Sports Nutrition

The bottom layer of the pyramid (basic nutrition) is important for all athletes and is the foundation. When the basic diet is not sufficient for an athlete and supplementation is needed, middle layer of the pyramid should be taken into consideration: sports nutrition. Sports nutrition entails a dietary regime that will aid in optimizing sports performance. You can consider food products such as sports drinks, sports bars, sports gels and protein shakes, but in most cases basic nutrition products are just as good (or sometimes better). The top of the nutrition pyramid, sports supplements, can be relevant when the basic nutrition and sports nutrition of an athlete have been optimized.

This document is about the middle layer of the nutrition pyramid.

1. Which criteria should you meet before sports-specific foods become necessary?

The type, intensity and duration of the effort will determine whether sports nutrition is interesting for you. Athletes are therefore classified into three classes:

- **Recreational athlete:** An athlete who exercises up to 3 hours a week
- **Competitive athlete:** An athlete who exercises between 3 and 6 hours a week
- **Professional athlete:** An athlete with a top-level status

*Recreational athlete/exerciser*

The basic nutrition (a healthy, balanced diet) is sufficient for the recreational athlete. On training and game days, the recreational athlete needs slightly more energy and fluids (Wardenaar, et al., 2014)
The energy expenditure can be calculated when multiplying the Basal Metabolic Rate (BMR) with the Personal Activity Level (PAL) (see the document Basic Nutrition for a more detailed explanation). For exertions shorter than 1 hour, water is sufficient to cover the fluid requirements (Wardenaar, et al., 2014). An isotonic thirst quencher\textsuperscript{1} can be appropriate when the exertion lasts longer than 1 hour. It is generally recommended to drink more fluids before and after sporting activities.

**Competitive athlete**

Basic nutrition (a healthy, balanced diet) is also the foundation for competitive athletes. In addition, a competitive athlete needs more energy in the form of carbohydrates and proteins (Academy of Nutrition and Dietetics, Dietitians of Canada & The American College of Sports Medicine, 2016). The exact carbohydrate requirement depends on the duration and intensity of the bouts of exercise in the training program. The recommended protein intake is between 1.2 and 2.0 g/kg/day (see Table 1 and 3). For training and competitions longer than 1 hour in duration you need a thirst quencher (or isotonic sports drink) (see Table 4). Water is sufficient for training sessions less than 1 hour in duration.

**Professional athlete**

The nutritional foundation for top level athletes is a good basic nutrition as well. Moreover, as a professional athlete you need considerably more energy in the form of carbohydrates and proteins (Academy of Nutrition and Dietetics, Dietitians of Canada & The American College of Sports Medicine, 2016). For training sessions longer than 1 hour you need a thirst quencher or isotonic sports drink (see Table 4). A general advice is: 1 liter of an isotonic sports drink per hour, if you do not consume any other form of carbohydrates outside the sports drink. Water is sufficient for training sessions of less than 1 hour.

**Hydration during exercise**

The general guideline to consume 150-350 ml of water every 15-20 minutes during exercise and to replenish 150% of the lost moisture after exercise applies to recreational athletes, competitive athletes and top athletes (Burke & Deakin, Clinical sports nutrition, 2015). You can roughly determine how much fluid you lose during exercise by weighing yourself before and after exercise. The exact amount that you should drink during the exercise to prevent your sporting performance from decreasing due to dehydration strongly depends on the individual athlete (Ayotte & Corcoran, 2018) (Goulet & Hoffman, 2019) (Hoffman, Cotter, Coulet, & Laursen, 2016).

\textsuperscript{1} An Isotonic sports drink (thirst quencher) contains 4-8% carbohydrate (4-8 gram of carbs per 100 ml). An isotonic drink has the same osmolality as blood. This means that an isotonic drink contains an equal number of particles as blood does. Because of this, an isotonic sports drink is easy to absorb during exercise and it diminishes the chance of gastrointestinal distress (McArdle, Katch, & Katch, 2015). Examples: Aquarius, Isostar, lemonade (ratio of syrup and water 1 : 8-10, depending on the amount of carbohydrates in the syrup in question), (orange/apple) juice mixed with water until the right carbohydrate-water ratio. For homemade isotonic drinks, add some salt to supplement the loss of body salts.
In any case: start well hydrated (Goulet, Performance Effects of Dehydration, 2013); make sure that your urine is light yellow in colour prior to training or competition.

2. The type, intensity and duration of the exertion determines the nutrient requirements

We will make a distinction between strength training and endurance training. Of course, you can subdivide this into specific sports (e.g. game/team sports such as soccer, rugby, rowing and boxing), but in this document we will not go into that much detail. As a player of game sports (combination of strength and endurance sports) you can fall (to varying degrees) in both categories. Keep this in mind when preparing your nutrition plan.

Strength sports

It is often said that the duration of an optimal strength training session does not last longer than 1 hour (Lewis-McCormick, 2012). It should be mentioned that this is not set in stone. The optimal duration has to do with, among other things, the type of training/sports (e.g. bodybuilding, power lifting, weightlifting, crossfit, strongman training, etc.), degree of training experience and training intensity (for example, how much rest you take between sets). In this document, the advice given is based on a training course of approximately one hour.

