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# THE EFFECTS OF PASSIVE, ACTIVE, AND BETA-ALANINE SUPPLEMENTED RECOVERY ON BLOOD LACTATE DURING ANAEROBIC EXERCISE

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# THE EFFECTS OF PASSIVE, ACTIVE, AND BETA-ALANINE SUPPLEMENTED RECOVERY ON BLOOD LACTATE DURING ANAEROBIC EXERCISE

by

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ABSTRACT

THE EFFECTS OF PASSIVE, ACTIVE, AND BETA-ALANINE SUPPLEMENTED RECOVERY ON BLOOD LACTATE DURING ANAEROBIC EXERCISE

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It is widely shown through experimentation and knowledge of human physiology that an active recovery following high-intensity exercise removes lactic acid (BLa) more quickly than passive recovery. Some research suggests that Beta-Alanine (BA) supplementation can decrease BLa levels following supramaximal exercise.

The purpose of this study was to assess whether passive, active, or Beta-Alanine supplemented recovery was more effective at lowering BLa accumulation anaerobic exercise.

Nine subjects participated in this experiment (one subject was excluded). Each completed three sessions of active, passive, or supplemented Wingate protocols.

Results were determined using SPSS ($p \leq 0.05$). There was no statistically significant difference between active and passive recovery (p = .292) or between Beta-Alanine and placebo groups (p = .962).

The results of this study indicated that there were no differences between BLa in passive and active recovery, and no benefits of Beta-Alanine supplementation on BLa accumulation following supramaximal exercise.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Lactic Acid

During moderate-intensity aerobic exercise glycolysis occurs, breaking down glucose into pyruvate. When the intensity of the exercise rises above the anaerobic threshold, the mitochondria can no longer use pyruvate. The compensatory pathway used by the body produces lactic acid. Lactic acid builds intramuscularly and then diffuses into the bloodstream, where it dissociates into $H^+$ and lactate. The increase in $H^+$ in the muscle and blood causes a decline in pH (blood is more acidic) that is believed to be the cause of muscular fatigue and decreased contractile functioning following high intensity exercise (10). It is widely known that the build-up of lactic acid affects exercise performance. The build-up of lactic acid is what many hardcore exercisers refer to as 'the burn.' As lactate in millimoles per liter of blood (BLa) increases, exercise performance tends to drop off. Many athletes try to raise their lactate or anaerobic threshold in order to improve performance.

## 1.2 Passive/Active Recovery

While some scholars disagree, it is widely shown through experimentation and knowledge of human physiology that an active recovery following a maximal or high-intensity exercise protocol removes lactic acid more quickly and efficiently from the blood than passive recovery (5). From a physiological standpoint, this is largely due to blood circulating more quickly (active recovery) and also distributing the lactate to organs and slow twitch muscles that can help in metabolically removing lactate.

## 1.3 Supplement Market

The supplement market is essentially uncontrolled and many supplements do not perform the functions they advertise. The Food and Drug Administration (FDA) is unable to completely regulate the supplement market. Instead of companies being required to provide evidence that their product works as advertised and is not harmful, the Food and Drug Administration (FDA) has to prove that the product has harmful effects or does not work.

## 1.4 Beta-Alanine

Beta-Alanine is a naturally occurring amino acid (found in low doses in most meat and fish products) that is a precursor for muscle carnosine, a well-known muscular proton (pH) buffer within the body (4). Beta-Alanine is known to increase muscle carnosine concentrations, and thus, the supplement market theorizes that supplementing with Beta-Alanine will be able to increase carnosine concentration, and increase the pH with improved buffering. Beta-Alanine has been shown in previous studies to increase total work, time to exhaustion, power output at the lactate threshold, and to attenuate fatigue during repeated bouts of exercise (10). These ergogenic effects are important because supramaximal anaerobic exercise causes an increased reliance on glycolysis during exercise. This reliance causes Exercise Induced Muscular Acidosis (EIMA) that decreases muscle function and exercise performance by increasing fatigue within the muscles (10). The Beta-Alanine variable in my study will examine how well Beta-Alanine helps to buffer blood lactate by increasing the concentration of muscle carnosine in the body (3). A study found that subjects who adhered to a Beta-Alanine regimen had a delayed onset of blood lactate accumulation (OBLA) (10). However, a different study obtained less conclusive

results. The results of this experiment show no significant change in blood lactate before and after Beta-Alanine supplementation (14). Another study found that supplementation with Beta-Alanine significantly reduced feelings of fatigue during and after exercise, but that the decline in fatigue was directly related to the length of time of Beta-Alanine supplementation (9). Hoffman conducted another study about the relationship between Beta-Alanine and hormone response to exercise, finding that Beta-Alanine increased exercise capacity by increasing muscular endurance (8).

