Elite Bicyclist Pilot Study
Using Two Levels of Alka-Plex® Supplementation

By Emily Cooper, M.D.
January 22, 2006

Background and Question:
Several research studies have investigated effects of bicarbonate supplementation on athletic performance. During high intensity exercise, lactic acid production impairs energy metabolism and muscle contraction. Theoretically, alkalizing agents, such as bicarbonate, restores the pH level, delays the onset of fatigue, and improves endurance during high intensity exercise. Improvements in lactate buffering and performance in sprints has been documented, but less is documented relating to endurance at the anaerobic (metabolic acidosis) threshold (AT) or muscle recovery the day after exhaustive exercise.

The question being tested is: Can Alka-Plex®, a mineral supplement that is formulated to act as an alkalizing agent, improve the body's ability to manage excess acids generated during high intensity exercise? Improvements in managing acidic stress is measured by: (1) various physiological tests (i.e. VO2max, fractional utilization of VO2 at AT, maximal respiratory frequency, R value, pain scale, lactate and bicarbonate blood levels); or (2) improved endurance; or (3) improved muscle recovery after exhaustive exercise?

Method:
Two elite male cyclists performed a series of tests over a six-week period. Cyclist "A" was a 49 year old, nationally ranked, male triathlete weighing 150 pounds. Cyclist "B" was a 57 year old, competitive male athlete weighing 160 pounds. Each athlete underwent three separate weeks of testing. Each week included a VO2max and anaerobic threshold (AT) test on Day 1 (see definitions for more details about these measures), a "Time to Fatigue at AT" test (i.e. exercise at the predetermined AT for as long as possible for each athlete) on Day 4, and a muscular recovery test (i.e. number of leg presses at 2.7 times body weight after exercising to exhaustion on the previous day) on Day 5.

Athletes were tested first to determine a baseline with no Alka-Plex supplementation. This was followed by a week of testing using a low dose of 4grams of Alka-Plex per day. A final week of testing used a higher dose of 2mEq/kilogram of body weight (about 11grams per day for a 150 pound athlete). Each testing week was separated by a week of rest.

Gas exchange testing was performed using the Cosmed K4B2 portable breath-by-breath analyzer. Lactate was measured using an Accusport Analyzer. Bicycle testing was done using a CompuTrainer with gearing set for the AT test on Day 1 and the "Time to Fatigue at AT test on Day 4. A Cybex leg press machine was used for the muscle recovery test on Day 5.

Conclusion:

The pilot study has too few participants to draw any firm conclusions. However, the following observations appear relevant:

1. Alka-Plex supplementation significantly increased the time to fatigue for both athletes (258% for Cyclist A, 28% for Cyclist B);
2. Lactate levels for both athletes (an indication of lactic acid processed during exercise) at exhaustion were not as high with Alka-Plex supplementation in spite of the increased work performed (17% lower for Cyclist A, 50% lower for Cyclist B);
3. High dose Alka-Plex supplementation improved muscle recovery for both athletes (243% for Cyclist A, 110% for Cyclist B); and
4. Alka-Plex supplementation may lower the heart rate and respiratory rate of athletes as they exercise to exhaustion.

Venous bicarbonate, total serum calcium and urine pH levels were within normal ranges. Cyclists did not report any gastro-intestinal system complaints while taking Alka-Plex. Typically, bicarbonates have side effects which include multiple potential gastro-intestinal system complaints.

It is unclear why the lactate levels and respiratory quotient (R value) were lower with Alka-Plex supplementation despite the same workload over a longer period of time. One explanation may be the prolonged isocapnic buffering (i.e. arterial carbon dioxide pressure remaining constant) associated with longer term exercise. Training has not been shown to improve isocapnic buffering[1] but I did not find any research specifically on iscapnic buffering for the work intervals of this test. If Alka-Plex accelerates lactate clearance, fat burning may be enhanced and the resulting increase in fat burning may lead to glycogen sparing.

---

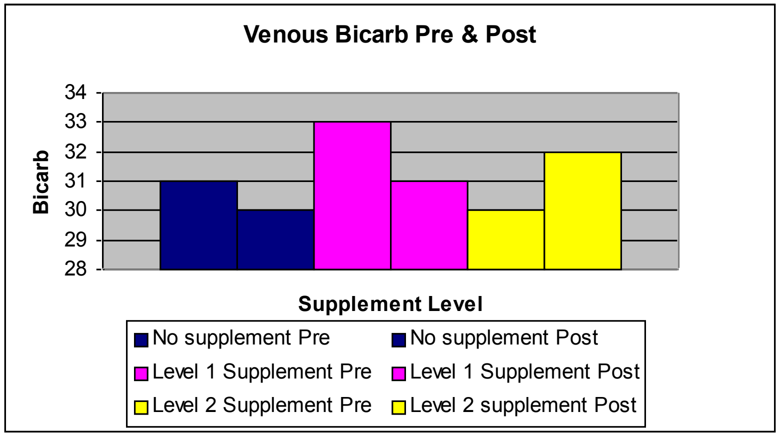
[1] Br. J.Sports Med, Dec 2000: Chicharro – **Effects of endurance training on the icocapnic buffering and hypocapnic hyperventilation phases in professional cyclists.**

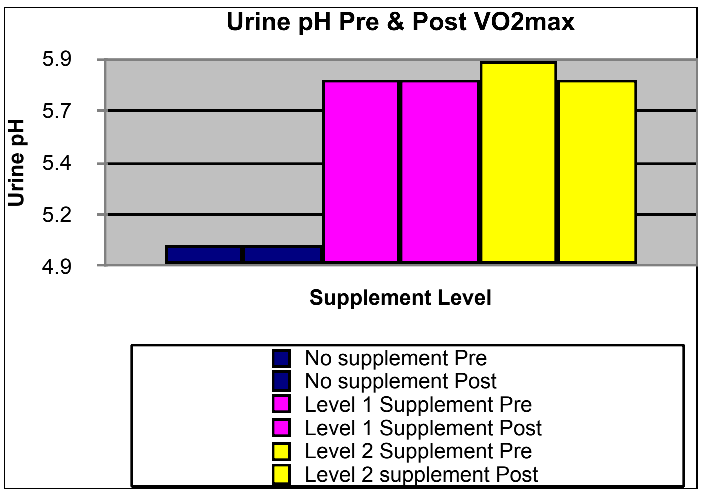
Recommendations for future research:

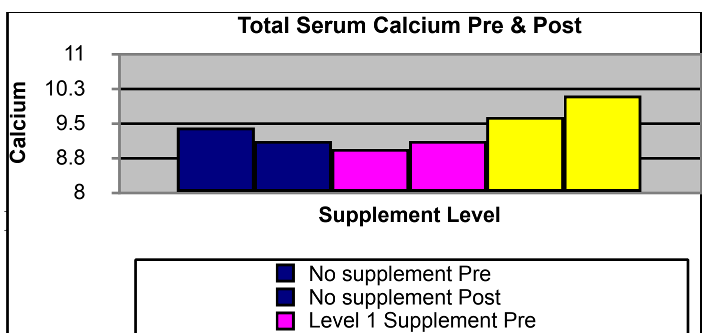
Additional research should confirm: (1) the increase in endurance at anaerobic threshold (AT) or lactate threshold and (2) improved muscle recovery using a double-blind, randomized controlled study with a greater number of athlete subjects. The study format could be simplified to use baseline gas exchange and/or lactate testing to obtain the anaerobic threshold (AT) power settings for completion of the endurance test. As long as the study is controlled and blind, the results should be reliable. If a more complex study were possible, it would be advantageous to confirm the improvement in fat burning, lower respiratory rate and lower heart rate at the same power output.

