The Effect of Wheatgrass Consumption on the Unloading of Oxygen and Accumulation of Lactic Acid in a Group of Collegiate Athletes During Exercise

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Abstract

Our laboratory previously demonstrated that wheat grass juice (WG) enhanced the decrease in blood oxygen saturation (SpO₂) that occurs during aerobic exercise. This effect may be due to more efficient unloading of oxygen from blood to muscle tissue. Such an effect would suppress anaerobic metabolism thereby suppressing lactic acid production. The goal of the current experiment is to confirm our previous results and determine the effects of exercise and WG on blood lactate concentrations. Thirteen athletes (10 men and 3 women) were subjected to two consecutive days of testing. During tests subjects received either WG dissolved in 59 ml of vehicle or 59 ml of vehicle. The order of treatments was randomly assigned. Within 20 min following ingestion of fluids subjects ran on a treadmill until they reached a peak heart rate of 85% maximum. SpO₂ and pulse rate were measured before, during (at peak heart rate) and immediately after exercise whereas blood lactate concentrations were measured before and immediately after exercise. Exercise caused a decrease (P<.0001) in SpO₂ and an increase (P<.01) in blood lactate concentrations. WG did not augment either of these effects (P>.1). Our results lend no support to the claim that WG promotes oxygen unloading during exercise.

Introduction

Previous research from this laboratory has shown that the ingestion of wheatgrass juice (WG) prior to exercise enhanced the decrease in blood oxygen saturation (SpO₂) that typically occurs during exercise (Rowell et al., 1964). This observation is consistent with the idea that WG increases unloading of oxygen to muscle tissues thereby reducing reliance on anaerobic metabolism and production of lactic acid. The mechanism by which WG acts is unknown, but it is clear that the increase in oxygen unloading observed during exercise is related to vasodilatation (Handzel et al., 2010). In light of this result, it seems reasonable to hypothesize that WG enhances oxygen delivery to muscle by increasing blood flow to these tissues. Any increase in oxygen delivery to muscle would be expected to improve athletic performance by enhancing peak oxygen intake (VO₂ max) and reducing discomfort caused by buildup of lactic acid in muscle tissue.

Materials and Methods

Subjects and Experimental Design.

The experiment was conducted over a two-day period. Thirteen (10 men; 3 women) members of the SUNY Oneonta swim team volunteered to participate in this study. Each participant served as his or her own control; that is, they were subjected to both the control and WG treatments. The order of treatments was randomly determined for each subject.

During each test period subjects ingested 59 ml of dehydrated WG dissolved in a mixture of water, lemon juice, and grape juice (vehicle) or 59 ml of vehicle and dill weed. Neither the subjects nor the investigators knew the identity of the fluid ingested. Solutions were consumed 20 min before onset of exercise.

Exercise Test and Data

The exercise regimen consisted of running on a treadmill until heart rate reached 85% of maximum. The Karvonen equation was used to calculate this target heart rate: Target Heart Rate = [(max HR – resting HR) × %Intensity] + resting HR ; where Intensity is 0.85.

The test period began by measuring each subject’s resting heart rate. In order to achieve the target heart rate both the speed and elevation of the treadmill were adjusted at one-minute intervals. At each interval subjects were asked to recite the alphabet. If they recited with ease then the incline and speed of the treadmill were increased simultaneously. This process was continued until the passage was recited with a noticeable inhalation between letters. This response (Bruce test) corresponds to the subject’s VT1. At this point pulse rate was determined for the second time after which the incline and speed were increased incrementally until the participants reached their target heart rates and sustained this level for one minute. At this reading pulse rate was determined for the third time. A fourth measurement of pulse rate was taken within one minute after cessation of exercise.

In addition to pulse rate, SpO₂ was determined 5 min before exercise, at VT1, at the target heart rate and one minute after termination of exercise and blood concentrations of lactic acid were determined 5 min before and one minute after exercise. SpO₂ and pulse rate were determined with a portable pulse oximeter whereas lactic acid concentrations were determined with a portable lactate analyzer. Lactic acid concentrations were measured in one-two drops of blood obtained by pricking a finger with a sterile lancet.

Preliminary statistical analysis involved comparisons of SpO₂ and lactate between treatments and between time intervals using paired T tests.

Results and Discussion

Our results are consistent with previous studies that showed a decrease in SpO₂ (Rowell et al., 1964) and an increase in circulating lactate concentrations (Katz and Sahlin, 1988) during exercise. The decrease in SpO₂ is likely due to elevated unloading of oxygen from blood, an effect that is attributed to a decrease in affinity of hemoglobin for oxygen. This shift in affinity is primarily attributed to the increase in production of carbon dioxide, a major byproduct of aerobic metabolism. The increase in lactate concentrations is likely due to an increased reliance on anaerobic metabolism. When exercise intensity increases to a point where oxygen delivery is insufficient to support aerobic metabolism, muscle cells rely more on anaerobic metabolism. Pyruvic acid is the byproduct of this metabolic pathway and this is converted to lactic acid and released into the blood.

WG did not enhance the decrease in SpO₂ associated with exercise, a result that conflicts with our previous work as well as the results of Handzel et al. (2010) who reported an increase in SpO₂ during exercise. The exercise-induced increase in lactic acid was not affected by WG and observation that is consistent with the lack of effect on SpO₂. Together these results support the conclusion that WG did not enhance oxygen delivery to muscle tissue during exercise.

It is unclear why there is disagreement between results of our previous and current experiment. The major difference between the two studies is that all of the subjects in the current study were trained athletes whereas most of the subjects in our previous study were not. This raises the possibility that the effectiveness of WG may depend on level of fitness. We plan to test this hypothesis in future experiments.

References


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