### 1.5 Wingate Anaerobic Testing

The Wingate Anaerobic Test (WAnT) is a widely used, valid and reliable test for the assessment of anaerobic muscle performance and evaluation of responses to supramaximal exercise (16). The WAnT is a 30 second supramaximal, all-out cycling test protocol with a high resistance set relative to the subject's body mass (16). Blood lactate has been used as a valid and reliable measure to test the effectiveness of the WAnT.

# CHAPTER 2

# METHODOLOGY

This study was approved by the Institutional Review Board. All volunteers were informed of the procedures included in this experiment, and from that were able to decide whether they wanted to participate in the study. Volunteers signed an Informed Consent Document and were provided with supplement information. They were also asked to complete a physical activity readiness questionnaire (PAR-Q) to determine their level of activity. The scheduling of each session was based on when each individual participant was available, and on the availability of the research equipment in the Exercise Science Research lab (MAC 223). All exercise testing was completed in the Exercise Science Research Laboratories at UTA.

## 2.1 Subjects

Subjects were recruited based on demographics outlined in Form 1. All participants were moderately active, English-speaking college-age students (18-26 yrs.) at UTA, determined healthy enough to participate in an intense exercise protocol by a PAR-Q. Participants were excluded if they were not UTA students. Participants were excluded if they were not college age (18-26 yrs.), did not speak English, had allergies to the ingredients in the All-Max Nutrition Beta-Alanine powder supplement, had any current injuries or health limitations, or were not moderately active. Subjects were excluded if they were pregnant or breastfeeding. During subject recruitment, each volunteer was given an overview of the experiment, along with information about the study, the procedures, the

supplement ingredients, and all possible side effects. All participants received information about the supplement and placebo, including the list of ingredients to determine any possible allergic reactions. They were asked to sign an Informed Consent Document and given a copy. The procedures regarding the Wingate testing were explained along with all rights as voluntary participants in this study and emergency information.

## 2.2 Instrumentation

### *2.2.1 Blood Lactate Measurement*

Participants were alerted that the first finger prick blood lactate measurement was about to occur. The participant's finger was cleaned with alcohol swabs and then pricked with a blood lancet to obtain a drop of blood. A capillary tube attached to a reflation applicator collected the sample of blood from their finger. The blood sample was placed on a strip of paper inside the Analyzer and the lactate level of that blood was found using the Accusport Lactate Analyzer. The participants were given a piece of gauze to stem the bleeding and a band aid as necessary. Either Dr. Judy Wilson or Professor Brad Heddins was present for all blood lactate measurements. All equipment was disposed of in the proper biohazard waste containers.

Next, the participant was instructed to sit on the Wingate bicycle (seat height altered for their height). They were given a towel, and instructed that they were about to begin the Wingate protocol.

### *2.2.2 WAnT Protocol with Recovery Periods*

The WAnT was set for each individual based on height and weight. Upon instruction, participants pedaled at 60-80 rpm for about 55 seconds of a one minute warm-up. With the command “start” during the last 5 seconds of the warm-up, the participant

pedaled as fast as possible in order to overcome the initial resistance and was encouraged to pedal as hard and fast as they could for the remaining 30 seconds (the WAnT Protocol). During this period, they were instructed to keep breathing, keep pedaling, and not to let their bottom come up off of the seat. After the 30-second period was over they were instructed to enter either the passive or active four minute recovery period. During the active stages of recovery, the participants were instructed to continue pedaling at a comfortable RPM against minimal resistance for four minutes. During the passive stages of recovery, the participant was instructed to sit passively without pedaling for four minutes. The passive and active recovery sessions were at least 24 hours apart, but no more than a week apart.

At the end of this period, participants went through another WAnT protocol. After this second protocol was completed they entered another four minutes of the same type of recovery. At the end of this four-minute period, they were helped off of the bike and into a chair. At this point, the second finger prick (blood lactate measurement) was initiated. All equipment used was disposed of in the proper biohazard waste containers.

## 2.3 Procedures

Participants would enter the lab, having filled out both the Informed Consent Document and the PAR-Q. They were instructed to sit in a chair while relaying their age, height, weight, full name, and birthday for the Wingate protocol. They were given a recap of how the session was laid out, what they were going to do, and whether the session would be the passive or active protocol. Each session of this experiment took approximately 20 minutes to complete. Each participant completed six Wingate tests, two with active recovery, two with passive recovery on randomly selected and different days, and two more

Wingate tests after a week-long regimen taking either All-Max Beta-Alanine powder or a Tylenol placebo.

Upon completion of both the passive and active recovery WAnT tests, blood lactate measurements, and recovery periods, participants were instructed to stretch and rest in order to minimize any delayed onset muscle soreness caused by the anaerobic exercise. This blood lactate measurement was repeated during the three testing sessions. Each measurement was compared to determine which type of recovery – active, passive, or beta alanine supplementation - more efficiently removed lactic acid from the blood.

