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KEY POINTS

- Carbohydrates are an important energy source for exercise of all types.
- Fatigue during bouts of exercise is often commensurate with low levels of blood glucose, which furnishes the brain with energy.
- At times, during prolonged bouts of exercise, the use of a carbohydrate 'shot' is useful in maintaining adequate levels of blood glucose and thereby offsetting reductions in brain activity.
- The use of a Carb Shot provides a rapid availability of glucose for muscle and brain – notably in the final quarter of a match and also before and during extra time.
- Carb Shots are useful in aiding carbohydrate loading during days when a high carbohydrate intake is desirable, e.g. the day before a competition or post-match.

INTRODUCTION

Three major nutritional factors associated with fatigue in most sporting events are (a) muscle glycogen depletion, (b) hypoglycaemia (low blood sugar level) and (c) dehydration. As a consequence, athletes have been encouraged to start sporting events with their muscle and liver glycogen stores as full as possible, and also to be as hydrated as possible – indeed the ACSM guidelines have encouraged this for many years (ACSM, 2009). Furthermore, ensuring blood glucose levels are maintained during the latter stages of performance/training and attempting to keep euhydrated are challenges facing athletes. The consequences of these established scientific facts is the development and use of a multiplicity of sports drinks, which in many cases have been shown to be efficacious (Cermak & van Loon, 2013).

In recent years, the ingestion of carbohydrate (CHO) in the form of a gel has become more prevalent. As a result, it is possible to manipulate CHO and fluid intake independently – the CHO arising from the gel and the fluid from additional water ingestion. There is evidence that taking a CHO gel results in greater amounts of CHO consumption compared with a CHO solution (Pfeiffer et al., 2010), and that a CHO gel can improve performance (Campbell et al., 2008; Earnest et al., 2004; Patterson & Gray, 2007; Phillips et al., 2012). Such improvements in performance may be due to maintenance of blood glucose levels and/or hydration. What is also interesting, is that despite a greater amount of CHO being available via a gel, there is no increase in gut discomfort for most individuals, although there may be personal variations (Pfeiffer et al., 2009; Phillips et al., 2012). For a greater awareness concerning the importance of CHO during exercise, this article should be read in conjunction with the Nutrition X-Change article on "Carbohydrate Intake During Exercise" (MacLaren, 2020). At Nutrition X, we have developed a Carbohydrate Shot containing 40g of easily digested carbohydrate, in addition to our gel (Energel).

A potential practical limitation of a CHO gel concerns the ingestion of the full amount of the gel whilst exercising. Some preliminary (unpublished) findings from the Nutrition X staff and associated club colleagues are that when the used gel packets are collected after a match, there remains, in some cases, a significant volume of unused gel. Consequently, we have produced a 100ml shot containing 40g of easily digested CHO, which ensures a more complete ingestion of the total volume since 100ml is typically consumed in just a couple of mouthfuls.

Bearing in mind that the final quarter of most games played (or indeed extra time if relevant)

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has been demonstrated to highlight problematic issues with physical and mental fatigue, it is pertinent to consider the use of the CHO shot within this period to ensure a more stable blood glucose response for brain/cognitive function, as well as energy for muscle function. We believe that ALL the benefits of a carbohydrate gel can be attained by using a shot instead; in fact the likely complete ingestion of carbohydrate in a shot may even prove advantageous.

CARBOHYDRATES & PERFORMANCE

The effects of CHO supplements on endurance performance have almost exclusively been examined with sports beverages (Jeukendrup, 2014). The goal of these drinks is to provide fluid, an exogenous source of CHO, and electrolytes during exercise to offset both dehydration and a reduction in blood glucose, which could compromise performance (Goulet, 2013). More recently, other CHO sources are commonly used by athletes, including commercially available gels and bars (Pfeiffer et al., 2012). However, the relative benefit to performance of each format has not been resolved empirically, such that it appears from research there is little difference between CHO format or type on performance (Campbell et al., 2008; Jeukendrup, 2014; Kern et al., 2007; Pfeiffer et al., 2010).

Having said that, the effects of CHO form on carbohydrate bioavailability (i.e. rate of intestinal absorption) and gastrointestinal distress are likely to alter endurance performance, since gut discomfort is frequently reported during higher-intensity endurance exercise, especially competition, related to food ingestion (Pfeiffer et al., 2012; Rehrer et al., 1992). Carbohydrate gels can be well tolerated by runners causing only mild gastrointestinal distress symptoms, although this can vary quite considerably with individual athletes (Pfeiffer et al., 2009). In runners and triathletes, no statistically significant differences were reported in race finishing time between carbohydrate drink or gel (Lee et al., 2014; Sareban et al., 2016), although gut comfort was decreased with the gel during triathlon (Sareban et al., 2016).

More recently, a study to establish the relative effects of a CHO drink, gel and bar, as well as a combination of the CHO formats, on intense cycling performance was reported (Guillochon & Rowlands, 2017). In this investigation, 14 trained cyclists performed 140-minutes of race simulation in which no differences were observed for peak power, power reduction or gut comfort measures between CHO drink, the gel and the CHO mixture, whereas ingestion of the bar resulted in decrements in performance and greater gut discomfort.

An interesting study concerning the efficacy of a CHO gel on extra-time after simulated football match play reported raised blood glucose concentrations and a 29% improved dribbling performance, with no observed detrimental effects compared with a placebo gel. (Harper et al., 2016). Similar findings in relation to football were found in another simulated football test i.e. the Loughborough Intermittent Shuttle Test (LIST) using 13 year old adolescents. Following the 4 x 15-min shuttles the intermittent endurance capacity test was improved by ~20% after consumption of CHO-electrolyte gels compared with placebo gels (Phillips et al., 2012).

So, it appears that the use of CHO gels could be employed in the same manner as CHO drinks before and during exercise, and that the likelihood of gastric issues is dependent on individual responses. A question remains as to how frequently a CHO gel should be ingested. A recent study explored the use of a CHO gel given prior to or during an exercise bout. The provision of the CHO gel during the 2-h exercise bout was either every 30 or 45 minutes. After the 2-h exercise bout, the trained cyclists performed a time trial (TT). The TT distance attained during 15-min was higher after both CHO gel treatments compared with a placebo and with a marginal greater distance achieved following the more frequent ingestion (i.e. 30-min) compared with the less frequent ingestion (i.e. 45-min).

All in all, there is merit in using CHO gels during prolonged exercise bouts where CHO is an important energy source for both muscle and brain. Furthermore, a CHO gel is easy to carry and consume when required

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during days where an increased CHO intake is essential i.e. the day before and after competition and/or the day before/after strenuous training. Naturally, under the latter circumstances, the CHO gel is employed in conjunction with sound eating practices.

RECOMMENDED USE OF THE CARB SHOT

The formulation of The Carb Shot has been made to contribute carbohydrate availability before, during and after training or matches, and to promote hydration through increased electrolyte intake as long as additional fluid is also imbibed.

- Ingest 1 shot per half hour for the duration of the exercise/competition after the first 45-minutes
- Ingest 1 shot with additional fluid every 30-min in recovery after strenuous training for 1-2 hours
- Ingest 1 shot at half-time with additional fluid and then again in the last quarter of a match
- Ingest 1 shot before extra time and again at half-time of extra time
- Ingest a shot frequently through the day with additional fluids on pre- and post-match days

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