

# Carbohydrate intake during exercise: when, what and how much?

The benefits of carbohydrate ingestion during exercise are well described. So, the obvious question is how the supply of carbohydrates can be optimized. Although dose-response studies have not been conclusive there is some emerging evidence that high oxidation rates of the carbohydrate can be beneficial in some situations (Table 1). This will require the ingestion of fairly large amounts of carbohydrate, which in itself could be linked to gastro-intestinal problems. Combinations of carbohydrates (for example glucose and fructose) ingested at high rates seem to minimize the negative side effects and optimize carbohydrate delivery.

| <u>EVENT</u>                                | <u>CHOICE OF CARBOHYDRATE</u> |  |                    |   |
|---|-------------------------------|--|--------------------|---|
|   | Energy expenditure            | Carbohydrate required for optimal performance and minimizing negative energy balance | Recommended intake | carbohydrate type   |
| Exercise of <45 min duration                | >18 kcal/min                  | No CHO required  | *                  | *   |
| Exercise of 1 h duration                    | 14-18 kcal/min                | Very small amounts of CHO  | *                  | *   |
| Exercise >2 h<br>Low to moderate intensity  | 5-7 kcal/min                  | Small amounts of CHO   | Up to 30 g/h       | Can be achieved with most forms of CHO                        |
| Exercise >2 h<br>Moderate to high intensity | 7-10 kcal/min                 | Moderate amounts of CHO  | Up to 60 g/h       | Can be achieved with CHO that are rapidly oxidized            |
| Ironman,<br>Tour de France stage races      | 10-14 kcal/min                | Large amounts of CHO   | Up to 90 g/h       | Can only be achieved by intakes of multiple transportable CHO |

## Strategies to take carbohydrate on board

**When** Carbohydrate ingestion can enhance performance during exercise of 45 min or longer. So if the quality of a training session is important or in competition, consuming some form of carbohydrate will help.

**What** The type of carbohydrate has considerable impact on the speed of energy delivery. Some carbohydrates are oxidized at higher rates than others. However, a combination of maltodextrins and fructose, glucose and fructose, glucose, sucrose and fructose seems to result in the highest oxidation rates.

**How** How the carbohydrate is ingested and in what form seems to be less important for the delivery of carbohydrate but can be important for fluid delivery. Highly concentrated carbohydrate solutions can impair fluid delivery. It is generally recommend to ingest a certain volume at the start to prime the stomach and to keep topping this up with smaller boluses at regular intervals.

**How much** How much you ingest depends on a number of factors including: 1) what type of exercise (intensity and duration; see Table 1). 2) The type of carbohydrate (or combination of carbohydrates) 3) Tolerance. Especially this factor is highly individually determined and only practicing in training (and competition) will help an individual find out what will work for them.

### **SUGGESTED ADDITIONAL RESOURCES**

1. Jeukendrup AE. Carbohydrate intake and exercise performance. *Nutrition* this issue: 2004.
2. Jeukendrup AE, and Jentjens R. Oxidation of carbohydrate feedings during prolonged exercise: current thoughts, guidelines and directions for future research. *Sports Med* 29: 407-424., 2000.
3. Jeukendrup AE, Jentjens RL, and Moseley L. Nutritional considerations in triathlon. *Sports Med* 35: 163-181, 2005.