### 2.4 Beta-Alanine/Placebo Supplementation

At the end of the second session, participants were randomly assigned to complete a week-long regimen taking either the All-Max Beta-Alanine powder twice a day or a placebo (Tylenol) twice a day. Each dosage was provided in individual pill containers, one per dose, or two doses per day for a total of 14. A teaspoon of All-Max Nutrition Beta-Alanine supplement was placed in each pill container or, for the placebo, one Tylenol pill was placed inside each box. Walgreens 7-Day AM/PM Detach N'Go Pill Organizers were used. Participants were instructed to put the contents of one box into water in the morning and again in the evening for 7 days, after which point they would return to the lab for the final session. After completing the week-long regimen, the participants came back to the lab to perform two Wingate tests using the passive recovery model as described previously. Blood lactate measurements were taken prior to testing and after the second passive recovery period to determine whether Beta-Alanine had an effect on blood lactate recovery. The alpha level was set at .05 to test for significance. Protocols were measured with Multivariate and Univariate repeated measure ANOVAs using SPSS.

# CHAPTER 3

## RESULTS

There were nine subjects in this study. The subjects were five male (M, 21.2 ±1.48 yrs, 178.25 ±6.36 cm, 85.59 ±10.30 kg) and three female (F, 22 ±1.73 yrs, 164.23 ±1.50 cm, 70.9 ±12.56 kgs) students at UTA. One female subject did not complete the study. These demographic variables are presented in Table 3.1 and Table 3.2 with means, standard deviation (SD), minimum (min), and maximum (max) values.

Table 3.1: Female Demographic

| Female (F) | Mean | SD | Min | Max |
|---|---|---|---|---|
| Age | 22 | 1.73 | 20 | 23 |
| Height (cm) | 164.2 | 1.50 | 162.5 | 165.1 |
| Weight (kg) | 70.9 | 12.56 | 56.8 | 80.9 |

Table 3.2: Male Demographic

| Male (M) | Mean | SD | Min | Max |
|---|---|---|---|---|
| Age | 21.2 | 1.48 | 19 | 23 |
| Height (cm) | 178.2 | 6.37 | 170 | 182.88 |
| Weight (kg) | 85.6 | 10.30 | 77.3 | 102.2 |

Blood Lactate measurements were compared between initial (resting) values and final values between differing protocols. Table 3.3 depicts data for the passive protocol mean, standard deviation (SD), minimum (min), and maximum (max) values between initial and final measurements while Table 3.4 depicts the results from the Active protocol. Figure 3.1 compares the initial values between passive and active protocol with the final BLa values for passive and active protocol. Active blood lactate was lower than passive blood

lactate in the final measurement, but was higher at rest. Results were determined using SPSS ($p \leq 0.05$). There was no statistically significant difference between active and passive recovery ($F(1,7)= 1.297$, $p = .292$).

Table 3.3: Passive Protocol Blood Lactate

| | Passive Initial | Passive Final |
|---|---|---|
| Mean | 2.79 | 15.2 |
| SD | 0.70 | 2.95 |
| Min | 1.9 | 12.2 |
| Max | 4.1 | 19.2 |

Table 3.4: Active Protocol Blood Lactate

| | Active Initial | Active Final |
|---|---|---|
| Mean | 3.64 | 13.75 |
| SD | 0.76 | 4.79 |
| Min | 2.2 | 8.3 |
| Max | 4.9 | 19.5 |

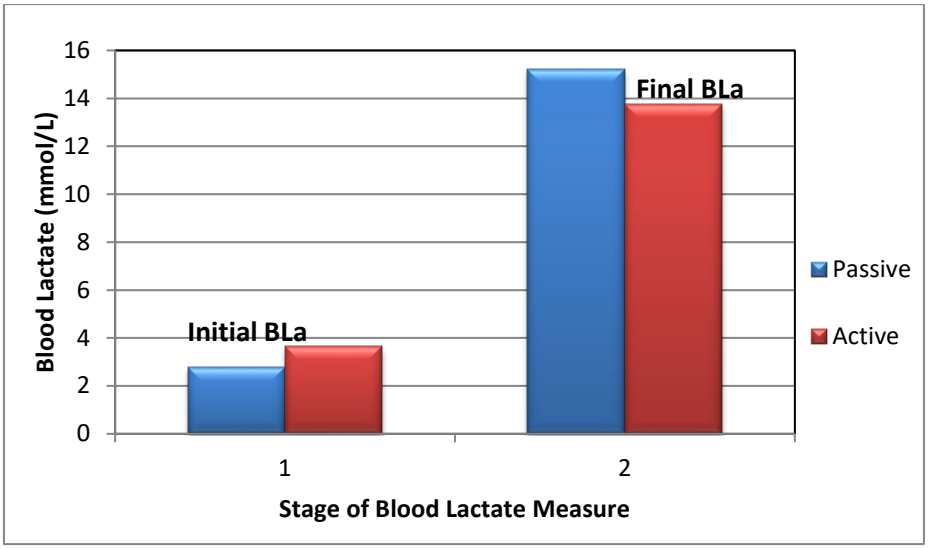


Figure 3.1: Differences in Initial and Final Blood Lactate Measurement between Passive and Active Recovery Protocols

