What does the research say about each ingredient? Each study is ranked as either GREEN, YELLOW, or RED depending on how closely the conclusions of the study support the claim listed above it. A GREEN study strongly supports it's above claim, a YELLOW study kind of supports it's above claim, and a RED study does not support it's above claim.

7 grams of Citrulline Malate

Citrulline malate is composed of the amino acid citrulline attached to the esther of malic acid. In the kidneys, citrulline is changed into arginine, and then arginine produces nitric oxide. Supplementing with citrulline increases arginine and nitric oxide levels in the body to a greater extent than supplementing with arginine as arginine undergoes excessive breakdown by the intestines and liver. Citrulline avoids breakdown in the intestines and liver making it a superior nitric oxide enhancer to arginine.

Highlighted below are ten different studies to support all of the claims that can be made for the dose we use in Jungle Shot.

1. Decreased Fatigue

a. Bendahan D, et al. Citrulline/malate promotes aerobic energy production in human exercising muscle. *Br J Sports Med*. (2002) (https://www.ncbi.nlm.nih.gov/pubmed/12145119)

Conclusions: "CM ingestion resulted in a significant reduction in the sensation of fatigue, a 34% increase in the rate of oxidative ATP production during exercise, and a 20% increase in the rate of phosphocreatine recovery after exercise, indicating a larger contribution of oxidative ATP synthesis to energy production. Considering subjects individually and variables characterising aerobic function, extrema were measured after either eight or 15 days of treatment, indicating chronological heterogeneity of treatment induced changes. One way analysis of variance confirmed improved aerobic function, which may be the result of an enhanced malate supply activating ATP production from the tricarboxylic acid cycle through anaplerotic reactions."

Type of study: Prospective Study

Participants: 18 males complaining of fatigue

Dosage: 6 grams per day

b. Hickner RC, et al. L-citrulline reduces time to exhaustion and insulin response to a graded exercise test. *Med Sci Sports Exerc*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/16679980

Conclusions: "Treadmill time to exhaustion was lower following citrulline ingestion than during placebo trials (888.2 +/- 17.7 vs 895.4 +/- 17.9 s; $P < 0.05$; $N = 17$), which was

accompanied by a higher rating of perceived exertion during exercise in the L-citrulline compared with the placebo condition."

Type of study: Randomized Control Trial

Participants: 17 young and healthy male and females

Dosage: 3 g/3 hr prior to testing or 9 g/24 hr prior to testing

c. Pérez-Guisado J, Jakeman PM. Citrulline malate enhances athletic anaerobic performance and relieves muscle soreness. *J Strength Cond Res*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/20386132

Conclusions: "The subjects' resistance was tested using the repetitions to fatigue test, at 80% of their predetermined 1 repetition maximum (RM), in the 8 sets of flat barbell bench presses during the pectoral training session (S1-4 and S1'-4'). The p-value was 0.05. The number of repetitions showed a significant increase from placebo treatment to CM treatment from the third set evaluated ($p < 0.0001$). This increase was positively correlated with the number of sets, achieving 52.92% more repetitions and the 100% of response in the last set (S4'). A significant decrease of 40% in muscle soreness at 24 hours and 48 hours after the pectoral training session and a higher percentage response than 90% was achieved with CM supplementation."

Type of Study: Randomized, double-blind, 2-period crossover design

Participants: 41 men

Dosage: 8g prior to session

2. Decreased Delayed Onset Muscle Soreness

a. Pérez-Guisado J, Jakeman PM. Citrulline malate enhances athletic anaerobic performance and relieves muscle soreness. *J Strength Cond Res*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/20386132

Conclusions: "The subjects' resistance was tested using the repetitions to fatigue test, at 80% of their predetermined 1 repetition maximum (RM), in the 8 sets of flat barbell bench presses during the pectoral training session (S1-4 and S1'-4'). The p-value was 0.05. The number of repetitions showed a significant increase from placebo treatment to CM treatment from the third set evaluated ($p < 0.0001$). This increase was positively correlated with the number of sets, achieving 52.92% more repetitions and the 100% of response in the last set (S4'). A significant decrease of 40% in muscle soreness at 24 hours and 48 hours after the pectoral training session and a higher percentage response than 90% was achieved with CM supplementation."

Type of Study: Randomized, double-blind, 2-period crossover design

Participants: 41 men

Dosage: 8g prior to session

3. Increased Nitric Oxide

a. Ochiai M, et al. Short-term effects of L-citrulline supplementation on arterial stiffness in middle-aged men. *Int J Cardiol*. (2012)
https://www.ncbi.nlm.nih.gov/pubmed/21067832

Conclusions: "Plasma citrulline, arginine and the ratio of arginine/asymmetric dimethylarginine (ADMA), an endogenous inhibitor of NO synthase (arginine/ADMA ratio) were significantly increased in the L-citrulline group compared with the placebo group ($p<0.05$, $p<0.01$, $p<0.05$, respectively). Moreover, there was a correlation between the increase of plasma arginine and the reduction of baPWV ($r=-0.553$, $p<0.05$)."

Type of Study: Double-blind, randomized, placebo-controlled parallel-group trial

Participants: 15 healthy male subjects

Dosage: 5.6 g/day

b. Sureda A, et al. L-citrulline-malate influence over branched chain amino acid utilization during exercise. *Eur J Appl Physiol*. (2010)
https://www.ncbi.nlm.nih.gov/pubmed/20499249

Conclusions: L-citrulline-malate supplementation can enhance the use of amino acids, especially the branched chain amino acids during exercise and also enhance the production of arginine-derived metabolites such as nitrite, creatinine, ornithine and urea.

Type of Study: Randomized Control Trial

Participants: Seventeen voluntary male pre-professional cyclists

Dosage: 6 g/ 2 hours before competition

4. Increased Growth Hormone

a. Sureda A, et al. L-citrulline-malate influence over branched chain amino acid utilization during exercise. *Eur J Appl Physiol*. (2010)
https://www.ncbi.nlm.nih.gov/pubmed/20499249

Conclusions: Growth hormone increased after exercise in both groups, although the increase was higher in the citrulline-malate supplemented group ($p < 0.05$).

Type of Study: Randomized Control Trial

Participants: Seventeen voluntary male pre-professional cyclists

Dosage: 6 g/ 2 hours before competition

5. Improved Blood Flow

a. Ochiai M, et al. Short-term effects of L-citrulline supplementation on arterial stiffness in middle-aged men. *Int J Cardiol*. (2012)
https://www.ncbi.nlm.nih.gov/pubmed/21067832

Conclusions: "Plasma citrulline, arginine and the ratio of arginine/asymmetric dimethylarginine (ADMA), an endogenous inhibitor of NO synthase (arginine/ADMA ratio) were significantly increased in the L-citrulline group compared with the placebo group ($p<0.05$, $p<0.01$, $p<0.05$, respectively). Moreover, there was a correlation between the increase of plasma arginine and the reduction of baPWV ($r=-0.553$, $p<0.05$)."

Type of Study: Double-blind, randomized, placebo-controlled parallel-group trial

Participants: 15 healthy male subjects

Dosage: 5.6 g/day

6. Decreased Blood Pressure

a. Figueroa A, et al. Oral L-citrulline supplementation attenuates blood pressure response to cold pressor test in young men. *Am J Hypertens*. (2010)
https://www.ncbi.nlm.nih.gov/pubmed/19851298

Conclusions: "Compared to placebo, oral L-citrulline treatment decreased ($P < 0.05$) brachial SBP (-6 +/- 11 mm Hg), aortic SBP (-4 +/- 10 mm Hg), and aortic PP (-3 +/- 6 mm Hg) during CPT but not at rest."

Type of Study: Crossover design

Participants: 17 young (21.6 +/- 0.9 years) normotensive men

Dosage: 6 g/day

b. Orozco-Gutiérrez JJ, et al. Effect of L-arginine or L-citrulline oral supplementation on blood pressure and right ventricular function in heart failure patients with preserved ejection fraction. *Cardiol J*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/21154265

Conclusions: "Duration on treadmill and right ventricular ejection fraction post exercise increased, while diastolic and systolic artery pressure decreased significantly in both groups." (note that other group was on 8 g of arginine per day)

Type of Study: RCT

Participants: 15 heart failure patients with preserved ejection fraction

Dosage: 3 g/day

7. Increased Immunity

a. Sureda A, et al. Effects of L-citrulline oral supplementation on polymorphonuclear neutrophils oxidative burst and nitric oxide production after exercise. *Free Radic Res*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19585317

Conclusions: "In conclusion, oral L-citrulline administration previous to a cycling stage increases plasma arginine availability for NO synthesis and PMNs priming for oxidative burst without oxidative damage."

Type of Study: Randomized Control Trial

Participants: Seventeen voluntary male pre-professional cyclists

Dosage: 6 g/ 2 hours before competition

8. Decreased Erectile Dysfunction

a. Cormio L, et al. Oral L-citrulline supplementation improves erection hardness in men with mild erectile dysfunction. *Urology*. (2011)

https://www.ncbi.nlm.nih.gov/pubmed/21195829

Results: "A total of 24 patients, mean age 56.5 ± 9.8 years, were entered and concluded the study without adverse events. The improvement in the erection hardness score from 3 (mild ED) to 4 (normal erectile function) occurred in 2 (8.3%) of the 24 men when taking placebo and 12 (50%) of the 24 men when taking L-citrulline ($P < .01$). The mean number of intercourses per month increased from 1.37 ± 0.93 at baseline to 1.53 ± 1.00 at the end of the placebo phase ($P = .57$) and 2.3 ± 1.37 at the end of the treatment phase ($P < .01$). All patients reporting an erection hardness score improvement from 3 to 4 reported being very satisfied."

Type of Study: Single Blind Study

Participants: 24 men 56.5 years of age ± 9.8 years with mild erectile dysfunction

Dosage: 1.5 g/day

9. Improved Right Ventricle Fraction and Exercise Capacity in those with heart failure

a. Orozco-Gutiérrez JJ, et al. Effect of L-arginine or L-citrulline oral supplementation on blood pressure and right ventricular function in heart failure patients with preserved ejection fraction. *Cardiol J*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/21154265

Conclusions: "Duration on treadmill and right ventricular ejection fraction post exercise increased, while diastolic and systolic artery pressure decreased significantly in both groups." (note that other group was on 8 g of arginine per day)

Type of Study: RCT

Participants: 15 heart failure patients with preserved ejection fraction

Dosage: 3 g/day

6 grams of Beta-Alanine
Beta-alanine is a modified amino acid that gets taken up by skeletal muscle and combines with the amino acid histidine to form carnosine.

Highlighted below are thirteen different studies to support all of the claims that can be made for the dose we use in Jungle Shot.

1. Increase in Muscular Endurance

a. Baguet A, et al. Important role of muscle carnosine in rowing performance. *J Appl Physiol*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/20671038

Conclusions: "It can be concluded that the positive correlation between baseline muscle carnosine levels and rowing performance and the positive correlation between changes in muscle carnosine and performance improvement suggest that muscle carnosine is a new determinant of rowing performance."

Type of Study: RCT

Participants: Eighteen Belgian elite rowers

Dosage: 5 g/ day or placebo

b. Hobson RM, et al. Effects of β-alanine supplementation on exercise performance: a meta-analysis. *Amino Acids*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/22270875

Conclusions: "In line with the purported mechanisms for an ergogenic effect of β-alanine supplementation, exercise lasting 60-240 s was improved (P=0.001) in BA compared to Pla, as was exercise of >240 s (P=0.046). In contrast, there was no benefit of β-alanine on exercise lasting <60 s (P=0.312). The median effect of β-alanine supplementation is a 2.85% (-0.37 to 10.49%) improvement in the outcome of an exercise measure, when a median total of 179 g of β-alanine is supplemented."

Type of Study: Meta-analysis

Participants: 15 studies - 360 individuals

Dosage: varied

c. Hoffman JR, et al. Short-duration beta-alanine supplementation increases training volume and reduces subjective feelings of fatigue in college football players.*Nutr Res*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/19083385

Conclusions: "In conclusion, despite a trend toward lower fatigue rates during 60 seconds of maximal exercise, 3 weeks of beta-alanine supplementation did not result in significant improvements in fatigue rates during high-intensity anaerobic exercise. However, higher training volumes and lower subjective feelings of fatigue in BA indicated that as duration of supplementation continued, the efficacy of beta-alanine supplementation in highly trained athletes became apparent."

Type of Study: RCT

Participants: football players

Dosage: 4.5 g per day/ placebo 4.5 g of maltodextrin

d. Hoffman J, et al. Beta-alanine and the hormonal response to exercise. *Int J Sports Med*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/18548362

Conclusions: "Results indicate that four weeks of beta-alanine supplementation can significantly improve muscular endurance during resistance training in experienced resistance-trained athletes. However, these performance gains did not affect the acute endocrine response to the exercise stimulus."

Type of Study: RCT

Participants: 8 experienced resistance trained men

Dosage: 4.8 g /day

e. Jordan T, et al. Effect of beta-alanine supplementation on the onset of blood lactate accumulation (OBLA) during treadmill running: Pre/post 2 treatment experimental design. *J Int Soc Sports Nutr*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/20482881

Conclusions: "betaA supplementation for 28 days enhanced sub-maximal endurance performance by delaying OBLA. However, betaA supplemented individuals had a reduced aerobic capacity as evidenced by the decrease in VO2max values post supplementation."

