-blind, randomized, placebo-controlled clinical trial vs. whey protein

Babault et al. JISSN, 12:3, 2015

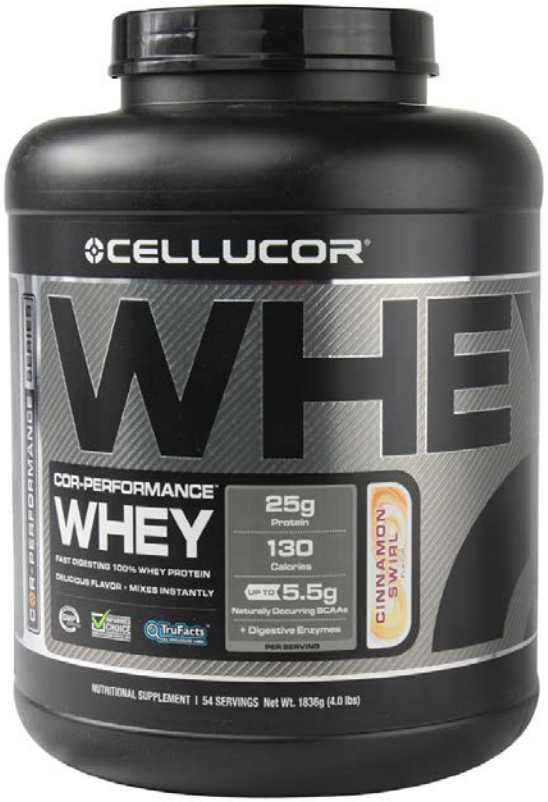
- 161 males underwent 12 wks of RT
- Participants randomized to ***Pea protein (n = 53), Whey protein (n = 54) or Placebo (n = 54) group***.
- Participants ingested ***25 g*** of the proteins or placebo ***twice a day during the 12-week training period***.
- Tests were performed on biceps muscles at inclusion (D0), mid (D42) and post training (D84).
- Muscle thickness was evaluated using ultrasonography, and strength was measured on an isokinetic dynamometer.
- ***Thickness increased from 24.9 ± 3.8 mm to 26.9 ± 4.1 mm and 27.3 ± 4.4 mm at D0, D42 and D84, respectively, with only a trend toward significant differences between groups (P = 0.09).***
- In the weakest participants, thickness increases were significantly different between groups (+20.2 ± 12.3%, +15.6 ± 13.5% and +8.6 ± 7.3% for Pea, Whey and Placebo, respectively; $P < 0.05$).
- ***Supplementation with Pea protein promoted a greater increase of muscle thickness as compared to Placebo and especially for people starting or returning to a muscular strengthening.***
- *Vegetable pea proteins could be used as an alternative to Whey-based dietary products.*



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

Minevich et al., JISSN. 12(S1):P25, 2015

- This study sought to investigate if co-ingestion of a ***plant protein specific digestive enzyme blend*** can reduce the differences in AA appearance in the blood between plant and animal proteins.
- 11 resistance-trained male subjects were randomly assigned to receive either ***60 grams of whey protein concentrate (WPC) or a 70:30 blend of pea protein and rice protein concentrate (PRPC), or PRPC plus Digest-All® VP*** (PRPC+DA) 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.
- ***Co-ingestion of a PRPC with DA increased time to peak, peak concentrations, and amount of amino acid appearance in the blood (AUC) in comparison to PRPC alone, and reduced differences between WPC and PRPC***.



Probiotic Bacillus coagulans GBI-30, 6086 reduces exercise-induced muscle damage and increases recovery

Jäger et al., Peer J. 4:e2276, 2016

- 29 trained males were assigned to consume either ***20 g of casein (PRO) or 20 g of casein plus probiotic (1 billion CFU Bacillus coagulans GBI-30, 6086, PROBC)*** in a crossover, diet-controlled design for 2-wks.
- After 2-wks, perceptional measures, athletic performance, and muscle damage were analyzed following a damaging exercise bout.
- Exercise increased muscle soreness and reduced perceived recovery.
- PROBC significantly increased recovery at 24 and 72 h, and decreased soreness at 72 h post exercise in comparison to PRO.
- CK increased in the PRO (+266.8%) and PROBC (+137.7%) groups with PROBC showing a trend towards less muscle damage ($p = 0.08$).
- Exercise significantly reduced athletic performance in PRO (Wingate Peak Power; PRO: (-39.8 watts, -5.3%, $p = 0.03$)), whereas PROBC maintained performance (+10.1 watts, +1.7%).
- **The results provide evidence that probiotic supplementation in combination with protein tended to reduce indices of muscle damage, improves recovery, and maintains physical performance subsequent to damaging exercise.**

Ganeden
Improving Quality of Life™

Lactobacillus helveticus Lafti L10 supplementation reduces respiratory infection duration in a cohort of elite athletes: a randomized, double-blind, placebo-controlled trial

Michalickova et al., Appl Physiol Nutr Metab. 7:782-9, 2016

- ***39 elite athletes*** were randomized to supplement their diet for ***14-wks during winter training*** with a ***placebo*** (n = 19) or the ***probiotic*** (n = 20) (*Lactobacillus helveticus* Lafti L10).
- Participants recorded the duration, severity, and incidence of URTI and donated fasting blood samples.
- ***Lafti L10 shortened the URTI episode duration*** (7.25 +/- 2.90 vs. 10.64 +/- 4.67 days, p = 0.047) and ***decreased the number of symptoms in the probiotic group*** (4.92 +/- 1.96 vs. 6.91 +/- 1.22, p = 0.035).
- No significant changes were seen in leukocyte subpopulation abundance, level of interleukin-10 secreted stimulated PBMCs, interferon-gamma level secreted from CON A-stimulated PBMCs or viability/proliferation of PBMCs upon antigen stimulation.
- ***Self-rated sense of vigor increased in the probiotic group*** (18.5 +/- 4.1 vs. 21.0 +/- 2.6, p = 0.012).
- ***Probiotic strain Lafti L10 can be a beneficial nutritional supplement for the reduction of URTI length in elite athletes.***

Table 2. The effect of probiotic on respiratory symptoms.

	Probiotic	Placebo	p
Proportion of athletes reported URTI episode	12/20	11/19	0.897
Duration (no. of days)	7.25±2.90	10.64±4.67*	0.047
Episode severity	110.92±96	129.73±40.33	0.078
No. of symptoms per episode	4.92±1.96	6.91±1.22*	0.035
No. of medications/supplements per episode	1.17±1.11	1.91±0.94	0.101
No. of days of medications per episode	3.67±4.33	7.55±5.84	0.166
Total no. of infected days	88	132*	0.000563

Note: Results are expressed as means ± standard deviations. URTI, upper respiratory tract illness.
*Significance: $p < 0.05$ (unpaired t test, except for incidence and total no. of days: χ^2 test).

Table 3. Training loads and influence of illness on training.

	Probiotic	Placebo	p
Training loads (MET-h/wk)	98.89±54.93	100.40±56.95	0.98
Illness influence on training ability score	22.92±26.41	28.82±22.58	0.57
Total no. of days without training	2.0±3.1	1.7±2.3	0.48
Proportion of athletes reporting impaired training	40%	42%	0.054

Note: Results are expressed as means ± standard deviations and significance: $p < 0.05$ (unpaired t test, except for proportion of athletes, significance was obtained by χ^2 test). MET, metabolic equivalent.

Table 4. Blood leukocyte and lymphocyte subpopulations absolute counts.

	Treatment time		Interaction effect (p, η^2)	Time effect (p, η^2)	Treatment effect (p, η^2)
	Baseline	14 wk			
Lymphocytes (cells 1×10⁹/L)					
Probiotic	1.96±0.59	2.35±1.24	0.849, 0.003	0.147, 0.144	0.504, 0.033
Placebo	2.13±0.70	2.64±0.87			
Monocytes (cells 1×10⁹/L)					
Probiotic	0.40±0.12	0.52±0.49	0.434, 0.044	0.615, 0.019	0.712, 0.010
Placebo	0.40±0.12	0.43±0.17			
Granulocytes (cells 1×10⁹/L)					
Probiotic	4.42±1.04	4.31±1.61	0.420, 0.047	0.226, 0.103	0.352, 0.062
Placebo	4.37±1.96	4.60±1.91			
CD3+CD4+ (cells 1×10⁹/L)					
Probiotic	0.82±0.32	0.89±0.26	0.330, 0.073	0.679, 0.014	0.073, 0.227
Placebo	0.77±0.12	0.89±0.40			
CD3+CD8+ (cells 1×10⁹/L)					
Probiotic	0.63±0.34	0.46±0.07	0.711, 0.012	0.100, 0.209	0.296, 0.090
Placebo	0.58±0.13	0.70±0.21			
CD3-CD56+ (cells 1×10⁹/L)					
Probiotic	0.16±0.09	0.12±0.07	0.198, 0.124	0.520, 0.033	0.006,* 0.449
Placebo	0.24±0.20	0.13±0.14			
CD4+CD45RO+ (cells 1×10⁹/L)					
Probiotic	0.43±0.30	0.39±0.27	0.785, 0.006	0.535, 0.030	0.394, 0.056
Placebo	0.44±0.09	0.52±0.19			
CD8+CD45RO+ (cells 1×10⁹/L)					
Probiotic	0.12±0.07	0.13±0.09	0.745, 0.008	0.811, 0.005	0.396, 0.056
Placebo	0.15±0.10	0.17±0.14			
CD19+ (cells 1×10⁹/L)					
Probiotic	0.18±0.07	0.21±0.17	0.214, 0.116	0.550, 0.028	0.420, 0.051
Placebo	0.19±0.04	0.28±0.14			
CD11b+ (cells 1×10⁹/L)					
Probiotic	3.81±1.52	2.96±1.17	0.764, 0.007	0.230, 0.101	0.140, 0.149
Placebo	4.00±1.59	4.52±1.88			
CD4+/CD8+ratio					
Probiotic	1.30±0.04	1.41±0.07	0.001,† 0.489	0.001,† 0.462	0.020,† 0.350
Placebo	1.28±0.05	1.29±0.06			

