Carbohydrate Loading

The Who, What, When, How and Why

Written by Greg Cox

Optimal performance during competition is achieved by targeting the factors that would otherwise cause fatigue or a reduction in work output and/or skill. Nutritional factors that can cause fatigue include depletion of glycogen stores, low blood glucose levels (hypoglycaemia), dehydration, low blood sodium levels (hyponatremia), and gastrointestinal upset. Eating strategies in the lead-up to a race should be undertaken to avoid or reduce the impact of these problems.

What is Carbohydrate loading?

Carbohydrate is stored within the muscle as glycogen – a bundle of glucose (sugar) units. Carbohydrate loading, if done appropriately, increases muscle glycogen stores – thereby delaying the point of fatigue, often called "bonking". If you have been involved in any endurance event, I am sure you have experienced "bonking" at some point in your career.

Carbohydrate loading isn't new and has been around since the sixties when Scandinavian researchers discovered the muscle biopsy needle – a nasty piece of work. In the classic carbohydrate loading study, Bergstrom and colleagues (1967) found that muscle glycogen stores were increased and subsequent endurance exercise performance was enhanced following 3 days of high carbohydrate eating, preceded by 3-4 days of carbohydrate deprivation. This study resulted in the classic carbohydrate loading strategy – the "depletion method", a trademark practice of some of the best Australian distance runners in the past. Mike Sherman, an eminent exercise physiologist in the 80's, found that muscle glycogen stores could be increased to a similar level without the 3 days of depletion prior to 3-4 days of high carbohydrate eating (Sherman et al, 1981). This method – "modified carbohydrate loading", simply involves 3-4 days of high carbohydrate eating with rest leading into exercise. Great – eat and don't move for 3 days and you can load your muscle glycogen stores!!

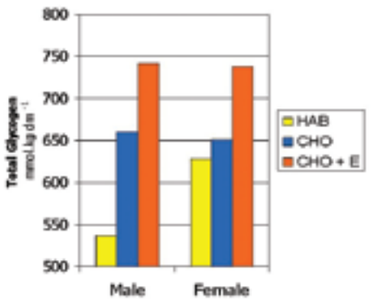


Figure 1 - Total Glycogen stored as a result of dietary interventions for Males and Females.

Why does it work?

Tim Noakes, a South African doctor who specialises in exercise physiology and nutrition recently published a study that investigated the benefits of carbohydrate loading on cycling time trial performance (Rauch et al 2005). Eight well-trained cyclists completed 2 hours of steady-state riding followed by a one hour time trial after three days of either high carbohydrate eating or their usual carbohydrate intake. Researchers found that after the high carbohydrate eating plan cyclists performed better during the one hour cycling time trial. The researchers concluded that "7 out of the 8 subjects who started with significantly higher muscle glycogen following carbohydrate loading used all additional stored glycogen and paced themselves higher throughout the time trial".

The authors speculate that receptors present in muscles detect muscle glycogen content and provide feedback to the brain, which ultimately dictates pacing during exercise. The higher the initial muscle glycogen content the faster the performance.

Who is it important for?

Canadian researchers investigated whether males and females carbohydrate load differently (Tarnopolsky et al. 2001). Researchers had well-trained male and female endurance athletes complete three separate, five-day trials where they consumed:

their habitual diet (HAB)

a diet containing 75% carbohydrate with the same amount of energy as their habitual diet (CHO)

or a diet containing 75% carbohydrate with an additional 34% energy(CHO-E).

Researchers found that female endurance athletes need to increase their total energy intake in order to load muscle glycogen stores along with modifying the percentage of carbohydrate in their diet (see Figure 1). So, if as a female endurance athlete, you simply select additional carbohydrate foods while maintaining your normal energy intake, you are likely to fail to super-compensate muscle glycogen stores in preparation for racing.

How many days are needed to carbohydrate load?

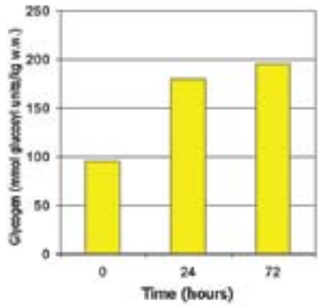
Recently, a group of West Australian researchers investigated the effects of 3 days of high carbohydrate eating (10grams of carbohydrate per kilogram body weight per day) combined with rest on muscle glycogen stores in 8 endurance trained cyclists and triathletes (Bassau et al, 2002). Figure 2 shows that despite a significant increase in muscle glycogen stores in the first 24 hours, two additional days of high carbohydrate eating failed to further increase muscle glycogen stores.