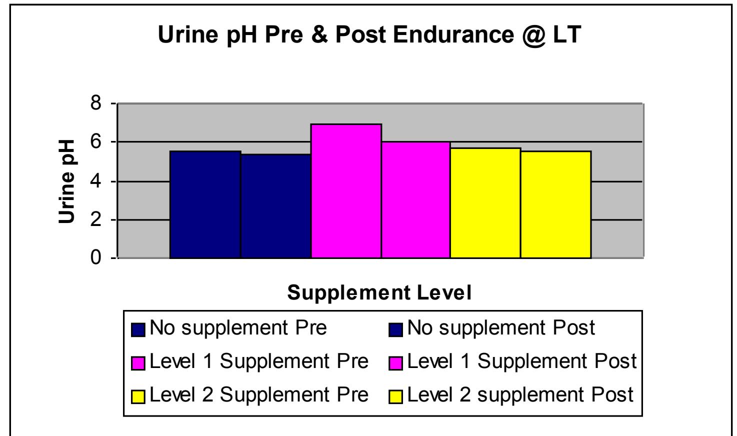
Hypercalcemia can be a medical emergency and calcium supplementation, a component of Alka-Plex, should be used with caution above the recommended daily allowance (RDA) adopted by the U.S. Food and Drug Administration (FDA). Safety of long term supplementation with alkalizing agents at high doses of 2mEq/kilogram of body weight, is not established.

