

**Improving Cardiovascular Performance and Decreasing Perceived Exertion with Lactate Supplement**Corey Peacock¹, Brandon Pollock², Keith Burns², Gabe Sanders², Ellen Glickman²¹Exercise and Sports Science, Nova Southeastern University, Fort Lauderdale, FL, USA, ²Exercise Physiology, Kent State University, Kent, OH, USA**ABSTRACT**

Peacock CA, Pollock BS, Burns, KL, Sanders, GJ, Glickman, EL. Improving Cardiovascular Performance and Decreasing Perceived Exertion with Lactate Supplement. **JEPonline** 2012;15(6):68-73. The purpose of this study was to determine the effect of a supplement containing Calcium Lactate, Magnesium Lactate Dihydrate, and Zinc Oxide (Muscle Sentry LLS, Cleveland, OH) (MS) versus a placebo (PLA) on physiological performance and muscle recovery. Twelve male subjects (23.7 ± 2.1 yrs) underwent an exercise protocol while ingesting a single dosage of both MS and PLA for two separate trials. Experimental testing was used to investigate the differences in maximum aerobic capacity (VO_2 max), creatine kinase levels (CK), perceived exertion index (PEI), and blood flow (BF) during single dosage supplementation. Paired samples t-tests demonstrated a significant improvement in VO_2 and PEI following MS supplementation when compared to PLA ($P < 0.05$). Analysis of variance demonstrated a main effect for time ($P < 0.05$) as BF increased during the exercise protocol but did not differ between supplementation. CK was not significantly different between conditions ($P > 0.05$), however change scores demonstrated less muscle damage following MS ingestion. From these findings, it appears that MS supplementation resulted in increased performance and decreased the perceived difficulty of the exercise when compared to PLA.

Key Words: Exercise, VO_2 max, PEI

INTRODUCTION

Ergogenic aids are defined as substances or devices used to improve exercise and athletic performance by improving the production of energy (4). Athletes and coaches aggressively pursue ergogenic aids in an attempt to better athletic performance, no matter how minute the effects (4). It has recently been suggested by the manufacturer, Muscle Sentry, LLC of Cleveland, OH, that a single dosage of a calcium lactate, magnesium lactate, and zinc oxide ergogenic aid known as Muscle Sentry (MS) will improve cardiovascular performance and prevent muscle trauma in athletes. Therefore, we designed the present investigation to examine the effectiveness of this ergogenic aid to meet its claims in improving performance and reducing muscle damage. In order to do so, we conducted a randomized, double blind placebo control study to account for all independent variables under the experimental conditions.

To address the company's claim as labeled on the bottle, "Formulated to Improve Cardiovascular Performance and Prevent Muscle Trauma," we opted to use a maximum aerobic capacity test (VO_2 max) as well as monitor creatine kinase (CK) levels both pre- and post-exercise. The maximal capacity to transport and use oxygen during exercise is known as maximal oxygen uptake (VO_2 max). It is considered by exercise physiologists to be the primary physiologic measurement of cardiovascular fitness (6) in the determination of performance capabilities. CK has been used as a marker for muscle damage. An increase in blood plasma concentrations of CK is typically observed following exercise. It can be indicative of muscle damage and tearing (5). Therefore inducing muscle damage will result in a rise in CK levels in the blood plasma.

Recent research has suggested that catecholamines improve athletic performance. During exercise, such as a VO_2 max test, catecholamines have also been shown to stimulate muscle glycolysis that increases the production of lactate (2). Hence, the lactate supplementation of MS may in fact promote performance enhancement similar to that of the naturally occurring catecholamines.

The purpose of this study was to investigate the response of physically active males to a lactate based supplement. The study was conducted to determine the potential ergogenic benefits of supplementing MS pre-exercise and to verify whether or not MS met the claims provided by the manufacturer (i.e., improve performance while preventing muscle trauma). A differential response following the ingestion of the supplement as compared to ingestion of the placebo was hypothesized. We expected to see different responses in VO_2 max, CK, blood flow (BF), and perceived exertion (PEI).

METHODS

Subjects

Twelve physically active and apparently healthy individuals were recruited for this study. The group of subjects was selected as a representation of the frequently used average sample found in current performance studies. The subjects were recruited using an active student population and from a database of students who had previously contacted our laboratory for separate, unrelated studies. Subjects were given an opportunity to familiarize themselves with the protocol, and were required to read and sign an informed consent form. This study was approved by the Kent State University Institutional Review Board.