Emerging Sport Ingredients

Botanical Bioactives

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- ***Nitrates***
  - Reduce afterload and blood pressure
  - Increase blood flow and nutrient delivery
  - Ergogenic Value
- ***Antioxidants***
  - Reduce exercise-induced oxidative stress
  - Reduce muscle damage
  - Enhance recovery
- ***Immune Support***
  - Lessen immunosuppressive effects of intense exercise
  - Reduce incidence of URTI
- ***Glycemic Control***
  - Enhance glycogen resynthesis
  - Improve blood glucose regulation
- ***Ergogenic Bioactive Extracts***

Beet Root Juices / Nitrates

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Dietary intake of food or juices with high nitrate levels has been reported to promote healthy blood pressure due to a vasodilatory effect
- Studies show consuming BRJ prior to exercise (e.g., 300-500 ml) improves aerobic endurance efficiency
- Some studies suggest nitrate supplementation can also enhance intermittent exercise performance and/or recovery

Beet Root Juice/Nitrates

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Larsen et al. (*Acta physiologica. 2007;191:59–66*) reported a ***reduction in maximal oxygen consumption***; and a trend for improvement in time-to-exhaustion accompanying the ingestion of sodium nitrate intake at 0.1 mmol/kg/day for three days.
- Larsen et al. (*Free Radic Biol Med. 2010;48:342–7*) reported a ***significant reduction in oxygen consumption and improvement in gross efficiency at sub-maximal workloads*** using the same ingestion schema.
- Bescos et al., (*Med Sci Sports Exerc. 2011;43:1979–86*) found that the consumption of 10 mg/kg of sodium nitrate prior to a cycle ergometer test ***reduced VO_2peak without influencing time to exhaustion or maximal power output in highly trained cyclist and triathletes.***

Inorganic nitrate supplementation improves muscle oxygenation, O(2) uptake kinetics, and exercise tolerance at high but not low pedal rates

Bailey et al. J Appl Physiol. 118(11):1396-405, 2015

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 7 subjects completed ***severe-intensity step cycle tests at pedal cadences of 35 rpm and 115 rpm*** during separate 9-d supplementation periods with NO_3- rich beetroot juice (BR) (providing 8.4 mmol NO_3-/d) and PLA.
- Compared with PLA, ***plasma nitrite concentration increased 178% with BR*** ($P < 0.01$).
- There were no significant differences in muscle oxyhemoglobin concentration ([O_2Hb]), phase II Vo_2 kinetics, or Tlim between BR and PLA when cycling at 35 rpm ($P > 0.05$).
- ***When cycling at 115 rpm, muscle [O_2Hb] was higher at baseline and throughout exercise, phase II Vo_2 kinetics was faster*** (47 +/- 16 s vs. 61 +/- 25 s; $P < 0.05$), and ***Tlim was greater*** (362 +/- 137 s vs. 297 +/- 79 s; $P < 0.05$) with BR compared with PLA.
- Results suggest that ***short-term BR supplementation can increase muscle oxygenation, expedite the adjustment of oxidative metabolism, and enhance exercise tolerance when cycling at a high, but not a low, pedal cadence.***

Nitrate Intake Promotes Shift in Muscle Fiber Type Composition during Sprint Interval Training in Hypoxia

De Smet et al. Front Physiol. 7: 233, 2016

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- ***27 moderately-trained participants*** were allocated to one of three experimental groups: ***Sprint Interval Training (SIT) in normoxia (20.9% FiO_2) + PLA (N), SIT in hypoxia (15% FiO_2) + PLA (H), or SIT in hypoxia + nitrate (HN).***
- All participated in 5 weeks of SIT on a cycle ergometer (30-s sprints interspersed by 4.5 min recovery-intervals, 3 weekly sessions, 4-6 sprints per session).
- Nitrate (6.45 mmol $NaNO_3$) or placebo capsules were administered ***3 h before each session***.
- SIT decreased the proportion of type IIx muscle fibers in all groups ($P < 0.05$).
- The relative number of type IIa fibers increased ($P < 0.05$) in HN ($P < 0.05$ vs. H), but not in the other groups.
- Compared with H, SIT tended to enhance 30-s sprint performance more in HN than in H ($P = 0.085$).
- ***SIT in hypoxia combined with nitrate supplementation increases the proportion of type IIa fibers in muscle, which may be associated with enhanced performance in short maximal exercise.***

The Effects of Nitrate-Rich Supplementation on Neuromuscular Efficiency during Heavy Resistance Exercise

Flanagan et al. J Am Coll Nutr. 35(2):100-7, 2016

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- ***14 resistance-trained consumed an nitrate-rich (NR) or nitrate-poor (NP) supplement for 3 d, performed a bout of heavy resistance exercise, completed a washout, and then repeated the procedures with the remaining supplement***.
- Before, during, and after exercise, individual and gross motor unit efficiency was assessed during isometric and dynamic muscle contractions and physical performance, heart rate, lactate, and oxygen consumption (VO_2) were determined.
- ***NR lowered initial muscle firing rates at rest and lower mean and maximum firing rates over the course of fatiguing exercise.***
- NP was accompanied by increased mean and maximum firing rates by the end of exercise and lower initial firing rates.
- Nitrate supplementation resulted in higher mean peak electromyography (EMG) amplitudes.
- ***Supplementation with an NR beetroot extract-based supplement provided neuromuscular advantages during metabolically taxing resistance exercise.***

Ingestion of a nitric oxide enhancing supplement improves resistance exercise performance

Mosher et al. J Strength Cond Res. e-pub, April 2, 2016

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

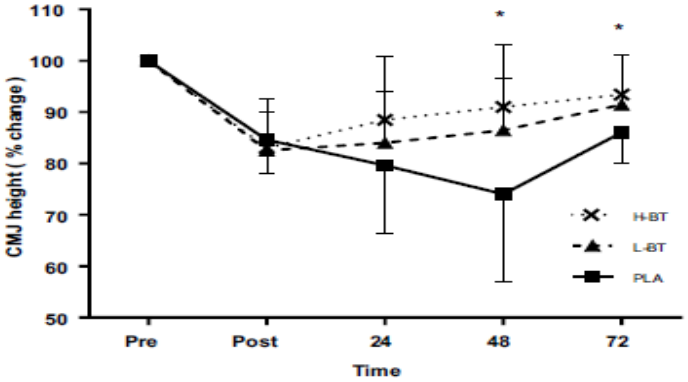
- 12 resistance trained males ingested either ***70 ml of "BEET It Sport" nitrate shot containing 6.4 millimoles (mmol/L) or 400 mg of nitrate; or a blackcurrant placebo drink.***
- Participants completed a resistance exercise session, consisting of bench press exercise at an intensity of 60% of their established 1 repetition maximum (1-RM), for three sets until failure with 2 minute rest interval between sets.
- ***Results showed a significant difference in repetitions to failure ($p < 0.001$) and total weight lifted ($p < 0.001$).***
- No significant differences were seen in lactate, local, or general indicators of fatigue.
- ***Nitrate supplementation before exercise improved resistance training performance and work output.***

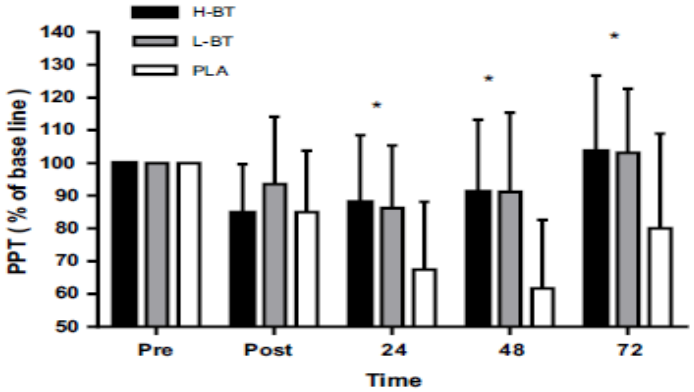
The effects of beetroot juice supplementation on indices of muscle damage following eccentric exercise

Clifford et al. EJAP. 116(2): 2016

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 30 males consumed ***high-dose BRJ (H-BT; 250 ml), a lower dose of BRJ (L-BT; 125 ml), or PLA immediately (x3 servings), 24 (x2 servings) and 48 h (x2 servings) following completion of 100-drop jumps.***
- Maximal isometric voluntary contractions (MIVC), countermovement jumps (CMJ), pressure pain threshold (PPT), creatine kinase (CK), interleukin-6 (IL-6), interleukin-8 (IL-8) and tumor necrosis factor-alpha (TNF-alpha) were measured pre, post, 2 (blood indices only), 24, 48 and 72 h following the drop jumps.
- ***Acute BRJ supplementation attenuated muscle soreness and decrements in CMJ performance induced by eccentric exercise*** while MIVC, CK, IL-6, TNF-alpha and IL-8 were not affected.