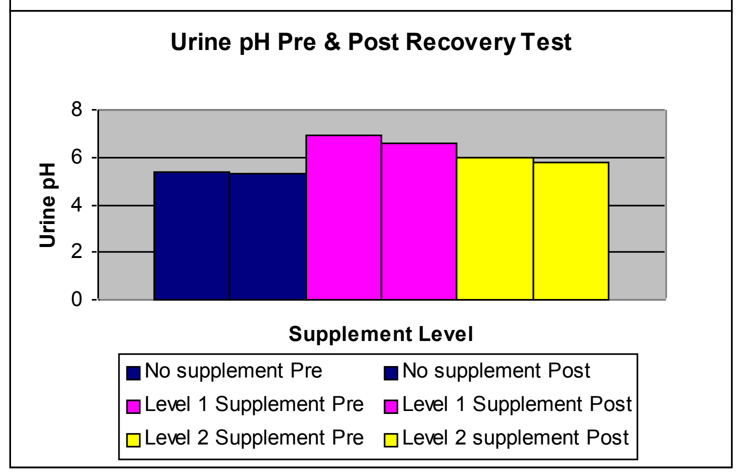
Results: Subject A - Lab test results



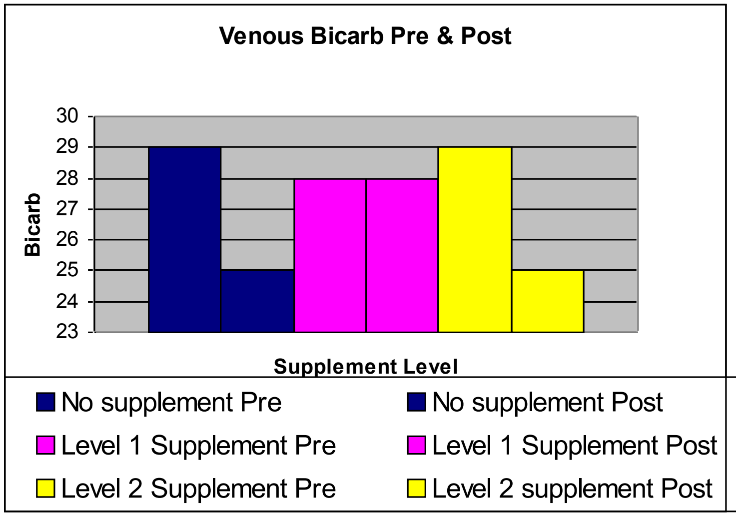


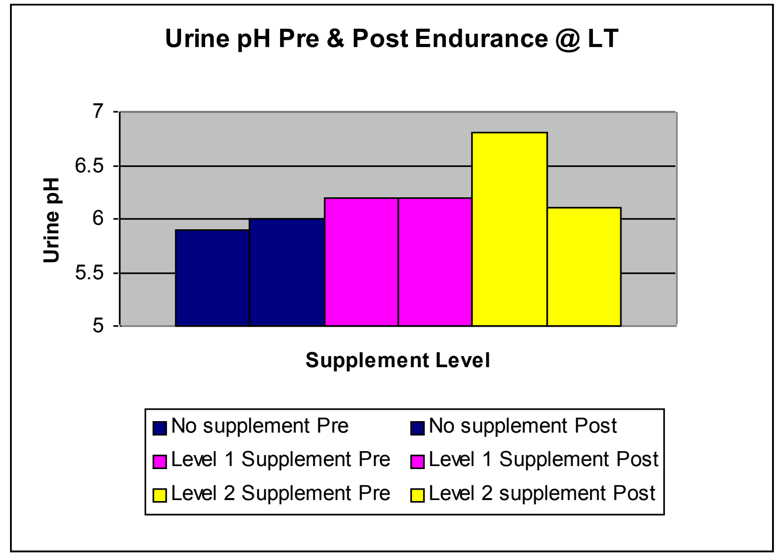


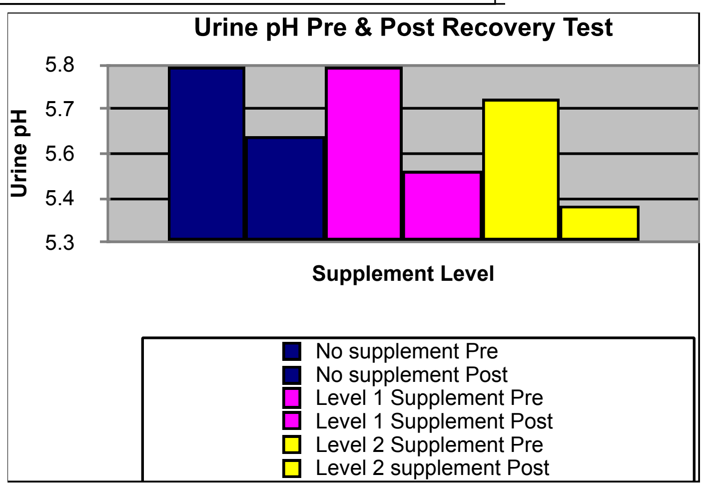


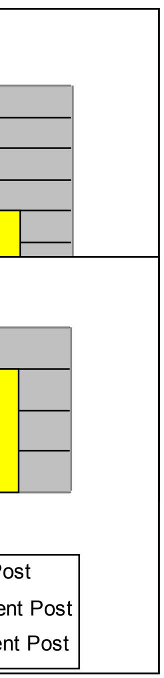


Results: Subject B - Lab test results

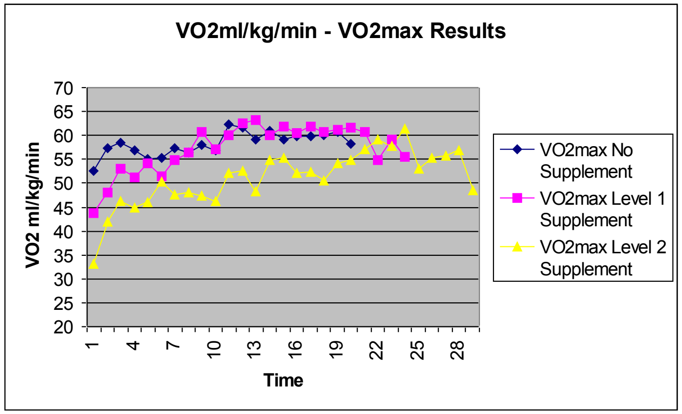


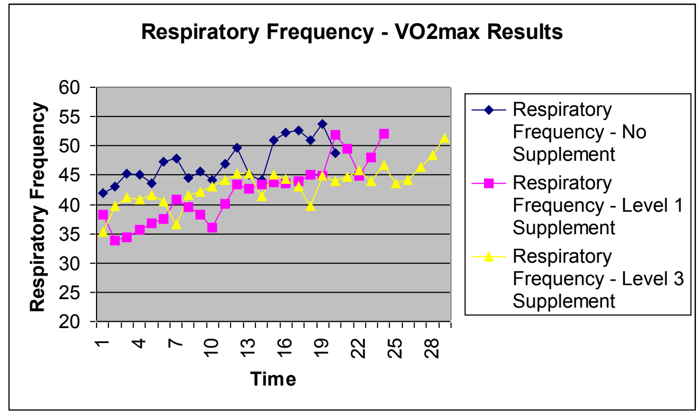


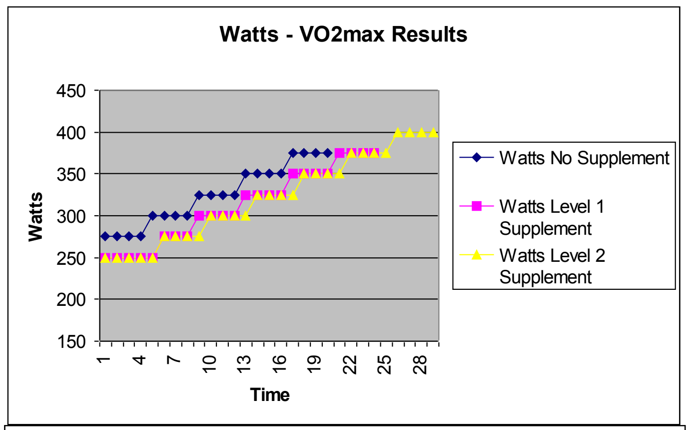


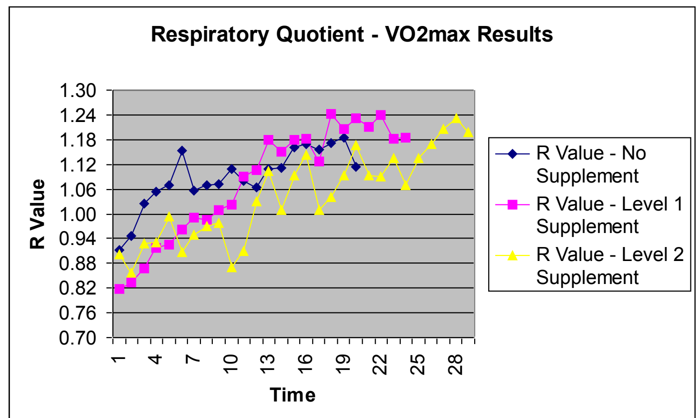


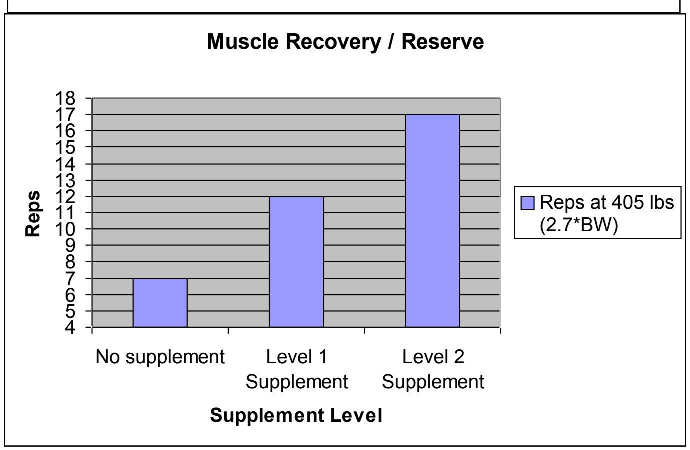
Results: Subject A - Exercise test results - VO2max & Muscle Recovery