Procedures

Protocol

The subjects reported to the Exercise Physiology Laboratory on five separate occasions. During the initial visit, the subjects were familiarized with the study protocol and, then, were asked to sign the informed consent document as well as complete a medical history questionnaire. The subjects' anthropometric measurements were also recorded. They were instructed to refrain from consuming caffeine containing foods and beverages prior to reporting to the laboratory and were asked to not engage in any outside physical activity while participating in the study. After the initial visit, the subjects underwent two separate exercise trials in which they consumed two capsules of MS or PLA and vice versa. Two days following each of the exercise sessions, the subjects reported to the laboratory for blood sampling. The exercise trials were scheduled a week apart to allow for adequate muscle recovery and rest. The supplement was randomized to eliminate an order effect as well as decrease tester bias.

Exercise Trials

The two separate exercise trials (MS, PLA) consisted of a cycling max test followed by an eccentric plyometric exercise protocol. An ultrasound Doppler (Logiq 7, General Electric Medical Systems, and Milwaukee, WI) was used to measure blood flow BF at the beginning of each exercise trial. During this non-invasive procedure, the subjects laid supine on a gurney with their right arm at a 90° angle to their chest. The ultrasound transducer was placed on the upper arm near the bicep brachii muscle to measure the diameter of the brachial artery to calculate the blood flow through the brachial artery. Following the initial ultrasound, venous blood samples were drawn via antecubital venipuncture. The samples were stored at -80°C for subsequent analysis. These blood samples were used to monitor CK levels as markers of muscle damage.

Following blood collection, the subjects ingested a single dosage of either supplement (MS, PLA). The subjects ingested the other supplement on the second exercise trial. After waiting 15 min (as suggested by the label) the subject were prepared for the VO_2 max test using a magnetically braked cycle ergometer (Lode Excalibur, Groningen, Netherlands). The graded exercise procedure (GXT) determined the subjects' maximal aerobic fitness. The GXT protocol began with the standard 2-min warm-up period at 60 W. Resistance increased 50-100 W each minute thereafter. This increase in workload allowed for a progressive maximal voluntary exhaustion of the subjects. In order to determine VO_2 max at the point of exhaustion, an automated open circuit metabolic system (Parvo Metabolic Cart, Sandy, Utah) was used. RER standards were assessed and achieved to validate maximum aerobic capacity in $\text{mL}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$.

Following the subjects' VO_2 max test, an eccentric resistance and plyometric exercise regimen was administered with the purpose of inducing muscle damage. This included 5 stations of 60 sec plyometric training exercises. This protocol incorporated upper, lower, and total body plyometric drills. Immediately following the exercise another BF recording was performed and the perceived exertion index test (PEI) was administered to determine the subjects' subjective exercise exertion. The subjects were then allowed to leave the laboratory for 48 hrs before returning for another blood sampling to monitor muscle damage. In total, the subjects completed a pre-screening, two separate blood draw and exercise tests, and two blood draw visits.

Statistical Analyses

Means and measures of variability were calculated. Paired samples t-tests were used to analyze VO_2 max and PEI differences between trials. A two time (pre, post) by two-condition (MS, PLA) repeated measures analysis of variance (ANOVA) was used to examine differences in BF and CK. Post-hoc analyses of any significant main effects of condition were achieved using t-tests with the Benjamini

and Hochberg False Discovery Rate correction for multiple comparisons (1). All statistical analyses were performed using SPSS for Windows (version 17.0, SPSS Inc., Evanston, IL).

RESULTS

Physical Characteristics

The subjects' physical characteristics are listed in Table 1. Each subject reported both resistance and aerobic training as part of their typical exercise routine.

Table 1. Physical Characteristics of the Subjects.

Variable	Males (n = 12)
Age (yrs)	23.7 ± 2.1
Height (in)	71.1 ± 2.7
Weight (lb)	189.5 ± 21.2

Data are Mean ± SD

VO₂ max

We used paired samples t-test to determine differences in aerobic performance. A significantly greater performance score was achieved during the VO₂ max (P=0.032) after ingesting MS compared to PLA (Table 2). The MS results suggest a greater maximum performance achieved when compared to PLA.