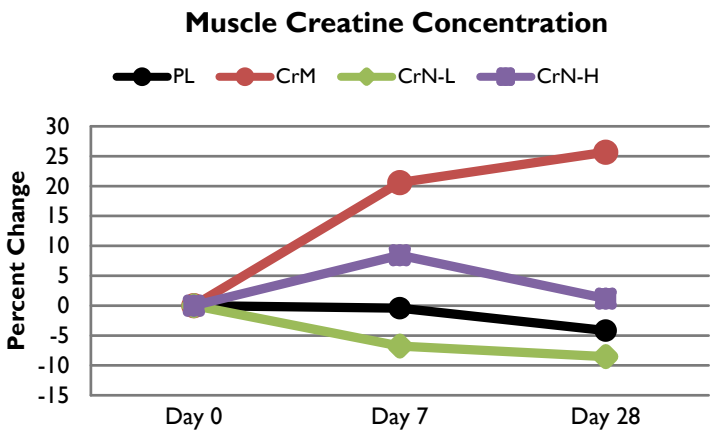


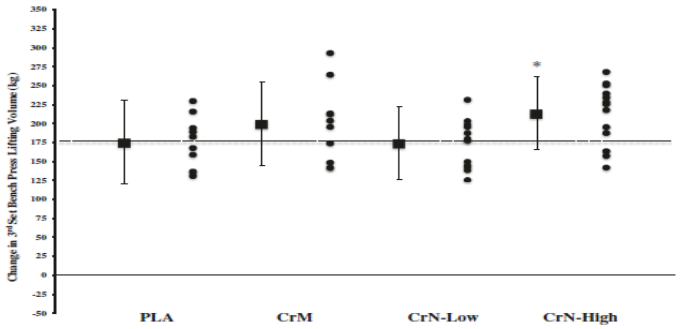
Acute and chronic safety and efficacy of dose dependent creatine nitrate supplementation and exercise performance

Galvan et al. JISSN 13:12, 2016

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Day 0 – 7: Loading Phase (4 doses/d)
  - PL: **26 g dextrose**/d
  - CrM: **12 g CrM** + 2 g flavoring + 8 g dextrose/d
  - CrN-L: **6 g CrN** + 2 g flavoring + 8 g dextrose/d
  - CrN-H: **12 g CrN** + 2 g flavoring + 8 g dextrose/d
- Day 8 – 28: Maintenance Phase (1 dose/d)
  - PL: **6.5 g dextrose**/d
  - CrM: **3 g CrM** + 0.5 g flavoring + 2 g dextrose/d
  - CrN-L: **1.5 g CrN** + 0.5 g flavoring + 2 g dextrose/d
  - CrN-H: **3.0 g CrN** + 0.5 g flavoring + 2 g dextrose/d
- Muscle creatine increased significantly by d-7 in the CrM and CrN-High groups, but then decreased by d-28 for CrN-High.
- ***Some ergogenic benefits were observed among groups most likely due to influence of nitrate.***
- CrN delivered at 3 g was well-tolerated, demonstrated similar performance benefits to 3 g CrM, and within the confines of this study, there were no safety concerns.
- ***There was no evidence that CrN at recommended or twice recommended doses is more efficacious than CrM at the doses studied.***

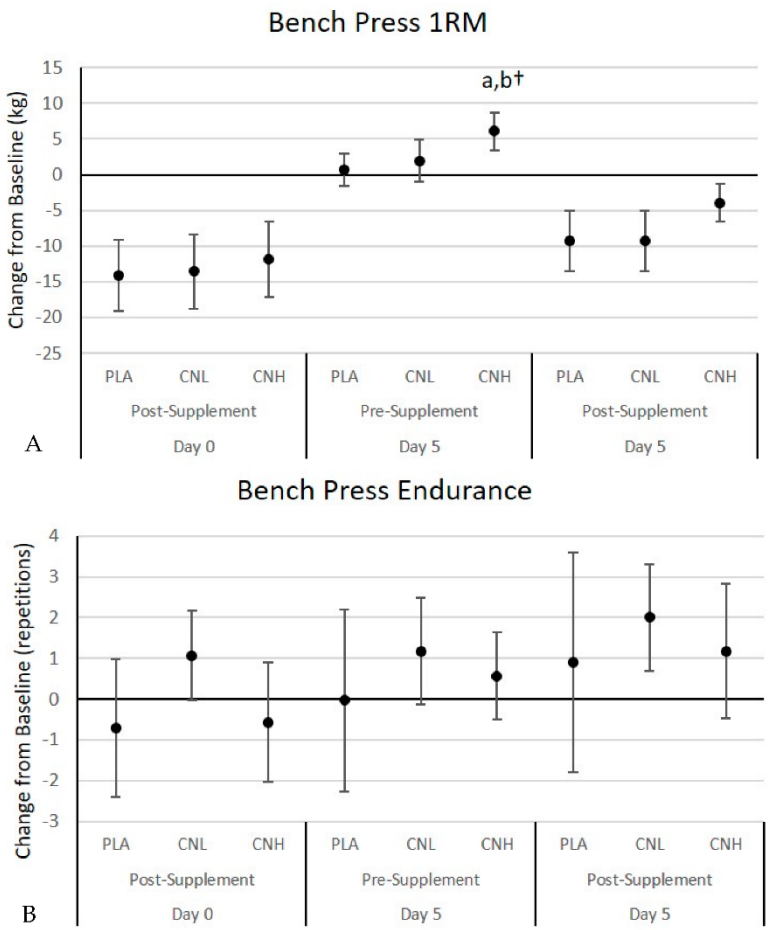




Hematological and Hemodynamic Responses to Acute and Short-Term Creatine Nitrate Supplementation

Dalton et al. Nutrients. 9(12):1359, 2017

- 28 men and women ingested a PLA, 3 g of creatine nitrate (CNL), and 6 g of creatine nitrate (CNH) for 6-d in a repeated measures crossover manner with a 7-d washout.
- Hemodynamic responses to a postural challenge, fasting blood samples, and bench press, leg press, and cycling time trial performance and recovery were assessed
- No significant differences were found among treatments for hemodynamic responses, clinical blood markers or self-reported side effects.
- After 5-d of supplementation, *1RM BP improved significantly for CNH (6.1 [3.5, 8.7] kg)* but not PLA (0.7 [−1.6, 3.0] kg or CNL (2.0 [−0.9, 4.9] kg, CNH, $p = 0.01$).
- CNL treatment promoted an increase in BP repetitions at 70% of 1RM during recovery on day 5 (PLA: 0.4 [−0.8, 1.6], CNL: 0.9 [0.35, 1.5], CNH: 0.5 [−0.2, 0.3], $p = 0.56$), greater LP endurance prior to supplementation on day 5 (PLA: −0.2 [−1.6, 1.2], CNL: 0.9 [0.2, 1.6], CNH: 0.2 [−0.5, 0.9], $p = 0.25$) and greater LP endurance during recovery on day 5 (PLA: −0.03 [−1.2, 1.1], CNL: 1.1 [0.3, 1.9], CNH: 0.4 [−0.4, 1.2], $p = 0.23$).
- Cycling time trial performance (4 km) was not affected.
- ***Benefits related to nitrate supplementation.***



Montmorency Tart Cherries

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

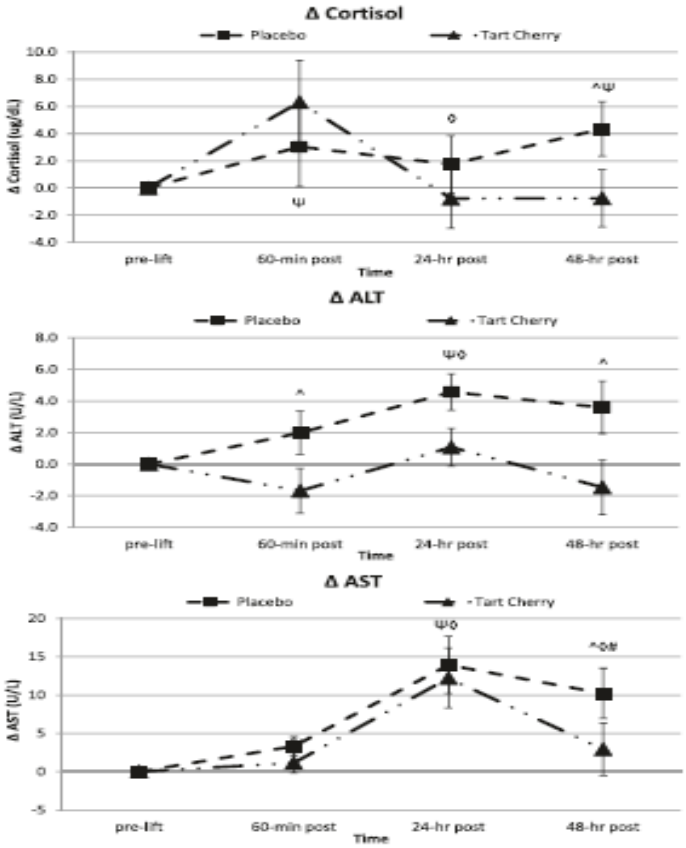
- Consumption of foods high in ***polyphenols***, particularly ***anthocyanins***, have been associated with improved health
- Tart cherry juice and powders have antioxidant properties and is thought to activate antioxidant response genes.
- Use of tart cherry juice/concentrates theorized to reduce exercise-induced oxidative stress and muscle damage.
- Some evidence of improved weight loss in animals
- Long-term supplementation theorized to enhance recovery and training tolerance

