

Fluid Containing Highly Branched Cyclic Dextrin: An Alternative Method to Enhance Endurance Exercise Performance

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Introduction

It has been widely established that the ingestion of carbohydrate (CHO) pre-, during and post-exercise can improve exercise performance in intense events that lasting longer than 60 to 90 minutes. CHO provides most of the energy for high-intensity endurance exercise (85% to 100% VO_{2max}) [1], maintains blood glucose, and possibly spares endogenous glycogen stores [2]. Consequently, CHO supplementation could be appropriate for athletes competing in endurance events. Fluid intake is a one frequent way to deliver CHO before, during and after exercise. However, the disadvantages of CHO-beverage are the monosaccharide and disaccharide composition which making the beverage very sweet [1] and the rate of gastric emptying and intestinal absorption are too slow compare to other form of CHO [3].

Table 1: Gastric emptying time of the test solutions.

Solution		Gastric emptying time (SEM) (min)
Water		12.8 (1.3) ^{af}
NaCl	0.90%	8.4 (0.6) ^a
Glucose	5%	20.4 (3.0) ^{be}
	10%	39.9 (4.7) ^c
Maltose	5%	16.2 (1.9) ^{bh}
	10%	31.2 (2.8) ^d
Sucrose	5%	14.9 (2.0) ^{bh}
	10%	24.4 (3.3) ^{eg}
Dextrin (DE16)	5%	12.1 (1.4) ^{eh}
	10%	17.3 (2.1) ^{bh}
HBCD	5%	18.8 (2.0) ^{ef}
	10%	26.7 (2.6) ^{dg}
Sports drink based on		
10% HBCD		17.0 (2.0) ^{bh}
10% dextrin (DE16)		21.9 (2.0) ^{eg}

Note: Adapted from Takii H et al. [3].

Data represent means \pm SEM for 10 subjects. Values that do not share common superscript letters are significantly different at $p < .05$.

Highly branched cyclic dextrin (HBCD) is a new type of maltodextrin, produced from waxy corn starch by the cyclization reaction of a branching enzyme (EC 2.4.1.18) [4-6]. HBCD has a high molecular weight and narrower molecular weight distribution than other maltodextrins. It is highly soluble in water and the solution is stable during storage, does

not have an unfavorable smell or taste in solution and has low osmotic pressure which is a key factor to determine the gastric emptying rate (GER) of a beverage [7]. As a result of its low osmotic pressure, drinks containing HBCD have a shorter gastric emptying rate than glucose-based drink and maltodextrin-based drinks [3] and less gastrointestinal disorders in humans during exercise [8]. Therefore, athletes who consume HBCD may possibly proceed the exercise comfortably with little fatigue (Table 1).

HBCD can improve endurance exercise performance by supplying glucose energy for a longer period. The effect of HBCD on endurance exercise can be seen from the study of Furuyashiki et al. [9] which investigated the effect of HBCD and maltodextrin on blood glucose concentration and the rating of perceived exertion (RPE) during endurance exercise in a crossover, double-blind study of healthy volunteers. The participants consumed HBCD or maltodextrin (15g) dissolved in 200ml distilled water then consumed the other 2 weeks later. The participants immediately started exercise using bicycle ergometer. The study was found that blood glucose concentration after ingestion tended to be higher in ingesting HBCD than maltodextrin and the rate of perceived exertion (RPE) tended to be lower after HBCD administration than maltodextrin [9]. The effect of HBCD was consistent with the study from Shiraki et al. [7]. Shiraki et al. [7] examined the effects of HBCD administration on endurance performance in elite swimmers. The subjects received either HBCD, glucose (1.5g/kg body weight) or water (a control) and followed by 10 cycles of intermittent swimming. When consuming HBCD, the time to fatigue was 70% longer than consuming glucose and water. In Addition, plasma glucose in the HBCD group was maintained at higher level during pre-swimming cycles than in the glucose or water group [7]. These results indicate that HBCD supplementation can enhances athletic endurance performance during exercise.

Conclusion

HBCD, a new type of maltodextrin, can play an important role in supplementation strategies for athletes. HBCD administration

has been observed to enhance endurance exercise performance. An administration from 15g to 1.5g/kg body weight was used to lower RPE, maintain blood glucose level and prolong the time to fatigue. However, the mechanism for lower RPE after HBCD ingestion is yet still unknown. Further study is required to provide more information regarding the mechanism for lower PRE after HBCD administration.

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