Type of Study: double blind RCT

Participants: 17 recreationally active men

Dosage: 6 g/ day placebo 6 g of maltodextrin

f. Stout JR, et al. Effects of beta-alanine supplementation on the onset of neuromuscular fatigue and ventilatory threshold in women. *Amino Acids*. (2007) https://www.ncbi.nlm.nih.gov/pubmed/17136505

Conclusions: "In conclusion, beta-alanine supplementation appears to improve submaximal cycle ergometry performance and TTE in young women, perhaps as a result of an increased buffering capacity due to elevated muscle carnosine concentrations."

Type of Study: RCT

Participants: Twenty-two women (age+/-SD 27.4+/-6.1 yrs)

Dosage: 3.2 g per day and placebo

2. Increase in Anaerobic Running Capacity

a. Sale C, et al. Effect of β-alanine plus sodium bicarbonate on high-intensity cycling capacity. *Med Sci Sports Exerc*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21407127

Conclusions: "Results show that BA improved high-intensity cycling capacity. However, despite a 6-s (~4%) increase in TTE with the addition of SB, this did not reach statistical significance, but magnitude-based inferences suggested a ~70% probability of a meaningful positive difference."

Type of Study: Blind Crossover Design

Participants:20 males; 20-30 years of age

Dosage: 6.4 g or placebo

b. Weiliang C, et al. Effect of 10 Week Beta-Alanine Supplementation on Competition and Training Performance in Elite Swimmers. *Nutrients*. (2012) http://www.mdpi.com/2072-6643/4/10/1441

Conclusions: "Beta-alanine supplementation appears to have minimal effect on swimming performance in non-laboratory controlled real-world training and competition settings."

Type of Study: RCT

Participants: Elite/Sub-elite swimmers (*n* = 23 males and 18 females, age = 21.7 ± 2.8 years; mean ± SD)

Dosage: (4 weeks loading phase of 4.8 g/day and 3.2 g/day thereafter) or placebo for 10 weeks.

3. Decrease in Fat Mass

a. Walter AA, et al. Six weeks of high-intensity interval training with and without beta-alanine supplementation for improving cardiovascular fitness in women. *J Strength Cond Res*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/20386120

Conclusions: "Although it is unclear why beta-alanine supplementation increased BM, there was no additive effects for increasing VO2 peak beyond the PL."

Type of Study: RCT

Participants: "Forty-four women (mean +/- SD age = 21.8 +/- 3.7 years; height = 166.5 +/- 6.6 cm; body mass (BM) = 65.9 +/- 10.8 kg; VO2 peak = 31.5 +/- 6.2 ml x kg(-1) x min(-1))"

Dosage: 3 groups; beta-alanine (BA, n = 14) 1.5 g + 15 g dextrose powder; placebo (PL, n = 19) 16.5 g dextrose powder; or control (CON, n = 11).

4. Increase in Lean Mass

a. Smith AE, et al. Effects of beta-alanine supplementation and high-intensity interval training on endurance performance and body composition in men; a double-blind trial. *J Int Soc Sports Nutr*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19210788

Conclusions: “The use of HIIT to induce significant aerobic improvements is effective and efficient. Chronic BA supplementation may further enhance HIIT, improving endurance performance and lean body mass.” They used within-group significance, not a between group test which is misleading.

Type of Study: Double Blind RCT Participants: Forty-six men (Age: 22.2 +/- 2.7 yrs; Ht: 178.1 +/- 7.4 cm; Wt: 78.7 +/- 11.9; VO2peak: 3.3 +/- 0.59 l.min-1)

Dosage: “placebo (PL - 16.5 g dextrose powder per packet; n = 18) or beta-alanine (BA - 1.5 g beta-alanine plus 15 g dextrose powder per packet; n = 18) group. All subjects supplemented four times per day (total of 6 g/day) for the first 21-days, followed by two times per day (3 g/day) for the subsequent 21 days”

b. Walter AA, et al. Six weeks of high-intensity interval training with and without beta-alanine supplementation for improving cardiovascular fitness in women. *J Strength Cond Res*. (2010)
https://www.ncbi.nlm.nih.gov/pubmed/20386120

Conclusions: Fat free mass increased similarly for all of the groups.

Type of Study: RCT

Participants: “Forty-four women (mean +/- SD age = 21.8 +/- 3.7 years; height = 166.5 +/- 6.6 cm; body mass (BM) = 65.9 +/- 10.8 kg; VO2 peak = 31.5 +/- 6.2 ml x kg(-1) x min(-1))”

Dosage: 3 groups; beta-alanine (BA, n = 14) 1.5 g + 15 g dextrose powder; placebo (PL, n = 19) 16.5 g dextrose powder; or control (CON, n = 11).

5. Decrease in Fatigue

a. Hoffman JR, et al. Short-duration beta-alanine supplementation increases training volume and reduces subjective feelings of fatigue in college football players.*Nutr Res*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/19083385

Conclusions: “In conclusion, despite a trend toward lower fatigue rates during 60 seconds of maximal exercise, 3 weeks of beta-alanine supplementation did not result in significant improvements in fatigue rates during high-intensity anaerobic exercise. However, higher training volumes and lower subjective feelings of fatigue in BA indicated that as duration of supplementation continued, the efficacy of beta-alanine supplementation in highly trained athletes became apparent.”

Type of Study: RCT

Participants: football players

Dosage: 4.5 g per day/ placebo 4.5 g of maltodextrin

b. Sale C, et al. Effect of β-alanine plus sodium bicarbonate on high-intensity cycling capacity. *Med Sci Sports Exerc*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21407127

Conclusions: "Results show that BA improved high-intensity cycling capacity. However, despite a 6-s (~4%) increase in TTE with the addition of SB, this did not reach statistical significance, but magnitude-based inferences suggested a ~70% probability of a meaningful positive difference."

Type of Study: Blind Crossover Design

Participants:20 males; 20-30 years of age

Dosage: 6.4 g or placebo

c. Stout JR, et al. Effects of beta-alanine supplementation on the onset of neuromuscular fatigue and ventilatory threshold in women. *Amino Acids*. (2007) https://www.ncbi.nlm.nih.gov/pubmed/17136505

Conclusions: "In conclusion, beta-alanine supplementation appears to improve submaximal cycle ergometry performance and TTE in young women, perhaps as a result of an increased buffering capacity due to elevated muscle carnosine concentrations."

Type of Study: RCT

Participants: Twenty-two women (age+/-SD 27.4+/-6.1 yrs)

Dosage: 3.2 g per day and placebo

d. Stout JR, et al. Effects of twenty-eight days of beta-alanine and creatine monohydrate supplementation on the physical working capacity at neuromuscular fatigue threshold. *J Strength Cond Res*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/17194255

Conclusions: "These findings suggested that b-Ala supplementation may delay the onset of neuromuscular fatigue."

Type of Study: Double Blind RCT

Participants: "Fifty-one men (mean age +/- SD = 24.5 +/- 5.3 years) volunteered to participate in this 28-day, double-blind, placebo-controlled study and were randomly assigned to 1 of 4 group"

Dosage: “placebo (PLA; 34 g dextrose; n = 13), CrM (5.25 g CrM plus 34 g dextrose; n = 12), b-Ala (1.6 g b-Ala plus 34 g of dextrose; n = 12), or b-Ala plus CrM (CrBA; 5.25 g CrM plus 1.6 g b-Ala plus 34 g dextrose; n = 14).”

e. Stout JR, et al. The effect of beta-alanine supplementation on neuromuscular fatigue in elderly (55-92 years): a double-blind randomized study. *J Int Soc Sports Nutr*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/18992136

Conclusions: “We suggest that BA supplementation, by improving intracellular pH control, improves muscle endurance in the elderly. This, we believe, could have importance in the prevention of falls, and the maintenance of health and independent living in elderly men and women.”

Type of Study: Double Blind RCT

Participants: twenty-six men (n = 9) and women (n = 17) (age ± SD = 72.8 ± 11.1 yrs)

Dosage: (BA: 800 mg × 3 per day; n = 12; CarnoSyn™) or Placebo (PL; n = 14) group

f. Zoeller RF, et al. Effects of 28 days of beta-alanine and creatine monohydrate supplementation on aerobic power, ventilatory and lactate thresholds, and time to exhaustion. *Amino Acids*. (2007) https://www.ncbi.nlm.nih.gov/pubmed/16953366

Conclusions: “Prior to and following supplementation, participants performed a graded exercise test on a cycle ergometer to determine VO2peak, time to exhaustion (TTE), and power output, VO2, and percent VO2peak associated with VT and LT. No significant group effects were found. However, within groups, a significant time effect was observed for CrBa on 5 of the 8 parameters measured. These data suggest that CrBA may potentially enhance endurance performance.”

Type of Study: Double Blind RCT

Participants: Fifty-five men (24.5 ± 5.3 yrs) participated in a double-blind, placebo-controlled study and randomly assigned to one of 4 groups

Dosage: ; placebo (PL, *n* = 13), creatine (Cr, *n* = 12), beta-alanine (β-Ala, *n* = 14), or beta-alanine plus creatine (CrBA, *n* = 16).

5 grams of Creatine Monohydrate

Creatine monohydrate is a molecule naturally produced within the liver, kidneys, and pancreas that stores phosphate in the form of phosphocreatine. Phosphocreatine increases strength as well as aids in cellular support of many of the organs in the body. Creatine monohydrate is probably the most researched supplement ever.

Highlighted below are thirty-seven different studies to support all of the claims that can be made for the dose we use in Jungle Shot.

1. Increased Power Output

a. Bazzucchi I, Felici F, Sacchetti M. Effect of short-term creatine supplementation on neuromuscular function. *Med Sci Sports Exerc*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19727018

Conclusions: "After supplementation, peak torque (PT) of maximal twitch was 33.4% higher, and the time to reach the PT was 54.7% lower in CRE than in PLA ($P < 0.05$). Torque-angular velocity curve was enhanced after Cr supplementation, especially at the higher velocities. Mean fiber CV was, on average, 8.9% higher in CRE at all angular velocities after supplementation ($P < 0.05$)."

Type of Study: Double Blind RCT

Participants: 16 men

Dosage: 5 grams four times per day

b. Bemben MG, et al. The effects of supplementation with creatine and protein on muscle strength following a traditional resistance training program in middle-aged and older men. *J Nutr Health Aging*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/20126965

Conclusions: "Resistance training in middle-aged and older men significantly increased muscular strength and added muscle mass with **no additional benefits from creatine and/or protein supplementation.**"

Type of Study: Double Blind RCT

Participants: 42 older men

Dosage: 5 grams per day

c. Branch JD. Effect of creatine supplementation on body composition and performance: a meta-analysis. *Int J Sport Nutr Exerc Metab*. (2003) https://www.ncbi.nlm.nih.gov/pubmed/12945830

Conclusions: "ES was greater for changes in lean body mass following short-term CS, repetitive-bout laboratory-based exercise tasks < or = 30 s (e.g., isometric, isokinetic, and isotonic resistance exercise), and upper-body exercise. CS does not appear to be effective in improving running and swimming performance. There is no evidence in the literature of an effect of gender or training status on ES following CS."

Type of Study: Meta-analysis of 96 peer reviewed papers

Participants: Varied

Dosage: Varied

d. Burke DG, et al. Effect of creatine and weight training on muscle creatine and performance in vegetarians. *Med Sci Sports Exerc*. (2003) https://www.ncbi.nlm.nih.gov/pubmed/14600563

Conclusions: "For Cr subjects, there was a greater increase in PCr, TCr, bench-press strength, isokinetic work, Type II fiber area, and whole-body lean tissue compared with subjects on placebo ($P<0.05$). Vegetarians who took Cr had a greater increase in TCr, PCr, lean tissue, and total work performance than nonvegetarians who took Cr ($P<0.05$). The change in muscle TCr was significantly correlated with initial muscle TCr, and the change in lean tissue mass and exercise performance. These findings confirm an ergogenic effect of Cr during resistance training and suggest that subjects with initially low levels of intramuscular Cr (vegetarians) are more responsive to supplementation."

Type of Study: Double Blind RCT

Participants: Vegetarians and Non-vegetarians

Dosage: Weight Dependant

Duration: 8 weeks

e. Cramer JT, et al. Effects of creatine supplementation and three days of resistance training on muscle strength, power output, and neuromuscular function. *J Strength Cond Res*. (2007) https://www.ncbi.nlm.nih.gov/pubmed/17685691

Conclusions: "These results indicated that 3 days of isokinetic resistance training was sufficient to elicit small, but significant, improvements in peak strength (PT) and ACC for both the CRE and PLA groups. Although the greater relative improvements in PT and ACC for the CRE group were not statistically significant, these findings may be useful for rehabilitation or strength and conditioning professionals who may need to rapidly increase the strength of a patient or athlete within 9 days."

Type of Study: Double Blind RCT

Participants: 25 Men (18-24 years old)

Dosage: 10g twice per day

Duration: 9 Days

f. del Favero S, et al. Creatine but not betaine supplementation increases muscle phosphorylcreatine content and strength performance. *Amino Acids*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/21744011

Conclusions: "CR and BET+CR presented greater muscle power output than PL in the squat exercise following supplementation ($p=0.003$ and $p=0.041$, respectively). Similarly, bench press average power was significantly greater for the CR-supplemented groups. CR and BET+CR groups also showed significant pre- to post-test increase in 1-RM squat and bench press (CR: $p=0.027$ and $p<0.0001$; BET+CR: $p=0.03$ and $p<0.0001$ for upper- and lower-body assessments, respectively)"

Type of Study: Double Blind RCT

Participants: Untrained

Dosage: 20 grams per day

g. Juhász I, et al. Creatine supplementation improves the anaerobic performance of elite junior fin swimmers. *Acta Physiol Hung*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19706374

Conclusions: "After five days of CrS the average power of one minute continuous rebound jumps increased by 20.2%. The lactate concentration was significantly less after 5 minutes restitution at the second measurement in both groups. The swimming time was significantly reduced in both first (pre: 50.69+/-1.41 s; post: 48.86+/-1.34 s) and second (pre: 50.39+/-1.38 s; post: 48.53+/-1.35 s) sessions of swimming in CR group, but remained almost unchanged in the P group."