Effects of powdered Montmorency tart cherry supplementation on an acute bout of intense lower body strength exercise in resistance trained males

Levers et al. JISSN. 12:41, 2015

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 23 resistance-trained men were randomly assigned to ingest, in a double blind manner, capsules containing 480 mg/d of a PL or powdered tart cherries (TC) for 10-d prior to and for 48-h post-exercise.
- Subjects performed 10 sets of 10 reps at 70% of a 1-RM back squat exercise after 10-d of supplementation.
- Fasting blood samples, isokinetic MVCs, and quadriceps muscle soreness ratings were taken pre-lift, 60-min, 24-h, and 48-h post-lift.
- *TC supplementation attenuated muscle soreness, strength decrement during recovery, and markers of muscle catabolism in resistance trained individuals.*

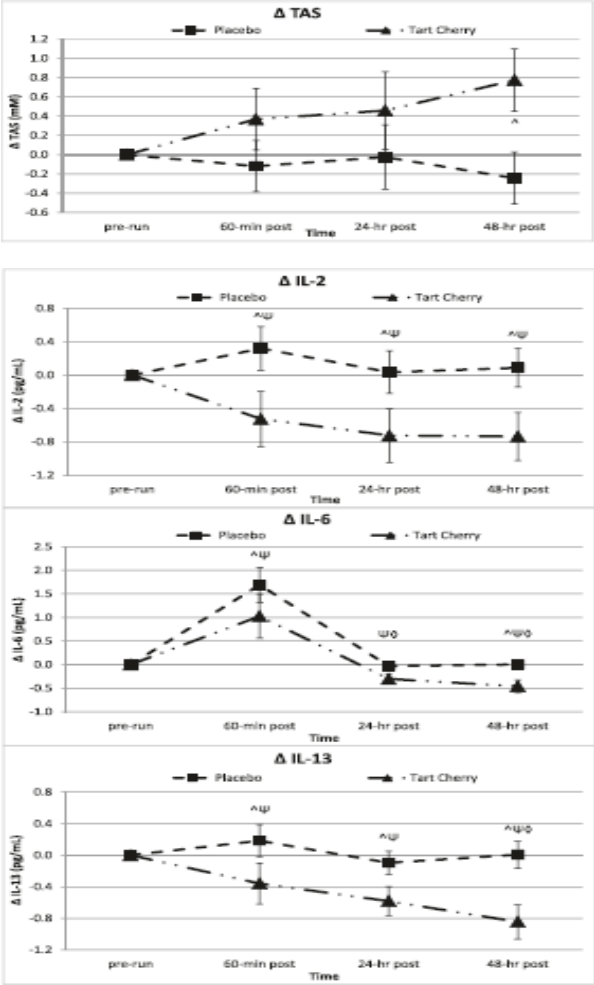


Effects of powdered Montmorency tart cherry supplementation on acute endurance exercise performance in aerobically trained individuals

Levers et al. JISSN. 13:22, 2016

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 27 endurance-trained athletes ingested, in a double-blind manner, capsules containing 480 mg of PL or powdered TC for 10-d prior to performing a half marathon and for 48-hr post-run.
- Fasting blood samples and quadriceps muscle soreness ratings were taken pre-run, 60-min, 24 and 48-h post-run.
- *TC supplementation attenuated markers of muscle catabolism, reduced immune and inflammatory stress, better maintained redox balance, and increased performance in aerobically trained individuals.*

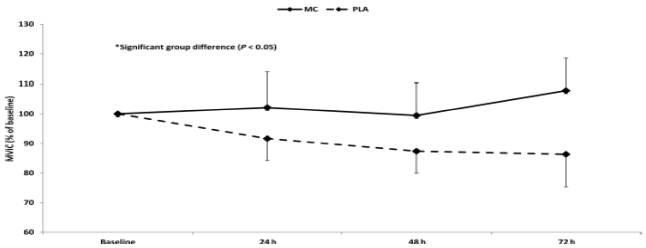


Recovery facilitation with Montmorency cherries following high-intensity, metabolically challenging exercise

Bell et al. Appl Physiol Nutr Metab. 40(4):414-23, 2015

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 16 trained cyclists consumed ***30 mL of PL or MC twice per day for 8-d***.
- On day 5. participants completed a 109-min cycling trial designed to replicate road race demands.
- Functional performance (MVIC) cycling efficiency, 6-s peak cycling power) and DOM were assessed at baseline, 24, 48, and 72 h post-trial.
- Blood samples collected at baseline, immediately pre- and post-trial, and at 1, 3, 5, 24, 48, and 72 h post-trial.
- MVIC ($P < 0.05$) did not decline in the MC group (vs. PLA) across the 72-h post-trial period and economy ($P < 0.05$) was improved in the MC group at 24 h.
- IL-6 ($P < 0.001$) and hsCRP ($P < 0.05$) responses to the trial were attenuated with MC (vs. PLA).
- ***MC concentrate can be an efficacious functional food for accelerating recovery and reducing exercise-induced inflammation following strenuous cycling exercise..***



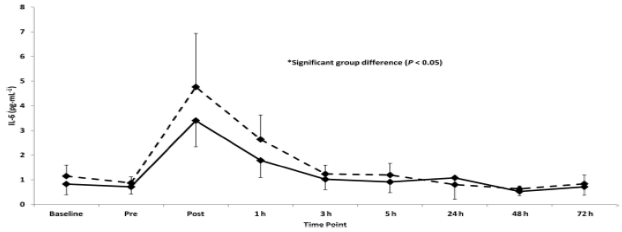
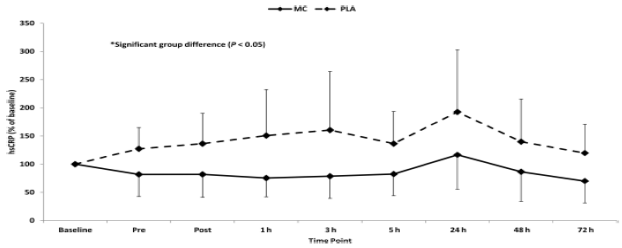


Fig. 5. High-sensitivity C-reactive protein (hsCRP) responses (% of baseline) to Montmorency cherry concentrate (MC) and isoenergetic placebo (PLA). *, Significant group effect ($P < 0.05$); values are means ± SD.

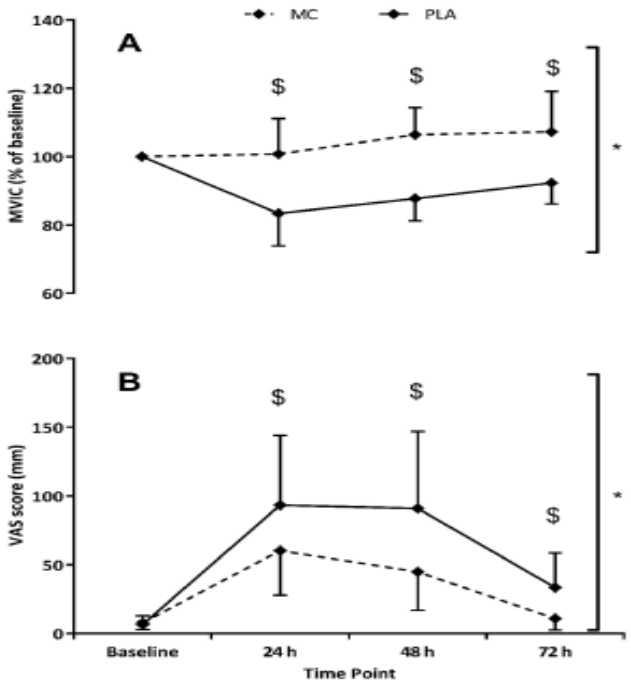


The effects of Montmorency tart cherry concentrate supplementation on recovery following prolonged, intermittent exercise

Bell et al. Nutrients. (7): 2016

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 16 semi-professional, ***male soccer players consumed either MC or PLA supplements for 8-d (30 mL x 2/d)***.
- On day 5, participants completed an adapted version of the Loughborough Intermittent Shuttle Test (LISTADAPT).
- MVIC, 20 m Sprint, counter movement jump (CMJ), agility and muscle soreness (DOMS) were assessed at baseline, and 24, 48 and 72 h post-exercise while measures of inflammation (IL-1-beta, IL-6, IL-8, TNF-alpha, hsCRP), muscle damage (CK) and oxidative stress (LOOH) were analyzed at baseline and 1, 3, 5, 24, 48 and 72 h post-exercise.
- ***Performance indices (MVIC, CMJ and agility) recovered faster and muscle soreness (DOMS) ratings were lower in the MC group*** ($p < 0.05$).
- ***Acute inflammatory response (IL-6) was attenuated by MC***.
- ***MC is efficacious in accelerating recovery following prolonged, repeat sprint activity, such as soccer and rugby.***



Quercetin

Theoretical Ergogenic Benefits

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Quercetin is a plant pigment found in many foods such as onions, apples, berries, tea, grapes and red wine.
- Classified as flavonoid
- Quercetin and rutin are used in many countries for blood vessel health and are ingredients of numerous multivitamin preparations and herbal remedies.
- Theorized to reduce immunosuppressive effects of intense exercise, oxidative stress, and improve aerobic exercise capacity.

