OPEN ACCESS

JSC | Journal of Science & Cycling
Breakthroughs in Cycling & Triathlon Sciences

Conference Abstract

Science and Cycling Conference, Barcelona 2026

Timing of Sodium Bicarbonate Uptake During Exercise and Rest in Highly Trained Cyclists

Tilmann Strepp [1,*], Stephen Smith [1,2], Nils Haller [3,4,5], Asker Jeukendrup [1,2,6] and Thomas Stöggl [1,5]

Received: 2 March 2026 **Accepted:** 20 March 2026 **Published:** 31 October 2026

[1] Red Bull Athlete Performance Center, Brunnbachweg 71, 5303 Thalgau, Austria

[2] Red Bull Pro Cycling GmbH & Co KG, Innstraße 1, 6342 Niederndorf, Austria

[3] Division of Exercise and Movement Science, Institute for Sport Science, University of Göttingen, Sprangerweg 2, 37075, Göttingen, Lower Saxony, Germany

[4] Johannes-Gutenberg-University of Mainz, Department of Sports Medicine, Rehabilitation and Disease Prevention, Albert-Schweitzer-Straße 22, 55128 Mainz, Germany

[5] University of Salzburg, Department of Sport and Exercise, Schlossallee 49, 5400 Hallein/Rif, Austria

[6] Loughborough University, School of Sport, Exercise and Health Sciences, Epinal Way, LE11 3TU Loughborough, United Kingdom

Correspondence

Tilmann Strepp

Red Bull Athlete Performance Center, Brunnbachweg 71, 5303 Thalgau, Austria

tilmann.strepp@redbullperformance.com

Keywords

cycling; sodium-bicarbonate; exercise nutrition; supplement timing

1 Abstract

Sodium bicarbonate (SB) has been extensively studied for its ergogenic effects in short-duration, high-intensity exercise (Grgic et al., 2021). More recently, SB has been increasingly used in endurance disciplines such as triathlon, road cycling, and cross-country skiing, to enhance performance during decisive, high-intensity efforts (Dalle et al., 2021). However, the influence of prolonged low-intensity exercise following SB ingestion on blood bicarbonate (HCO_3) uptake kinetics remains unclear. Therefore, this study aimed to assess the effects of low-intensity cycling compared with passive rest following SB ingestion on HCO_3 kinetics, including the timing and magnitude of peak HCO_3.

CRC CYCLING RESEARCH CENTER

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/) which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Fourteen highly trained cyclists (female n = 5: body mass 53.0 ± 4.4 kg, height 169 ± 6 cm, VO_{2max} 64.7 ± 4.1 mL·kg^{-1}·min^{-1}; male n = 9: body mass 70.9 ± 3.3 kg, height 180 ± 6 cm, VO_{2max} 74.5 ± 7.7 mL·kg^{-1}·min^{-1}) completed three laboratory visits separated by ≥48 h. Visit one involved an incremental step and ramp test to determine lactate threshold 1 (LT1) and VO_{2max}. On visits two and three, participants completed the exercise (EXC) and resting (REST) conditions, with identical time points for data collection. In both conditions, participants consumed a standardized breakfast at 08:00 AM, followed by SB ingestion (0.3 g·kg^{-1}) provided as mini-tablets within a carbohydrate hydrogel mixture at 08:45 AM. During EXC, participants cycled indoors for three hours at LT1 (3.0 ± 0.3 W·kg^{-1}) starting at 10:00 AM, with 50 g·h^{-1} carbohydrate intake. During REST, participants refrained from exercise and food intake. In both conditions, HCO_3 was measured every 25 min from 08:45 to 10:00, and every 30 min from 10:00 AM to 1:00 PM using a blood gas analyzer (i-STAT Alinity, Abbott, USA). All data were assessed for normality using the Shapiro–Wilk test. Differences in HCO_3 time course were analyzed with repeated measures ANOVA, correcting for sphericity violations with Greenhouse–Geisser when necessary. Post-hoc pairwise comparisons were Bonferroni-adjusted. Effect sizes were calculated using partial eta squared ($_p\eta^2$). Peaks in HCO_3 were identified as the first point within ±0.6 mmol·L^{-1} of the local maximum, corresponding to a 2% technical error of measurement at 30 mmol·L^{-1} (Larcher et al., 2023), thereby capturing the initial plateau while minimizing measurement noise. Differences between peak and baseline (08:45 AM) concentrations (ΔHCO_3) and time to peak were compared between conditions using paired t-tests.