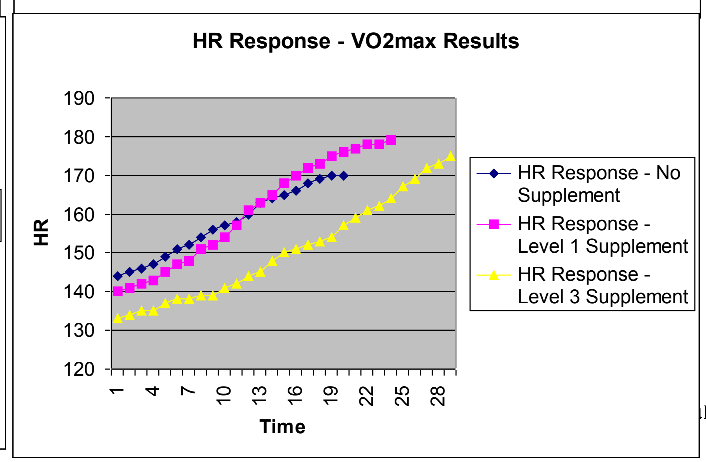




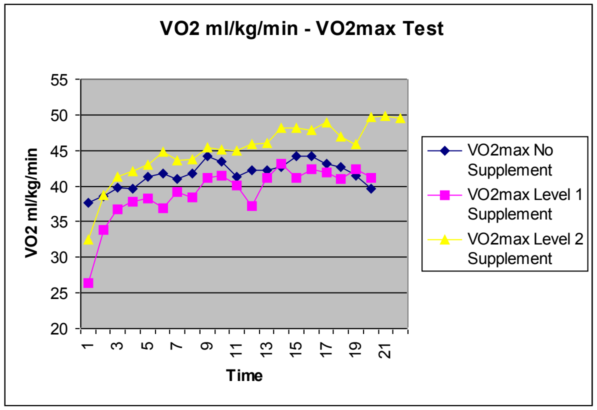


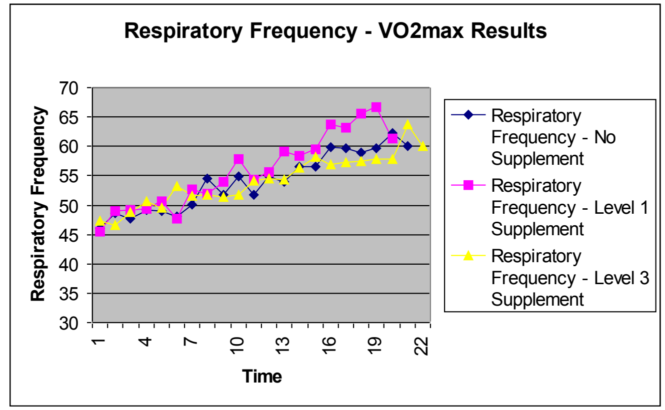


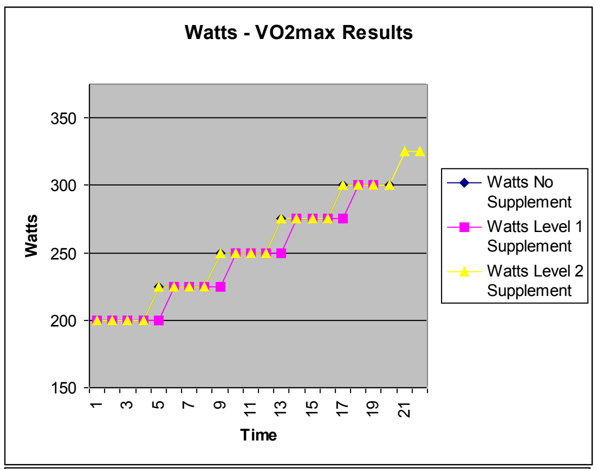


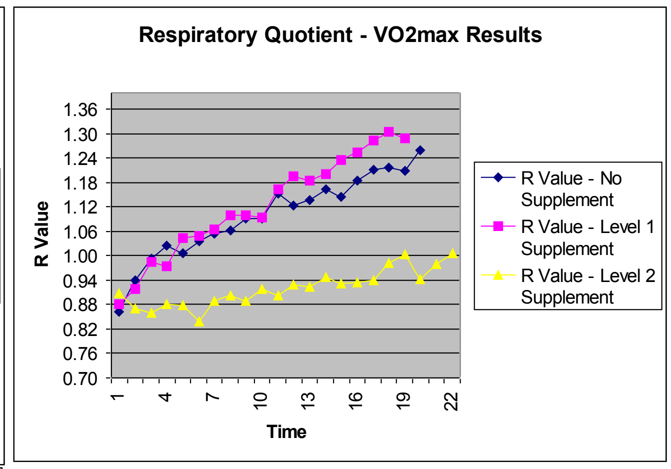


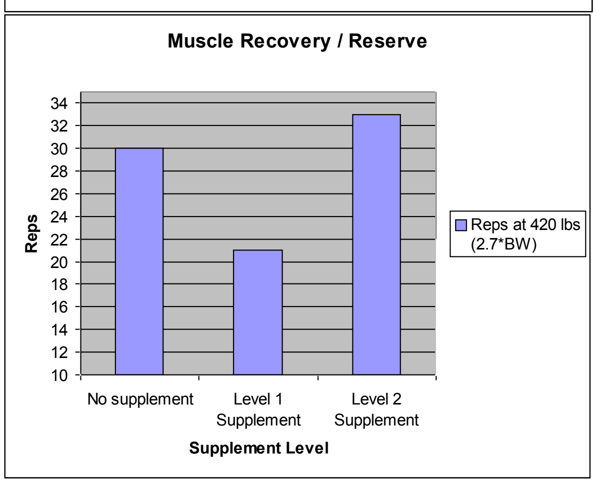
Results: Subject B - Exercise test results - VO2max & Muscle Recovery

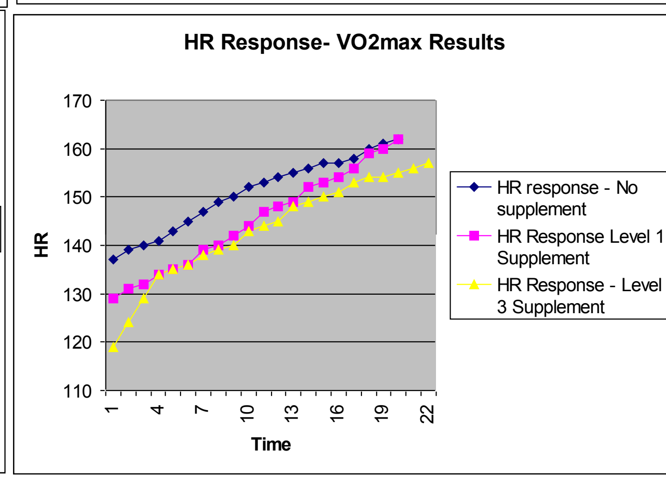




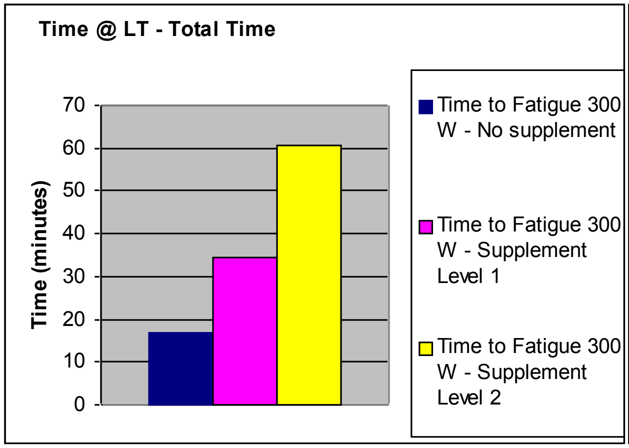


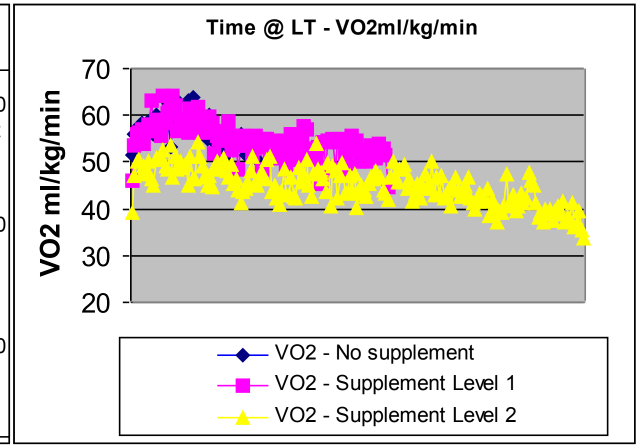


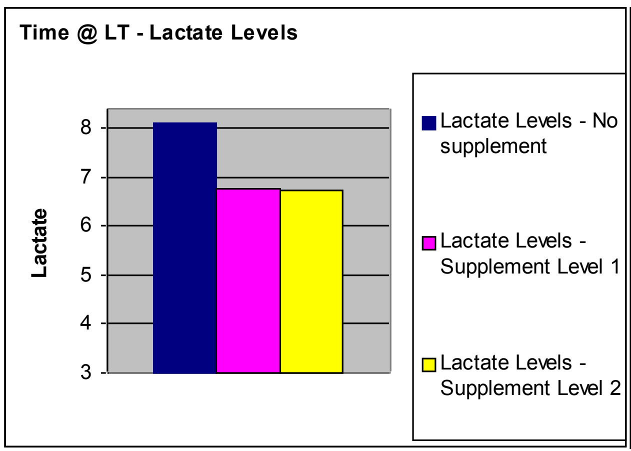


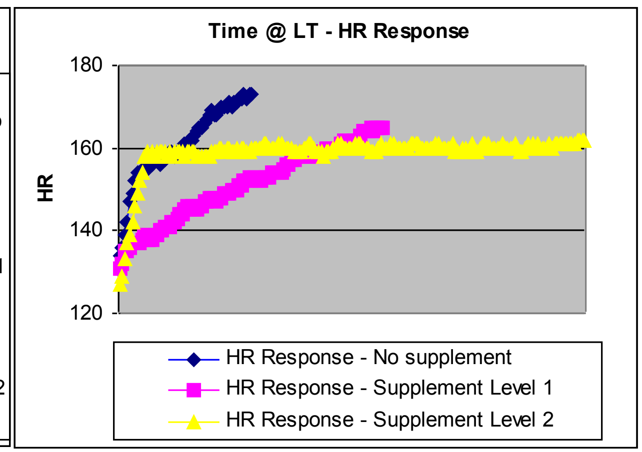


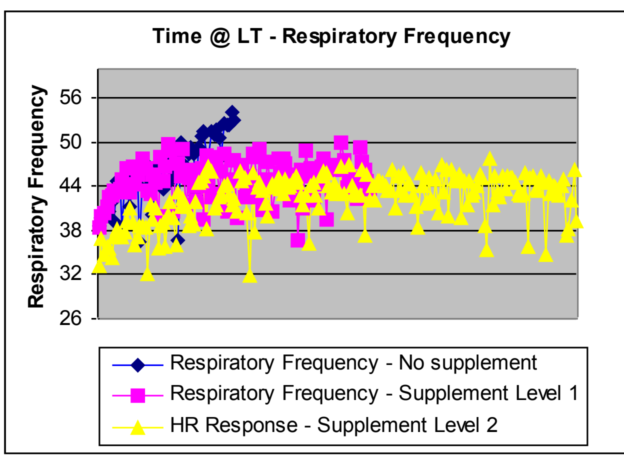
Results: Subject A - Time at Lactate Threshold Test

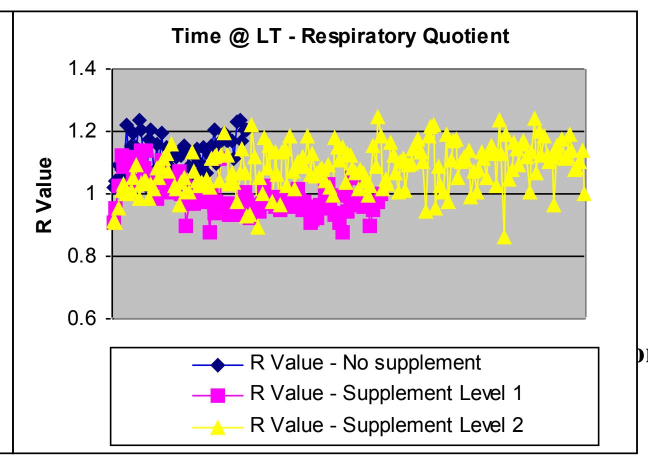

Time @ LT - Total Time
Time (minutes)
0
10
20
30
40
50
60
70
Time to Fatigue 300 W - No supplement
Time to Fatigue 300 W - Supplement Level 1
Time to Fatigue 300 W - Supplement Level 2