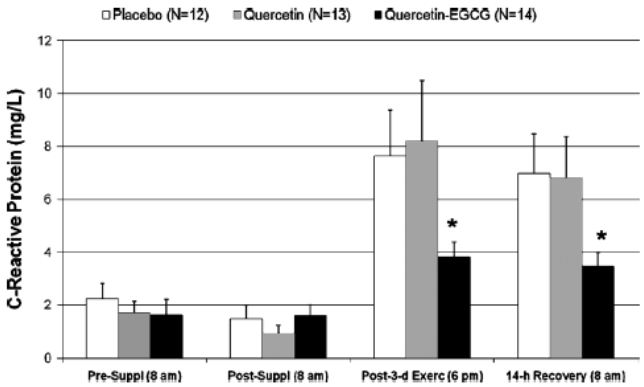
http://www.raysahelian.com/quercetin.html

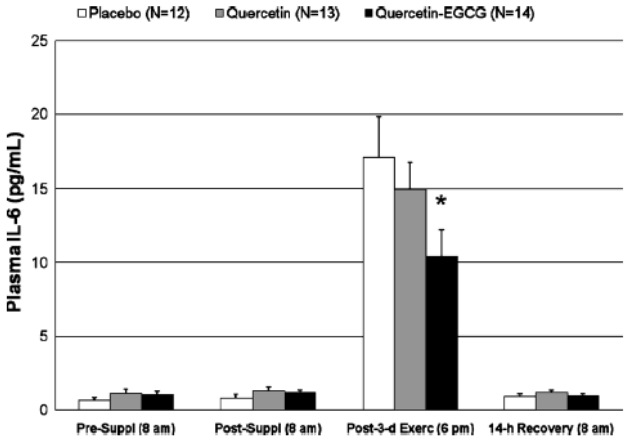
Effects of quercetin and EGCG on mitochondrial biogenesis and immunity

Neiman et al. Med Sci Sports Exerc. 41(7), 1467-75, 2009

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Trained cyclists (N = 39) were randomized to placebo (P), Q (1 g/d), or ***Q-EGCG (400 mg/d Q, 400 mg/d EGCG) for 14-d before, during, and 1 wk after a 3-d period in which subjects cycled for 3 h/d at approximately 57% Wmax***.
- Blood, saliva, and muscle biopsy samples were collected before, after 2 wk of supplementation, after 3-d of exercise, and after 3-d recovery.
- Plasma quercetin was increased in the Q and Q-EGCG trials while granulocyte oxidative burst activity (GOBA) was increased with Q-EGCG.
- ***After the 3rd exercise bout, significant decreases for CRP, IL-6, and IL-10 were seen with Q-EGCG***.
- Granulocyte colony-stimulating factor and CRP were reduced in Q-EGCG 14 h after exercise.
- ***Q-EGCG supplementation augmented GOBA and countered inflammation after 3 d of heavy exertion in trained cyclists.***



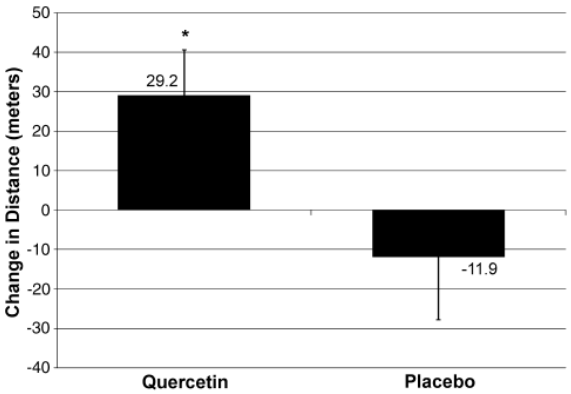


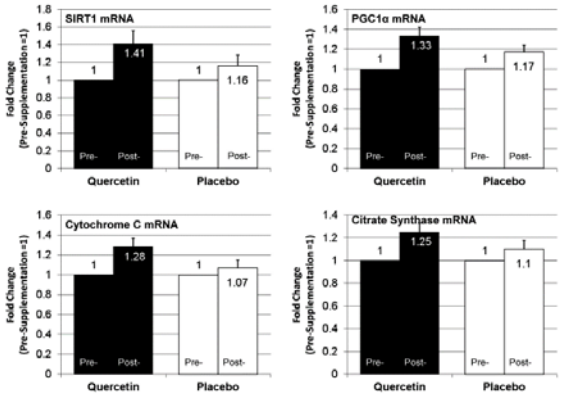
Quercetin's influence on exercise performance and muscle mitochondrial biogenesis

Nieman et al. Med Sci Sports Exerc. 42(2), 338-45, 2010

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Untrained males (N = 26) were randomized to placebo (P) or Q (1 g/d) 14-d
- Subjects provided blood and muscle biopsy samples prior to and following supplementation.
- Plasma Q levels rose significantly in Q versus P.
- During the 12-min trial, the net change in distance achieved was significantly greater during Q compared with P (29.5±11.5 vs -11.9±16.0 m, respectively).
- Skeletal muscle messenger RNA expression tended to increase (range = 16-25%) during Q versus P for sirtuin 1, peroxisome proliferator-activated receptor gamma coactivator-1alpha, cytochrome c oxidase, and citrate synthase.
- Muscle mitochondrial DNA (relative copy number per diploid nuclear genome) increased 140 ± 154 (4.1%) with Q compared with -225 ± 157 (6.0% decrease) with P.
- ***Q supplementation (1 g/d) for 14-d, promoted a small but significant improvement in 12-min treadmill time trial performance and modest but insignificant increases in the relative copy number of mitochondrial DNA and messenger RNA levels of four genes related to mitochondrial biogenesis.***





The dietary flavonoid quercetin increases VO($_2$max) and endurance capacity

Davis et al. Int J Sport Nutr Exerc Metab. 20(1), 56-62, 2010

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 12 volunteers were randomly assigned to ***ingest 500 mg of Q two times/d or a PLA for 7-d*** in a double-blind, crossover manner.
- Baseline VO_2max and bike-ride times to fatigue were established.
- After treatment both VO_2max and ride time to fatigue were determined.
- ***Q supplementation were associated with a modest increase in VO2max (3.9% vs. placebo; p < .05) along with a substantial (13.2%) increase in ride time to fatigue (p < .05)***.
- These data suggest that as little as ***7 days of Q supplementation can increase endurance without exercise training in untrained participants.***

The effect of quercetin supplementation on selected markers of inflammation and oxidative stress

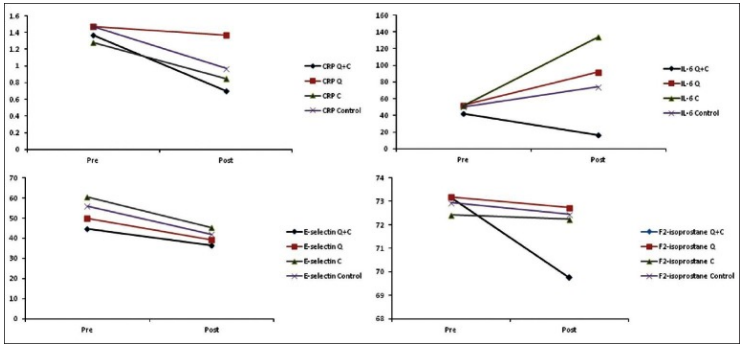
Askari et al. J Res Med Sci. 17(7), 637-41, 2012

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- In a double-blind and randomized manner, 15 subjects ingested ***500 mg Q + 250 mg vitamin C, (Q+C), 500 mg of Q, 250 mg of vitamin C (C) or a PLA for 8-weeks.***
- IL-6, CRP, E-selectin and F2-isoprostane were measured before and after intervention.
- ***Significant differences were observed in IL-6 (P<0.1), CRP (P<0.01) and F2-isoprostane for Q+C. Q+C had marginally smaller F2-isoprostane (P<0.1) and interleukin 6 than PLA***.
- There were marginal differences in CRP between Q+C and Q compared to PLA.
- ***8-wks of Q+C supplementation was effective in reducing oxidative stress and reducing inflammatory biomarkers***

		CRP		Interleukin 6		E-selectin		F2-isoprostane	
Group		(mg/L)	P-value[a]	(pg/mL)	P-value	(ng/mL)	P-value	(pg/mL)	P-value
Q+C	Pre	1.37 ± 0.06		42.09 ± 10.61		44.73±3.58		73.15±0.38	
	Post	0.70 ±0.14	0.098*	16.0 ±4.76	0.049**	36.54±2.74	0.43	69.75±1.26	0.074*
		t=5.56 (P<0.01)		t=2.09 (P=0.068)		t=2.09 (P=0.085)		t=2.35 (P=0.035)	
Q	Pre	1.47±0.25		52.1±9.91		49.89±7.14		73.18±0.53	
	Post	1.37±0.23	0.095*	91.7±30.08	0.64	39.22±8.57	0.85	72.73±0.8	0.41
		t=2.07 (P=0.76)		t=2.10 (P=0.23)		t=2.12 (P=0.086)		t=0.49 (P=0.635)	
C	Pre	1.28±0.12		51.71±17.20		60.57±5.75		72.42±0.86	
	Post	0.85±0.15	0.26	134.14±45.23	0.32	45.28±1.80	0.86	72.24±0.81	0.16
		t=2.07 (P=0.04)		t=2.18 (P=0.11)		t=2.18 (P=0.085)		t=1.14 (P=0.0.29)	
Control	Pre	1.47±0.07		50.5±16.87		56.00±6.92		72.94±0.7	
	Post	0.97±0.13		74.13±36.61		42.00±3.59		72.44±1.13	
		t=3.67 (P<0.01)		t=2.15 (P=0.85)		t=2.14 (P=0.094)		t=0.37 (P=0.72)	

[a]Between group comparisons significant at: *P<0.1, **P<0.05 versus placebo; Q: quercetin alone; C: vitamin C alone; and Control: placebo



Grape Seeds & Extracts

Theoretical Ergogenic Benefits

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Grape skins and/or seeds are rich sources of proanthocyanins, anthocyanins, catechins, quercetin, and resveratrol.
- Evidence that consumption of grape extracts can reduce blood pressure
- Theorized to reduce exercise-induced oxidative stress and/or inflammation and possibly affect endurance capacity.

