

Effects of bicarbonate ingestion on the respiratory compensation threshold and maximal exercise performance.

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Six males performed cycle ergometer exercise on two occasions in random order. Each exercise was preceded by a 2-h period in which matched capsules were administered orally, containing either starch (C) or NaHCO₃ (E) in a dose of 0.2 g.kg⁻¹ body wt; pre-exercise blood pH and [HCO₃⁻] were 7.34 ± 0.01 and 23.7 ± 0.5 mM (mean ± S.E.) for the C study, and 7.41 ± 0.01 and 28.6 ± 1.3 mM for the E study (p less than 0.001 and p less than 0.01, respectively). Exercise was continuous and maintained for 10 min at 40% of maximal oxygen uptake (40% VO₂max), followed by 15 min at 12 W above the respiratory compensation threshold ([+RCT]) which was determined by the increase of the ventilatory equivalent for carbon dioxide (VE.VCO₂(-1)), and for as long as possible at 95% VO₂max. **Endurance time at 95% VO₂max was significantly longer in E than in C (2.98 ± 0.64 min vs. 2.00 ± 0.44 min, p less than 0.05).** The rate of increase in arterialized venous lactate (LA) was higher in E than in C from rest to exercise at [+RCT], while there was no significant difference in the hydrogen ions ([H⁺]). Consequently, [H⁺].LA-1 (nM.mM⁻¹) was significantly lower in E than in C. The change of VE.VCO₂(-1) was shifted downward in E compared to C during exercise with the lowest value being observed at the same exercise stage. These results suggest that the respiratory responses to exercise are not affected by the higher level of [HCO₃⁻] induced by NaHCO₃ ingestion, and appear to reflect the net change of plasma [HCO₃⁻] or [H⁺]. Also, induced metabolic acidosis has little effect on [H⁺] appearance in blood.

Effect of pH on cardiorespiratory and metabolic responses to exercise.

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Five male subjects performed exercise at 33, 66, and 95% of their maximum power output on three occasions in random order. Each study was preceded by a 3-h period in which capsules were taken by mouth, containing either CaCO₃ (control), NH₄Cl (acidosis), or NaHCO₃ (alkalosis) in a dose of 0.3 g/kg body wt; preexercise blood pH was 7.38 ± 0.015, 7.21 ± 0.033, and 7.43 ± 0.029, respectively. Exercise was continuous and maintained for 20 min at the two lower power outputs and for as long as possible at the highest. **Compared with control (270 ± 13 s), endurance time at the highest power output was reduced in acidosis (160 ± 22 s) and increased in alkalosis (438 ± 120 s).** No differences were observed for central cardiovascular changes in exercise (cardiac output, frequency, or stroke volume). The respiratory changes expected from changes in blood pH were observed, with a higher alveolar ventilation in acidosis. At all power outputs arterialized venous lactate was lowest in acidosis and highest in alkalosis. Plasma glycerol and free fatty acids were lowest in acidosis. Changes in blood [HCO₃⁻] and pH were shown to have major effects on metabolism in exercise which presumably were responsible for impaired endurance.