Type of Study: Double Blind RCT

Participants: 16 male swimmers (14-17 years old)

Dosage: 4-5 grams per day

h. Kerksick CM, et al. The effects of creatine monohydrate supplementation with and without D-pinitol on resistance training adaptations. *J Strength Cond Res*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19858753

Conclusions: "Creatine monohydrate supplementation helps to improve strength and body composition while resistance training. Data from this study assist in determining the potential role the addition of D-pinitol to creatine may aid in facilitating training adaptations to exercise."

Type of Study: Double Blind RCT

Participants: Twenty-four resistance trained males were randomly assigned in a double-blind manner to creatine + pinitol (CRP) or creatine monohydrate (CR) prior to beginning a supervised 4-week resistance training program.

Dosage: Subjects ingested a typical loading phase (i.e., 20 g/d-1 for 5 days) before ingesting 5 g/d-1 the remaining 23 days.

i. Koçak S, Karli U. Effects of high dose oral creatine supplementation on anaerobic capacity of elite wrestlers. *J Sports Med Phys Fitness*. (2003) https://www.ncbi.nlm.nih.gov/pubmed/14767410

Conclusions: "This study demonstrates that short-term high dose oral creatine supplementation has an ergogenic effect on anaerobic capacity of elite wrestlers."

Type of Study: Comparative Randomized Design

Participants: 20 active international level wrestlers participated (22 to 27 years old).

Dosage: "the daily dosage of creatine or placebo was divided into 4 equal amounts (5 gx4 = 20 g). Every 5 g of supplement was dissolved in 250 ml water and it was given to participants 1 hour before breakfast, lunch, dinner, and workout session."

j. Lamontagne-Lacasse M, Nadon R, Goulet ED. Effect of Creatine Supplementation on Jumping Performance in Elite Volleyball Players. *Int J Sports Physiol Perform*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21941005

Conclusions: "In conclusion, CrMS likely improved repeated BJ height capability without influencing the magnitude of muscular fatigue in these elite, university-level volleyball players."

Type of Study: Double Blind RCT

Participants: 12 elite males of the Sherbrooke University volleyball team

Dosage: "a placebo or creatine solution for 28 d, at a dose of 20 g/d in days 1-4, 10 g/d on days 5-6, and 5 g/d on days 7-28"

k. Rawson ES, Volek JS. Effects of creatine supplementation and resistance training on muscle strength and weightlifting performance. *J Strength Cond Res*. (2003)

https://www.ncbi.nlm.nih.gov/pubmed/14636102

Conclusions: “Thus there is substantial evidence to indicate that creatine supplementation during resistance training is more effective at increasing muscle strength and weightlifting performance than resistance training alone, although the response is highly variable.”

Type of Study: meta-analysis

Participants: n/a

Dosage: n/a

l. Spillane M, et al. The effects of creatine ethyl ester supplementation combined with heavy resistance training on body composition, muscle performance, and serum and muscle creatine levels. *J Int Soc Sports Nutr*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19228401

Conclusions: “In conclusion, when compared to creatine monohydrate, creatine ethyl ester was not as effective at increasing serum and muscle creatine levels or in improving body composition, muscle mass, strength, and power. Therefore, the improvements in these variables can most likely be attributed to the training protocol itself, rather than the supplementation regimen.”

Type of Study: Double Blind RCT

Participants: 30 non-resistance-trained males

Dosage: “The supplements were orally ingested at a dose of 0.30 g/kg fat-free body mass (approximately 20 g/day) for five days followed by ingestion at 0.075 g/kg fat free mass (approximately 5 g/day) for 42 days.”

2. **Increased Muscle Creatine Levels**

a. Burke DG, et al. Effect of creatine and weight training on muscle creatine and performance in vegetarians. *Med Sci Sports Exerc*. (2003) https://www.ncbi.nlm.nih.gov/pubmed/14600563

Type of Study: Double Blind RCT

Participants: Vegetarians and Non-vegetarians

Dosage: Weight Dependant

Duration: 8 weeks

Conclusions: “For Cr subjects, there was a greater increase in PCr, TCr, bench-press strength, isokinetic work, Type II fiber area, and whole-body lean tissue compared with subjects on placebo ($P<0.05$). Vegetarians who took Cr had a greater increase in TCr, PCr, lean tissue, and total work performance than nonvegetarians who took Cr ($P<0.05$). The change in muscle TCr was significantly correlated with initial muscle TCr, and the change in lean tissue mass and exercise performance. These findings confirm an ergogenic effect of Cr during resistance training and suggest that subjects with initially low levels of intramuscular Cr (vegetarians) are more responsive to supplementation.”

b. del Favero S, et al. Creatine but not betaine supplementation increases muscle phosphorylcreatine content and strength performance. *Amino Acids*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/21744011

Conclusions: “In conclusion, we reported that betaine supplementation does not augment muscle PCr content. Furthermore, we showed that betaine supplementation combined or not with creatine supplementation does not affect strength and power performance in untrained subjects.”

Type of Study: Double Blind RCT

Participants: Un-trained

Dosage: 20 grams per day

c. Spillane M, et al. The effects of creatine ethyl ester supplementation combined with heavy resistance training on body composition, muscle performance, and serum and muscle creatine levels. *J Int Soc Sports Nutr*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19228401

Conclusions: “In conclusion, when compared to creatine monohydrate, creatine ethyl ester was not as effective at increasing serum and muscle creatine levels or in improving body composition, muscle mass, strength, and power. Therefore, the improvements in these variables can most likely be attributed to the training protocol itself, rather than the supplementation regimen.”

Type of Study: Double Blind RCT

Participants: 30 non-resistance-trained males

Dosage: “The supplements were orally ingested at a dose of 0.30 g/kg fat-free body mass (approximately 20 g/day) for five days followed by ingestion at 0.075 g/kg fat free mass (approximately 5 g/day) for 42 days.”

d. Watt KK, Garnham AP, Snow RJ. Skeletal muscle total creatine content and creatine transporter gene expression in vegetarians prior to and following creatine

supplementation. *Int J Sport Nutr Exerc Metab*. (2004)https://www.ncbi.nlm.nih.gov/pubmed/15673098

Conclusions: "The results indicate that VEG have a lower muscle TCr content and an increased capacity to load Cr into muscle following CrS. Muscle CreaT gene expression does not appear to be affected by vegetarianism."

Type of Study: Double Blind Crossover Design

Participants: "7 vegetarians (VEG) and nonvegetarians (NVEG) were assigned Cr or placebo supplements for 5 d and after 5 wk, received the alternative treatment"

Dosage: n/a

3. Increased Muscle Mass

a. Branch JD. Effect of creatine supplementation on body composition and performance: a meta-analysis. *Int J Sport Nutr Exerc Metab*. (2003) https://www.ncbi.nlm.nih.gov/pubmed/12945830

Conclusions: "ES was greater for changes in lean body mass following short-term CS, repetitive-bout laboratory-based exercise tasks < or = 30 s (e.g., isometric, isokinetic, and isotonic resistance exercise), and upper-body exercise. CS does not appear to be effective in improving running and swimming performance. There is no evidence in the literature of an effect of gender or training status on ES following CS."

Type of Study: Meta-analysis of 96 peer reviewed papers

Participants: Varied

Dosage: Varied

b. Candow DG, et al. Effect of different frequencies of creatine supplementation on muscle size and strength in young adults. *J Strength Cond Res*. (2011)https://www.ncbi.nlm.nih.gov/pubmed/21512399

Conclusions: "We conclude that creatine supplementation during RT has a small beneficial effect on regional muscle thickness in young adults but that giving the creatine over 3 d wk did not differ from giving the same dose over 2 d wk."

Type of Study: Double Blind RCT

Participants: A group of 38 physically active, nonresistance trained university students (21-28 years)

Dosage: "randomly allocated to 1 of 4 groups: CR2 (0.15 g·kg creatine during 2 d wk of RT; 3 sets of 10 repetitions; n = 11, 6 men, 5 women), CR3 (0.10 g·kg creatine during 3 d wk of RT; 2 sets of 10 repetitions; n = 11, 6 men, 5 women;), PLA2 (placebo during 2 d wk of RT; n = 8, 5 men, 3 women), and PLA3 (placebo during 3 d wk of RT; n = 8, 4 men, 4 women) for 6 weeks."

c. Gotshalk LA, et al. Creatine supplementation improves muscular performance in older women. *Eur J Appl Physiol*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/17943308

Conclusions: "Short-term creatine supplementation resulted in an increase in strength, power, and lower-body motor functional performance in older women without any adverse side effects."

Type of Study: RCT

Participants: Thirty 58-71 year old women performed three test sessions (T1-T3) each separated by one week

Dosage: "subjects were assigned to a creatine monohydrate (0.3 g kg body mass(-1) for 7 days) (CR: 63.31 +/- 1.22 year, 160.00 +/- 1.58 cm, 67.11 +/- 4.38 kg) or a placebo (PL: 62.98 +/- 1.11 year, 162.25 +/- 2.09 cm, 67.84 +/- 3.90 kg) supplementation group."

d. Hoffman J, et al. Effect of creatine and beta-alanine supplementation on performance and endocrine responses in strength/power athletes. *Int J Sport Nutr Exerc Metab*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/17136944

Conclusions: "Creatine plus beta-alanine supplementation appeared to have the greatest effect on lean tissue accruement and body fat composition."

Type of Study: Double Blind RCT

Participants: Thirty-three male subjects

Dosage: "either a placebo (P), creatine (C), or creatine plus beta-alanine (CA) group."

e. Neves M Jr, et al. Beneficial effect of creatine supplementation in knee osteoarthritis. *Med Sci Sports Exerc*. (2011)https://www.ncbi.nlm.nih.gov/pubmed/21311365

Conclusions: "CR supplementation improves physical function, lower limb lean mass, and quality of life in postmenopausal women with knee OA undergoing strengthening exercises."

Type of Study: Double Blind RCT

Participants: Postmenopausal women with knee OA

Dosage: "CR (20 g·d(-1) for 1 wk and 5 g·d(-1) thereafter) or placebo (PL)"

4. Hydration Levels Unaffected

a. Lopez RM, et al. Does creatine supplementation hinder exercise heat tolerance or hydration status? A systematic review with meta-analyses. *J Athl Train*. (2009)https://www.ncbi.nlm.nih.gov/pubmed/19295968

Conclusions: "No evidence supports the concept that creatine supplementation either hinders the body's ability to dissipate heat or negatively affects the athlete's body fluid balance. Controlled experimental trials of athletes exercising in the heat resulted in no adverse effects from creatine supplementation at recommended dosages."

Type of Study: meta-analysis - Ten studies were selected on the basis of inclusion and exclusion criteria

Participants: n/a

Dosage: n/a

b. Weiss BA, Powers ME. Creatine supplementation does not impair the thermoregulatory response during a bout of exercise in the heat. *J Sports Med Phys Fitness*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/17119520

Conclusions: "Cr loading did not impair the thermoregulatory response during a bout of exercise in the heat."

Type of Study: RCT

Participants: "Twenty-four aerobically trained male subjects (age 22.93+/-3.01 years, height 179.52+/-7.28 cm, mass 82.06+/-14.32 kg)"

Dosage: 5 day supplementation period

5. Increased Anaerobic Running Capacity

a. Eckerson JM, et al. Effect of two and five days of creatine loading on anaerobic working capacity in women. *J Strength Cond Res*. (2004) https://www.ncbi.nlm.nih.gov/pubmed/14971965

Conclusions: "These results suggest that Cr supplementation is effective for increasing AWC in women following 5 days of loading without an associated increase in BW."

Type of Study: RCT

Participants: Ten physically active women

Dosage: " (A) 18 g dextrose as placebo (PL) or (B) 5.0 g Cr + 18 g dextrose taken 4 times per day for 5 days"

b. Glaister M, et al. Creatine supplementation and multiple sprint running performance. *J Strength Cond Res*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/16686553

Conclusions: "Despite widespread use as an ergogenic aid in sport, the results of this study suggest that creatine monohydrate supplementation conveys no benefit to multiple sprint running performance."

Type of Study: Double Blind RCT

Participants: 42 physically active men

Dosage: "5 days of either creatine (4 x d(-1) x 5 g creatine monohydrate + 1 g maltodextrin) or placebo (4 x d(-1) x 6 g maltodextrin) supplementation."

c. Juhász I, et al. Creatine supplementation improves the anaerobic performance of elite junior fin swimmers. *Acta Physiol Hung*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19706374

Conclusions: "The results of this study indicate that five day Cr supplementation enhances the dynamic strength and may increase anaerobic metabolism in the lower extremity muscles, and improves performance in consecutive maximal swims in highly trained adolescent fin swimmers."