Grape extract improves antioxidant status and physical performance in elite male athletes

Lafay et al. J Sports Sci Med. 8(3), 468-80, 2009

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 20 athletes ingested a PLA or ***400 mg/d of a GE for 30-days*** during training.
- Antioxidant capacity, oxidative stress, skeletal cell muscle damage, and other general biomarkers were determined before and after 30-days of supplementation.
- GE increased the ORAC and urinary isoprostane while preventing reductions in FRAP and decreasing CK levels.
- Explosive power was significantly increased in a cohort of handball players
- ***GW improved the oxidative stress/antioxidant status balance in athletes while showing some evidence of improved performance***.

Table 4. Body weight, plasma and urinary parameters, and relative values of effort test, before (D0) and after (D30) supplementation of GE or placebo in handball players. Values are means (±SEM) of 10 determinations performed in duplicate on samples from different subjects; n = 10 handball players.

	Placebo n=10		Grape extract n=10	
	D0	D30	D0	D30
Weight (kg)	88.5 (5.7)	86.5 (5.4)	88.4 (5.7)	87.1 (5.7)
Biomarkers of antioxidant status and oxidative stress				
ORAC ($\mu mol \cdot L^{-1}$)	13 678 (487)	13 946 (482)	13 336 (384)	15 132 (536) ***
FRAP ($\mu mol \cdot L^{-1}$ Fe^{2+})	1 168 (57)	988 (39) ***	1 110 (45)	1 060 (55) #
LDLox (mU·mL-1)	537 (174)	562 (189)	622 (202)	693 (229)
SOD ($U \cdot g^{-1}$ Hb)	2 381 (116)	2 549 (122) *	2 710 (157) ‡	2 679 (113) #
GPx ($\mu mol \cdot min^{-1} \cdot g^{-1}$ Hb)	17.0 (1.4)	14.2 (1.5) *	18.8 (1.7)	18.0 (1.6) #
Catalase ($mol \cdot min^{-1} \cdot g^{-1}$ Hb)	.580 (.056)	.545 (.090)	.640 (.044)	.681 (.088)
Vitamin E ($\mu g \cdot mL^{-1}$)	12.0 (.5)	12.0 (.7)	12.2 (.6)	12.9 (.7) ##
Vit E/cholesterol ratio ($\mu g \cdot mg^{-1}$)	6.7 (.3)	6.9 (.3)	6.9 (.4)	7.5 (.5) *#
Vit C ($\mu mol \cdot L^{-1}$)	65.8 (9.1)	55.5 (9.1)	59.3 (5.1)	54.7 (5.8)
Isoprostanes ($ng \cdot mg^{-1}$ creatinine)	1.3 (.1)	1.7 (.2) *	1.3 (.2)	1.3 (.2) #
Biomarker of skeletal muscle damage				
Creatine phosphokinase ($UI \cdot L^{-1}$)	704 (223)	725 (326)	790 (300)	464 (120)
General plasmatic biomarkers				
Triglycerides ($g \cdot L^{-1}$)	.47 (.04)	.58 (.07)	.53 (.05)	.66 (.10)
Cholesterol ($g \cdot L^{-1}$)	1.81 (.1)	1.76 (.10)	1.78 (.10)	1.78 (.10)
Ferritin ($\mu g \cdot L^{-1}$)	69.1 (14.7)	57.8 (13.3) *	68.8 (15.5)	56.8 (13.0) *
Urea ($g \cdot L^{-1}$)	.29 (.02)	.28 (.01)	.30 (.05)	.27 (.06)
Triglycerides ($g \cdot L^{-1}$)	14.6 (.20)	14.56 (.19)	14.52 (.21)	14.87 (.30) *
Effort test				
Performance (EnRJ45, %)	-4.4 (6.1)		19.5 (9.7) †	
Explosive power (RJ110, %)	-3.57 (2.50)		2.82 (4.25)	
Fatigue (RJ5, %)	2.95 (3.47)		10.85 (6.88)	

*, ** and *** denote $p < 0.05$, $p < 0.01$ and $p < 0.001$, respectively, from the pre-treatment (D0) by paired t test. # and ## denote $p < 0.05$ and $p < 0.01$, respectively, from the placebo post-treatment (D30) by paired t test. † significantly ($p < 0.05$) different from the placebo relative values by paired z test. ‡ significantly ($p < 0.05$) different from the placebo pre-treatment (D0).

Potential ergogenic activity of grape juice in runners

Toscano et al. Appl Physiol Nutr Metab. 40(9), 899-906, 2015

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

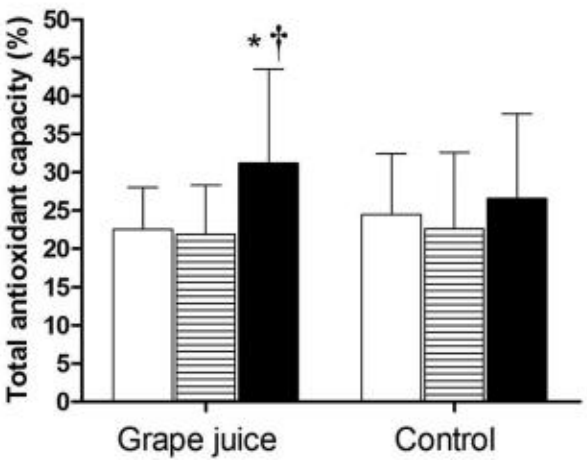
- 28 runners were randomized into either a group that received grape juice (GJ) or an isocaloric PLA.
- Time-to-exhaustion, anaerobic threshold test, and aerobic capacity tests were performed, together with assessments of markers of oxidative stress, inflammation, immune response, and muscle injury, performed at baseline and 48 h after supplementation.
- ***GJ increased (15.3%) running time-to-exhaustion without significant improvements in either anaerobic threshold (3.6%) or aerobic capacity (2.2%).***
- ***GJ exhibited significant increases in total antioxidant capacity (38.7%;), vitamin A (11.8%), and uric acid (28.2%), whereas alpha-1-acid glycoprotein significantly decreased (20.2%) and high-sensitivity CRP remained unchanged.***
- ***GJ ingestion shows an ergogenic effect in recreational runners by promoting increased time-to-exhaustion, accompanied by increased antioxidant activity and a possible reduction in inflammatory markers.***

Table 2. Effects of red grape juice on physical performance tests.

	Initial	28 days	Δ (%)
Exhaustion test (min)			
GJG	89.1±49.9	101.9±56.0†	↑15.3±9.2
CG	69.0±34.0	68.2±33.2	↓2.2±23.9
Anaerobic threshold (km/h)			
GJG	10.6±2.3	11.0±2.4	↑3.6±14.6
CG	11.8±2.1	11.6±2.8	↓1.6±19.6
$\dot{V}O_{2peak}$ (mL/(kg·min))			
GJG	45.0±8.1	45.9±8.8	↑2.2±11.9
CG	48.8±10.0	49.9±10.9	↑2.3±9.0

Note: Data are expressed as the mean ± SD. CG, control group; GJG, grape juice group; $\dot{V}O_{2peak}$, peak oxygen consumption.

†Significant difference ($p < 0.05$) compared to baseline values (paired *t* test and unpaired *t* test).



Betaine

Theoretical Ergogenic Benefits

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

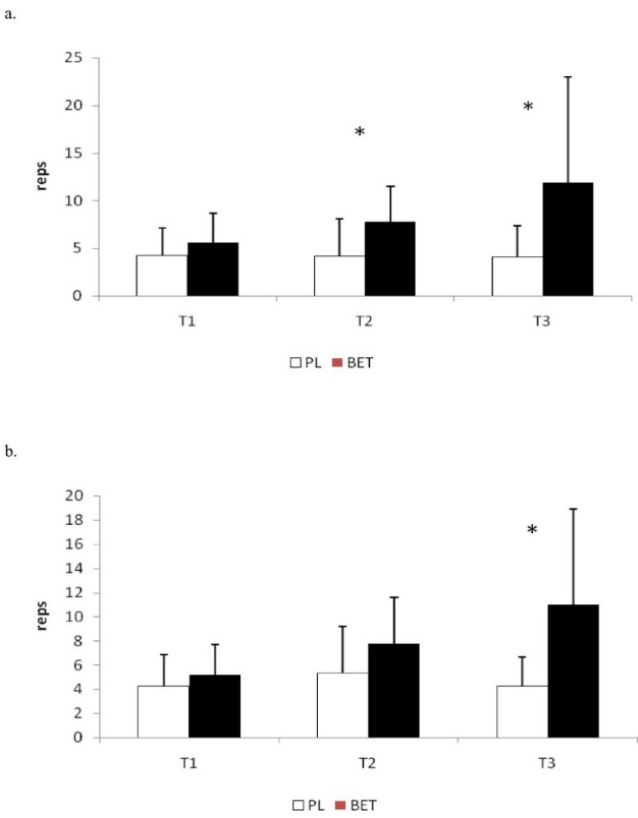
- Betaine is a trimethyl derived from the amino acid glycine that is involved in the metabolism of choline and homocysteine.
- Dietary sources of betaine include spinach, cereal grains, seafood, wine, and sugar beets.
- Several studies have reported that betaine supplementation improves muscle endurance, strength, and/or power.
- According to Cholewa et al. (*Amino Acids*, *46(8)*, *2014*) mechanisms may involve the stimulation of lipolysis and inhibition of lipogenesis via gene expression and subsequent activity of lipolytic-/lipogenic-related proteins, stimulation of autocrine/endocrine IGF-1 release and insulin receptor signaling pathways, stimulation of growth hormone secretion, increased creatine synthesis, increases in protein synthesis via intracellular hyper-hydration, as well as exerting psychological effects such as attenuating sensations of fatigue.