Table 3.5 shows the mean, SD, min, and max values of initial and final blood lactate measurements with Beta-Alanine supplementation. Figure 3.2 compares the data from the Beta-Alanine supplemented passive protocol with passive protocol initial and final blood lactate values. At rest and during the final blood lactate measurement, the Beta-Alanine supplemented passive recovery yielded a higher blood lactate than passive recovery without supplement.

Table 3.5: Beta-Alanine Supplemented Passive Protocol Blood Lactate Values

| | Beta-Alanine Initial | Beta-Alanine Final |
|---|---|---|
| Mean | 3.65 | 16.2 |
| SD | 1.51 | 3.07 |
| Min | 2.8 | 13.5 |
| Max | 5.9 | 20.1 |

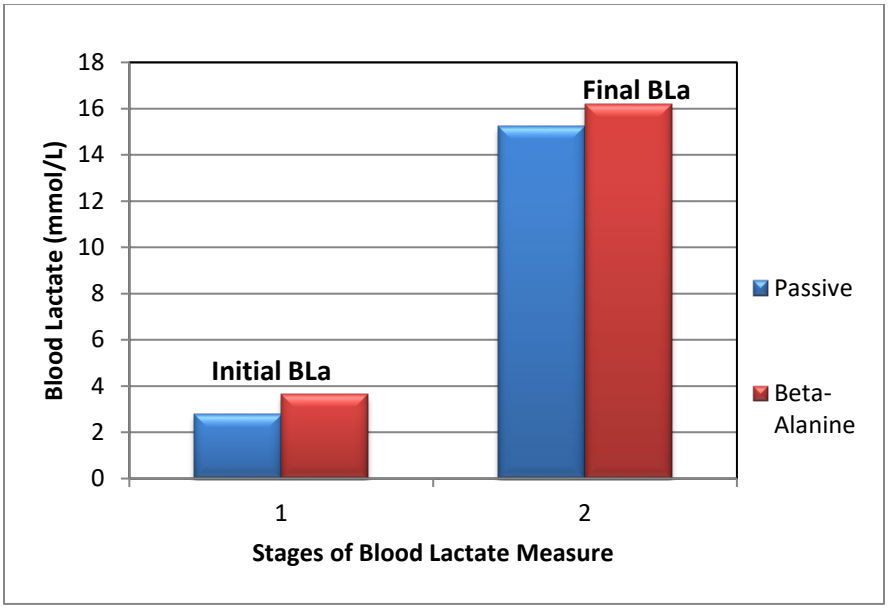


Figure 3.2: Differences in Initial and Final Blood Lactate Measurements between Passive and Beta-Alanine Supplemented Passive Protocols

Table 3.6 depicts the mean, SD, min, and max values of initial and final blood lactate measurements of placebo supplemented passive protocol. Figure 3.3 compares the initial

and final BLa between placebo supplemented passive protocol and passive protocol. Placebo supplemented passive recovery yielded higher blood lactate measurements at rest and after completion of the protocol.

Table 3.6: Placebo Supplemented Passive Protocol Blood Lactate Values

| | Placebo Initial | Placebo Final |
|---|---|---|
| Mean | 4.48 | 16.3 |
| SD | 1.35 | 2.55 |
| Min | 3.4 | 13.1 |
| Max | 6.2 | 19.2 |

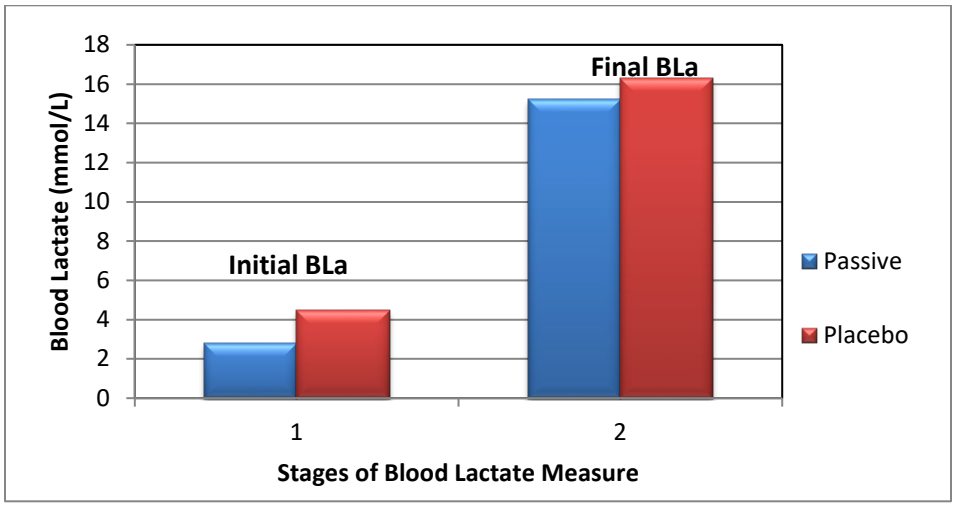


Figure 3.3: Differences in Initial and Final Blood Lactate Measurements between Passive and Placebo Supplemented Passive Recovery Protocols