- Prior to exercise, the basic nutrition is sufficient to provide the energy you need during the bout of exercise. As a strength athlete you have a (slight) increased energy requirement (MBR*PAL) and an increased protein requirement (see Table 1).

Table 1: Protein requirements for strength athletes

<table>
<thead>
<tr>
<th>Source</th>
<th>Strength sports (proteins in g/kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phillips &amp; Van Loon (2011)</td>
<td>1.3 – 1.8</td>
</tr>
<tr>
<td>International Society of Sports Nutrition (2017)</td>
<td>1.2 – 2.0</td>
</tr>
<tr>
<td>Morton, et al. (2018)</td>
<td>~ 1.6</td>
</tr>
</tbody>
</table>

- Based on a requirement of 1.6 g of protein per kg of body weight, a good distribution of protein intake could be: 0.4 g of protein per kg body weight per meal (Schoenfeld & Aragon, 2018). In practice, depending on your body weight of course, it often comes down to a portion of 20-30 g of protein per meal if you eat 4 (main) meals per day. The most optimal distribution, however, depends on a multitude of factors, such as time, practical options, personal preference for a certain meal frequency and social expectations/ circumstances. Find what’s optimal within the recommendations, but still is sustainable for you.

- During exercise, fluids in the form of water will generally suffice. The glycogen stores are not depleted during a 1-hour strength training session (except maybe during intensive circuit training and cross-fit workouts).
After exercise, supplementing protein (20-30 g) and fluids, with or without some carbohydrates, is recommended to promote recovery (Academy of Nutrition and Dietetics, Dietitians of Canada & The American College of Sports Medicine, 2016). A few examples:
- Protein shake: whey protein² (20 - 30 g protein) mixed with water or milk
- Pea protein² (20-30 g protein) mixed with water or a plant-based beverage (e.g. almond, oat or soy drink)
- Low-fat cottage cheese or skyr with fruit and/or honey/sugar and fluids (water)
- Cottage cheese with fruit and fluids (water)
- Sandwiches with lean meat and a glass of milk
- Sandwiches with egg and fluids (water)
- Large portion of soy yogurt/soy quark

This meal/snack is part of your total energy intake for that day.

**Endurance sports**

With endurance training, there is a huge range in intensity as well the duration of the training (compare a short and high-intensive training with a long and low-intensive training). Professional athletes have an increased need for carbohydrates and proteins compared to recreational (endurance) athletes (Maughan & Burke, 2009) (Academy of Nutrition and Dietetics, Dietitians of Canada & The American College of Sports Medicine, 2016).

Prior to exercise, the basic nutrition is sufficient to provide the energy you need during the bout of exercise. As an endurance athlete you have an increased carbohydrate requirement (see table 2) and an increased protein requirement (see Table 3).

### Table 2: Carbohydrate requirements for endurance athletes (Thomas, Erdman, & Burke, 2016)

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Carbohydrate requirement</th>
<th>Timing of intake of carbohydrate over the day</th>
<th>Other considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>3-5 g/kg of athlete’s body</td>
<td>Time of intake may be manipulated to promote high carbohydrate availability before or during the session or in recovery from a previous session.</td>
<td>As long as total fuel needs are provided, the pattern of intake may simply be guided by convenience and individual choice.</td>
</tr>
<tr>
<td>Moderate</td>
<td>5-7 g/kg/d</td>
<td>6-10 g/kg/d</td>
<td>Athletes should choose nutrient-rich carbohydrate sources to allow overall nutrient needs to be met.</td>
</tr>
<tr>
<td>High</td>
<td>8-12 g/kg/d</td>
<td>Time of intake may be manipulated to promote high carbohydrate availability before or during the session or in recovery from a previous session.</td>
<td>Otherwise, as long as total fuel needs are provided, the pattern of intake may simply be guided by convenience and individual choice.</td>
</tr>
</tbody>
</table>

### Table 3: Protein requirements for endurance athletes

<table>
<thead>
<tr>
<th>Source</th>
<th>Endurance sports (protein as g/kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine (2016)</td>
<td>1.2 – 2.0</td>
</tr>
<tr>
<td>International Society of Sports Nutrition (2017)</td>
<td>1.4 – 2.0</td>
</tr>
</tbody>
</table>

² Whey protein is generally superior to other protein powders due to its favorable amino acid profile; whey protein contains a lot of leucine, which has an anabolic (muscle gain stimulating) effect in the body (Berrazaqa, Micard, Gueugneau, & Walrand, 2019).

³ There are vegan variations of protein powders on the market with a modified amino acid profile, making them more equivalent to the animal variants.
Carbohydrates serve as the main form of fuel (fast and efficient form of energy). Carbohydrate stores are depleted after an intensive ~45- to 60-minute workout (specifically in the used/exhausted muscles) (Burke, Wong, Hawley, & Jeukendrup, 2011). Table 4 shows what an optimal supplement of carbohydrates during exercise would be.