Type of Study: Double Blind RCT

Participants: Sixteen male swimmers (age:15.9+/-1.6 years)

Dosage: "creatine (CR, 4x5 g/day creatine monohydrate for 5 days) or placebo group (P, same dose of a dextrose-ascorbic acid placebo)"

d. Mero AA, et al. Combined creatine and sodium bicarbonate supplementation enhances interval swimming. *J Strength Cond Res*. (2004) https://www.ncbi.nlm.nih.gov/pubmed/15142001

Conclusions: "The data indicate that simultaneous supplementation of creatine and sodium bicarbonate enhances performance in consecutive maximal swims."

Type of Study: Double Blind Crossover

Participants: . Sixteen competitive male and female swimmers

Dosage: “Both treatments consisted of placebo or creatine supplementation (20 g per day) in 6 days. In the morning of the seventh day, there was placebo or sodium bicarbonate supplementation (0.3 g per kg body weight) during 2 hours before a warm-up for 2 maximal 100-m freestyle swims that were performed with a passive recovery of 10 minutes in between”

e. Wright GA, Grandjean PW, Pascoe DD. The effects of creatine loading on thermoregulation and intermittent sprint exercise performance in a hot humid environment. *J Strength Cond Res*. (2007) http://www.ncbi.nlm.nih.gov/pubmed/17685723

Conclusions: “It appears that ingestion of Cr for 6 days does not produce any different thermoregulatory responses to intermittent sprint exercise and may augment sprint exercise performance in the heat.”

Type of Study: RCT

Participants: Ten physically active, heat-acclimatized men

Dosage: “The first week, subjects ingested 5 g of a placebo (P, maltodextrin) in 4 flavored drinks (20 g total) per day for 6 days and were retested on day 7. The second week was similar to the first except a similar dose (4 x 5 g/day) of creatine monohydrate (Cr) replaced maltodextrin in the flavored drinks.”

6. Decreased Fatigue

a. Anomasiri W, Sanguanrungsirikul S, Saichandee P. Low dose creatine supplementation enhances sprint phase of 400 meters swimming performance. *J Med Assoc Thai*. (2004) https://www.ncbi.nlm.nih.gov/pubmed/16083193

Conclusions: “Therefore, the creatine supplement in amateur swimmers in the present study enhanced the physical performance up to the maximum capacity.”

Type of Study: RCT

Participants: Nineteen swimmers in the experimental group received creatine monohydrate 5 g with orange solution 15 g, twice per day for 7 days and nineteen swimmers in the control group received the same quantity of orange solution.

Dosage: 10 g / day

b. McMorris T, et al. Effect of creatine supplementation and sleep deprivation, with mild exercise, on cognitive and psychomotor performance, mood state, and plasma concentrations of catecholamines and cortisol. *Psychopharmacology (Berl)*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/16416332

Conclusions: "Following 24-h sleep deprivation, creatine supplementation had a positive effect on mood state and tasks that place a heavy stress on the prefrontal cortex."

Type of Study: Double Blind RCT

Participants: Subjects were divided into a creatine group (n=10) and a placebo group (n=9)

Dosage: "5 g of creatine monohydrate or a placebo, dependent on their group, four times a time a day for 7 days, immediately prior to the experiment."

c. Schneider-Gold C, et al. Creatine monohydrate in DM2/PROMM: a double-blind placebo-controlled clinical study. Proximal myotonic myopathy. *Neurology*. (2003) https://www.ncbi.nlm.nih.gov/pubmed/12578937

Conclusions: "Some measures indicated trends toward mild improvement with Cr. Myalgia improved in two patients."

Type of Study: Double Blind RCT

Participants: Twenty patients received either Cr or placebo for 3 months

Dosage: n/a

d. Watanabe A, Kato N, Kato T. Effects of creatine on mental fatigue and cerebral hemoglobin oxygenation. *Neurosci Res*. (2002) https://www.ncbi.nlm.nih.gov/pubmed/11985880

Conclusions: "After taking the creatine supplement, task-evoked increase of cerebral oxygenated hemoglobin in the brains of subjects measured by near infrared spectroscopy was significantly reduced, which is compatible with increased oxygen utilization in the brain."

Type of Study: Double Blind RCT

Participants: n/a

Dosage: 8 g/day for 5 days

7. Decreased Blood Glucose

a. Gualano B, et al. Effects of creatine supplementation on glucose tolerance and insulin sensitivity in sedentary healthy males undergoing aerobic training. *Amino Acids*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/17396216

Conclusions: "The results suggest that creatine supplementation, combined with aerobic training, can improve glucose tolerance but does not affect insulin sensitivity, and may warrant further investigation with diabetic subjects."

Type of Study: Double Blind RCT

Participants: 22 healthy males

Dosage: "creatine (CT) (approximately 10 g . day over three months) or placebo (PT) (dextrose). Administration of treatments was double blind."

8. Increased Testosterone

a. Cook CJ, et al. Skill execution and sleep deprivation: effects of acute caffeine or creatine supplementation - a randomized placebo-controlled trial. *J Int Soc Sports Nutr*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21324203

Conclusions: "Salivary testosterone was not affected by sleep deprivation, but trended higher with the 100 mg/kg creatine dose, compared to the placebo treatment ($p = 0.067$)."

Type of Study: Crossover Design

Participants: 10 elite rugby players

Dosage: 50 or 100 mg/kg

b. D.Sheikholeslami Vatani et al. The effects of creatine supplementation on performance and hormonal response in amateur swimmers. *Elsevier.* (2011) http://www.sciencedirect.com/science/article/pii/S0765159711001171

Conclusions: "But, testosterone concentration was significantly greater in CR compared to PL after supplementation period ($P < 0.05$)."

Type of Study: Double Blind

Participants: Twenty amateur male swimmers

Dosage: creatine monohydrate (CR) or a matched placebo (PL) for 6 days.

c. Hoffman J, et al. Effect of creatine and beta-alanine supplementation on performance and endocrine responses in strength/power athletes. *Int J Sport Nutr Exerc Metab*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/17136944

Conclusions: "Resting testosterone concentrations were elevated in C"

Type of Study: RCT Double Blind

Participants: Thirty-three male subjects

Dosage: "either a placebo (P), creatine (C), or creatine plus beta-alanine (CA) group."

d. Volek JS, et al. The effects of creatine supplementation on muscular performance and body composition responses to short-term resistance training overreaching. *Eur J Appl Physiol*. (2004) https://www.ncbi.nlm.nih.gov/pubmed/14685870

Conclusions: "Total testosterone (TT) and the free androgen index (TT/SHBG) decreased in CrM and P"

Type of Study: RCT

Participants: 17 men

Dosage: 0.3 g/kg per day of creatine monohydrate (CrM:*n*=9) or placebo (P: *n*=8)

9. Increased Perceived Well-Being

a. Deacon SJ, et al. Randomized controlled trial of dietary creatine as an adjunct therapy to physical training in chronic obstructive pulmonary disease. *Am J Respir Crit Care Med*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/18420964

Conclusions: "Health status, measured using the CRQ-SR, showed statistical and clinically significant improvements in all domains after PR"

Type of Study: Double Blind RCT

Participants: One hundred subjects with COPD

Dosage: Subjects ingested creatine (22 g/d loading for 5 d; maintenance, 3.76 g/d throughout PR) or placebo.

b. Fuld JP, et al. Creatine supplementation during pulmonary rehabilitation in chronic obstructive pulmonary disease. *Thorax*. (2005) https://www.ncbi.nlm.nih.gov/pubmed/15994258

Conclusions: “We found clinically meaningful improvements in health related quality of life with creatine and rehabilitation compared with rehabilitation alone.”

Type of Study: Double Blind RCT

Participants: Thirty eight patients with COPD

Dosage: (glucose polymer 40.7 g) or creatine (creatine monohydrate 5.7 g, glucose 35 g)

c. McMorris T, et al. Effect of creatine supplementation and sleep deprivation, with mild exercise, on cognitive and psychomotor performance, mood state, and plasma concentrations of catecholamines and cortisol. *Psychopharmacology (Berl)*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/16416332

Conclusions: “Following 24-h sleep deprivation, creatine supplementation had a positive effect on mood state and tasks that place a heavy stress on the prefrontal cortex.”

Type of Study: Double Blind RCT

Participants: Subjects were divided into a creatine group (n=10) and a placebo group (n=9)

Dosage: “5 g of creatine monohydrate or a placebo, dependent on their group, four times a time a day for 7 days, immediately prior to the experiment.”

d. Neves M Jr, et al. Beneficial effect of creatine supplementation in knee osteoarthritis. *Med Sci Sports Exerc*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21311365

Conclusions: “CR supplementation improves physical function, lower limb lean mass, and quality of life in postmenopausal women with knee OA undergoing strengthening exercises.”

Type of Study: Double Blind RCT

Participants: Postmenopausal women

Dosage: CR (20 g·d(-1) for 1 wk and 5 g·d(-1) thereafter) or placebo (PL)

10. Decreased Depression

a. Lyoo IK, et al. A Randomized, Double-Blind Placebo-Controlled Trial of Oral Creatine Monohydrate Augmentation for Enhanced Response to a Selective Serotonin Reuptake Inhibitor in Women With Major Depressive Disorder. *Am J Psychiatry*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/22864465

Conclusions: “The current study suggests that creatine augmentation of SSRI treatment may be a promising therapeutic approach that exhibits more rapid and efficacious responses in women with major depressive disorder.”

Type of Study: Double Blind RCT

Participants: 52 women with major depressive disorder

Dosage: creatine (5 g/day, N=25) or placebo (N=27)

11. Increased Cognition In Vegetarians

a. Benton D, Donohoe R. The influence of creatine supplementation on the cognitive functioning of vegetarians and omnivores. *Br J Nutr*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21118604

Conclusions: “However, in vegetarians rather than in those who consume meat, creatine supplementation resulted in better memory.”

Type of Study: Double Blind RCT

Participants: 128 people broken in to vegetarians and non-vegetarians

Dosage: placebo or 20 g of creatine supplement for 5 d

b. Rae C, et al. Oral creatine monohydrate supplementation improves brain performance: a double-blind, placebo-controlled, cross-over trial. *Proc Biol Sci*. (2003) https://www.ncbi.nlm.nih.gov/pubmed/14561278

Conclusions: “Creatine supplementation had a significant positive effect ($p < 0.0001$) on both working memory (backward digit span) and intelligence (Raven's Advanced Progressive Matrices), both tasks that require speed of processing.”

Type of Study: Double Blind Crossover Design

Participants: 45 young adult vegetarian subjects

Dosage: 5 g/ day for 6 weeks

12. Decrease DNA damage

a. Rahimi R. Creatine supplementation decreases oxidative DNA damage and lipid peroxidation induced by a single bout of resistance exercise. *J Strength Cond Res*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/22080314

Conclusions: “These results indicate that Cr supplementation reduced oxidative DNA damage and lipid peroxidation induced by a single bout of RE.”

Type of Study: Double Blind RCT

Participants: 27 resistance trained men

Dosage: “(the Cr group [21.6 ± 3.6 years], taking 4 × 5 g Cr monohydrate per day) or a placebo (PL) supplementation group (the PL group [21.2 ± 3.2 years], taking 4 × 5 g maltodextrin per day)”

13. Decrease in Headaches

a. Sakellaris G, et al. Prevention of traumatic headache, dizziness and fatigue with creatine administration. A pilot study. *Acta Paediatr*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/18053002 - cohort

Conclusions: “The administration of Cr to children and adolescents with TBI improved results in several parameters, including duration of post traumatic amnesia (PTA), duration of intubation, intensive care unit stay. Significant improvement was recorded in the categories of headache ($p<0.001$), dizziness ($p=0.005$) and fatigue ($p<0.001$), aspects in all patients. No side effects were seen due to Cr administration.”

Type of Study: Prospective, Randomized, Comparative, Open-labelled Pilot Study

Participants: 39 children and adolescents, aged between 1 and 18 years of age, with TBI

Dosage: 6 months at a dose of 0.4 g/kg in an oral suspension form every day

14. Increase in Cognitive Ability When Sleep Deprived

a. McMorris T, et al. Creatine supplementation, sleep deprivation, cortisol, melatonin and behavior. *Physiol Behav*. (2007) https://www.ncbi.nlm.nih.gov/pubmed/17046034

Conclusions: “It was concluded that, during sleep deprivation with moderate-intensity exercise, creatine supplementation only affects performance of complex central executive tasks.”

Type of Study: Double Blind RCT

Participants: n/a

Dosage: “They took 5g of creatine monohydrate or a placebo, dependent on their group, four times a day for 7 days immediately prior to the experiment.”

b. McMorris T, et al. Effect of creatine supplementation and sleep deprivation, with mild exercise, on cognitive and psychomotor performance, mood state, and plasma concentrations of catecholamines and cortisol. *Psychopharmacology (Berl)*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/16416332

Conclusions: "Following 24-h sleep deprivation, creatine supplementation had a positive effect on mood state and tasks that place a heavy stress on the prefrontal cortex."

Type of Study: Double Blind RCT

Participants: Subjects were divided into a creatine group (n=10) and a placebo group (n=9)

Dosage: "5g of creatine monohydrate or a placebo, dependent on their group, four times a day for 7 days, immediately prior to the experiment."

3 grams of Tyrosine

L-Tyrosine is an amino acid found mostly in high protein food sources like beef and has been shown to increase catecholamine, especially when the body is under stress.

Highlighted below are four different studies to support all of the claims that can be made for the dose we use in Jungle Shot.