Figure 3.4 compares data for the initial and final BLa between Beta-Alanine and placebo supplemented passive recovery protocols. The mean values of resting blood lactate were slightly lower in Beta-Alanine supplementation, but at completion of protocol, both placebo and Beta-Alanine yielded the same mean blood lactate measurement.

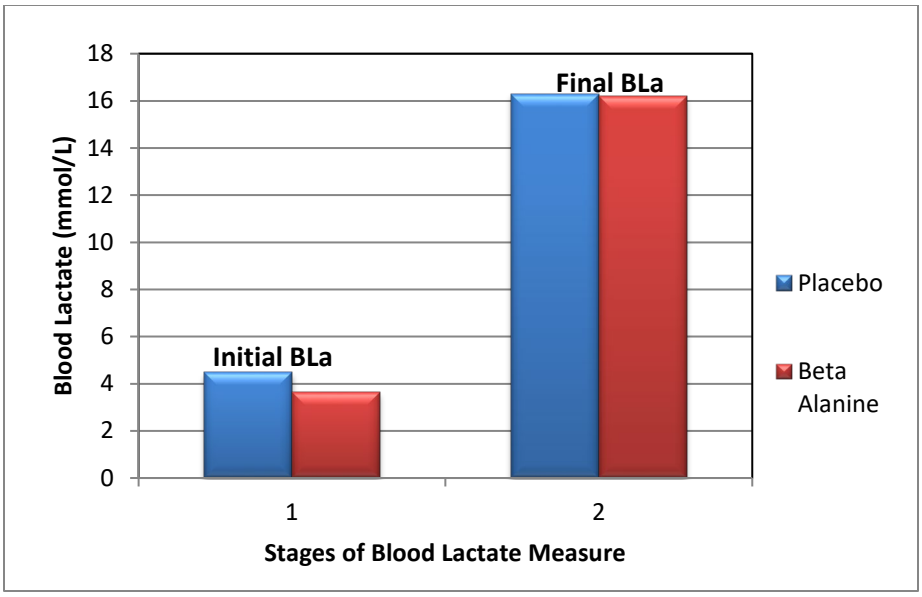


Figure 3.4: Differences in Initial and Final Blood Lactate Measurements between Beta-Alanine and Placebo Supplemented Passive Recovery Protocols

Figure 3.5 compares data for the initial and final BLa between Active and Beta-Alanine supplemented passive recovery protocols. Resting values of blood lactate during active recovery and Beta-Alanine supplemented passive recovery were the same. At completion of protocols, Beta-Alanine supplemented passive recovery yielded a higher blood lactate measurement. There was no statistically significant difference between supplementation and placebo ($F(1,6)= .003$, $p = .962$).

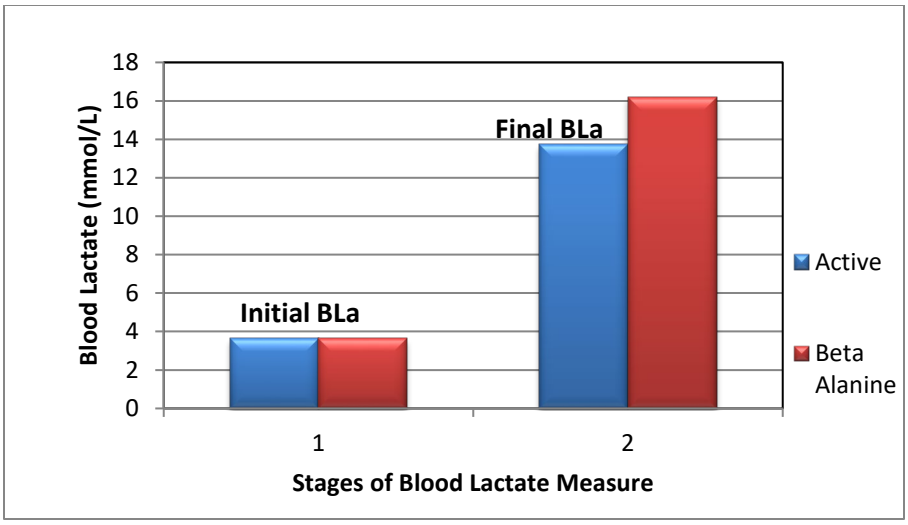


Figure 3.5: Differences in Initial and Final Blood Lactate Measurements between Active and Beta-Alanine Supplemented Passive Recovery Protocols

