

THE EFFECTS OF BETA-ALANINE ON THE INFLAMMATORY RESPONSE OF DELAYED ONSET MUSCLE SORENESS

Abstract

The effect of beta-alanine (a naturally occurring amino acid which is a component of muscle carnosine (a dipeptide highly concentrated in the muscles, which opposes muscle acidity) supplementation on the inflammatory response of delayed onset muscle soreness (DOMS) was tested on four subjects in a double-blind placebo-controlled test. Subjects had baseline blood testing before undertaking strenuous exercise to produce DOMS, both under the effects of beta-alanine and whilst taking a placebo. Blood testing and subjective rating was completed 18 hours after both exercise sessions. Results show a significantly lower subjective reading, higher Creatine Phosphokinase (CPK) and unchanged C-Reactive Protein (CRP) after exercising while supplementing with beta-alanine.

Introduction

I chose to conduct my study on the effects of beta-alanine on the inflammatory response of DOMS after using the supplement personally to great effect. The aim was to find an objective measure of the supplement's effect, as I knew it performed very well subjectively. Internet research was conducted to learn the role of beta-alanine in the body. I consulted three general practitioners and a haematologist to discuss possible tests that would have observable differences through the use of beta-alanine. It was recommended that Creatine Phosphokinase (CPK) and C-Reactive Protein (CRP) be tested. CPK is the catalyst for the conversion of creatine and adenine triphosphate (ATP) into phosphocreatine. Higher CPK readings are evidence of the enzyme leaking into the blood, commonly as a result of tissue damage or stress. C-Reactive Protein levels rise in response to inflammation. Before the study was conducted, I hypothesised that I would see some change in the inflammatory markers being tested as my understanding of beta-alanine's effect dictated that it would cause a change in the body's way of responding to muscle damage. This understanding was that beta-alanine would assist in the synthesis of carnosine, aiding in the neutralization of lactate produced whilst exercising. I was also confident of a subjective result due to personal experience with the supplement.

Aim: To observe the effects of beta-alanine supplementation on the inflammatory response of delayed onset muscle soreness (DOMS).

Hypothesis: Beta-alanine will assist in the reduction of muscle inflammation and damage caused by strenuous exercise, therefore reducing the severity of DOMS.

Table 1 – Experimental Variables

Independent Variables	Dependent Variables	Controlled Variables
- Mass of beta-alanine ingested (g)	- Creatine Phosphokinase (CPK) levels in the blood - C-Reactive Protein (CRP) levels in the blood (as determined by blood testing) - Subjective rating of soreness (using a visual analog scale)	-Exercise levels/types (based on subjects' fitness levels) -Diet -Sleep times (maintained by subject) -Recovery time -Times of ingestion -Duration of exercise -Scheduling of blood testing

Materials

- 15 x Creatine Phosphokinase (CPK) blood tests
- 15 x High sensitivity C-Reactive Protein (CRP) blood tests
- 80g glucose powder (for use as placebo)
- 80g beta-alanine powder
- 5 x subjects
- Visual analog scale for soreness rating

Method

1. Subject partook in preliminary CPK and CRP blood tests.
2. Subject began pre-loading period of one week with supplementation of beta-alanine/placebo, taking 2g daily at 4:00pm. (Note. Subject was unaware of which supplement they were using)
3. On the seventh day of supplementation, subject underwent eccentric training designed to induce DOMS. Subject took a standard 2g dose of supplement 30 minutes before and after exercise.
4. Approximately 18 hours after activity, subject completed a visual analog scale of soreness and sat for another CPK and CRP blood test.
5. Procedure was repeated from step 2 on the day of blood testing, alternating use between placebo and beta-alanine. (Note. For reliable results, subject completed week two of testing as identically as possible to week one. This includes the activities and intensity of training, as well as the time between exercise and blood testing.)
6. Results were collected and compared.

