Physical Fitness and Plasma Non-Enzymatic

Antioxidant Status at Rest and After a Wingate Test

Seven male physical education students underwent the Wingate test, a 30 sec sprint anaerobic exercise, and their plasma non-enzymatic antioxidant status (plasma uric acid, ascorbic acid, ß-carotene, alpha-tocopherol) were tested in order to demonstrate the effect of exercise on oxidated stress evaluated by lipid radical levels. Venous blood samples were taken prior to the warm-up and prior to the Wingate test after completing the warm-up. Venous blood samples were also completed five different times following the Wingate test. Samples were taken immediately after cessation of exercise, at 5 min, 10 min, 20 min, and 40 min increments post exercise. An arterialized capillary blood sample was also collected 3 min after the end of exercise for the determination of maximal blood lactate concentration.

The results of the study produced a negative relationship between serum lipid levels with plasma alpha-tocopherol and plasma uric acid concentrations at rest. The resting lipid levels were high when the alpha-tocopherol and plasma uric acid levels were low. The low plasma alpha-tocopherol and uric acid level at rest where associated with a high sprint performance which also produced a negative correlation. The level of concentration of plasma uric acid showed a significant increase at 10 min (13.2%), 20 min (42.9%), 40 min (72.9%) of recovery when compared to resting levels. The plasma concentration of ascorbic acid increased at 20 min (12.7%) and 40 min (15.3%) of recovery when compared to resting level concentrations. The plasma alpha-tocopherol concentrations decreased significantly at 5 min (-10.9%) and 10 min (-9%) recovery when compared to rest levels. An association was revealed between high levels of lipid radical levels and the 20 min post exercise through a significant increase in ESR signal intensity when compared to rest. The researchers demonstrated that a sprint anaerobic exercise is associated with changes in non-enzymatic antioxidant levels. The subjects that displayed the largest leg peak power also exhibited the lowest plasma antioxidant (uric acid and alpha-tochopherol) at rest.

B. The major theoretical principle upon which the study was based deals with previous research showing an association between the increased production of free radicals during exhaustive aerobic exercise and whether antioxidant intake may protect against damage by exercise induced oxidative stress. The enzymatic enzymes, catalase, Superoxide dismutase, glutathiase peroxidase and the non-enzymatic antioxidants, alpha-tocopherol, ascorbic acid, ß-carotene, glutathione and uric acid are all part of the blood antioxidant defense. Through exhaustive aerobic exercise, the activity of antioxidant enzymes in the body increases as well as the activity of free radicals where lipid peroxidation may damage cellular and subcellular muscles in the body, leading to muscle soreness. In theory the prevention of the resulting muscular damage may enable the athlete to train more effectively whic may result in a more desirable performance (Williams, 2002). The focus of this study evaluated oxidative stress, defined through serum lipid radical levels, resulting from a 30 sec maximal sprint anaerobic exercise and whether the levels where sufficient to alter levels of alpha-tocopherol, ascorbic acid, ß-carotene and uric acid. The relationship between plasma antioxidant status serum lipid radical levels and sprint performance was also evaluated.

C. Two main limitations or weaknesses of this study include the factors of nutritional status and physical fitness status of the subjects. The nutritional intake of the participants were not monitored or standardized in the weeks prior to the study. The only guideline prescribed in regards to food intake of the subjects was to eat a standardized breakfast which contained 55% carbohydrates, 15% proteins, and 30% lipids 2 hours prior to the start of the test. The resting antioxidant levels found in this study were near the lower limits of the normal range and the individual differences in their diets may have had an influence on the plasma antioxidant status. Further more, the criterion for physical fitness status in this study was that subjects were active (approximately 14h/wk of various sport activity for at least 2 years) but they were not involved in regular athletic training (endurance or sprint). The level of physical fitness may have also influenced the antioxidant status and the individual differences for fitness status may have also been a contributing factor to antioxidant status.

D. The major finding of this study demonstrates an association with acute changes in non-enzymatic plasma antioxidant status and 30 sec ergocycle sprinting. The maximal plasma volume change was -17% at the end of the Wingate test. This study also showed that subjects who exhibited the highest sprint performance also displayed the lowest resting plasma non-enzymatic antioxidant status (uric acid, alpha-tocopherol). Other research studies found similar results where a negative relationship was found between VO sub2max and plasma uric acid or plasma alpha-tocopherol. The combination of these findings and other investigations suggest higher aerobic and anaerobic exercise may be associated with lower plasma antioxidant status (uric acid and alpha-tocopherol). The researchers suggested that low non-enzymatic antioxidants stores at rest also exhibits a higher oxidative stress level if it is assumed the resting lipid radical level is a good marker of the oxidative stress level. This was due to a negative relationship found at rest between plasma uric acid concentration and serum lipid radical level and a similar relationship at rest for plasma alpha-tocopherol and serum lipid radical level. Most studies that have been conducted in the past have found aerobic training reinforces antioxidant potential, which has beneficial effects by increasing enzymatic antioxidant activity and decreasing lipid peroxide levels over a short training period. The results of this study may suggest training might result in a chronic status of oxidative stress if the subjects who displayed the highest VO sub2max or W subpeak are also the better trained. Previous studies that compared highly trained subjects that followed training over several years to sedentary controls, instead of sedentary individuals subjected to acute physical exercise over a short duration found results that differed. Few studies have investigated effects of non-aerobic exercise on markers of oxidative stress or the changes in plasma non-enzymatic antioxidants brought about by anaerobic exercise. The major finding of this study was that a sprint exercise bout was associated with significant concentration changes in the main plasma non-enzymatic antioxidant compounds. Ascorbic acid and uric acid increases as alpha-tocopherol and ß-carotene decreases. This rise in uric acid has also been found to occur after various aerobic and anaerobic exercise by existing documentations or research. The researchers suggested, based on the results of this study along with the existing body of knowledge in this area, that athletes intake of antioxidants play an important role in maintaining plasma antioxidant concentrations within the normal range and protecting against acute or chronic exercise induced oxidative stress.

E. Overall, I feel that this study was well constructed, conducted and analyzed as well as bringing novelty to the field of nutrition with research in regards to anaerobic exercise and antioxidant status. If I had to perform this study the features that I would change deal with previously stated limitations or weaknesses of this study. The level of training one possesses has an influence on the plasma antioxidant status. To try and control the level of variability between individuals, I would choose subjects of the elite athlete status in an attempt to create homogeneity among the subject's physical fitness level. Another aspect that I would try to control as a researcher in this study would be the nutritional intake of the participants for several weeks preceding the testing. A highly specific diet would include the caloric intake that the individual were to consume for several weeks with instruction to refrain from any nutritional supplement including vitamins or minerals in order to modify the resting plasma antioxidant status.

References

Williams, M. H. (2002). *Nutrition for health, fitness.* Boston: McGraw Hill.