All participants completed the protocol without adverse events, such as gastrointestinal problems. Data were normally distributed. A significant condition × time interaction was observed ($F(9,117) = 5.36$, $p < 0.001$, $_p\eta^2 = 0.29$), indicating that the temporal pattern of HCO_3 differed between EXC and REST. Pairwise comparisons revealed higher HCO_3 concentrations during REST compared with EXC at 30 min (mean diff. = 1.2 ± 1.2 mmol·L^{-1}, $p = 0.003$) and 60 min (mean diff. = 2.9 ± 2.6 mmol·L^{-1}, $p = 0.001$) after 10:00 AM (exercise onset in EXC). No differences were observed at any other time point (all $p > 0.05$). A significant main effect of time was detected ($F(9,117) = 197$, $p < 0.001$, $_p\eta^2 = 0.94$), reflecting the expected increase in HCO_3 following SB ingestion. However, there was no significant main effect of condition ($F(1,13) = 3.95$, $p = 0.068$, $_p\eta^2 = 0.23$), indicating similar overall mean HCO_3 concentrations between EXC and REST. ΔHCO_3 did not differ between conditions (EXC: 9.0 ± 1.8 mmol·L^{-1}, CV 20%; REST: 9.3 ± 1.4 mmol·L^{-1}, CV 15%; $p = 0.32$). In contrast, time to peak HCO_3 was significantly longer during EXC (208 ± 42 min, CV 20%) compared with REST (146 ± 22 min, CV 15%; $p < 0.001$). Descriptively, responses were similar between sexes, with comparable ΔHCO_3 and time to peak HCO_3 in females (EXC: 9.1 ± 1.9 mmol·L^{-1};

213 ± 46 min; REST: 9.6 ± 1.5 mmol·L^{-1}; 147 ± 16 min) and males (EXC: 9.0 ± 1.9 mmol·L^{-1}; 205 ± 42 min; REST: 9.2 ± 1.3 mmol·L^{-1}; 145 ± 26 min).

In summary, SB ingestion effectively elevated HCO_3, with peak concentrations being comparable between EXC and REST. However, low-intensity cycling delayed the time to peak by ~1 hour, emphasizing the importance of accounting for exercise during the absorption period when planning nutritional strategies for prolonged endurance events. These findings suggest that athletes and practitioners should adjust the timing of SB intake to align peak HCO_3 with critical performance periods during prolonged exercise.

References

1. Dalle, S., Koppo, K., & Hespel, P. (2021). Sodium bicarbonate improves sprint performance in endurance cycling. Journal of Science and Medicine in Sport, 24(3), 301-306. https://doi.org/10.1016/j.jsams.2020.09.011
2. Grgic, J., Pedisic, Z., Saunders, B., Artioli, G. G., Schoenfeld, B. J., McKenna, M. J., Bishop, D. J., Kreider, R. B., Stout, J. R., Kalman, D. S., Arent, S. M., Vandusseldorp, T. A., Lopez, H. L., Ziegenfuss, T. N., Burke, L. M., Antonio, J., & Campbell, B. I. (2021). International Society of Sports Nutrition position stand: sodium bicarbonate and exercise performance. Journal of the International Society of Sports Nutrition, 18(1). https://doi.org/10.1186/s12970-021-00458-w
3. Larcher, R., Lottelier, M., Badiou, S., Dupuy, A.-M., Bargnoux, A.-S., & Cristol, J.-P. (2023). Analytical Performances of the Novel i-STAT Alinity Point-of-Care Analyzer. Diagnostics, 13(2), 297. https://doi.org/10.3390/diagnostics13020297