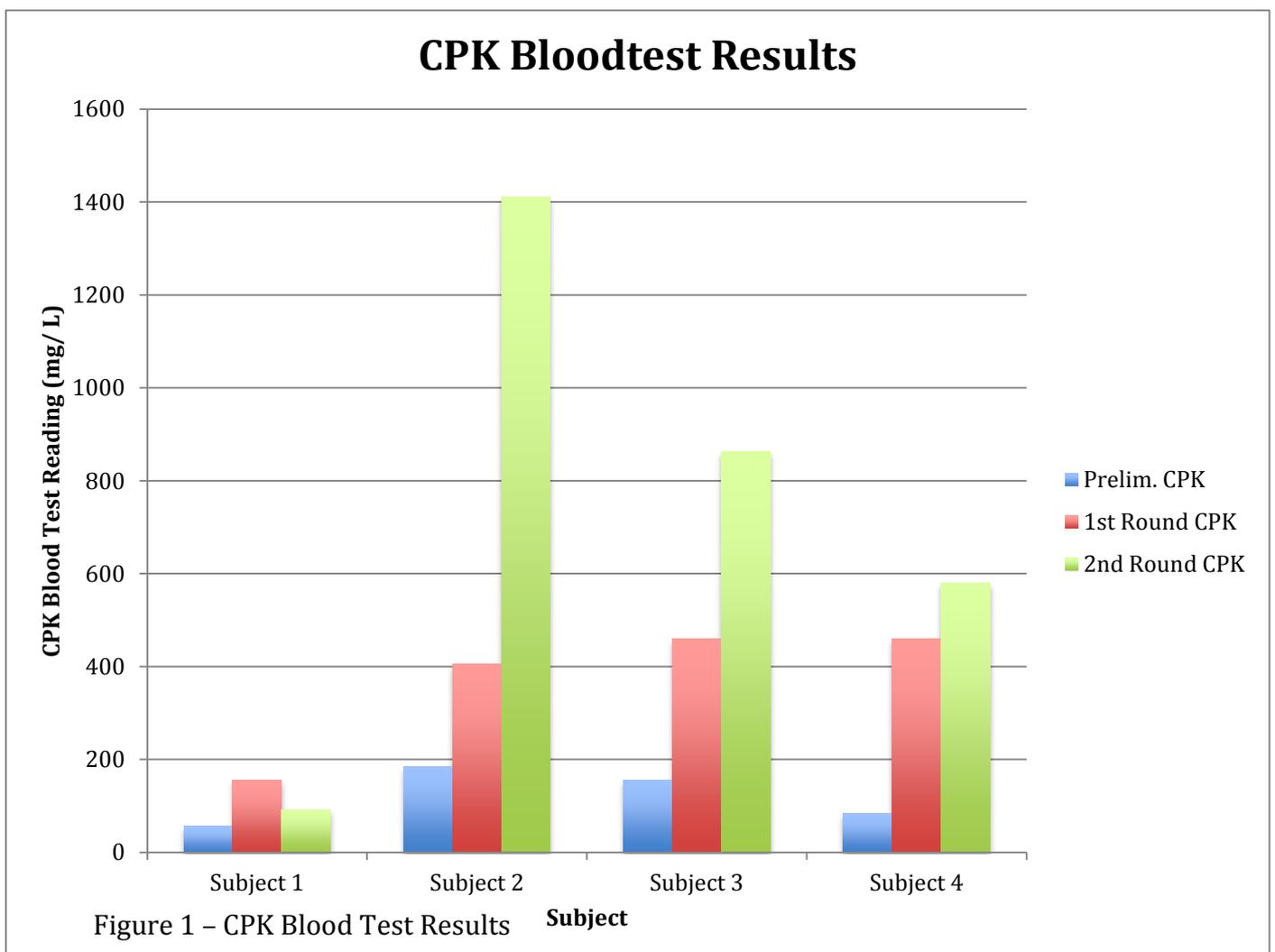
Henceforth, the week of placebo supplementation will be referred to as “round one” of testing, and the week with beta-alanine supplementation will be known as “round two.”

Results

Blood test results showed an increase in CK results for three of the four subjects, while CRP tests showed no discernable pattern in relation to supplementation. Subjective results show vast improvements in soreness levels for all subjects whilst supplementing with beta-alanine.

Table 2- Blood Test Results

	Subject 1	Subject 2	Subject 3	Subject 4
Prelim. CPK (mg/L)	56	124	156	83
Prelim. CRP (U/L)	0.2	0.8	0.1	0.5
1st Round CPK (mg/L)	156	405	460	460
1st Round CRP (U/L)	1.2	0.8	0.1	0.5
2nd Round CPK (mg/L)	92	1411	863	579
2nd Round CRP (U/L)	0.5	1.9	0.2	0.3