1. Increased Cognition

a. Banderet LE, Lieberman HR. Treatment with tyrosine, a neurotransmitter precursor, reduces environmental stress in humans. *Brain Res Bull*. (1989) https://www.ncbi.nlm.nih.gov/pubmed/2736402

Conclusions: "Tyrosine significantly decreased symptoms, adverse moods, and performance impairments in subjects who exhibited average or greater responses to these environmental conditions."

Type of Study: Double Blind Crossover Design

Participants: Humans

Dosage: 100 mg/kg

b. Deijen JB, et al. Tyrosine improves cognitive performance and reduces blood pressure in cadets after one week of a combat training course. *Brain Res Bull*. (1999) https://www.ncbi.nlm.nih.gov/pubmed/10230711

Conclusions: “The group supplied with the tyrosine-rich drink performed better on a memory and a tracking task than the group supplied with the carbohydrate-rich drink.”

Type of Study: RCT

Participants: 21 cadets during a demanding military combat training course.

Dosage: “Ten subjects received five daily doses of a protein-rich drink containing 2 g tyrosine, and 11 subjects received a carbohydrate rich drink with the same amount of calories (255 kcal)”

c. Neri DF, et al. The effects of tyrosine on cognitive performance during extended wakefulness. *Aviat Space Environ Med*. (1995)
https://www.ncbi.nlm.nih.gov/pubmed/7794222

Conclusions: “The results of this study also suggest that tyrosine is a relatively benign treatment at this dose. After further testing with other doses and timing of administration, tyrosine may prove useful in counteracting performance decrements during episodes of sustained work coupled with sleep loss.”

Type of Study: Double Blind RCT

Participants: Humans

Dosage: 150 mg.kg-1 tyrosine in a split dose while the other half received cornstarch placebo

2. Decreased Stress

a. Banderet LE, Lieberman HR. Treatment with tyrosine, a neurotransmitter precursor, reduces environmental stress in humans. *Brain Res Bull*. (1989)
https://www.ncbi.nlm.nih.gov/pubmed/2736402

Conclusions: “Tyrosine significantly decreased symptoms, adverse moods, and performance impairments in subjects who exhibited average or greater responses to these environmental conditions.”

Type of Study: Double Blind Crossover Design

Participants: Humans

Dosage: 100 mg/kg

b. Deijen JB, et al. Tyrosine improves cognitive performance and reduces blood pressure in cadets after one week of a combat training course. *Brain Res Bull*. (1999) https://www.ncbi.nlm.nih.gov/pubmed/10230711

Conclusions: "These findings suggest that supplementation with tyrosine may, under operational circumstances characterized by psychosocial and physical stress, reduce the effects of stress and fatigue on cognitive task performance."

Type of Study: RCT

Participants: 21 cadets during a demanding military combat training course.

Dosage: "Ten subjects received five daily doses of a protein-rich drink containing 2 g tyrosine, and 11 subjects received a carbohydrate rich drink with the same amount of calories (255 kcal)"

3. Increased Subjective Well-Being

a. Banderet LE, Lieberman HR. Treatment with tyrosine, a neurotransmitter precursor, reduces environmental stress in humans. *Brain Res Bull*. (1989) https://www.ncbi.nlm.nih.gov/pubmed/2736402

Conclusions: "Tyrosine significantly decreased symptoms, adverse moods, and performance impairments in subjects who exhibited average or greater responses to these environmental conditions."

Type of Study: Double Blind Crossover Design

Participants: Humans

Dosage: 100 mg/kg

b. Deijen JB, et al. Tyrosine improves cognitive performance and reduces blood pressure in cadets after one week of a combat training course. *Brain Res Bull*. (1999) https://www.ncbi.nlm.nih.gov/pubmed/10230711

Conclusions: "No effects on mood were found. These findings suggest that supplementation with tyrosine may, under operational circumstances characterized by psychosocial and physical stress, reduce the effects of stress and fatigue on cognitive task performance."

Type of Study: RCT

Participants: 21 cadets during a demanding military combat training course.

Dosage: Ten subjects received five daily doses of a protein-rich drink containing 2 g tyrosine, and 11 subjects received a carbohydrate rich drink with the same amount of calories (255 kcal)

4. Increased Working Memory

a. Shurtleff D, et al. Tyrosine reverses a cold-induced working memory deficit in humans. *Pharmacol Biochem Behav*. (1994) https://www.ncbi.nlm.nih.gov/pubmed/8029265

Conclusions: "Administration of tyrosine significantly improved matching accuracy at the longest delay interval most affected by cold exposure, such that matching accuracy in the cold following tyrosine was at the same level as matching accuracy following placebo or tyrosine administration at 22 degrees C."

Type of Study: Double Blind RCT

Participants: Eight male volunteers

Dosage: 150 mg/kg of L-tyrosine or placebo

2 grams of Taurine

Taurine is an amino sulphonic acid that aides in cellular as well as organ function (mostly seen in the heart) and helps maintain a stable fluid balance in cells lowering the risk of cramps.

Highlighted below are three different studies to support all of the claims that can be made for the dose we use in Jungle Shot.

1. Increased Blood Flow

a. Moloney MA, et al. Two weeks taurine supplementation reverses endothelial dysfunction in young male type 1 diabetics. *Diab Vasc Dis Res*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/20667936

Conclusions: "In conclusion, 2 weeks taurine supplementation reverses early, detectable conduit vessel abnormalities in young male diabetics."

Type of Study: Double Blind Crossover Design

Participants: 9 type 1 male diabetics.

Dosage: 2 weeks of placebo or taurine

2. Lowers Cholesterol Levels

a. Chapman, R.A., Suleinan, M.S. & Earm, Y.E. (1993) *Taurine and the heart*, Cardiovascular Research, Volume 27, issue 3, (pp. 358-363

Conclusions: "We conclude that taurine reduces blood pressure in SHR and decreases cardiac hypertrophy by impacting the antioxidant activity."

Type of Study: RCT

Participants: Hypertensive rats

Dosage: 1g/l for 4 weeks

3. Increased Exercise Capacity

a. Beyranvand MR, et al. Effect of taurine supplementation on exercise capacity of patients with heart failure. *J Cardiol*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21334852

Conclusions: "Taurine supplementation in patients with HF who are taking standard medical treatment can increase their exercise capacity."

Type of Study: Single Blind RCT

Participants: 29 patients with HF

Dosage: 500 mg three times a day

1 gram of Alpha-Glyceryl phosphoryl choline (Alpha-GPC)
Alpha-glyceryl phosphoryl choline is a enzymatic deacylation of phosphatidylcholine enriched soy phospholipids which then is followed and created through chromatographic purification. Alpha-GPC seems to be the most effective supplement of increasing systemic and brain levels of choline.

Highlighted below are four different studies to support all of the claims that can be made for the dose we use in Jungle Shot.

1. Decrease in Cognitive Decline

a. De Jesus Moreno Moreno M. Cognitive improvement in mild to moderate Alzheimer's dementia after treatment with the acetylcholine precursor choline alfoscerate: a multicenter, double-blind, randomized, placebo-controlled trial. *Clin Ther*. (2003) https://www.ncbi.nlm.nih.gov/pubmed/12637119

Conclusions: “The results of this study suggest the clinical usefulness and tolerability of CA in the treatment of the cognitive symptoms of dementia disorders of the Alzheimer type.”

Type of Study: Double Blind RCT

Participants: 261 patients with mild to moderate dementia

Dosage: 400-mg capsules) or placebo capsules, 3 times daily, for 180 days

2. Increased in Power Output

a. Ziegenfuss T, et al. Acute supplementation with alpha-glycerylphosphorylcholine augments growth hormone response to, and peak force production during, resistance exercise. *Journal of the International Society of Sports Nutrition.* (2008) https://jissn.biomedcentral.com/articles/10.1186/1550-2783-5-S1-P15

Conclusions: “These data indicate that a single 600 mg dose of A-GPC, when administered 90 minutes prior to resistance exercise, increases post-exercise serum GH and peak bench press force.”

Type of Study: Crossover Design

Participants: 7 men with two years or more of lifting experience

Dosage: 600 mg or placebo

3. Decrease in Alzheimer symptoms

a. De Jesus Moreno Moreno M. Cognitive improvement in mild to moderate Alzheimer's dementia after treatment with the acetylcholine precursor choline alfoscerate: a multicenter, double-blind, randomized, placebo-controlled trial. *Clin Ther*. (2003) https://www.ncbi.nlm.nih.gov/pubmed/12637119

Conclusions: “The results of this study suggest the clinical usefulness and tolerability of CA in the treatment of the cognitive symptoms of dementia disorders of the Alzheimer type.”

Type of Study: Double Blind RCT

Participants: 261 patients with mild to moderate dementia

Dosage: 400-mg capsules) or placebo capsules, 3 times daily, for 180 days

4. Increase in Growth Hormone

a. Kawamura T, et al. Glycerophosphocholine enhances growth hormone secretion and fat oxidation in young adults. *Nutrition*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/22673596

Conclusions: "These findings suggest that a single dose of GPC increases growth hormone secretion and hepatic fat oxidation, with concomitant increases in choline levels, in young adults."

Type of Study: Double Blind Randomized Crossover Study

Participants: 8 healthy male subjects

Dosage: 1 g

b. Ziegenfuss T, et al. Acute supplementation with alpha-glycerylphosphorylcholine augments growth hormone response to, and peak force production during, resistance exercise. *Journal of the International Society of Sports Nutrition.* (2008) https://jissn.biomedcentral.com/articles/10.1186/1550-2783-5-S1-P15

Conclusions: "These data indicate that a single 600 mg dose of A-GPC, when administered 90 minutes prior to resistance exercise, increases post-exercise serum GH and peak bench press force."

Type of Study: Crossover Design

Participants: 7 men with two years or more of lifting experience

Dosage: 600 mg or placebo

5. Increase in Fat Oxidation

a. Kawamura T, et al. Glycerophosphocholine enhances growth hormone secretion and fat oxidation in young adults. *Nutrition*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/22673596

Conclusions: "These findings suggest that a single dose of GPC increases growth hormone secretion and hepatic fat oxidation, with concomitant increases in choline levels, in young adults."

Type of Study: Double Blind Randomized Crossover Design

Participants: 8 healthy male subjects

Dosage: 1 g

6. Increase in Iron Absorption

a. Armah CN, et al. L-alpha-glycerophosphocholine contributes to meat's enhancement of nonheme iron absorption. *J Nutr*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/18424594

Conclusions: “We have identified L-alpha as a component of muscle tissue that enhances nonheme iron absorption, and this finding provides new opportunities for iron fortification of foods.”

Type of Study: Single Blind RCT

Participants: 13 women of childbearing age with low iron stores

Dosage: Fortified vegetable lasagna with alpha gpc

500 mg of Ashwagandha

Ashwagandha is an herb used quite often in Ayurveda medicine. The major mechanism of how Ashwagandha works in unknown but it's profound beneficial effects have been seen in the literature.

Highlighted below are nine different studies to support all of the claims that can be made at the dose we use in Jungle Shot.

1. Decreased Anxiety

a. Andrade C, et al. A double-blind, placebo-controlled evaluation of the anxiolytic efficacy of an ethanolic extract of withania somnifera. *Indian J Psychiatry*. (2000) https://www.ncbi.nlm.nih.gov/pubmed/21407960

Conclusions: “It is concluded that this ethanolic extract of Withania somnifera has useful anxiolytic potential and merits further investigation.”

Type of Study: Double Blind RCT

Participants: 39 people

Dosage: ethanolic extract of Aswagandha (Withania somnifera)

b. Cooley K, et al. Naturopathic care for anxiety: a randomized controlled trial ISRCTN78958974. *PLoS One*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19718255

Conclusions: “Group comparison demonstrated a significant decrease in anxiety levels in the NC group over the PT group. Significant improvements in secondary quality of life measures were also observed in the NC group as compared to PT. The whole system of naturopathic care for anxiety needs to be investigated further including a closer examination of the individual components within the context of their additive effect.”

Type of Study: RCT

Participants: Seventy-five participants

Dosage: 300 mg

c. Chandrasekhar K, Kapoor J, Anishetty S. A prospective, randomized double-blind, placebo-controlled study of safety and efficacy of a high-concentration full-spectrum extract of ashwagandha root in reducing stress and anxiety in adults. *Indian J Psychol Med*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/23439798

Conclusions: “The findings of this study suggest that a high-concentration full-spectrum Ashwagandha root extract safely and effectively improves an individual's resistance towards stress and thereby improves self-assessed quality of life.”

Type of Study: RCT

Participants: 64 subjects

Dosage: 300 mg

2. Decreased C-Reactive Protein

a. Biswajit A, et al. A Standardized Withania Somnifera Extract Significantly Reduces Stress-Related Parameters in Chronically Stressed Humans: A Double-Blind, Randomized, Placebo-Controlled Study. *JANA*. (2008) http://www.enaonline.org/files/artikel/205/JANA%20Vol.11_May%2031%202008.pdf

Conclusions: “This study determined that daily consumption of standardized WSE at three dosages (125 mg QD, 125 mg BID, and 250 mg BID) reduced experiential feelings of stress and anxiety, serum concentrations of cortisol and CRP, pulse rate and blood pressure; and increased serum concentration of DHEAS in the chronically stressed adults who completed the study. The WSE 125 mg BID and WSE 250 mg BID dosages also improved fasting blood glucose levels and lipid profiles for study participants in those groups. Cardiac risk ratios improved for the two higher dosage WSE groups.”