Time @ LT - VO2ml/kg/min
VO2 ml/kg/min
20
30
40
50
60
70
VO2 - No supplement
VO2 - Supplement Level 1
VO2 - Supplement Level 2

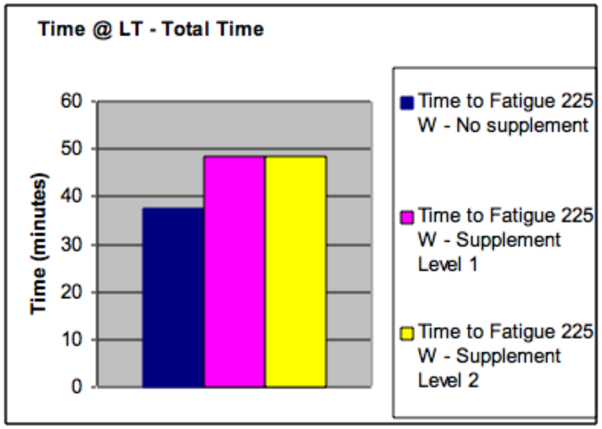

Time @ LT - Lactate Levels
Lactate
3
4
5
6
7
8
Lactate Levels - No supplement
Lactate Levels - Supplement Level 1
Lactate Levels - Supplement Level 2

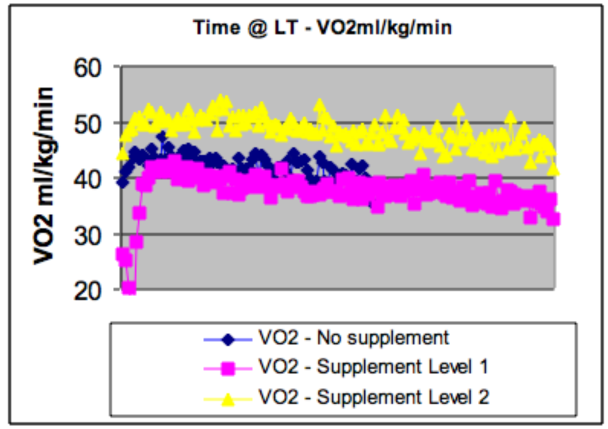

Time @ LT - HR Response
HR
120
140
160
180
HR Response - No supplement
HR Response - Supplement Level 1
HR Response - Supplement Level 2

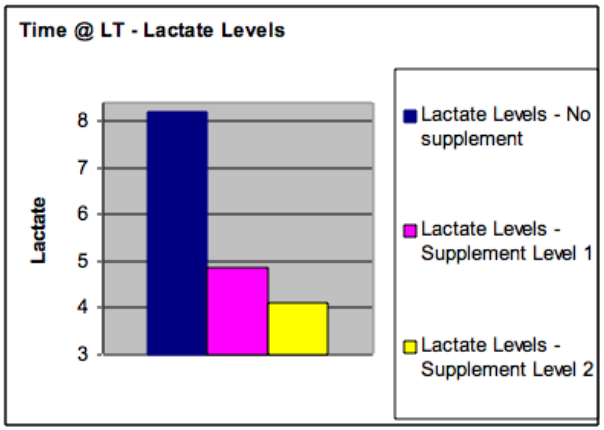

Time @ LT - Respiratory Frequency
Respiratory Frequency
26
32
38
44
50
56
Respiratory Frequency - No supplement
Respiratory Frequency - Supplement Level 1
HR Response - Supplement Level 2

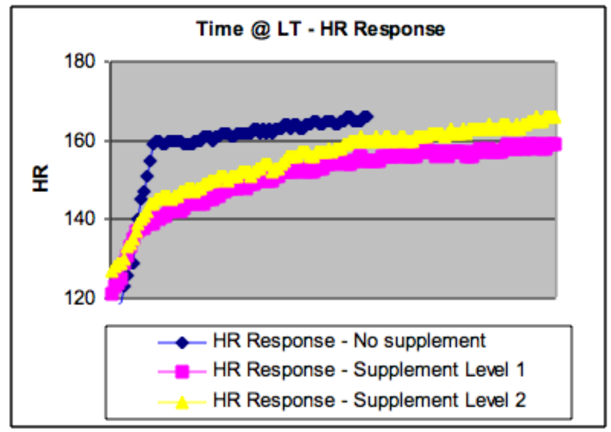

Time @ LT - Respiratory Quotient
R Value
0.6
0.8
1
1.2
1.4
R Value - No supplement
R Value - Supplement Level 1
R Value - Supplement Level 2

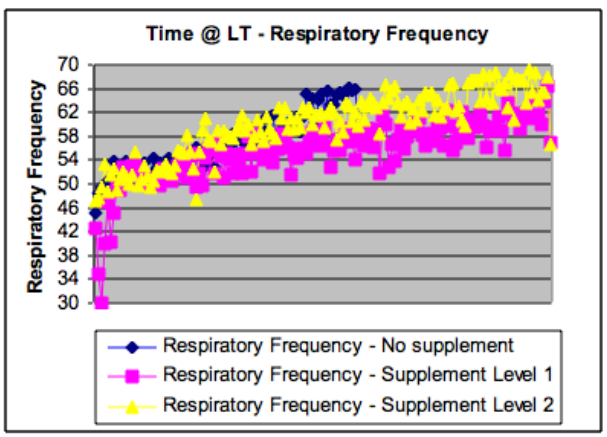
Results: Subject B - Time at Lactate Threshold Test

