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Milk protein addition to a post-exercise carbohydrate–electrolyte rehydration solution. Is there a dose-response relationship?

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The ingestion of low-fat milk has been shown to be more effective at restoring fluid balance after exercise-induced dehydration than the ingestion of a commercially available carbohydrate–electrolyte sports drink[1]. More recently, it has been shown that after exercise-induced dehydration, the inclusion of 25 g/l milk protein in a carbohydrate–electrolyte rehydration solution increased drink retention in comparison with an isoenergetic, electrolyte content matched carbohydrate solution[2]. This suggests that the protein present in milk (~36 g/l) accounts for at least some of the increased drink retention previously reported. It is currently unknown whether there is a dose-response effect of milk protein on drink retention after exercise-induced dehydration. The aim of the present study was to investigate this.

Eight males [mean (SD): age 22 (SD 2) years, height 1.77(SD 0.08) m, body mass 76.96(SD 8.73) kg] completed intermittent exercise in a hot environment [35.0(SD 0.1)°C, 51.8(SD 5.9) relative humidity] until they lost 1.83(SD 0.10)% of their initial body mass. Subjects then ingested a volume of drink in litres equivalent to 150% of their body mass loss in kg. This drink was provided in four aliquots of equal volume at 15 min intervals (0, 15, 30 and 45 min) over a 1 h rehydration period. Subjects then remained in the laboratory for a further 4 h. During each trial, subjects consumed one of the three drinks: a 60 g/l carbohydrate solution (C); a 40 g/l carbohydrate, 20 g/l milk-protein solution (CP20); or a 20 g/l carbohydrate, 40 g/l milk-protein solution (CP40). Drinks were matched in terms of energy density, as well as Na (~20 mmol/l) and K (~5 mmol/l) content. Urine samples were collected before and after exercise, after rehydration and every hour during the 4 h recovery period. Urine samples were measured for volume, osmolality and Na and K concentration. Trials were administered in a double blind, randomised crossover design.

Total cumulative urine output after rehydration was greater for trial C [1150(SD 245) ml] than for trial CP20 [857(SD 270) ml] ($P = 0.007$) and CP40 [769(SD 129) ml] ($P = 0.006$), with no difference between CP20 and CP40 ($P = 1.000$). As a result, total drink retention was greater for CP20 [58(SD 9)%] ($P = 0.002$) and CP40 [64(SD 7)%] ($P < 0.001$) than C [43(SD 7%] ($P = 0.008$), but there was no difference between CP20 and CP40 ($P = 1.000$). At the end of the study period, whole-body net-fluid balance (estimated from fluid lost through sweat and urine production and fluid gained through drink ingestion) was less negative for trials CP20 [−203(SD 315) ml] ($P = 0.029$) and CP40 [−97(SD 146)]l) ($P = 0.001$) than for trial C [−487(SD 149) ml], but there was no difference between CP20 and CP40 ($P = 1.000$). Although the mean net-fluid balance was negative for all trials at the end of the study, it was only significantly negative after ingestion of drink C ($P = 0.002$).

This study further demonstrates that after exercise-induced dehydration, a carbohydrate–milk protein solution is better retained than a carbohydrate solution, when solutions are matched in terms of energy density, as well as Na and K content. The results also suggest that there is no dose-response relationship between milk-protein ingestion and drink retention after exercise-induced dehydration, at least in the concentrations of milk protein used in this study.

1. Shirreffs SM, Watson P & Maughan RJ (2007) *Br J Nutr* **98**, 173–180.
2. James LJ, Clayton D & Evans GH (2011) *Br J Nutr* **105**, 393–399.