Assuming your not carbohydrate depleted at the start of your carbohydrate loading plan and that you consume adequate carbohydrate only perform light training, you may only require 24-36 hours of high carbohydrate eating to maximise your muscle glycogen stores. This strategy may be worthwhile for athletes fearful of gaining weight in the lead-up to endurance an event.

When do you need to carbohydrate load?

Despite a greater reliance on muscle glycogen when pre-exercise concentrations are elevated carbohydrate loading prior to exercise is generally associated with enhanced performance when exercise duration exceeds 90 minutes. For shorter duration events, normal resting glycogen stores of a well-trained athlete are likely to be sufficient to fuel the performance of moderate-intensity events lasting 60-90 mins – so you're covered in 10km and half marathon events, particularly if you have a history of endurance training.

In the shorter duration events, e.g. 10km and half marathons, suitable fuel stores in the muscle are achieved by a combination of tapered exercise or rest, plus adequate carbohydrate (7-10g per kg body mass) over the 24-36 hours prior to the event. In many situations, this dietary prescription is already achieved in the everyday training diet, so no extra effort is needed. However, for some athletes (e.g. women or athletes on a weight reduction diet) increasing carbohydrate intake above their normal intake maybe needed to achieve these fuelling up goals.



Total glycogen stored as a result of carbohydrate loading for 24 and 72 hours.

For longer duration events such as the marathon, achieving a high carbohydrate intake (10-12g per kg body mass) for 24-72 hours prior to an event,will mean modifying normal daily food and fluid intake for most athletes. It's unlikely that your normal carbohydrate intake will accidentally fall into this range in order to super-compensate muscle glycogen stores.

Carbohydrate Loading Tips

As you start your taper into a race, your total food intake should reflect this taper in training. There is no value in increasing your energy (kilojoule) intake for the entire week leading into a race as this may lead to unwanted weight gain. Twenty-four to seventy-two hours is sufficient for your muscles to increase glycogen stores, given you consume adequate carbohydrate and reduce your physical activity.

Be sure that the day prior to racing is a light activity day. If you exercise heavily the day prior to racing you will need to increase total energy (kilojoule) and carbohydrate intake above those listed above in order to super-compensate muscle glycogen stores.

Get to know the carbohydrate content of foods you normally eat so you can gauge as to whether you are likely to consume sufficient carbohydrate in order to truly carbohydrate load your muscles. Alternatively, seek the expert advice of a Sports Dietitian to assist you in personalising a carbohydrate plan. Visit www.sportsdietitians.com.au to find a Sports Dietitian located nearest to you.

To maintain normal bowel habits you don't want your fibre intake to increase drastically the day before a race. Refined carbohydrate choices such as honey, jam, added sugar, sports drinks, cordial, soft drink and lollies are compact, low-fibre carbohydrate sources. These foods when added to your normal intake will increase your carbohydrate intake without increasing your fibre intake.

If you're racing early the next day or you're one that gets too nervous to eat on race day, including a late supper option (~9.00pm) the night before racing takes the pressure away from a more substantial pre-race meal.

R4YL

Chicken Schnitzel Burgers

From Survival Around the World

4 chicken breast fillets (150 g each)
1/4 cup plain flour
salt, pepper
2 eggs, lightly beaten
1 tablespoon skim milk
1 cup dry breadcrumbs
2 tablespoons chopped parsley

1/4 cup fat free mayonnaise
200 g lettuce mix
2 tomatoes, sliced
1 cucumber, sliced
4 bread rolls (omit for low fuel)

Preheat oven to 200^{0}C. Beat or roll each chicken breast between two sheets of plastic wrap until ~ 1 cm thick. Place flour in plastic bag, season with salt and pepper and shake to combine. Combine egg and milk and pour onto a plate. Place breadcrumbs and parsley in plastic bag and shake to combine. Place chicken breast in bag with flour, shake to coat then shake off excess flour. Dip the chicken in the combined egg and milk, then toss in combined breadcrumbs and parsley. Place the schnitzels on a baking tray and freeze for 5 minutes. Cook in oven for 20 minutes or until golden. Serve with salad, mayonnaise and rolls (for high fuel option).