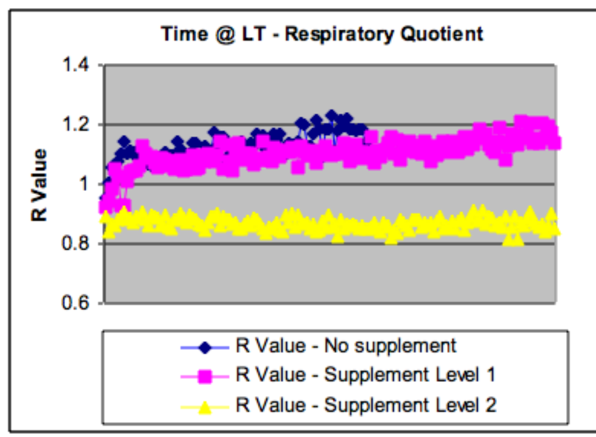




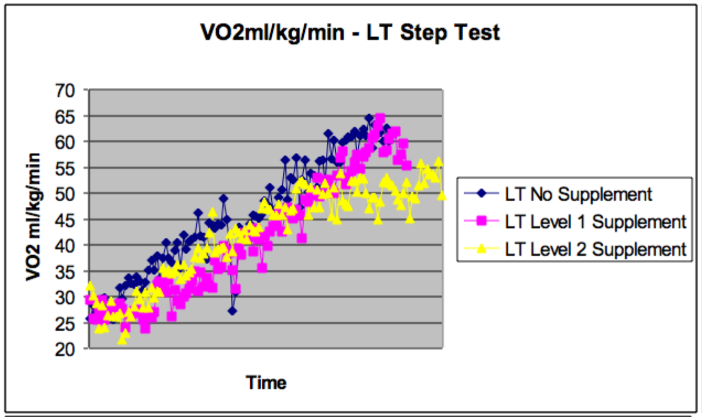


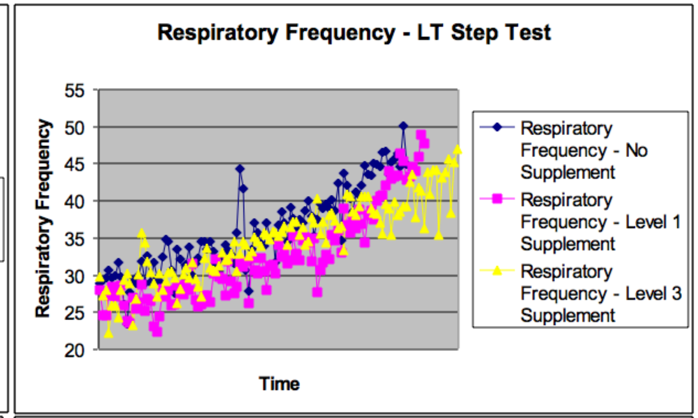


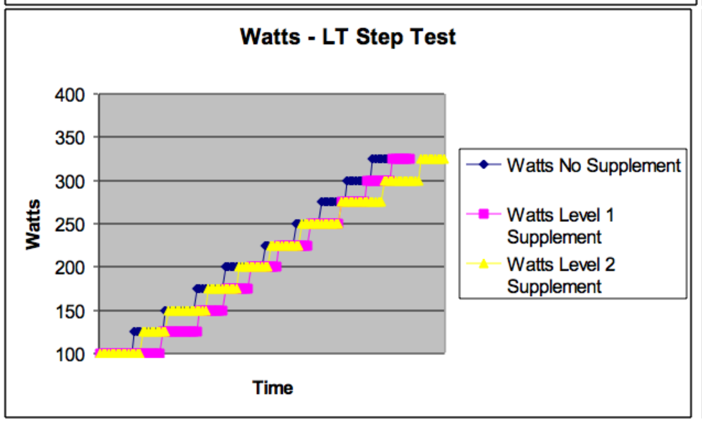


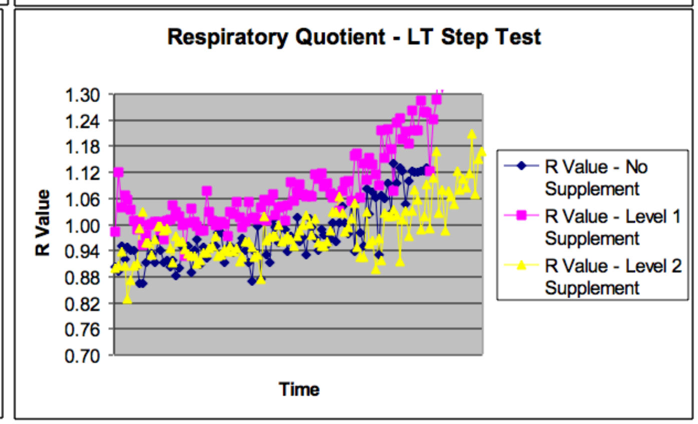


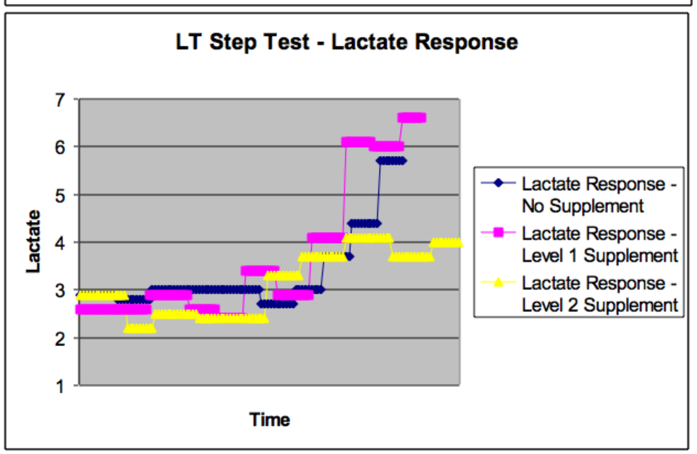
<u>Results Subject A: Lactate Threshold Step Test (same day as Baseline VO2max)</u>