Type of Study: RCT

Participants: 160 men and women

Dosage: 125 mg and 250 mg

b. Chandrasekhar K, Kapoor J, Anishetty S. A prospective, randomized double-blind, placebo-controlled study of safety and efficacy of a high-concentration full-spectrum extract of ashwagandha root in reducing stress and anxiety in adults. *Indian J Psychol Med*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/23439798

Conclusions: "The findings of this study suggest that a high-concentration full-spectrum Ashwagandha root extract safely and effectively improves an individual's resistance towards stress and thereby improves self-assessed quality of life."

Type of Study: RCT

Participants: 64 subjects

Dosage: 300 mg

3. Decreased Cortisol

a. Biswajit A, et al. A Standardized Withania Somnifera Extract Significantly Reduces Stress-Related Parameters in Chronically Stressed Humans: A Double-Blind, Randomized, Placebo-Controlled Study. *JANA*. (2008) http://www.enaonline.org/files/artikel/205/JANA%20Vol.11_May%2031%202008.pdf

Conclusions: "This study determined that daily consumption of standardized WSE at three dosages (125 mg QD, 125 mg BID, and 250 mg BID) reduced experiential feelings of stress and anxiety, serum concentrations of cortisol and CRP, pulse rate and blood pressure; and increased serum concentration of DHEAS in the chronically stressed adults who completed the study. The WSE 125 mg BID and WSE 250 mg BID dosages also improved fasting blood glucose levels and lipid profiles for study participants in those groups. Cardiac risk ratios improved for the two higher dosage WSE groups."

Type of Study: RCT

Participants: 160 men and women

Dosage: 125 mg and 250 mg

b. Chandrasekhar K, Kapoor J, Anishetty S. A prospective, randomized double-blind, placebo-controlled study of safety and efficacy of a high-concentration full-spectrum extract of ashwagandha root in reducing stress and anxiety in adults. *Indian J Psychol Med*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/23439798

Conclusions: “The findings of this study suggest that a high-concentration full-spectrum Ashwagandha root extract safely and effectively improves an individual's resistance towards stress and thereby improves self-assessed quality of life.”

Type of Study: RCT

Participants: 64 subjects

Dosage: 300 mg

4. Increased Power Output

a. Sandhu JS, et al. Effects of Withania somnifera (Ashwagandha) and Terminalia arjuna (Arjuna) on physical performance and cardiorespiratory endurance in healthy young adults. *Int J Ayurveda Res*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/21170205

Conclusions: “Withania somnifera may therefore be useful for generalized weakness and to improve speed and lower limb muscular strength and neuromuscular coordination.”

Type of Study: RCT

Participants: forty healthy individuals

Dosage: 500 mg/ d for 8 weeks

b. Wankhede S, et al. Examining the effect of Withania somnifera supplementation on muscle strength and recovery: a randomized controlled trial. *J Int Soc Sports Nutr*. (2015) https://www.ncbi.nlm.nih.gov/pubmed/26609282

Conclusions: “This study reports that ashwagandha supplementation is associated with significant increases in muscle mass and strength and suggests that ashwagandha supplementation may be useful in conjunction with a resistance training program.”

Type of Study: Prospective Blind Study

Participants: 57 young male subjects

Dosage: “300 mg of ashwagandha root extract twice daily, while the control group consumed starch placebo”

5. Decreased Stress

a. Chandrasekhar K, Kapoor J, Anishetty S. A prospective, randomized double-blind, placebo-controlled study of safety and efficacy of a high-concentration full-spectrum

extract of ashwagandha root in reducing stress and anxiety in adults. *Indian J Psychol Med*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/23439798

Conclusions: "The findings of this study suggest that a high-concentration full-spectrum Ashwagandha root extract safely and effectively improves an individual's resistance towards stress and thereby improves self-assessed quality of life."

Type of Study: RCT

Participants: 64 subjects

Dosage: 300 mg

6. Decreased Cholesterol

a. Biswajit A, et al. A Standardized Withania Somnifera Extract Significantly Reduces Stress-Related Parameters in Chronically Stressed Humans: A Double-Blind, Randomized, Placebo-Controlled Study. *JANA*. (2008) http://www.enaonline.org/files/artikel/205/JANA%20Vol.11_May%2031%202008.pdf

Conclusions: "This study determined that daily consumption of standardized WSE at three dosages (125 mg QD, 125 mg BID, and 250 mg BID) reduced experiential feelings of stress and anxiety, serum concentrations of cortisol and CRP, pulse rate and blood pressure; and increased serum concentration of DHEAS in the chronically stressed adults who completed the study. The WSE 125 mg BID and WSE 250 mg BID dosages also improved fasting blood glucose levels and lipid profiles for study participants in those groups. Cardiac risk ratios improved for the two higher dosage WSE groups."

Type of Study: RCT

Participants: 160 men and women

Dosage: 125 mg and 250 mg

7. Increased Aerobic Capacity

a. Shenoy S, et al. Effects of eight-week supplementation of Ashwagandha on cardiorespiratory endurance in elite Indian cyclists. *J Ayurveda Integr Med*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/23326093

Conclusions: "Ashwagandha improved the cardiorespiratory endurance of the elite athletes."

Type of Study: RCT

Participants: 40 elite Indian Cyclists

Dosage: 1 g/ day for 8 weeks

8. Increased Anaerobic Running Capacity

a. Sandhu JS, et al. Effects of Withania somnifera (Ashwagandha) and Terminalia arjuna (Arjuna) on physical performance and cardiorespiratory endurance in healthy young adults. *Int J Ayurveda Res*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/21170205

Conclusions: "Withania somnifera may therefore be useful for generalized weakness and to improve speed and lower limb muscular strength and neuromuscular coordination."

Type of Study: RCT

Participants: forty healthy individuals

Dosage: 500 mg/ d for 8 weeks

9. Decrease in Depression

a. Andrade C, et al. A double-blind, placebo-controlled evaluation of the anxiolytic efficacy of an ethanolic extract of withania somnifera. *Indian J Psychiatry*. (2000) https://www.ncbi.nlm.nih.gov/pubmed/21407960

Conclusions: "It is concluded that this ethanolic extract of Withania somnifera has useful anxiolytic potential and merits further investigation."

Type of Study: Double Blind RCT

Participants: 39 people

Dosage: ethanolic extract of Aswagandha (Withania somnifera)

b. Chandrasekhar K, Kapoor J, Anishetty S. A prospective, randomized double-blind, placebo-controlled study of safety and efficacy of a high-concentration full-spectrum extract of ashwagandha root in reducing stress and anxiety in adults. *Indian J Psychol Med*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/23439798

Conclusions: "The findings of this study suggest that a high-concentration full-spectrum Ashwagandha root extract safely and effectively improves an individual's resistance towards stress and thereby improves self-assessed quality of life."

Type of Study: RCT

Participants: 64 subjects

Dosage: 300 mg

10. Decrease in Fatigue

a. Cooley K, et al. Naturopathic care for anxiety: a randomized controlled trial ISRCTN78958974. *PLoS One*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19718255

Conclusions: "Group comparison demonstrated a significant decrease in anxiety levels in the NC group over the PT group. Significant improvements in secondary quality of life measures were also observed in the NC group as compared to PT. The whole system of naturopathic care for anxiety needs to be investigated further including a closer examination of the individual components within the context of their additive effect."

Type of Study: RCT

Participants: Seventy-five participants

Dosage: 300 mg

11. Increase in Motivation

a. Cooley K, et al. Naturopathic care for anxiety: a randomized controlled trial ISRCTN78958974. *PLoS One*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19718255

Conclusions: "Group comparison demonstrated a significant decrease in anxiety levels in the NC group over the PT group. Significant improvements in secondary quality of life measures were also observed in the NC group as compared to PT. The whole system of naturopathic care for anxiety needs to be investigated further including a closer examination of the individual components within the context of their additive effect."

Type of Study: RCT

Participants: Seventy-five participants

Dosage: 300 mg

12. Increase in Seminal Motility

a. Gupta A, et al. Efficacy of Withania somnifera on seminal plasma metabolites of infertile males: A proton NMR study at 800MHz. *J Ethnopharmacol*. (2013) https://www.ncbi.nlm.nih.gov/pubmed/23796876

Conclusions: “The results suggest that Withania somnifera may be used as an empirical therapy for clinical management and treatment of infertility.”

Type of Study: Prospective

Participants: 180 infertile patients

Dosage: 5 g/day for three months

13. Increase in Subjective Well Being

a. Biswajit A, et al. A Standardized Withania Somnifera Extract Significantly Reduces Stress-Related Parameters in Chronically Stressed Humans: A Double-Blind, Randomized, Placebo-Controlled Study. *JANA*. (2008) http://www.enaonline.org/files/artikel/205/JANA%20Vol.11_May%2031%202008.pdf

Conclusions: “This study determined that daily consumption of standardized WSE at three dosages (125 mg QD, 125 mg BID, and 250 mg BID) reduced experiential feelings of stress and anxiety, serum concentrations of cortisol and CRP, pulse rate and blood pressure; and increased serum concentration of DHEAS in the chronically stressed adults who completed the study. The WSE 125 mg BID and WSE 250 mg BID dosages also improved fasting blood glucose levels and lipid profiles for study participants in those groups. Cardiac risk ratios improved for the two higher dosage WSE groups.”

Type of Study: RCT

Participants: 160 men and women

Dosage: 125 mg and 250 mg

14. Increase in Testosterone

a. Ahmad MK, et al. Withania somnifera improves semen quality by regulating reproductive hormone levels and oxidative stress in seminal plasma of infertile males.*Fertil Steril*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/19501822

Conclusions: “The treatment with W. somnifera effectively reduced oxidative stress, as assessed by decreased levels of various oxidants and improved level of diverse antioxidants. Moreover, the levels of T, LH, FSH and PRL, good indicators of semen quality, were also reversed in infertile subjects after treatment with the herbal preparation.”

Type of Study: Prospective Study

Participants: 75 normal healthy fertile males (control) and 75 men undergoing infertility screening

Dosage: 5 g/ day with milk

b. Gupta A, et al. Efficacy of Withania somnifera on seminal plasma metabolites of infertile males: A proton NMR study at 800MHz. *J Ethnopharmacol*. (2013) https://www.ncbi.nlm.nih.gov/pubmed/23796876

Conclusions: "The results suggest that Withania somnifera may be used as an empirical therapy for clinical management and treatment of infertility."

Type of Study: Prospective

Participants: 180 infertile patients

Dosage: 5 g/ day for three months

c. Wankhede S, et al. Examining the effect of Withania somnifera supplementation on muscle strength and recovery: a randomized controlled trial. *J Int Soc Sports Nutr*. (2015) https://www.ncbi.nlm.nih.gov/pubmed/26609282

Conclusions: "significantly greater increase in testosterone level (Placebo: 18.0 ng/dL, 95% CI, -15.8, 51.8 vs. Ashwagandha: 96.2 ng/dL, 95% CI, 54.7, 137.5; p = 0.004)"

Type of Study: Prospective Blind Study

Participants: 57 young male subjects

Dosage: "300 mg of ashwagandha root extract twice daily, while the control group consumed starch placebo"

15. Increase in Sperm Quality

a. Gupta A, et al. Efficacy of Withania somnifera on seminal plasma metabolites of infertile males: A proton NMR study at 800MHz. *J Ethnopharmacol*. (2013) https://www.ncbi.nlm.nih.gov/pubmed/23796876

Conclusions: "The results suggest that Withania somnifera may be used as an empirical therapy for clinical management and treatment of infertility."

Type of Study: Prospective

Participants: 180 infertile patients

Dosage: 5 g/ day for three months

16. Decrease in Triglycerides

a. Agnihotri AP, et al. Effects of Withania somnifera in patients of schizophrenia: A randomized, double blind, placebo controlled pilot trial study. *Indian J Pharmacol*. (2013) https://www.ncbi.nlm.nih.gov/pubmed/24014929
Conclusions: "a statistically significant (P<0.05) reduction in serum triglycerides and FBG was observed after 1 month of WS treatment compared to the placebo group."

Type of Study: Double Blind RCT

Participants: 30 participants

Dosage: 1.2 g/ day for 1 month

b. Biswajit A, et al. A Standardized Withania Somnifera Extract Significantly Reduces Stress-Related Parameters in Chronically Stressed Humans: A Double-Blind, Randomized, Placebo-Controlled Study. *JANA*. (2008) http://www.enaonline.org/files/artikel/205/JANA%20Vol.11_May%2031%202008.pdf

Conclusions: "This study determined that daily consumption of standardized WSE at three dosages (125 mg QD, 125 mg BID, and 250 mg BID) reduced experiential feelings of stress and anxiety, serum concentrations of cortisol and CRP, pulse rate and blood pressure; and increased serum concentration of DHEAS in the chronically stressed adults who completed the study. The WSE 125 mg BID and WSE 250 mg BID dosages also improved fasting blood glucose levels and lipid profiles for study participants in those groups. Cardiac risk ratios improved for the two higher dosage WSE groups."

Type of Study: RCT

Participants: 160 men and women

Dosage: 125 mg and 250 mg

17. Decrease in Fat

a. Wankhede S, et al. Examining the effect of Withania somnifera supplementation on muscle strength and recovery: a randomized controlled trial. *J Int Soc Sports Nutr*. (2015) https://www.ncbi.nlm.nih.gov/pubmed/26609282

Conclusions: "significantly greater decrease in body fat percentage (Placebo: 1.5%, 95% CI, 0.4%, 2.6% vs. Ashwagandha: 3.5%, 95% CI, 2.0%, 4.9%; p = 0.03)." It is unclear whether the decrease in body fat % was due to fat mass decreasing or FFM increasing.

