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Combined Polyphenol and Dietary Nitrate Interventions in Endurance Performance: A Narrative Review with a Mechanistic Focus on Mitohormesis

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Abstract

Background

Polyphenols and dietary nitrates are both well-known nutritional strategies that can enhance endurance performance, but they work through different physiological pathways. Polyphenols affect mitochondrial ROS signaling, support redox signaling adaptations, and decrease inflammation. In contrast, nitrates boost nitric-oxide availability, improve oxygen-use efficiency, and enhance blood flow. Although these mechanisms appear complementary, no studies have thoroughly examined whether using polyphenols and nitrates together could create stronger, mitohormesis-related benefits for endurance athletes.



Objective

The purpose of this narrative review is to assess the available data regarding the use of polyphenol-only and nitrate-only supplements in endurance athletes, summarize the mechanistic effects of these supplements on mitochondrial redox biology and performance, and pinpoint research gaps pertaining to combined interventions.

Methods

A comprehensive literature search was conducted in PubMed, Scopus, and Google Scholar up to 2025. Keywords included polyphenol, flavonoid, nitrate, beetroot, nitric oxide, endurance performance, mitochondrial ROS, redox signaling, and mitohormesis. Human trials, athlete-based interventions, mechanistic research, and sport nutrition reviews were all considered eligible. Data were synthesized narratively to highlight mechanistic pathways and performance outcomes.

Results

Randomized trials show that nitrates consistently improve exercise economy and endurance capacity via NO-mediated hemodynamic effects through polyphenols support mitochondrial biogenesis, redox signaling, and post-exercise inflammatory recovery. No studies have directly examined combined polyphenol + nitrate supplementation in athletes. Mechanistic considerations suggest potential synergy-enhanced oxygen delivery with optimized ROS-mediated adaptations-but also the possibility of interference if antioxidant activity attenuates mitohormetic signaling.



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Conclusion

Although polyphenols and nitrates both improve endurance performance on their own, their combined effects are still unknown. This indicates a significant research gap and an opportunity for novel research. To determine whether co-supplementation can improve or worsen mitohormetic adaptation in endurance athletes, more controlled studies about mitochondrial and redox biomarkers are needed.

Keywords: Polyphenol; Dietary nitrate; Mitohormesis; Endurance performance;
Mitochondrial signaling