Phosphate Loading

Phosphate loading improves time trial performance


It has been purported that phosphate loading can increase endurance performance. The mechanism proposed is an increased availability of intracellular phosphate (the P in ATP) and consequently increased oxidative phosphorylation. Oxidative phosphorylation is the formation of ATP, aerobically. Phosphate is also thought to increase the production of a metabolic intermediate formed in red blood cells (2,3 diphosphoglycerate) which is known to enhance the release of oxygen from red blood cells. Phosphate is also a buffer that consumes hydrogen produced during metabolic processes. Hydrogen interferes with the excitation contraction coupling process during muscle contraction and contributes to the onset of fatigue. Based on this information it seems plausible that phosphate would enhance endurance performance. However, the research to date is mixed, some studies showing an effect and some showing no effect. It has been speculated that the discrepancy is the result of the type of phosphate that has been used in the studies. It was noted that studies using calcium phosphate found no effect and studies using sodium phosphate found a positive effect. The purpose of this study was to investigate the effect of sodium phosphate (SP) loading on a laboratory 16.1 km cycling time-trial performance.

Methods: Seven male, trained (mean VO2peak 64 + 2.8 ml/kg/min), cyclists participated in this study. The subjects performed three time trials spaced apart by 7 days. The first time trial served as the control (C) and the second and third time trial were randomly assigned either as placebo (P) or SP. During SP trial, the subjects phosphate loaded for six days by ingesting a 1 gram capsule of sodium phosphate four times daily. During the P trial, subjects ingested capsules containing lactose monohydrate 4 times daily for six days. The subjects were blinded to the treatment, as were the researchers (double blind design). The time trials were performed on an air braked cycle ergometer using the subject's own bicycle. During the tests power output and heart rate were monitored continuously. Blood lactate was measured at the end of each trial and VO2 was measured at the 4 and 9 mile points of each time trial.

Results: Power output during the time trial was significantly high than both the placebo and control trials (C, 322 ± 38W; P, 317 ± 41W; SP 347 ± 51W). Although time trial performance was faster during the SP condition it was only statistically significant compared to the P group (C, 21:50 ± 1:00; P, 21:59 ± 1:07; SP 21:19 ± 1:05) All other physiologic variables were non significant.

Discussion: In this study 6 days of sodium phosphate loading increased power production by 9.8% and reduce time trial time by 3%. Although the time improvement didn't reach statistical significance compared to control, the effects size is designated as large. Considering that an aerodynamic road bike frame saves about 2%*, this difference appears to be meaningful. This study is not without limitations. The sample size was small (n=6) which limits the external validity of the study, that is, its applicability to people outside of the study. Also, the researchers did not measure serum phosphate to determine if, in fact, phosphate levels increased in the body. Despite these limitations, the results seem promising.
Sodium phosphate has no known toxic side effects. In this study one subject did report GI distress and dropped from the study. But no long term studies have been conducted.