# CHAPTER 4

# DISCUSSION

The results do not suggest whether active or passive recovery is better in recovering from lactate buildup associated with WAnT protocol. Existing data suggests that active recovery improves exercise performance by lowering blood lactate faster due to increased circulation (13). However, several studies suggest that this active recovery must be at 80% of an individual's $VO_{2max}$ in order to see the most lactate clearance (5, 13). Lactate clearance occurs on an intensity-dependent scale, where the closer the recovery is to the lactate threshold, the more quickly lactate clearance occurs (13). Another study found that passive recovery is better for exercise performance with two or fewer protocols, while active is better for two or more protocols because it helps to maintain a higher power output at subsequent protocols (12). A similar study found that short periods of passive recovery following 30-second maximal cycling are more restorative as far as measures of power on consecutive tests (6). Another study determined that following active recovery, the second exercise protocol exhibited a higher Total Work (J) and increased muscle oxygenation (11). A study devoted to decreasing post-judo match blood lactate concentrations found no significant difference in active versus passive protocols despite previous research suggesting quicker lactate recovery with active protocol (15)

While the blood lactate results in this study have no significant findings on passive vs active recovery, seven out of eight subjects verbalized preferring active recovery and dreading the passive recovery. Passive recovery was cited as a more uncomfortable

recovery mode due to the uncomfortable seat of the cycle ergometer, stiffness from sitting so long after maximal effort, as well as more dizziness and nausea associated with the sudden change in intensity. Six of eight subjects indicated muscle soreness at the beginning of the second passive protocol WAnT made it difficult to get the speed back to 60-80 rpms. Only two of eight subjects had previous experience with WAnT protocol. It is possible that data from the first session may be skewed due to a lack of personal experience with the difficulty of the protocol. In future studies, a training period or session should be used to help the subject acclimate to the protocol. Active recovery in this particular study was specified only as a comfortable speed that the subject could maintain (most were at 50-70 rpm). Future studies should specify that active protocol must be at 80% of each individual subject's $VO_{2max}$. Further discrepancy between expected and actual results of passive versus active protocol may be related to discontinuous arrival conditions (subsequent activities prior to testing may have altered resting blood lactate). Resting blood lactate was taken for each subject about five minutes post arrival, but these values varied widely. Subjects were not asked to abstain from intense exercise 24 hours prior to each session. Many subjects admitted to having rushed across campus in order to make it to the session on time. Both of these could affect resting blood lactate levels, and thus affect the final blood lactate measure.

The results of this study suggest that AllMax Nutrition Beta-Alanine does not significantly reduce blood lactate following supramaximal anaerobic exercise. Most studies that did find a significant reduction in blood lactate or improvement in exercise performance had a longer supplementation period. One study found that there were no significant blood lactate changes caused by Beta-Alanine within a three week

supplementation period (9). The only improvement seen was lower fatigue index at same power output during WAnT testing. Another study found that when testing Beta-Alanine alone or supplemented along with creatine monohydrate, supplementing with creatine seemed to improve power at the lactate threshold (17). No significant increase in exercise performance was seen with Beta-Alanine on its own. Another study found that Beta-Alanine improved exercise performance by increasing training volume and lessening fatigue (8). However, this study did not test the blood lactate variable. This study did implement measures to ensure a 100% compliance rate with the supplement and placebo groups (8). A separate study elaborated on the effects of four weeks of Beta-Alanine supplementation on female Masters Athletes. This study found that performance increased as did lactate clearance because of the increase in muscle carnosine caused by the supplementation (7). The study suggests that response to Beta-Alanine is dependent on how trained the muscle is. A final Beta-Alanine study measured the effects of the supplement after a 28-day supplementation period on OBLA and $VO_2$ in cyclists. While the study concluded that the OBLA was delayed, the cyclists also performed with reduced aerobic capacity, or lower $VO_2$ measures (10).

While subjects in this study did take the recommended dosage of Beta-Alanine (6.4 grams/day), the supplementation period of this study was much shorter than those that yielded an effect. Most studies suggest a four to six week period, while due to time constraints, the supplementation period of this study was only a week. In the future, longer Beta-Alanine supplementation periods should be encouraged in order for any increase in muscle carnosine to occur, and thus significantly affect blood lactate.