PEI

A paired sample t-test was used to compare mean difference in PEI between conditions. The test revealed a significantly lower PEI (P=0.002) after MS supplementation (Table 2). Therefore, it is reasonable to conclude that MS promoted a lower perceived energy expenditure following exercise.

Table 2. Performance and Perceived Exertion Following a Single Dosage of MS or PLA.

Variable	MS	PLA
VO ₂ max (mL·kg ⁻¹ ·min ⁻¹)	39.7 ± 6.9*	37.9 ± 7.3
PEI	7.1 ± 1.3*	8.1 ± 1.0

*Significant improvement (P<0.05). (Mean ± SD)

CK

There was not a significant main effect of condition for changes in CK levels (P=0.205). MS did show a lower level of CK in the blood (42.6 ± 125.3 mg·dl⁻¹ MS, 110.6 ± 153.5 mg·dl⁻¹ PLA, Table 3), but the difference was not significance.

BF

There was a significant main effect of time Pre and Post ($P=0.001$) for BF. However, there was neither a significant main effect for condition ($P=0.284$) nor an interaction between time and condition ($P=0.291$). Post hoc paired samples t-tests revealed that BF increased across time (182.6 ± 119.1) $\text{L}\cdot\text{min}^{-1}$ MS, 215.6 ± 128.0 $\text{L}\cdot\text{min}^{-1}$ PLA, Table 3) while supplementing either MS or PLA ($P<0.05$).

Table 3. Subjects' Physiological Responses Following a Single Dosage of MS or PLA.

Variable	MS	PLA
Δ CK ($\text{mg}\cdot\text{dl}^{-1}$)	42.6 ± 125.3	110.6 ± 153.5
Δ BF ($\text{L}\cdot\text{min}^{-1}$)	182.6 ± 119.1	215.6 ± 128.0

*Significance ($P<0.05$). (Mean \pm SD)

DISCUSSION

The present study was the first to examine the physiologic and performance related results of a single dosage of a particular calcium lactate, magnesium lactate dehydrate, and zinc oxide supplement (MS) prior to exercise. Earlier research investigating a carbohydrate sports drink with the addition of a lactate solution showed increased endurance performance and peak power during a cycling trial at a level just below the respiratory threshold (3). However, the consumption of lactate did not affect a change in VO_2 max or the difference in perceived exertion (3). Our study differed in that we found improvements in our exercise group following MS supplementation when compared to PLA. The subjects' VO_2 max increased significantly with a single dosage of MS prior to test. Bryner et al. (1998) observed no differences in time to exhaustion with lactate supplementation. Another group monitored exertion and observed that lactate led to no differences in exhaustion as well (6). Our study differed as our subject group reported a significantly lower PEI immediately following exercise. Therefore, our findings suggest that a single dosage of MS resulted in an increase in performance and a decrease in perceived exertion.

Interestingly, there were no significant differences in both muscle damage and BF. However, when looking at the raw data, the average change in CK from pre- to post-exercise trial was lower with the single dosage of MS. The subjects' BF showed similar trends across both trials meaning that blood flow increased to the working muscles with the dosage of MS and PLA.

Limitations

As a result of these findings, we have found some limitations to our study. First, it is apparent that sample size was a limitation. We may have added to the finding of the current study with a larger sample size. The investigation did lead to statistical significance in a few variables, but not in other variables. This may have been due to the large deviations found between subjects. Second, another limitation to this study may have been the homogenous "low-fitness" of the subjects. It may have been more beneficial to focus on subjects with a higher level of aerobic fitness since the supplement was designed and synthesized for athletes. In the future, it is important that researchers explore dosage sizes. If the dose is individualized based on each participant's weight, it may be possible to discern different results.

CONCLUSIONS

As hypothesized, a single dosage of Muscle Sentry demonstrated different physiological effects when compared to a Placebo. In terms of the subjects' cardiovascular performance and perceived exertion, MS resulted in significant physiologic improvements. The results did not meet significant standards in demonstrating differences in muscle damage prevention and improved localized blood flow between MS and PLA. Therefore, we can clearly state that a single dosage of MS will allow an athlete to work at a higher intensity for a longer period of time without perceiving the increased workload. This could result in improved performance during both training and competition from both a physical and a mental standpoint. Both factors are equally important when high level athletes are competing.

ACKNOWLEDGMENTS

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