DIETARY CURCUMIN SUPPLEMENTATION REDUCES GASTROINTESTINAL PERMEABILITY DURING EXERTIONAL HEAT STRESS

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ABSTRACT

PURPOSE: Exertional heat stress increases gastrointestinal barrier permeability and risk of exertional heatstroke (EHS) via a TLR4-mediated inflammatory pathway. Oral curcumin supplementation is known to inhibit both the MyD88 & TRIF-dependent pathways of TLR4 signaling. This work investigated the effect of 3d of 500mg/d Merivita® curcumin supplementation on gastrointestinal (GI) barrier permeability and systemic physiology responses to exertional heat stress in non-heat acclimated humans. METHODS: Eight subjects ran (65%VO2max) for 60min in a Darwin® chamber (37°C / 26%RH) two times (CURCUMIN/PLACEBO). Intestinal fatty acid binding protein (1-FABP) and associated pro-inflammatory (MCP-1/TNFα/IL-6) and anti-inflammatory (IL-1Ra/IL-10) cytokines were assayed from plasma collected before (PRE), after (POST), 1hr (1-POST), and 4hrs after (4-POST) exercise. Core (Tc), skin (Tk), and mean body (Tb) temperatures; HR; and physiological strain index (PSI) were measured throughout exercise. Group differences were determined with 2-Way (Condition x Time) RM ANOVAs. RESULTS: Intriguingly, one of the major findings of this study was that the interaction of Condition x Time was significant (p=0.05) for both 1-FABP and IL-1α. Post hoc analysis indicated the increase in 1-FABP (from PRE to POST (87%) and 1-POST (33%) in PLACEBO exceeded that in CURCUMIN (58% & 18%; respectively). IL-1α also increased more from PRE to 1-POST in PLACEBO (153%) than in CURCUMIN (77%). TNFα increased (p=0.01) from PRE to POST (19%) and 1-POST (24%) in PLACEBO but not in CURCUMIN. IL-10 increased (p=0.01) from PRE to POST (61%) and 1-POST (42%) in PLACEBO but not in CURCUMIN. The PSI, which indicates EHS risk, was also lower (p=0.01) in CURCUMIN from 40-60min of exercise. CONCLUSION: Collectively, these data suggest 3d curcumin supplementation reduces GI permeability and cytokine responses to exertional heat stress.

CONCLUSIONS

• CURCUMIN contributed to improvements in systems-level physiological responses, as indicated by the trend towards reductions in Core Temperature (Fig. 1A) and Heart Rate (Fig. 1C) as well as a significant reduction in the Physiological Strain Index from 35-60min of exercise (Fig. 1D).
• Gastrointestinal barrier permeability was also reduced in CURCUMIN, as indicated by lower circulating concentrations of 1-FABP at POST and 1-POST (Fig. 2A). This may have contributed to a reduced need for elevations in IL-1Ra with exercise, as indicated by the lower circulating concentration of IL-1Ra in CURCUMIN at 1-POST (Fig. 2B).
• Collectively, the lower level of gastrointestinal barrier permeability, circulating concentrations of anti-inflammatory cytokines, and possibly monocyte activation in CURCUMIN, in concert with improvements in the Physiological Strain Index, suggest that short-term dietary curcumin supplementation may improve an individual’s tolerance of exertional heat stress in the time period prior to when traditional heat acclimation can be achieved.

RESULTS

• Exertional heat stress increases gastrointestinal barrier permeability, resulting in the release of lipopolysaccharide (LPS) into the bloodstream and increased systemic inflammation by way of the TLR-4 mediated NF-κB pathway [1,2].
• This increased ratio of pro-inflammatory (TNF-α, IL-6, MCP-1) to anti-inflammatory (IL-1Ra, IL-10) cytokines has been shown to contribute to the disseminated intravascular coagulation and multiple organ failure that accompany exertional heatstroke.
• Curcumin is a polyphenol supplement that affords antioxidant and anti-inflammatory properties. It has also been shown to suppress the activity of the pro-inflammatory NF-κB pathway in both cell culture and human exercise models [3,4].
• This research investigated the effect of 3 days of 500mg/d dietary curcumin supplementation on circulating markers of gastrointestinal barrier permeability and systems-level physiological responses to exertional heat stress.

METHODS

• CURCUMIN contributed to improvements in systems-level physiological responses, as indicated by the trend towards reductions in Core Temperature (Fig. 1A) and Heart Rate (Fig. 1C) as well as a significant reduction in the Physiological Strain Index from 35-60min of exercise (Fig. 1D).
• Gastrointestinal barrier permeability was also reduced in CURCUMIN, as indicated by lower circulating concentrations of 1-FABP at POST and 1-POST (Fig. 2A). This may have contributed to a reduced need for elevations in IL-1Ra with exercise, as indicated by the lower circulating concentration of IL-1Ra in CURCUMIN at 1-POST (Fig. 2B).
• Collectively, the lower level of gastrointestinal barrier permeability, circulating concentrations of anti-inflammatory cytokines, and possibly monocyte activation in CURCUMIN, in concert with improvements in the Physiological Strain Index, suggest that short-term dietary curcumin supplementation may improve an individual’s tolerance of exertional heat stress in the time period prior to when traditional heat acclimation can be achieved.

REFERENCES