The group of eight subjects was split randomly into two groups (supplement and placebo). Every subject was given supplement and placebo information within the Informed Consent Document that they signed, and as a separate sheet to take home with them. They were verbally warned about the paresthesia (benign tingling sensation) that Beta-Alanine might cause. All subjects in the Beta-Alanine group reported feeling either centralized or peripheral tingling, itching, or nausea (these effects were less noticeable if supplement was taken on a full stomach). Subjects in the placebo group appeared to believe they were taking the supplement and reported tingling and itching as well. The placebo administered was low dose (325 mg) Tylenol. This was administered in the same daily pill boxes as the supplement, but the placebo was in pill form while the supplement was powder form. This risk was taken due to the controlled situation in which the supplement/placebo was administered. Subjects were not aware of powder/pill differences nor were other subjects present when these were received. However, in future studies the supplement and placebo should both be in pill or in powder form.

All subjects had difficulty with the supplementation regimen. Although each dose was prepared for morning and night and delivered in pill containers labeled as such, subjects reported forgetting to take the supplement/placebo. Compliance with the regimen was low and the discrepancies in this supplementation period likely influenced the outcome.

This particular study aimed to measure blood lactate concentration differences following supramaximal anaerobic exercise, and therefore did not include any performance, oxygen consumption, or other physiological measures. It is possible that while no effect was seen from Beta-Alanine in blood lactate, other physiological measures

may have been affected. In the future, coupling blood lactate measures with oxygen consumption ($VO_2$) measures may allow for a more efficacious study. Subjects were given pre-measured supplements of AllMax Nutrition Beta-Alanine. This was not supplemented with creatine or any other product or dietary change. Future studies may combine Beta-Alanine with creatine in order to augment any ergogenic effects. While participants were all moderately active (as determined by a PAR-Q), only one out of the eight subjects had any previous cycling experience. All subjects were recreationally active in either aerobic (cardio) or anaerobic (weight lifting) activity, but it is likely that some were better trained. Further experimentation might answer whether more highly trained individuals respond better to Beta-Alanine supplementation.

# CHAPTER 5

# CONCLUSION

This experiment yielded no significant difference between active and passive recovery protocols or between Beta-Alanine and placebo supplemented passive recovery protocols. Research included in the discussion suggests that a number of changes in experimental set-up could provide significant difference in further experimentation. To control resting blood lactate, participants should be asked to abstain from intense exercise 24 hours prior to testing, and one Wingate session should be considered a training period for the subject to acclimate to the protocol. For supplemented recoveries, encouraging compliance with regimens, and extending the supplementation period of Beta-Alanine may provide more experimental efficacy. Cosupplementation with creatine or testing a more highly trained population may yield more conclusive results. While no significant improvement was observed in this study, other studies suggest that Beta-Alanine may still be a viable method in reducing blood lactate and improving exercise performance.

# APPENDIX A

# SUPPLEMENT FACTS

## Ingredients

***Active ingredient:*** Acetaminophen

***Purpose:*** Pain reliever/fever reducer

| Tablets | Active ingredients | Inactive ingredients |
|---|---|---|
| | Acetaminophen 325 mg in each tablet | corn starch, magnesium stearate, powdered cellulose, pregelatinized starch, sodium starch glycolate |

## Other information

- store between 20-25°C (68-77°F)

# Supplement Facts

Beta-Alanine 100 g

| | |
|---|---|
| Serving Size: | (1 teaspoon) 3.2 g |
| Servings Per Container: | 31 |

Amount Per Serving

| | |
|---|---|
| Beta-Alanine (as CarnoSyn®) | 3.2 g |

Suggested Use: 1 teaspoon (2 times daily) dissolved in juice, water or your favorite pre-workout drink. Do not add to products already containing BETA-ALANINE. BETA-ALANINE can create excess sensory effects at the skin level in some users. Initiate use with half of a single serving to assess your tolerance to ALLMAX CarnoSyn® BETA-ALANINE. As you become accustomed to the feeling, increase your dosage to 2 servings (6.4 g). Do not exceed 4 servings in a 24 hour period.

* Percent daily values are based on a 2000 calorie diet

† Daily Value not established

# Tylenol

REFERENCES


1. AllMax Nutrition Beta-Alanine - IllPumpYouUp.com. Retrieved April 12, 2015, from http://www.illpumpyouup.com/allmax-nutrition/beta-alanine-100-grams.htm
2. Baguet, A., Reyngoudt, H., Pottier, A., Everaert, I., Callens, S., Achten, E., & Derave, W. (2009). Carnosine loading and washout in human skeletal muscles. *Journal of Applied Physiology*, *106*(3), 837–842.
3. Culbertson, J. Y., Kreider, R. B., Greenwood, M., & Cooke, M. (2010). Effects of Beta-Alanine on Muscle Carnosine and Exercise Performance: A Review of the Current Literature. *Nutrients*, *2*(1), 75–98.
4. Derave, W., Ozdemir, M. S., Harris, R. C., Pottier, A., Reyngoudt, H., Koppo, K., Achten, E. (2007). Beta-Alanine supplementation augments muscle carnosine content and attenuates fatigue during repeated isokinetic contraction bouts in trained sprinters. *Journal of Applied Physiology*, *103*(5), 1736–1743.
5. Devlin, J., Paton, B., Poole, L., Sun, W., Ferguson, C., Wilson, J., & Kemi, O. J. (2014). Blood lactate clearance after maximal exercise depends on active recovery intensity. *The Journal of Sports Medicine and Physical Fitness*, *54*(3), 271–278.
6. Dupont, G., Moalla, W., Matran, R., & Berthoin, S. (2007). Effect of Short Recovery Intensities on the Performance during Two Wingate Tests. *Medicine & Science In Sports & Exercise*, *39*(7), 1170-1176.