Type of Study: Prospective Blind Study

Participants: 57 young male subjects

Dosage: “300 mg of ashwagandha root extract twice daily, while the control group consumed starch placebo.”

18. Decrease in LDL

a. Biswajit A, et al. A Standardized Withania Somnifera Extract Significantly Reduces Stress-Related Parameters in Chronically Stressed Humans: A Double-Blind, Randomized, Placebo-Controlled Study. *JANA*. (2008) http://www.enaonline.org/files/artikel/205/JANA%20Vol.11_May%2031%202008.pdf

Conclusions: “This study determined that daily consumption of standardized WSE at three dosages (125 mg QD, 125 mg BID, and 250 mg BID) reduced experiential feelings of stress and anxiety, serum concentrations of cortisol and CRP, pulse rate and blood pressure; and increased serum concentration of DHEAS in the chronically stressed adults who completed the study. The WSE 125 mg BID and WSE 250 mg BID dosages also improved fasting blood glucose levels and lipid profiles for study participants in those groups. Cardiac risk ratios improved for the two higher dosage WSE groups.”

Type of Study: RCT

Participants: 160 men and women

Dosage: 125 mg and 250 mg

19. Increase in Immunity

a. Mikolai J, et al. In vivo effects of Ashwagandha (Withania somnifera) extract on the activation of lymphocytes. *J Altern Complement Med*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19388865 - cohort

Conclusions: “Significant increases were observed in the expression of CD4 on CD3+ T cells after 96 hours. CD56+ NK cells were also activated after 96 hours as evidenced by expression of the CD69 receptor. At 96 hours of use, mean values of receptor expression for all measured receptor types were increased over baseline, indicating that a major change in immune cell activation occurred across the sample.”

Type of Study: Case Study

Participants: Five (5) participants - few participants

Dosage: “6 mL of an Ashwagandha root extract twice daily for 96 hours. Ashwagandha was administered with *anupana* (whole milk). Peripheral blood samples were collected at 0, 24, and 96 hours and compared for differences in cell surface expression of CD4, CD8, CD19, CD56, and CD69 receptors by flow cytometry.”

20. Decrease in Insomnia

a. Biswal BM, et al. Effect of Withania somnifera (Ashwagandha) on the development of chemotherapy-induced fatigue and quality of life in breast cancer patients.*Integr Cancer Ther*. (2013) https://www.ncbi.nlm.nih.gov/pubmed/23142798 - cohort

Conclusions: “Withania somnifera has potential against cancer-related fatigue, in addition to improving the quality of life. However, further study with a larger sample size in a randomized trial is warranted to validate our findings.”

Type of Study: open-label prospective nonrandomized comparative trial - need RCT

Participants: 100 patients with breast cancer

Dosage: 2 g every 8 hours

21. Decrease in Pain

a. Biswal BM, et al. Effect of Withania somnifera (Ashwagandha) on the development of chemotherapy-induced fatigue and quality of life in breast cancer patients.*Integr Cancer Ther*. (2013) https://www.ncbi.nlm.nih.gov/pubmed/23142798

Conclusions: “Withania somnifera has potential against cancer-related fatigue, in addition to improving the quality of life. However, further study with a larger sample size in a randomized trial is warranted to validate our findings.”

Type of Study: open-label prospective nonrandomized comparative trial

Participants: 100 patients with breast cancer

Dosage: 2 g every 8 hours

22. Decrease in Muscle Damage

a. Wankhede S, et al. Examining the effect of Withania somnifera supplementation on muscle strength and recovery: a randomized controlled trial. *J Int Soc Sports Nutr*. (2015) https://www.ncbi.nlm.nih.gov/pubmed/26609282

Conclusions: “Compared to the placebo subjects, the subjects receiving ashwagandha also had significantly greater reduction of exercise-induced muscle damage as indicated by the stabilization of serum creatine kinase “

Type of Study: Prospective Blind Study

Participants: 57 young male subjects

Dosage: “300 mg of ashwagandha root extract twice daily, while the control group consumed starch placebo”

23. Increase in Natural Killer Cell

a. Mikolai J, et al. In vivo effects of Ashwagandha (Withania somnifera) extract on the activation of lymphocytes. *J Altern Complement Med*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19388865

Conclusions: “Significant increases were observed in the expression of CD4 on CD3+ T cells after 96 hours. CD56+ NK cells were also activated after 96 hours as evidenced by expression of the CD69 receptor. At 96 hours of use, mean values of receptor expression for all measured receptor types were increased over baseline, indicating that a major change in immune cell activation occurred across the sample.”

Type of Study: Case Study

Participants: Five (5) participants

Dosage: “6 mL of an Ashwagandha root extract twice daily for 96 hours. Ashwagandha was administered with *anupana* (whole milk). Peripheral blood samples were collected at 0, 24, and 96 hours and compared for differences in cell surface expression of CD4, CD8, CD19, CD56, and CD69 receptors by flow cytometry.”

24. Increase in Sperm Count

a. Mahdi AA, et al. Withania somnifera Improves Semen Quality in Stress-Related Male Fertility. *Evid Based Complement Alternat Med*. (2009) https://www.ncbi.nlm.nih.gov/pubmed/19789214

Conclusions: “Treatment resulted in a decrease in stress, improved the level of anti-oxidants and improved overall semen quality in a significant number of individuals. The treatment resulted in pregnancy in the partners of 14% of the patients.”

Type of Study: Cohort

Participants: "normozoospermic but infertile individuals (N = 60), further categorized in three groups: normozoospermic heavy smokers (N = 20), normozoospermics under psychological stress (N = 20) and normozoospermics with infertility of unknown etiology (N = 20). Normozoospermic fertile men (N = 60) were recruited as controls."

Dosage: 5 g/ day for 3 months

300mg of Pure Ocean Atlantic Sea Salt

1. Improved Anaerobic Performance

a. Sale C, et al. Effect of β-alanine plus sodium bicarbonate on high-intensity cycling capacity. *Med Sci Sports Exerc*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21407127

Conclusions: "Results show that BA improved high-intensity cycling capacity. However, despite a 6-s (~4%) increase in TTE with the addition of SB, this did not reach statistical significance, but magnitude-based inferences suggested a ~70% probability of a meaningful positive difference."

Type of Study: Blind crossover design

Participants: 20 males; 20-30 years of age

2. Higher Blood Volume

a. Mora-Rodriguez R et al. Salt and Fluid Loading: Effects on Blood Volume and Exercise Performance. *Acute Topics in Sport Nutrition.* (2013)

Conclusions: "In summary, the available literature suggests that pre-exercise saline ingestion with concentrations not over 164 mmol/l Na+ is an ergogenic aid for subsequent prolonged exercise in a warm or thermoneutral environment."

Type of Study: meta-analysis, 4 studies

Participants: n/a

3. Improved Muscular Pump

a. Mora-Rodriguez R et al. Salt and Fluid Loading: Effects on Blood Volume and Exercise Performance. *Acute Topics in Sport Nutrition.* (2013)

Conclusions: "In summary, the available literature suggests that pre-exercise saline ingestion with concentrations not over 164 mmol/l Na+ is an ergogenic aid for subsequent prolonged exercise in a warm or thermoneutral environment."

Type of Study: meta-analysis, 4 studies

Participants: n/a

4. Improved Hydration

a. Bog-Hieu Lee, et al. Natural sea salt consumption confers protection against hypertension and kidney damage in Dahl salt-sensitive rats. *Food Nutr Res.* (2017) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5328355/

Conclusions: "We conclude from our findings that both the level of salt intake as well as the type of salt can influence blood pressure. As expected, higher salt consumption led to higher blood pressure. However, even when the effects of salt concentration were ruled out, sea salt intake induced less hypertension than refined salt and caused less damage to the heart and the kidney. It is likely that the major beneficial effect of sea salt is associated with the mineral content of the sea salt that is known to be anti-hypertensive such as potassium, calcium and magnesium. It is also possible that there are as yet undetermined component(s) of the sea salt that might confer resistance to hypertension. Further studies are required to elucidate the mechanism of how sea salt attenuates blood pressure. Based on our findings it would also be important to determine if sea salt consumption would have similar effects on blood pressure in humans."

Type of Study: RCT

Participants: Four-week-old male Dahl salt sensitive rats

Dosage: "control diet (CON, $n = 10$), 4% sea salt diet (SS4, $n = 12$), 4% refined salt diet (RS4, $n = 12$), 8% sea salt diet (SS8, $n = 12$), and 8% refined salt diet (RS8, $n = 12$)."

5. Protects Against Kidney Damage and Hypertension

a. Bog-Hieu Lee, et al. Natural sea salt consumption confers protection against hypertension and kidney damage in Dahl salt-sensitive rats. *Food Nutr Res.* (2017) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5328355/

Conclusions: "We conclude from our findings that both the level of salt intake as well as the type of salt can influence blood pressure. As expected, higher salt consumption led to higher blood pressure. However, even when the effects of salt concentration were ruled out, sea salt intake induced less hypertension than refined salt and caused less damage to the heart and the kidney. It is likely that the major beneficial effect of sea salt is associated with the mineral content of the sea salt that is known to be anti-hypertensive such as potassium, calcium and magnesium. It is also possible that there are as yet undetermined component(s) of the sea salt that might confer resistance to hypertension. Further studies are required to elucidate the mechanism of how sea salt attenuates blood

pressure. Based on our findings it would also be important to determine if sea salt consumption would have similar effects on blood pressure in humans."

Type of Study: RCT

Participants: Four-week-old male Dahl salt sensitive rats

Dosage: "control diet (CON, *n* = 10), 4% sea salt diet (SS4, *n* = 12), 4% refined salt diet (RS4, *n* = 12), 8% sea salt diet (SS8, *n* = 12), and 8% refined salt diet (RS8, *n* = 12)."

200mg of Caffeine

Caffeine is a xanthine compound that is an adenosine receptor antagonist meaning it blocks adenosine from binding to the adenosine receptor and therefore wards off feelings drowsiness and fatigue.

Highlighted below are twenty-six different studies to support all of the claims that can be made for the dose we use in Jungle Shot.

1. Increased Anaerobic Running Academy

a. Carr AJ, Gore CJ, Dawson B. Induced alkalosis and caffeine supplementation: effects on 2,000-m rowing performance. *Int J Sport Nutr Exerc Metab*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21799214

Conclusions: "Rowers' performance in 2,000-m efforts can improve by ~2% with 6 mg/kg BM caffeine supplementation"

Type of Study: Double Blind Crossover Design

Participants: 8 well trained rowers

Dosage: 6 mg/kg caffeine

b. Paton CD, Lowe T, Irvine A. Caffeinated chewing gum increases repeated sprint performance and augments increases in testosterone in competitive cyclists. *Eur J Appl Physiol*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/20737165

Conclusions: "The acute ingestion of caffeine via chewing gum attenuated fatigue during repeated, high-intensity sprint exercise in competitive cyclists. Furthermore, the delayed fatigue was associated with substantially elevated testosterone concentrations and decreased cortisol in the caffeine trials."

Type of Study: RCT

Participants: 9 male cyclists

Dosage: 240 mg/ d or placebo

c. Pontifex KJ, et al. Effects of caffeine on repeated sprint ability, reactive agility time, sleep and next day performance. *J Sports Med Phys Fitness*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/21178933

Conclusions: "Caffeine improved RSA, including next day performance"

Type of Study: Single Blind Randomized Crossover Design

Participants: 10 moderately trained individuals

Dosage: 6 mg per kg or placebo 1 hour before training

d. Schneiker KT, et al. Effects of caffeine on prolonged intermittent-sprint ability in team-sport athletes. *Med Sci Sports Exerc*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/16540848

Conclusions: "This study revealed that acute caffeine ingestion can significantly enhance performance of prolonged, intermittent-sprint ability in competitive, male, team-sport athletes."

Type of Study: Double Blind, Placebo-Controlled Design

Participants: 10 males

Dosage: 6 mg/ kg

2. Increased Power Output

a. Beaven CM, et al. Dose effect of caffeine on testosterone and cortisol responses to resistance exercise. *Int J Sport Nutr Exerc Metab*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/18458357

Conclusions: "Testosterone concentration showed a small increase of 15% (90% confidence limits, +/- 19%) during exercise. Caffeine raised this concentration in a dose-dependent manner by a further small 21% (+/- 24%) at the highest dose. The 800-mg dose also produced a moderate 52% (+/- 44%) increase in cortisol. The effect of caffeine on the testosterone:cortisol ratio was a small decline (14%; +/- 21%)."

Type of Study: Double Blind Crossover Design

Participants: Twenty-four professional rugby-league players

Dosage: ingested caffeine doses of 0, 200, 400, and 800 mg in random order 1 hr before a resistance-exercise session.

b. Cook C, et al. Acute caffeine ingestion's increase of voluntarily chosen resistance-training load after limited sleep. *Int J Sport Nutr Exerc Metab.* (2012) https://www.ncbi.nlm.nih.gov/pubmed/22349085

Conclusions: "Caffeine increased voluntary workload in professional athletes, even more so under conditions of self-reported limited sleep. Caffeine may prove worthwhile when athletes are tired, especially in those identified as responders."

Type of Study: Double blind, crossover design

Participants: 16 professional rugby players

Dosage: 4 mg/ kg 1 hour before exercise or placebo

c. Del Coso J, et al. Dose response effects of a caffeine-containing energy drink on muscle performance: a repeated measures design. *J Int Soc Sports Nutr*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/22569090

Conclusions: "A caffeine dose of at least 3 mg/kg in the form of an energy drink is necessary to significantly improve half-squat and bench-press maximal muscle power."