Effect of betaine supplementation on power performance and fatigue

Hoffman et al. JISSN. 6(7), 2009

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 24 males were randomly assigned to ingest ***BET or a PLA for 14-d***
- Subjects were tested at 0, 7, and 14-d
- No differences were seen in the repetitions performed to exhaustion or in the number of repetitions performed at 90% of both peak and mean power between the groups in the bench press exercise.
- ***The number of repetitions performed in the squat exercise for BET was significantly greater*** ($p < 0.05$) than that seen for PLA after 7-d.
- ***The number of reps performed at 90% or greater of peak power in the squat exercise was significantly greater for BET*** at 7 and 14-d than PLA.
- No differences were seen in any power assessment (VJP, BPT, WAnT) between the groups
- ***14-d of betaine supplementation in active, college males appeared to improve muscle endurance of the squat exercise, and increase the quality of repetitions performed.***

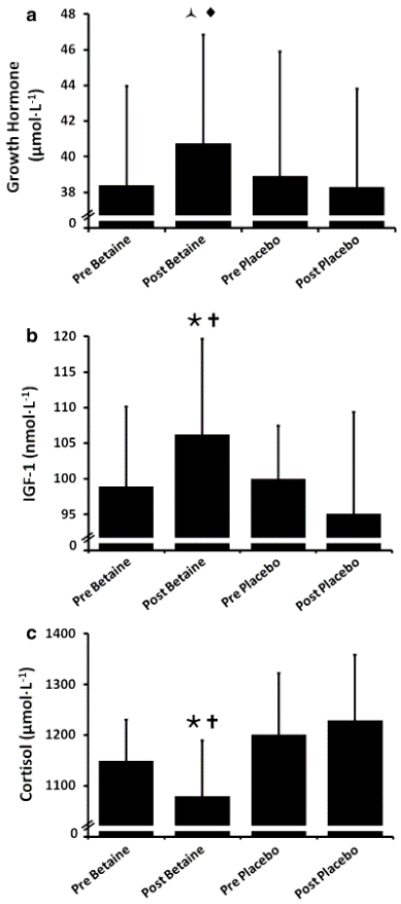


Betaine supplementation enhances anabolic endocrine and Akt signaling in response to acute bouts of exercise

Apicella et al. EJAP 113(3), 2013

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 12 trained individuals ingested ***1.25 g BID of BET or PLA for 2-wks*** in a double-blind and crossover manner with a 2-wk washout
- Before and after each 2-week period, subjects performed an acute exercise session (AES).
- Circulating GH, IGF-1, cortisol, and insulin were measured. Vastus lateralis samples were analyzed for signaling proteins (Akt, p70 S6k, AMPK).
- ***BET (vs. P) supplementation approached a significant increase in GH and significantly increased IGF-1*** while decreasing cortisol with no affects on insulin.
- ***BET increased resting total muscle Akt while potentiating phosphorylation (relative to P) of Akt (Ser(473)) and p70 S6 k (Thr(389))***
- ***BET (vs. placebo) supplementation enhanced both the anabolic endocrine profile and the corresponding anabolic signaling environment, suggesting increased protein synthesis.***

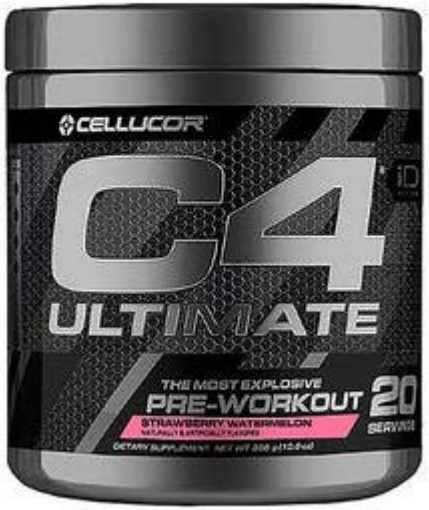


Pre-Workout Supplements

Theoretical Ergogenic Benefits

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Ready-to drink (RTD) pre-workout supplements and energy drinks have been purported to improve exercise performance and/or cognitive function.
- These supplements typically contain combinations of various purported ergogenic nutrients including carbohydrate, caffeine, amino acids, creatine, beta-alanine, vasodilators (e.g., nitrates, l-citrulline, l-arginine), nutrients purported to improve concentration (e.g., citicoline), and various vitamins.
- PWS also typically contain maintenance doses of nutrients that can support training adaptations (e.g., creatine, B-alanine, etc.)
- ISSN concluded that consuming ***energy drinks primarily containing caffeine and beta alanine can approve acute exercise performance, cognitive function, and/or training adaptations***

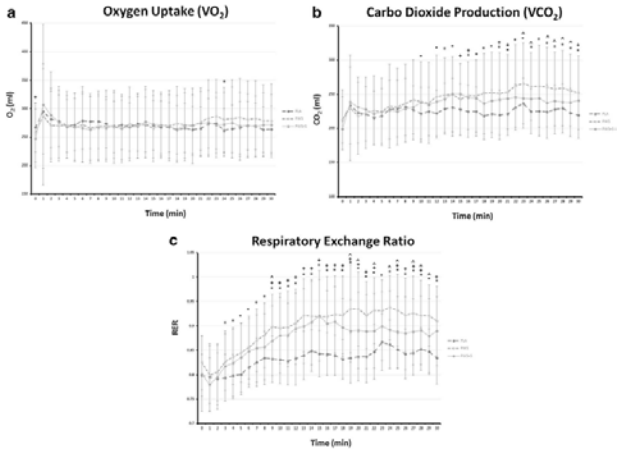


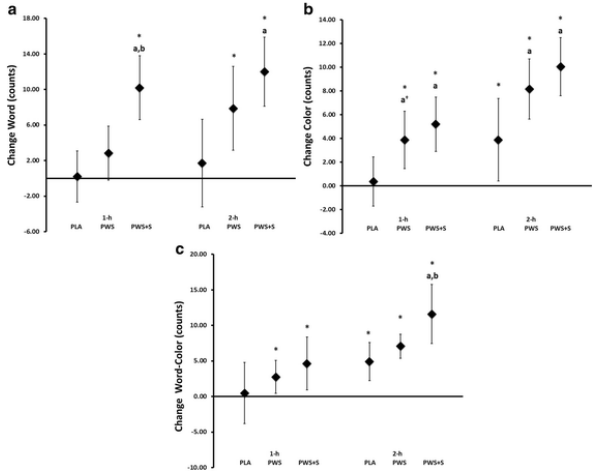
Effects of acute ingestion of a pre-workout dietary supplement with and without p-synephrine on resting energy expenditure, cognitive function and exercise performance

Jung et al. JISSN. 14:3: 2017

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- In a DBCPC manner; 25 apparently men and women had resting BP, HR, 12-lead ECG, and REE measured for 10-min.
- Participants ingested a flavored placebo (P); a ***PWS containing 3.0 g beta alanine, 2 g creatine nitrate, 2 g arginine AKG, 300 mg of N-acetyl tyrosine, 270 mg caffeine, 15 mg of Mucuna pruriens; or, the PWS with 20 mg of synephrine (PWS+S).***
- Participants had HR, BP, REE, ECG's, perceptions about readiness to perform, cognitive function (Stroop Color-Word test), BP & LP performance (2 sets of 10 repetitions at 70% of 1RM and 1 set to failure), and Wingate anaerobic capacity (WAC) sprint performance determined prior to and following exercise.
- No clinically significant differences were observed among treatments in HR, BP, ECG, or general clinical blood panels.
- ***PWS and PWS + S ingestion promoted greater changes in REE responses.***
- ***Participants reported higher perception of optimism about performance and vigor and energy and there was evidence that PWS and PWS + S improved changes in cognitive function scores from baseline to a greater degree than PLA after 1 or 2 h.***
- No statistically significant differences were observed among treatments in total bench press lifting volume, leg press lifting volume or WAC sprint performance.