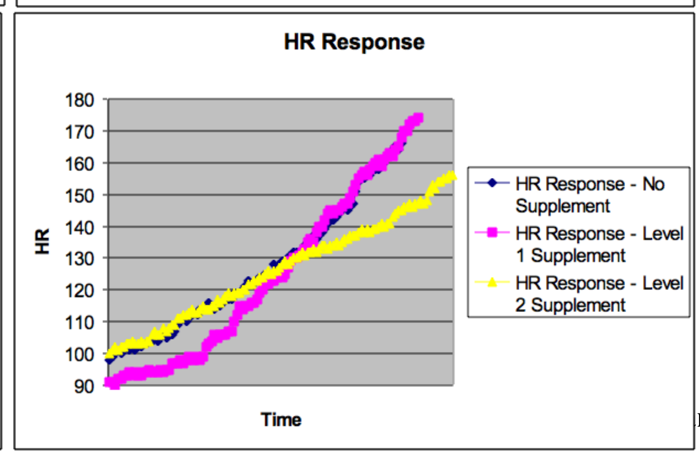




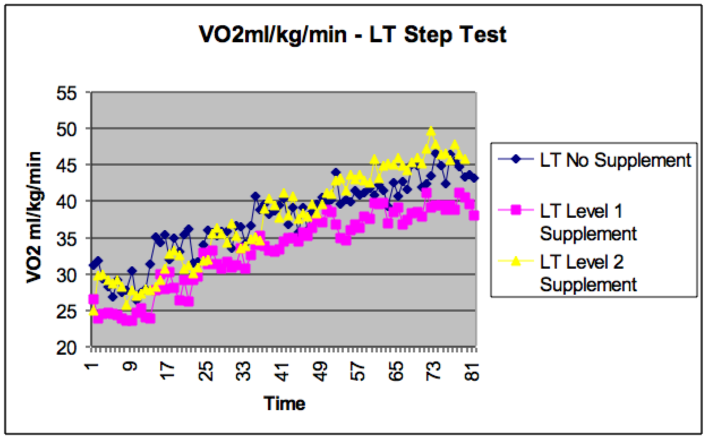


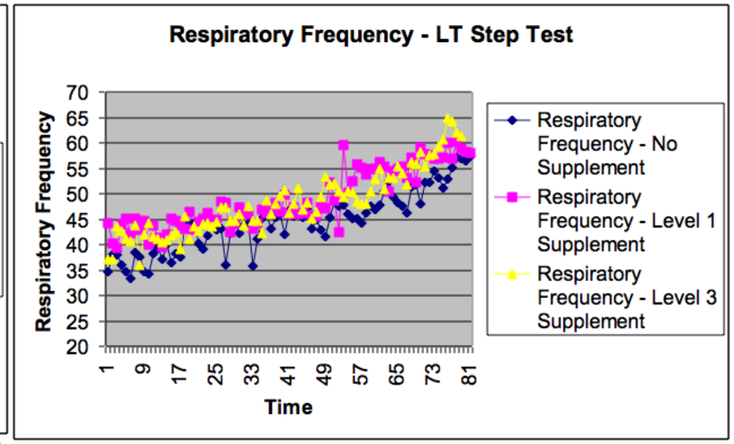


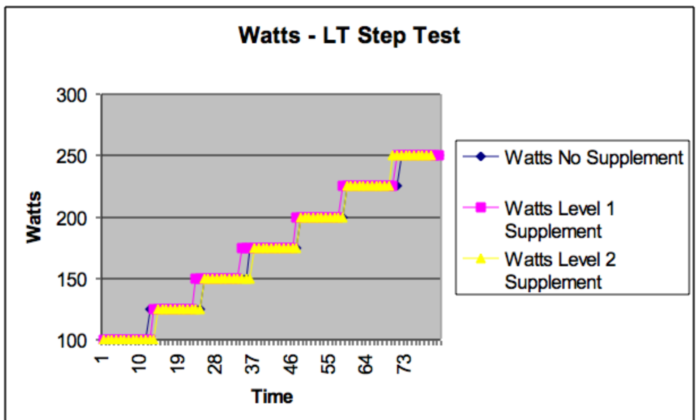


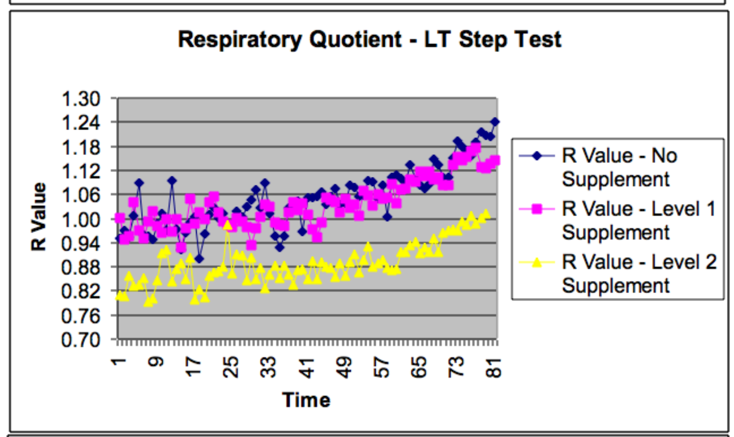


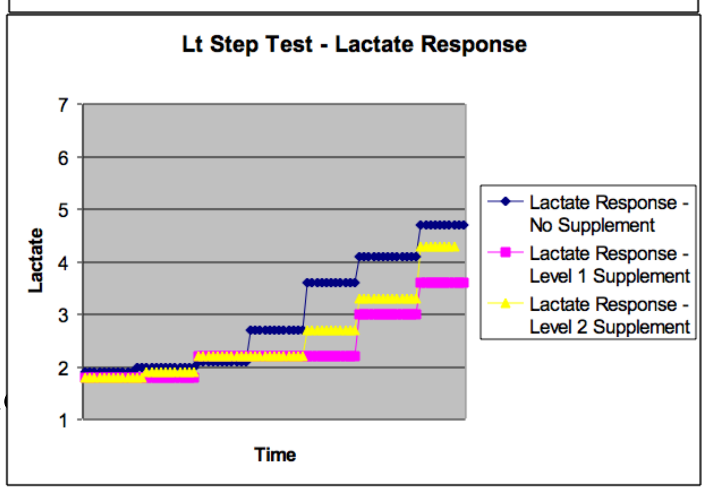
Results Subject B: Lactate Threshold Step Test (same day as Baseline VO2max)