Type of Study: Randomized Crossover Design

Participants: 12 active participants

Dosage: 1 and 3 mg/ kg

d. Glaister M, et al. Caffeine supplementation and multiple sprint running performance. *Med Sci Sports Exerc*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/18799995

Conclusions: "Although the effect of recovery duration on caffeine-induced responses to multiple sprint work requires further investigation, the results of the present study show that caffeine has ergogenic properties with the potential to benefit performance in both single and multiple sprint sports."

Type of Study: Double Blind RCT

Participants: 21 active men

Dosage: 5 mg/ kg or placebo

e. Mora-Rodríguez R, et al. Caffeine ingestion reverses the circadian rhythm effects on neuromuscular performance in highly resistance-trained men. *PLoS One*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/22496767

Conclusions: "These results indicate that caffeine ingestion reverses the morning neuromuscular declines in highly resistance-trained men, raising performance to the levels of the afternoon trial. Our electrical stimulation data, along with the NE values, suggest that caffeine increases neuromuscular performance having a direct effect in the muscle."

Type of Study: Randomized Crossover Design

Participants: 12 highly resistance trained males

Dosage: 3 mg/ kg or placebo

f. Schneiker KT, et al. Effects of caffeine on prolonged intermittent-sprint ability in team-sport athletes. *Med Sci Sports Exerc*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/16540848

Conclusions: "This study revealed that acute caffeine ingestion can significantly enhance performance of prolonged, intermittent-sprint ability in competitive, male, team-sport athletes."

Type of Study: Double Blind, Placebo Controlled Design

Participants: 10 males

Dosage: 6 mg/ kg

3. Increased Adrenaline

a. Anderson DE, Hickey MS. Effects of caffeine on the metabolic and catecholamine responses to exercise in 5 and 28 degrees C. *Med Sci Sports Exerc*. (1994) https://www.ncbi.nlm.nih.gov/pubmed/8201901

Conclusions: "Thus, caffeine increases plasma epinephrine; cold increases oxygen consumption and carbohydrate metabolism, while decreasing lipid metabolism; and the combination of caffeine and cold during exercise increases plasma epinephrine and lipid metabolism, but decreases carbohydrate metabolism."

Type of Study: Randomized Crossover Design

Participants: 8 healthy males

Dosage: 5 mg/kg or placebo

b. Keijzers GB, et al. Caffeine can decrease insulin sensitivity in humans. *Diabetes Care*. (2002) https://www.ncbi.nlm.nih.gov/pubmed/11815511

Conclusions: "Plasma epinephrine increased fivefold ($P < 0.0005$), and smaller increases were recorded in plasma norepinephrine ($P < 0.02$) and blood pressure ($P < 0.001$)."

Type of Study: Randomized Double Blind Crossover Design

Participants: 12 healthy volunteers

Dosage: 3 mg/ kg

c. Norager CB, et al. Metabolic effects of caffeine ingestion and physical work in 75-year old citizens. A randomized, double-blind, placebo-controlled, cross-over study. *Clin Endocrinol (Oxf)*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/16886964

Conclusions: "Caffeine treatment increased epinephrine, fatty acids, lactate and norepinephrine at different times during test session."

Type of Study: Double Blind Placebo Controlled Cross Study

Participants: 30 subjects

Dosage: 6 mg/ kg

4. Increased Aerobic Capacity

a. Desbrow B, et al. The effects of different doses of caffeine on endurance cycling time trial performance. *J Sports Sci*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/22142020

Conclusions: "A caffeine dose of 3 mg x kg(-1) body mass appears to improve cycling performance in well-trained and familiarised athletes. Doubling the dose to 6 mg x kg(-1) body mass does not confer any additional improvements in performance."

Type of Study: Double-Blind Crossover Design

Participants: Sixteen well-trained and familiarised male cyclists

Dosage: 3 mg/ kg and 6 mg/ kg

b. Ganio MS, et al. Effect of ambient temperature on caffeine ergogenicity during endurance exercise. *Eur J Appl Physiol*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21120518

Conclusions: "These findings suggest that caffeine at the dosage utilized (6 mg/kg body mass) is a, legal drug that provides an ergogenic benefit in 12 and 33°C."

Type of Study: Double Blind RCT

Participants: 11 male cyclists

Dosage: "Subjects ingested 3 mg kg(-1) of encapsulated caffeine (CAF) or placebo (PLA) 60 min prior to and after 45 min of exercise."

c. Womack CJ, et al. The influence of a CYP1A2 polymorphism on the ergogenic effects of caffeine. *J Int Soc Sports Nutr*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/22420682

Conclusions: "Caffeine supplementation reduced 40 kilometer time by a greater ($p < 0.05$) magnitude in AA homozygotes (4.9%; caffeine = 72.4 ± 4.2 min, placebo = 76.1 ± 5.8 min) as compared to C allele carriers (1.8%; caffeine = 70.9 ± 4.3 min, placebo = 72.2 ± 4.2 min)."

Type of Study: Double Blind RCT

Participants: 35 trained male cyclists

Dosage: 6 mg/ kg or placebo

5. Increase in Blood Glucose - Mobilizes Energy

a. Greer F, et al. Caffeine ingestion decreases glucose disposal during a hyperinsulinemic-euglycemic clamp in sedentary humans. *Diabetes*. (2001) https://www.ncbi.nlm.nih.gov/pubmed/11574419

Conclusions: These data support our hypothesis that caffeine ingestion decreases glucose disposal and suggests that adenosine plays a role in regulating glucose disposal in resting humans.

Type of Study: Double Blind Randomized Crossover Design

Participants: 9 lean healthy sedentary males

Dosage: 5 mg/ kg or placebo

b. Pizziol A, et al. Effects of caffeine on glucose tolerance: a placebo-controlled study. *Eur J Clin Nutr*. (1998) https://www.ncbi.nlm.nih.gov/pubmed/9846599

Conclusions: "The data suggest that caffeine intake induces a rise in blood glucose levels that is insulin independent."

Type of Study: Single Blind Latin Square

Participants: 30 healthy subjects

Dosage: 200 mg or placebo

6. Increase in Testosterone

a. Beaven CM, et al. Dose effect of caffeine on testosterone and cortisol responses to resistance exercise. *Int J Sport Nutr Exerc Metab*. (2008) https://www.ncbi.nlm.nih.gov/pubmed/18458357

Conclusions: "Testosterone concentration showed a small increase of 15% (90% confidence limits, +/- 19%) during exercise. Caffeine raised this concentration in a dose-dependent manner by a further small 21% (+/- 24%) at the highest dose. The 800-mg dose also produced a moderate 52% (+/- 44%) increase in cortisol. The effect of caffeine on the testosterone:cortisol ratio was a small decline (14%; +/- 21%)."

Type of Study: Double Blind Crossover Design

Participants: Twenty-four professional rugby-league players

Dosage: ingested caffeine doses of 0, 200, 400, and 800 mg in random order 1 hr before a resistance-exercise session.

b. Cook C, et al. Acute caffeine ingestion's increase of voluntarily chosen resistance-training load after limited sleep. *Int J Sport Nutr Exerc Metab.* (2012) https://www.ncbi.nlm.nih.gov/pubmed/22349085

Conclusions: "Testosterone response to exercise increased with caffeine compared with placebo, as did cortisol response."

Type of Study: Double blind, Crossover Design

Participants: 16 professional rugby players

Dosage: 4 mg/ kg 1 hour before exercise or placebo

c. Paton CD, Lowe T, Irvine A. Caffeinated chewing gum increases repeated sprint performance and augments increases in testosterone in competitive cyclists. *Eur J Appl Physiol*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/20737165

Conclusions: The acute ingestion of caffeine via chewing gum attenuated fatigue during repeated, high-intensity sprint exercise in competitive cyclists. Furthermore, the delayed fatigue was associated with substantially elevated testosterone concentrations and decreased cortisol in the caffeine trials.

Type of Study: RCT

Participants: 9 male cyclists

Dosage: 240 mg/ d or placebo

7. Increase in Reaction Time

a. Adan A, Serra-Grabulosa JM. Effects of caffeine and glucose, alone and combined, on cognitive performance. *Hum Psychopharmacol*. (2010) https://www.ncbi.nlm.nih.gov/pubmed/20521321

Conclusions: "Caffeine only showed improvement in simple reaction time"

Type of Study: Double Blind RCT

Participants: 72 healthy subjects

Dosage: water (150 ml); water plus 75 mg of caffeine; water plus 75 g of glucose; water plus and 75 mg of caffeine and 75 g of glucose. Attention, manual dexterity, visuo-spatial and frontal functions, memory (immediate, consolidation and working) and subjective state were all assessed.

b. Duvnjak-Zaknich DM, et al. Effect of caffeine on reactive agility time when fresh and fatigued. *Med Sci Sports Exerc*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21266929

Conclusions: "Caffeine ingestion may be beneficial to RA performance when athletes are fresh and fatigued."

Type of Study: Randomized, Double Blind, Counterbalanced Design

Participants: 10 moderately trained males

Dosage: 6 mg/ kg or placebo

c. Hunt MG, Momjian AJ, Wong KK. Effects of diurnal variation and caffeine consumption on Test of Variables of Attention (TOVA) performance in healthy young adults. *Psychol Assess*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21244169

Conclusions: "Caffeine consumption led to significantly faster response times, but only for participants who typically consumed relatively little caffeine."

Type of Study: Double Blind, Placebo Controlled Experiment

Participants: Healthy college students

Dosage: n/a

8. Increase in Blood Flow

a. Shechter M, et al. Impact of acute caffeine ingestion on endothelial function in subjects with and without coronary artery disease. *Am J Cardiol*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21349479

Conclusions: In conclusion, acute caffeine ingestion significantly improved endothelial function assessed by brachial artery FMD in subjects with and without CAD and was associated with lower plasma markers of inflammation.

Type of Study: Prospective

Participants: 40 controls and 40 age- and gender-matched patients with documented stable CAD

Dosage: 200 mg or placebo

9. Increase in Metabolic Rate

a. Astrup A, et al. Caffeine: a double-blind, placebo-controlled study of its thermogenic, metabolic, and cardiovascular effects in healthy volunteers. *Am J Clin Nutr*. (1990) https://www.ncbi.nlm.nih.gov/pubmed/2333832

Conclusions: "The results suggest that lactate and triglyceride production and increased vascular smooth muscle tone may be responsible for the major part of the thermogenic effect of caffeine."

Type of Study: Double Blind Placebo Controlled

Participants: Habitual moderate caffeine intakes

Dosage: Placebo and 100, 200, and 400 mg oral caffeine

10. Increase in Perceived Well-Being

a. Childs E, de Wit H. Subjective, behavioral, and physiological effects of acute caffeine in light, nondependent caffeine users. *Psychopharmacology (Berl)*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/16541243

Conclusions: "We confirm that acute doses of caffeine, at levels typically found in a cup of coffee, produce stimulant-like subjective effects and enhance performance in light, nondependent caffeine users. These findings support the idea that the drug has psychoactive effects even in the absence of withdrawal."

Type of Study: Randomized Double Blind Crossover Design

Participants: 102 light, nondependent caffeine users

Dosage: 0, 50, 150, and 450 mg caffeine

b. Duncan MJ, Oxford SW. The effect of caffeine ingestion on mood state and bench press performance to failure. *J Strength Cond Res*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21157384

Conclusions: "Caffeine ingestion enhances performance in short-term, resistance exercise to failure and may favorably change the mood state response to exercise compared to a placebo."

Type of Study: Randomized Crossover Design

Participants: 13 moderately trained men

Dosage: 5 mg/ kg or placebo

11. Increased Wakefulness

a. Barry RJ, Clarke AR, Johnstone SJ. Caffeine and opening the eyes have additive effects on resting arousal measures. *Clin Neurophysiol*. (2011) https://www.ncbi.nlm.nih.gov/pubmed/21489866

Conclusions: "Caffeine and opening the eyes have additive effects on two measures of arousal, increasing SCL and reducing global EEG alpha. However, the independent variable effects are not equivalent, suggesting that one or both measures reflect additional non-arousal processes."

Type of Study: Counterbalanced Randomised Double Blind Study

Participants: 22 University students

Dosage: Caffeine or Placebo

b. Childs E, de Wit H. Subjective, behavioral, and physiological effects of acute caffeine in light, nondependent caffeine users. *Psychopharmacology (Berl)*. (2006) https://www.ncbi.nlm.nih.gov/pubmed/16541243

Conclusions: "We confirm that acute doses of caffeine, at levels typically found in a cup of coffee, produce stimulant-like subjective effects and enhance performance in light, nondependent caffeine users. These findings support the idea that the drug has psychoactive effects even in the absence of withdrawal."

Type of Study: Randomized Double Blind Crossover Design

Participants: 102 light, nondependent caffeine users

Dosage: 0, 50, 150, and 450 mg caffeine

12. Increased Oxygen Uptake

a. Karapetian GK, et al. Effect of Caffeine on LT, VT and HRVT. *Int J Sports Med*. (2012) https://www.ncbi.nlm.nih.gov/pubmed/22499570

Conclusions: "During progressive exercise, minute ventilation volumes were higher in caffeine trials but no other parameters were significantly different compared to placebo tests."

Type of Study: Randomized placebo controlled, Double Blind Study Design

Participants: 10 adults

Dosage: 5 mg/ kg