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## Abstract

We examined 28 days of randomly assigned of (1) Placebo (PL), (2) Creatine Monohydrate (CR, 3 g), (3) Creatine Nitrate (CrN; 1 g CR; 0.5 N) and (4) Creatine Nitrate 2x (CrN2X; 2 g CR; 1.0 g N) supplementation on exercise performance and body composition. Participants (N=48; 21±3 y) presented for fasted (12-hr) testing after abstaining from exercise for 48-hr. Performance (repetitions at 70% of bench press 1 RM (BP) and repeated sprints on cycle ergometer) was measured at 0 & 4 weeks. Body composition (DXA) was measured at 0, 1, & 4 weeks. We used GLM to examine mean change (95% CI) from baseline. While all three treatment groups significantly increased bench press (BP) repetitions at 4 weeks; total BP lifting volume was greater at 4 weeks for CrN2X (294.6 lbs; 95% CI, 196, 393) vs. CrN (164.2 lbs; 95% CI, 25, 304) and PL (187.1 lbs; 95% CI, 37, 336, both P = 0.02). No treatment effects were observed for cycle ergometry testing (peak or mean power, fatigue slope, and total work). While no differences in fat mass were observed for any treatment group, CrN2X did augment lean mass (1.2 lbs; 95% CI, 0.3, 2.1 and fat-free mass (1.1 lbs; 98.4, 95% CI, 0.2, 2). Our results indicate that CrN2X can increase muscular endurance, and lean and fat-free mass.

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## Rationale

Athletes use ergogenic aids in an attempt to increase training-adaptations, which serves to enhance their performance during competition. Creatine monohydrate is one of the most studied ergogenic aids. Creatine monohydrate has been shown to improve muscular strength, power, and endurance. Additionally, an increase in lean mass and a decrease in fat-mass have also been observed with Creatine monohydrate supplementation. Although many studies have shown the efficacy and effectiveness of creatine monohydrate supplement manufacturers continually introduce newer forms of creatine into the marketplace. The newer forms of creatine purport to be more effective than creatine monohydrate alone. However, there is little evidence to support the manufacturers claims. The purpose of this experiment is to examine the effects of 28 days of supplementation—(1) Placebo (PL), (2) Creatine Monohydrate (CR, 3 g), (3) Creatine Nitrate (CrN; 1 g CR; 0.5 N) and (4) Creatine Nitrate 2x (CrN2X; 2 g CR; 1.0 g N) - on exercise performance and body composition.

- Analysis included GLM to examine mean change (95% CI) from baseline using

## Statistical Analysis

- IBM SPSS for Windows version 22.0 software (Chicago, IL).
- Subjects were recruited through flyers and email using the university's Listserv.

## Methods and Procedures

- Subjects were asked to refrain from exercise, alcohol, and non-steroidal anti-inflammatory drugs 48-hrs prior to each testing session
- 1 repetition maximum on bench press determined at familiarization session (visit 1). Anaerobic sprint practice test also administered at this visit.
- Subjects instructed to begin standardized resistance training program two weeks before next lab visit.
- 4-day food records were obtained at each visit and analyzed.

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## Subjects

## Experimental Design

- 48, apparently healthy males (N=13; 21±2 y) were recruited for this study.
- Subjects were informed of experimental procedures and signed a consent statement in adherence with the human subject guidelines of Texas A&M University.
- A standard medical exam and review of subject medical history was performed by a research RN for clearance to participate in the study.

### Testing Protocol

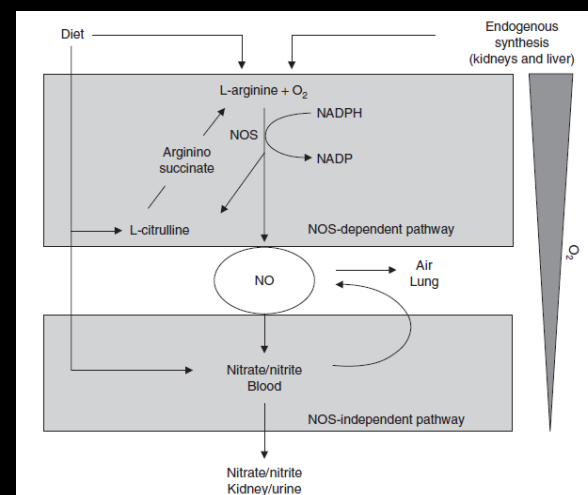
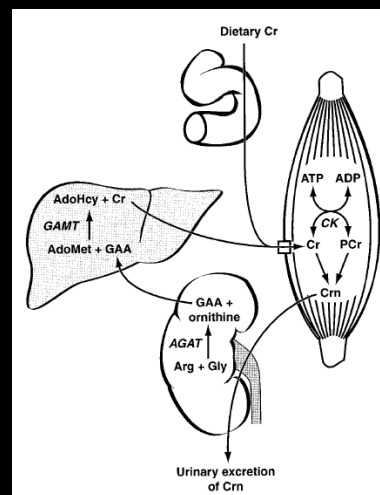
- Testing Session 1:** Subjects signed informed consent statement and completed physical exam. Also completed a 1 repetition maximum bench press test and an anaerobic sprint practice test on a cycle ergometer. The next testing session occurred two weeks later.
- Testing Session 2:** Muscle biopsy performed 24-hr prior to performance testing. Performance testing session measures included: 12-h fasting blood sample, body composition (DXA), bench press test (3 sets of 10 reps @ 70% of 1RM, with total repetitions to failure on last set), and Wingate anaerobic sprint test (6 X 6 sprints with 30 second rest between sprints; 3 minute rest; then Wingate test). The next testing session occurred approximately one week later.

- Testing Session 3:** Muscle biopsy performed, 12-hr fasting blood sample collected, and body composition (DXA) determined. The next testing session occurred three weeks later.

- Testing Session 4:** Muscle biopsy performed 24-hr prior to performance testing. Performance testing session measures included: 12-h fasting blood sample, body composition (DXA), bench press test (3 sets of 10 reps @ 70% of 1RM, with total repetitions to failure on last set), and Wingate anaerobic sprint test (6 X 6 sprints with 30 second rest between sprints; 3 minute rest; then Wingate test).

### Supplementation Protocol

- Subjects assigned to ingest either: 1) Placebo (PL), (2) Creatine Monohydrate (CR, 3 g), (3) Creatine Nitrate (CrN; 1 g CR; 0.5 N) and (4) Creatine Nitrate 2x (CrN2X; 2 g CR; 1.0 g N)
- Consumed supplement with 8 oz. of water four times per day (at approximately 0800, 1200, 1600, 2000) on days one through seven.
- Then consumed supplement with 8 oz. one time per day for the remainder of the study (days eight through 28).



## Results

- While all three treatment groups significantly increased BP repetitions at 4 weeks; total BP lifting volume was greater at 4 weeks for CrN2X (294.6 lbs; 95% CI, 196, 393) vs. CrN (164.2 lbs; 95% CI, 25, 304) and PL (187.1 lbs; 95% CI, 37, 336, both P = 0.02).
- No treatment effects were observed for cycle ergometry testing (peak or mean power, fatigue slope, and total work).
- While no differences in fat mass were observed for any treatment group, CrN2X did augment lean mass (1.2 lbs; 95% CI, 0.3, 2.1 and fat-free mass (1.1 lbs; 98.4, 95% CI, 0.2, 2). Our results indicate that CrN2X can increase muscular endurance, and lean and fat-free mass.

## Conclusions

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## Figures