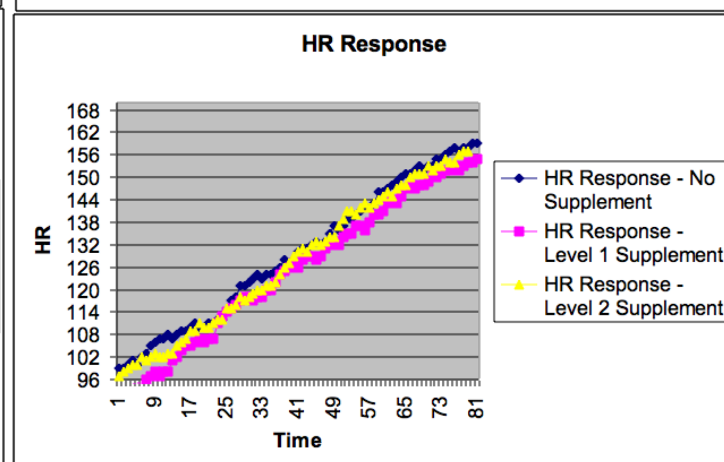




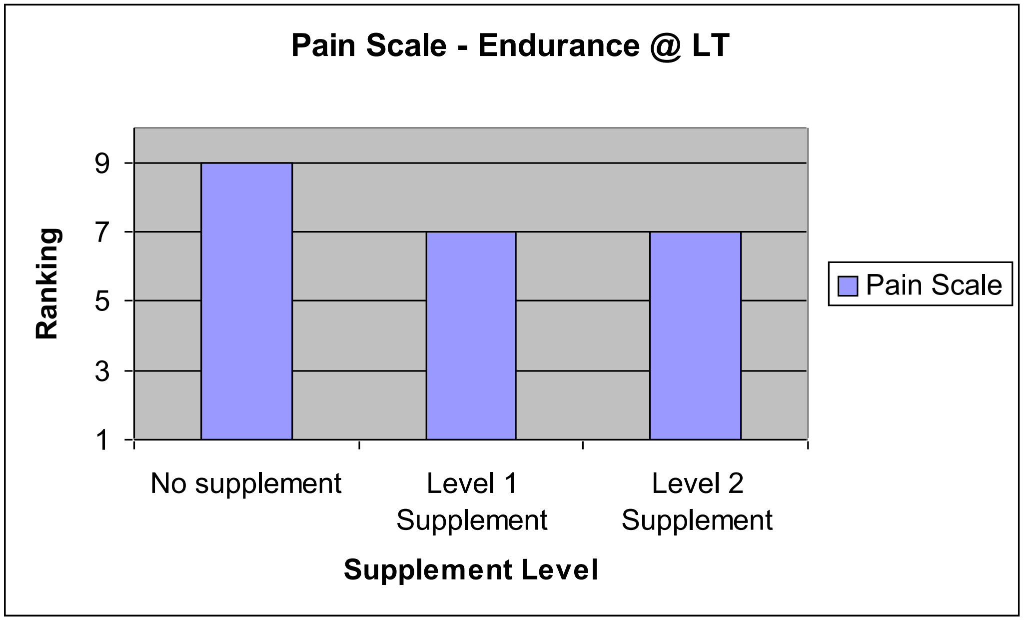


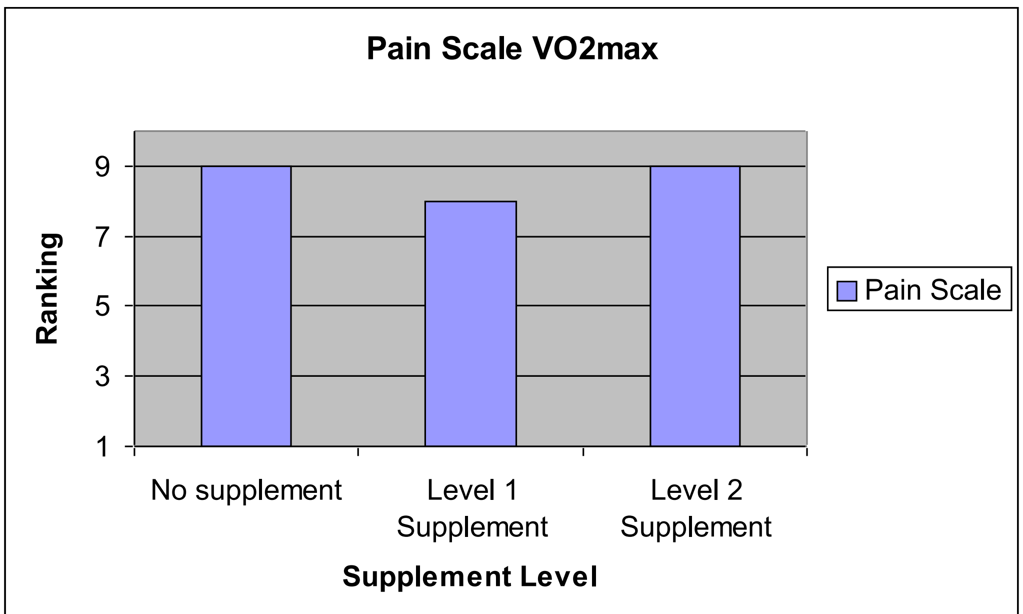




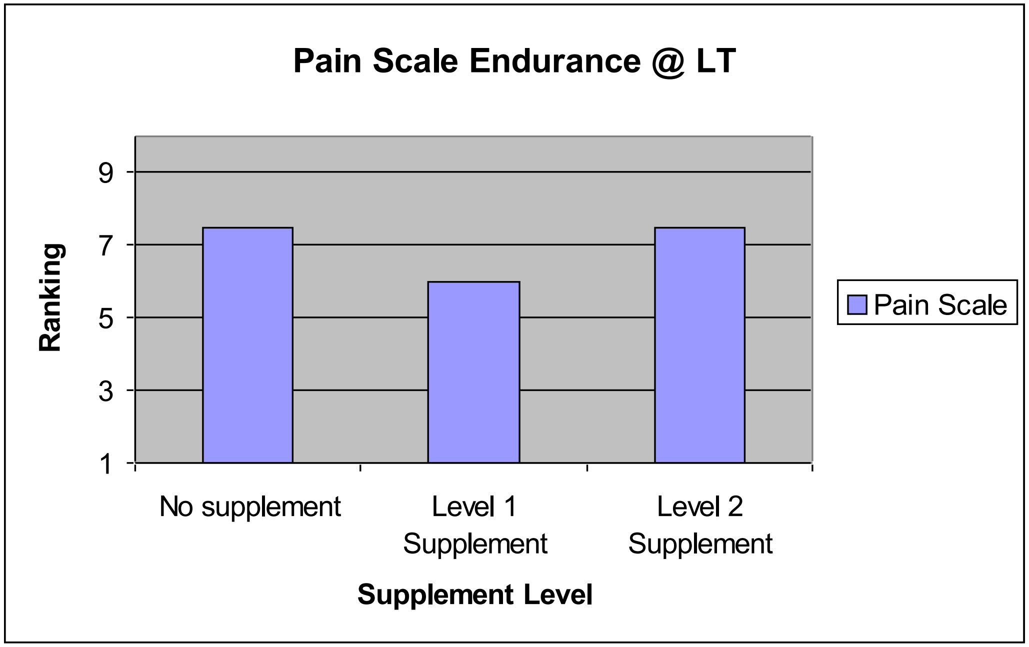


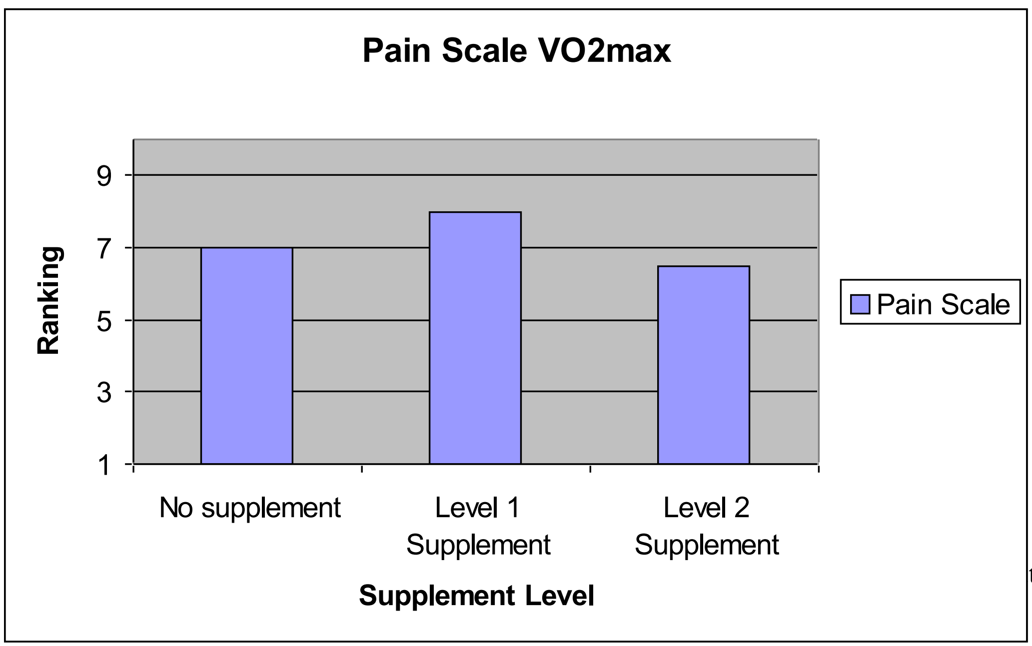
<u>Results Subject A: Pain Scales</u>





Results Subject B: Pain Scales





The following definitions are provided for the lay reader.

Definitions:

VO2Max – Fitness can be measured by the volume of oxygen you can consume while exercising at your maximum capacity. VO2 max is the maximum amount of oxygen in milliliters, one can use in one minute per kilogram of body weight. Those who are most fit have higher VO2 max values and can exercise more intensely than those who are not as well conditioned. Numerous studies show that you can increase your VO2 max by working out at an intensity that raises your heart rate to between 65 and 85% of its maximum for at least 20 minutes three to five times a week. A mean value of VO2 max for male athletes is about 3.5 liters/minute and for female athletes it is about 2.7 liters/minute.

Anaerobic Threshold (AT) – The anaerobic threshold, the point at which lactic acid starts to accumulates in the muscles, is considered to be somewhere between 85% and 90% of your maximum heart rate. This is approximately 20 beats higher than the aerobic threshold. Your anaerobic threshold can be determined with anaerobic threshold testing. The anaerobic threshold is also known as the lactate threshold (LT).

Lactic Acid – The expression "lactic acid" is used most commonly by athletes to describe the intense pain felt during exhaustive exercise, especially in events like the 400 meters and 800 meters. When energy is required to perform exercise it is supplied from the breakdown of Adenosine Triphosphate (ATP). The body has a limited store of about 85 grams of ATP and would use it up very quickly if we did not have ways of resynthesizing it. There are three systems that produce energy to resynthesize ATP: ATP-PC, anaerobic and aerobic.

Respiratory Quotient (the "R Value") – Carbohydrates, fat and protein all play a part in energy metabolism and for a certain volume of oxygen the energy released will depend upon the energy source. It is possible to estimate which particular fuel (carbohydrate, fat or protein) is being oxidized by calculating the R Value. R Value is the ratio of carbon dioxide (CO_2) produced to oxygen (O_2) consumed and is also known as the Respiratory Exchange Ratio (RER).

<u>Bibliography</u>:

Avedisian, L., Guerra, A., Wilcox, A., & Fox, S. (1995). The effect of selected buffering agents on performance in the competitive 1600 meter run. *Medicine and Science in Sports and Exercise*, 27(5), Supplement abstract 133.

Chicharro, J.L., Hoyos, J., & Alejandro, L. (2000). Effects of endurance training on the isocapnic buffering and hypocapnic hyperventilation phases in professional cyclists. *British Journal of Sports Medicine*, 34, 450-455.

Frank, C.M., & Völker, K., (Editors). 2005. Molecular and cellular exercise physiology. Champaign, IL: Human Kinetics.

Gore, J.G. 2000. Physiological tests for elite athletes. Champaign, IL: Human Kinetics.

Hyland, P. J., MacConnie, S. E., & Meigs, R. A. (1993). The effect of sodium bicarbonate ingestion on work output during a 2,000 meter rowing ergometer time trial. *Medicine and Science in Sports and Exercise, 25(5),* Supplement abstract 1085.

Myers, J.N. 1996. Essentials of cardiopulmonary exercise testing. Champaign, IL: Human Kinetics.

Santalla, A., Perez, M., Montilla, M., Vicente, L., Davidson, R., Earnest, C., & Lucia, A. (2003). Sodium bicarbonate ingestion does not alter the slow component of oxygen update kinetics in professional cyclists. *Journal of Sports Science*, 21(1), 39-47.

Sleivert, G. Aerobic Assessment. Guidelines for Athlete Assessment in New Zealand Sport.

Viru, A. & Viru, M. 2001. Biochemical monitoring of sport training. Champaign, IL: Human Kinetics.

Wasserman, K., Hansen, J.E., Sue, D.Y., Casaburi, R., & Whipp, B.J. (1999). Principles of exercise testing and interpretation: Including pathophysiology and clinical applications, 3rd Ed. Baltimore, MD: Lippincott Williams & Wilkins.