

# Newsletter

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## Essentials of Carbohydrate Replenishment After Exercise

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As reviewed in other articles on this site, carbohydrate nutrition is an important determinant of exercise performance for sports that require repeated bouts of all-out-effort (i.e. hockey shift) and long distance races. Consuming a carbohydrate-rich meal 3-4 hours prior to exercise, a fructose-rich drink 30 minutes prior to exercise and the ingestion of 5-8 ounces of a carbohydrate sports drink every 10-15 minutes during exercise are considered prudent ergogenic (exercise enhancing) strategies in the field of sports nutrition. This applies primarily to sports activities executed at a strenuous level and lasting a minimum of 60-90 minutes.

Once the training session or sports event is over there are two concerns to address with respect to carbohydrate replenishment. First, the craving within the muscle for carbohydrate storage is extremely high in the first 2 to 6 hours following the completion of exercise. Thus, this represents an ideal opportunity to rapidly drive carbohydrates into the muscles' carbohydrate fuel tank (glycogen) thereby helping to prepare the muscle for the next training session or competition.

Secondly, on a more long-term basis it is important to derive sufficient carbohydrate calories from day to day as it requires at least 24 hours to fully refuel the muscles' carbohydrate fuel tank. Very conveniently the size of the muscles' carbohydrate fuel tank doubles with exercise training. So, the key is to completely refuel the tank between training sessions as greater concentrations of muscle glycogen are correlated with better performance. This includes improved ability to perform repeated all-out sprints, better sustained maximum power in long distance events and the postponement of fatigue. Hence, reloading the muscles' carbohydrate stores to a maximum level is deemed to be very desirable for athletes competing in a wide variety of sports. The ability to store twice as much carbohydrate in trained muscles versus untrained muscles is known as glycogen super compensation, which requires sufficient daily carbohydrate intake. For sports that rely heavily upon carbohydrate energy the athlete's diet should consist of 60-70 percent carbohydrates from day to day.

On a more technical level the rate of post-exercise muscle glycogen storage, when supplied by dietary carbohydrates is reported to be 5 to 8 mmol/kg/hour, which means at least 20 to 24 hours are required for complete restoration of normal muscle glycogen levels. The rate of resynthesis is faster if carbohydrates are consumed immediately following exercise rather than delaying carbohydrate intake by 2 hours. Thus, athletes should ingest carbohydrates as soon after exercise as possible.

Interestingly, in the early post-exercise period the optimal carbohydrate intake appears to be 50 grams every 2 hours aiming for a total carbohydrate intake in 24 hours of 600 grams (2,400 calories) for athletes involved in strenuous training or tournament weekends where carbohydrate demanding sports are involved (i.e. basketball, hockey, swim meets).

Ingestion of simple rather than complex carbohydrates are preferred between games and events scheduled on the same day. Examples include sports drinks, sports bars, pancakes, bread, rice, pasta, potatoes, fruit and fruit juice. Sweet vegetables such as carrots, squash and sweet potatoes are also a consideration. If the next game or race is less than 3 hours following the preceding one, then a complete meal is not recommended. Rather, reliance upon sports drinks, sports bars, fruit juice, fruit and carrot sticks are viable dietary suggestions.

In the event of over training that produces muscle soreness, muscle damage and presence of inflammatory cells, the refueling of muscle carbohydrate (glycogen resynthesis) is reduced, resulting in poorer performance in future events. The effect of muscle damage can be partially overcome by the ingestion of increased amounts of carbohydrate. Thus, athletes should be aware of the potential need of increased dietary carbohydrate following intense, prolonged exercise that produces muscle damage and soreness.

From a metabolic standpoint glucose and sucrose (white sugar) results in faster muscle glycogen resynthesis than fructose, although fructose may be of more benefit in the restoration of liver glycogen.

In summary, in view of the importance of carbohydrate for performance in many sports, the goal of carbohydrate nutrition strategies aimed at before, during and after exercise as well as day to day carbohydrate loading can help to optimize athletic performance, providing an important competitive edge.

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