CRP Bloodtest Results

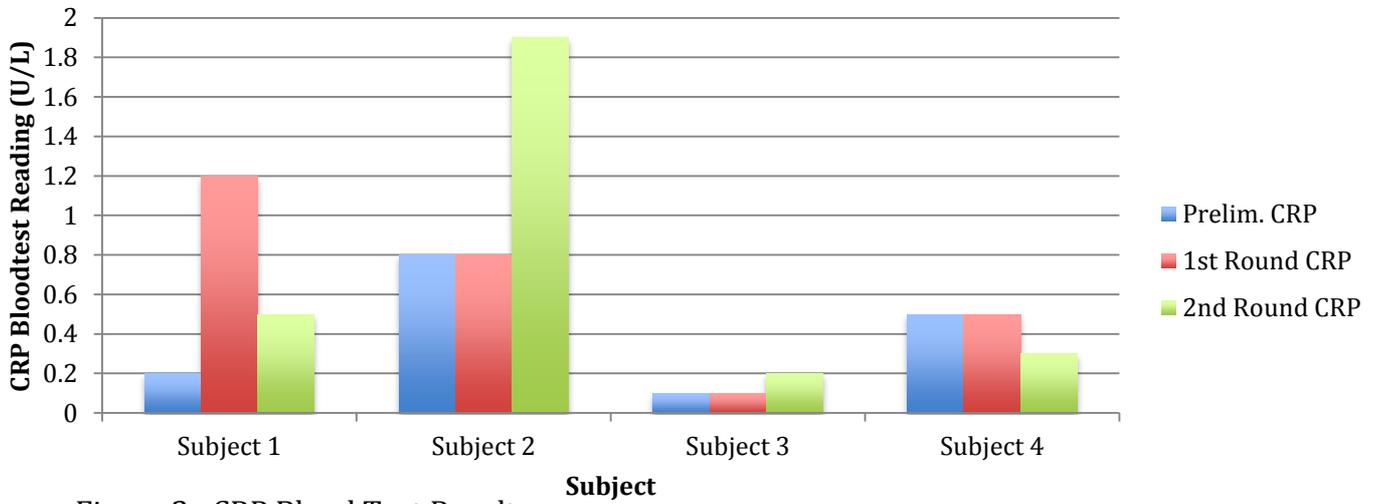


Figure 2 –CRP Blood Test Results.

Table 3 - Visual Analog Scale Soreness Rating

	1 st Round Rating	2 nd Round Rating
Subject 1	7/10	4/10
Subject 2	7/10	2/10
Subject 3	8/10	1/10
Subject 4	8.5/10	1/10

Visual Analog Scale Results

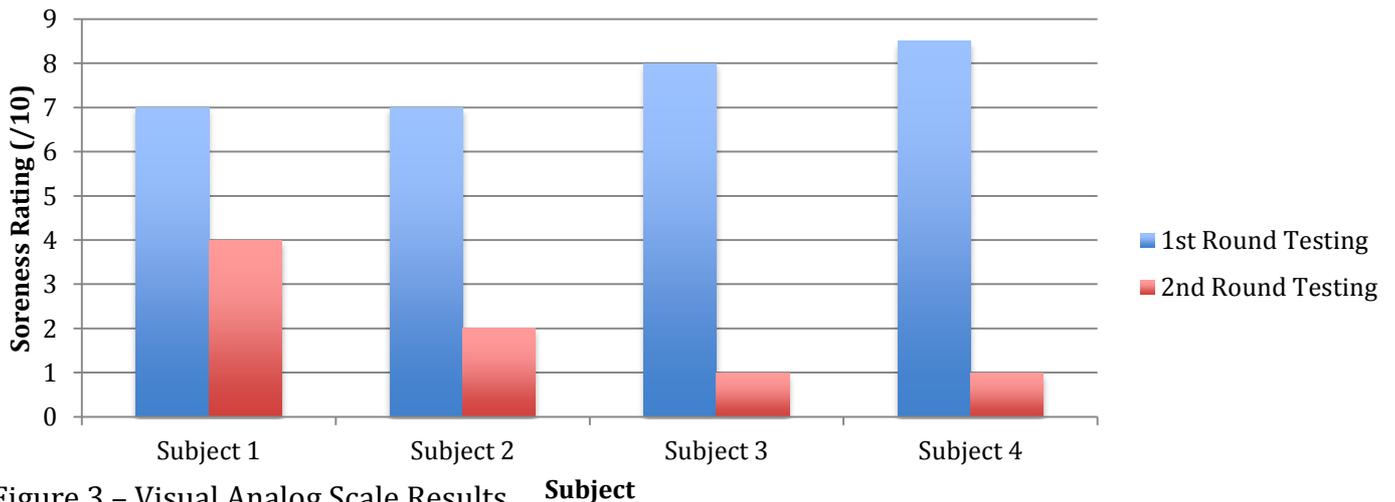


Figure 3 – Visual Analog Scale Results

Discussion

The aim of this experiment was to observe the effects of beta-alanine on the inflammatory response of delayed onset muscle soreness (DOMS). Throughout testing, a variety of encouraging and unexpected results were recorded. These results have assisted in the development of a new theory as to the effect of beta-alanine on DOMS.