Short-Term Effects of a Ready-to-Drink Pre-Workout Beverage on Exercise Performance and Recovery

Collins et al. Nutrients. 9(8), 823, 2017

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- In a DBCPC manner; 25 resistance-trained participants ingested a PLA beverage and a beverage ***(RTD) containing caffeine (200 mg), β-alanine (2.1 g), arginine nitrate (1.3 g), niacin (65 mg), folic acid (325 mcg), and Vitamin B12 (45 mcg) for 7-days, separated by a 7–10-day.***
- On day 1 and 6, participants donated a fasting blood sample, completed an SEQ, hemodynamic challenge test, 1-RM and muscular endurance tests (3 × 10 reps @ 70% of 1-RM with the last set to failure) on the BP and LP followed by ingesting the assigned beverage.
- After 15 min, participants repeated the hemodynamic test, 1-RM tests, and performed a repetition to fatigue (RtF) test at 70% of 1-RM, followed by completing the SEQ.
- On day 2 and 7, participants donated a fasting blood sample, completed the SEQ, ingested the assigned beverage, rested 30 min, and performed a 4 km cycling time-trial (TT).

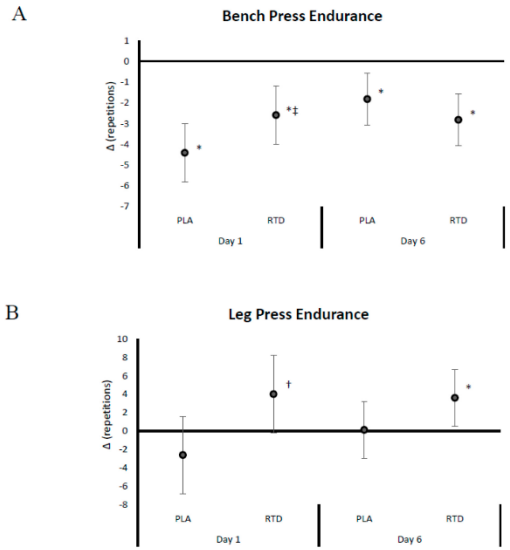
Protocol Overview					
	Baseline			Follow-Up	
Familiarization	Day 1	Day 2	Day 3-5	Day 6	Day 7
Physical Exam	BIA	8-h fasting blood sample		BIA	8-h fasting blood sample
Body Weight	8-h fasting blood sample	Side Effects Questionnaire		8-h fasting blood sample	Side Effects Questionnaire
DXA Body Composition	Side Effects Questionnaire	Ingest Supplement		Side Effects Questionnaire	Ingest Supplement
BIA Body Water	Pre-Ingestion Hemodynamic Tilt Test	Wait 30-min		Pre-Ingestion Hemodynamic Tilt Test	Wait 30-min
Bench Press & Leg Press 1RM and 70% 1RM Test	Pre-Ingestion Initial Strength Testing	4-km Time Trial		Pre-Ingestion Initial Strength Testing	4-km Time Trial
Practice 4 km Cycling Time Trial	Ingest Supplement	Side Effects Questionnaire		Ingest Supplement	Side Effects Questionnaire
Schedule Baseline Testing	Wait 30-min			Wait 30-min	
Randomize to Treatment	Post Ingestion Hemodynamic Tilt Test			Post Ingestion Hemodynamic Tilt Test	
	Post Ingestion Recovery Strength Testing			Post Ingestion Recovery Strength Testing	
	Side Effects Questionnaire			Side Effects Questionnaire	

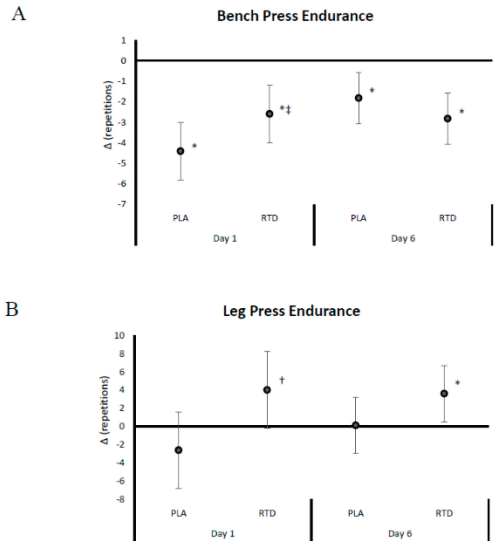
Short-Term Effects of a Ready-to-Drink Pre-Workout Beverage on Exercise Performance and Recovery

Collins et al. Nutrients. 9(8), 823, 2017

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- ***An overall multivariate interaction was observed on strength performance variables (p = 0.01).***
- ***Acute RTD ingestion better maintained LP 1-RM; increased LP RtF; increased BP lifting volume; and, increased total lifting volume.***
- ***Short-term RTD ingestion maintained baseline LP 1-RM; LP RtF; and, LP lifting volume to a greater degree than PLA.***
- No significant differences were observed between treatments in cycling TT performance, hemodynamic assessment, fasting blood panels, or self-reported side effects. View Full-Text



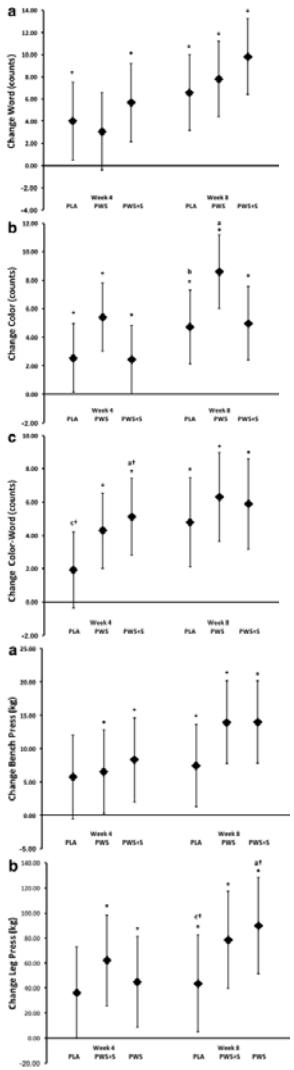


Effects of ingesting a pre-workout dietary supplement with and without synephrine for 8- weeks on training adaptations in resistance-trained males

Jung et al. JISSN. 14:1, 2017

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- RT males (N=80) were randomly assigned to supplement their diet in a DBPC manner with a PLA; a ***PWS containing beta alanine (3 g), creatine nitrate (2 g), arginine alpha-ketoglutarate (2 g), N-Acetyl-L-Tyrosine (300 mg), caffeine (284 mg), Mucuna pruiriens extract standardized for 15% L-Dopa (15 mg); or, the PWS with Citrus aurantium (PWS+S) extract standardized for 30% synephrine (20 mg) once per day for 8-weeks during training.***
- PWS and PWS + S did not increase the incidence of reported side effects or affect the number of blood values above clinical norms compared to PLA.
- No significant differences were observed among groups for body composition, resting heart and blood pressure, readiness to perform questions, 1RM strength, anaerobic sprint capacity, or blood chemistry panels.
- There was some evidence that cognitive function and 1RM strength were increased to a greater degree in the PWS and/or PWS + S groups after 4- and/or 8-weeks compared to PLA responses.
- ***Results provide some evidence that 4-weeks of PWS and/or PWS + S supplementation can improve some indices of cognitive function and exercise performance during resistance-training without significant side effects in apparently health males.***
- ***Effects were similar to PLA responses after 8-weeks of supplementation and inclusion of synephrine did not promote additive benefits.***



Planned / Proposed Studies

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Effects of ***omega 3 fatty*** acids on resiliency and markers of stress in soldiers
- Effects of ***Tart Cherry*** Ingestion on Food-Induced Serum Uric Acid Elevation
- Effects of ***Rice Bran*** Ingestion on Markers of Glucose Homeostasis, Insulin Sensitivity, Lipid Profiles, Eating Satisfaction, and Weight Loss in Overweight and Sedentary Men and Women
- A Randomized, Double-Blind, Controlled Study to Evaluate the Efficacy of ***BioCurc®*** (***Curcumin***) on Exercise-Induced Pain
- Effects of Baker's Yeast (***B-glucan***) Supplementation on Immune and Inflammatory Response to Intense Endurance Exercise
- Effects of CeyLean™ (***cinnamon hydro-alcoholic extract***) Supplementation on Glycemic and Insulinemic Response to an Carbohydrate Meal
- Effects of ***Phyllanthus emblica fruit*** extract (Capros™) supplementation on markers of endothelial function and health in sedentary and overweight men and women initiating an exercise program
- Effects of Withania Somnifera (***Ashwagandha Root and Leaf***) extract (Sensoril™) supplementation on markers of stress, appetite, and body composition in sedentary men and women initiating an exercise program.
- Nanoemulsion-Mediated Delivery of ***Citrus Terpenoids*** for Neuroprotection: A Potential Bioactive to Reduce the Severity of Concussion and Traumatic Brain Injury

Summary

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- A number of emerging nutrients are available in dietary supplements including:
  - Blends of plant sources of protein with digestive enzymes or probiotics
  - Bioactive nutrients from botanicals purported to:
    - promote vasodilation
    - serve as antioxidants,
    - support the immune system,
    - improve glycemic control, and/or
    - enhance performance.
- Continue to see nutritional formulations developed that incorporate bioactive nutrients into pre-workout supplements, supplements to ingest during exercise, and post-workout supplements.
- Only consider recommending quality supplements that contain proper levels of active nutrients that have solid research support.

CONGRESO INTERNACIONAL
ACADEMIA & FITNESS
presented by: EXPOFITNESS

Gracias

Richard B. Kreider, PhD, FACSM, FASEP, FISSN, FACN, FNAK
Texas A&M University

rbkreider@tamu.edu
ExerciseAndSportNutritionLab.com | hcrf.tamu.edu