7. Glenn, J. M., Gray, M., Stewart, R., Moyen, N. E., Kavouras, S. A., DiBrezzo, R. Baum, J. (2015). Incremental effects of 28 days of beta-alanine supplementation on high-intensity cycling performance and blood lactate in masters female cyclists. *Amino Acids*, *47*(12), 2593–2600.
8. Hoffman, J., Ratamess, N., Ross, R., Kang, J., Magrelli, J., Neese, K., Wise, J. (2008). β-Alanine and the Hormonal Response to Exercise. *International Journal of Sports Medicine*, *29*(12), 952–958.
9. Hoffman, J. R., Ratamess, N. A., Faigenbaum, A. D., Ross, R., Kang, J., Stout, J. R., & Wise, J. A. (2008). Short-duration β-alanine supplementation increases training volume and reduces subjective feelings of fatigue in college football players. *Nutrition Research*, *28*(1), 31–35.
10. Jordan, T., Lukaszuk, J., Misic, M., & Umoren, J. (2010). Effect of beta-alanine supplementation on the onset of blood lactate accumulation (OBLA) during treadmill running: Pre/post 2 treatment experimental design. *Journal of the International Society of Sports Nutrition*, *7*(1), 20.
11. Koizumi, K., Fujita, Y., Muramatsu, S., Manabe, M., Ito, M., & Nomura, J. (2011). Active recovery effects on local oxygenation level during intensive cycling bouts. *Journal Of Sports Sciences*, *29*(9), 919-926.
12. Lopez, E. D., Smoliga, J. M., & Zavorsky, G. S. (2014). The Effect of Passive Versus Active Recovery on Power Output Over Six Repeated Wingate Sprints. *Research Quarterly For Exercise & Sport*, *85*(4), 519-526.

13. Menzies, P., Menzies, C., McIntyre, L., Paterson, P., Wilson, J., & Kemi, O. J. (2010). Blood lactate clearance during active recovery after an intense running bout depends on the intensity of the active recovery. *Journal of Sports Sciences*, *28*(9), 975–982.
14. Sweeney, K. M., Wright, G. A., Glenn Brice, A., & Doberstein, S. T. (2010). The Effect of β-Alanine Supplementation on Power Performance During Repeated Sprint Activity: *Journal of Strength and Conditioning Research*, *24*(1), 79–87.
15. Touguinha, H. M., Silva, F. F., Carvalho, W., Freitas, W. Z., Silva, E., & Souza, R. A. (2011). Effects of active vs. passive recovery on blood lactate after specific judo-task. *Journal of Exercise Physiology Online*, *14*(6), 54+.
16. Weinstein, Y., Bediz, C., Dotan, R., & Falk, B. (1998). Reliability of peak-lactate, heart rate, and plasma volume following the Wingate test: *Medicine & Science in Sports & Exercise*, *30*(9), 1456–1460.
17. Zoeller, R. F., Stout, J. R., O'Kroy, J. A., Torok, D. J., & Mielke, M. (2007). Effects of 28 days of beta-alanine and creatine monohydrate supplementation on aerobic power, ventilatory and lactate thresholds, and time to exhaustion. *Amino Acids*, *33*(3), 505–510.

## BIOGRAPHICAL INFORMATION

Tracey B. Hampshire attended UT Arlington and will graduate in December 2015 with an Honors Bachelors of Exercise Science – Clinical Track. Ms. Hampshire spent much of her undergraduate career actively seeking out anything related to physical therapy. Ms. Hampshire volunteered with Dr. Priscilla Cacola's Little Mavs Movement Academy, worked as a FLOW Technician at Barkman and Smith Physical Therapy, volunteered as a trained technician at the Neuro-Fitness Foundation, interned at Texas Health Resources Arlington Memorial Hospital in the Physical Therapy Department, and was an active member and President of UT Arlington's Run Club. Ms. Hampshire devoted her last semester (Fall 2015) to her classes, Honors thesis, and Physical Therapy school applications. She has applied to different Doctorate Physical Therapy programs throughout the country, has had the pleasure to reach the interviewing process, and hopes to be an Entry-Level DPT student by August of 2016.