For reference, C-reactive protein (CRP) is a protein found in the blood that is raised in response to inflammation. Creatine phosphokinase (CPK) is an enzyme found in various tissues. It is released intramuscularly when muscle fibre damage occurs.

It should be noted that the results of this experiment have been influenced by several ineludible factors, the most significant of which is the loss of a subject, and as a direct impact, the loss of another set of results. As stated in the materials, the original intention was to have the testing completed on 5 subjects. Unfortunately, a subject was unable to participate in the trial as a result of injury limiting their ability to exercise. Other inescapable and influential factors include the minor injury of subject 1 in the first round of testing and the contraction of an infection by subject 2 in round two. Both of these factors are identifiable by spikes in the CRP readings of corresponding weeks.

This being said, results of the experiment do show interesting trends. For instance, in all cases but subject 1's, CPK readings are at their highest whilst supplementing with beta-alanine. Before testing, I would have presumed that CPK readings would be higher without this supplement, due to my understanding that beta-alanine would assist in the reduction of creatine phosphokinase produced whilst exercising. I now hypothesize that improvements in beta-alanine levels help in the removal of creatine phosphokinase from the muscles by expelling it into the bloodstream, resulting in a higher reading.

As there is no discernable pattern from the CRP test results, it could be hypothesized that the production of C-Reactive Protein is unaffected by beta-alanine supplementation. However, the CRP results are useful in theorizing the reasons behind significant peaks in the CPK results of subject one in round one of testing and subject two in round two. I would speculate that the greater readings of these tests were as a result of the aforementioned injury and infection, which is also demonstrated through the significant rise in CRP readings of the corresponding weeks.

It is clear that beta-alanine had a significant subjective effect with the average rating of soreness while supplementing being 2. This is 3.8 times less than the average 7.6 (rounded to one decimal place) recorded without the use of beta-alanine. Without objective results, this finding is still significant for determining the ergogenic value of beta-alanine supplementation and is an obvious symptom of the amino acid's effect on delayed onset muscle soreness.

Through the repetition of this experiment with a larger and more diverse demographic of subjects the result would be more credible. Repetition with a larger group could also provide a link between the supplementation of beta-alanine and CRP blood test results. When repeating this experiment provide a larger rest period between the first week's testing and the beginning of preloading for the second week, to ensure the eradication of cumulative blood test results.

Conclusion

Throughout this experiment, the effects of beta-alanine on the inflammatory response of delayed onset muscle soreness have been observed, with interesting results. While it has demonstrated that there is a possible link between beta-alanine and soreness levels post-exercise, further testing is required to prove any link between supplementation of the amino acid and inflammatory marker levels in the blood. However, the lack of reduction in levels of creatine-phosphokinase disapproves my hypothesis that beta-alanine will assist in the reduction of muscle damage, instead indicating that the supplement aids in expelling CPK from the muscles and into the blood, causing a subjective reduction of soreness but an objective spike in CPK blood level readings.

Table 3: Risk Assessment

Risks	Strategies
Infection/Injury from improper blood testing	<ul style="list-style-type: none">• Blood tests will be conducted by a professional• Clean needles to be used
Injury from oversteering of muscles	<ul style="list-style-type: none">• Exercise programs tailored to subject fitness
Injury from environmental factors	<ul style="list-style-type: none">• Activity conducted in controlled environment
Allergic reaction to supplement	<ul style="list-style-type: none">• Use pure form of supplement• If symptoms occur, discontinue use

The original copies of appendices, including references, have been forwarded to STANSW for the “Young Scientist Awards.” Unfortunately, a copy was not retained.

Acknowledgements

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- 1) Lavery pathology, who generously provided all blood collection and testing free of charge.



- 2) Each of my subjects, who have all unselfishly undertaken strenuous exercise and sat through 3 blood tests.
- 3) Doctors Joe Romeo, Sadek Hamied and Wade Mitchell, who have offered me helpful medical and scientific advice, as well as signing off on pathology forms.
- 4) Nathaniel Romeo, who initially introduced me to beta-alanine.