Table 4: Carbohydrates during exercise (Academy of Nutrition and Dietetics, Dietitians of Canada & The American College of Sports Medicine, 2016)

<table>
<thead>
<tr>
<th>Activity duration</th>
<th>Carbohydrates to enhance performance</th>
<th>Recommended amount</th>
<th>Type of carbohydrate</th>
<th>Glucose</th>
<th>Glucose + fructose</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 45 min</td>
<td>No carbohydrates needed</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>45 – 75 min</td>
<td>Very small amounts</td>
<td>Mouth rinse</td>
<td>Most types of carbohydrates</td>
<td>Suitable/recommended</td>
<td>Suitable/recommended</td>
</tr>
<tr>
<td>1 – 2 hours</td>
<td>Small amounts</td>
<td>Up to 30 g per hour</td>
<td>Most types of carbohydrates</td>
<td>Suitable/recommended</td>
<td>Suitable/recommended</td>
</tr>
<tr>
<td>2 – 3 hours</td>
<td>Moderate amounts</td>
<td>Up to 60 g per hour</td>
<td>Rapidly digested carbohydrates (glucose/maltodextrins)</td>
<td>Suitable</td>
<td>Suitable/recommended</td>
</tr>
<tr>
<td>&gt; 3 hours</td>
<td>Large amounts</td>
<td>Up to 90 g per hour</td>
<td>Only combinations of glucose:fructose or maltodextrin: fructose (approximate ratio 2:1)</td>
<td>Only suitable in combination with another form of carbohydrates</td>
<td>Suitable/recommended</td>
</tr>
</tbody>
</table>

Fluids, carbohydrates and protein are recommended to promote recovery post exercise. An easy mnemonic is:
- Rehydrate: water (fluids)
- Replenish: carbohydrates
- Repair: protein

The combination of carbohydrates and proteins provide a better recovery than if only carbohydrates or proteins would be consumed (Academy of Nutrition and Dietetics, Dietitians of Canada & The American College of Sports Medicine, 2016). This can be achieved with for instance a meal or snack that contains (at least) 0.8 g/kg of carbohydrates together with 0.2 - 0.4 g/kg of protein (Wardenaar, et al., 2014). Of course, this will also depend on the total energy and protein requirement and how the meals are spread during the day. A high-carbohydrate diet is recommended.

Nowadays, low carbohydrate diets (50 to a maximum of 150 g carbohydrates per day) and ketogenic diets (20 to a maximum of 50 g carbohydrates per day) seem to become increasingly popular among endurance athletes. However, there is no scientific evidence to date that this has a greater performance-enhancing effect compared to carbohydrate-rich foods (Burke, et al., 2017).
diet ensures that the glycogen stores, which are located in the liver and muscles, are replenished faster, as shown in Figure 1.

A carbohydrate-rich diet optimally consists of products/foods that are recommended as basic nutrition, in particular complex carbohydrates. In some cases, supplementation with fast carbohydrates may be needed. Depending on the intensity of the bout of exercise, this may be necessary for competitive or top-level athletes. If you decide to use sports drinks, sports bars and/or sports gels, carefully read the packaging of these products to determine which products (and quantities) are suitable for you in which situation.

Figure 1: Restoration of carbohydrates (Senders, 2019)

3. Proteins for vegetarians and vegans
Depending on which type of vegetarian you are, achieving your protein requirement doesn’t have to be a problem. It becomes more challenging if you only occasionally eat products of animal origin and have an imbalanced diet. The Dutch Health Council recommends lacto-ovo vegetarians to increase their protein requirements by 20% (Gezondheidsraad, 2001). The reason is that vegetable protein sources do not have all the necessary amino acids (mainly lysine, methionine and leucine) for muscle building to a sufficient degree (Kniskern & Johnston, 2010) (Gorissen, et al., 2018). It is harder for vegans to reach their daily protein requirements, because the lack of animal protein in their diet. The advice for vegans to increase their protein requirements by 30% (Gezondheidsraad, 2001). But everything stands or falls with the composition of the daily diet. Both vegans and vegetarians who barely consume animal products are advised to eat as varied as possible. In theory, making different food combinations could complement the amino acid profiles of the different products (Van Vliet, Burd, & Van Loon, 2015) (Gorissen, et al., 2018). This includes the combination of grains with legumes (Berrazaga, Micard, Gueugneau, & Walrand, 2019).
Consult a (sports) dietician if you are unsure whether you are getting enough nutrients.
4. Timing and distribution of nutrients

The timing of nutrients (in other words: the moments surrounding the training when you should consume carbohydrates and proteins) is not essential for everyone. As for protein, the distribution of the daily protein needs over several servings per day is the most important (International Society of Sports Nutrition, 2017), so that your body has a continuous supply of proteins5. The timing (mainly of carbohydrates for the resynthesis of muscle glycogen in endurance sports) only starts to play a role if:

- the effort is intense and lasts longer than an hour (see Table 3),
- you have to exert yourself again within 24 hours after the previous exercise bout (Burke, Van Loon, & Hawley, 2017),
- you are not recovering sufficiently between training sessions (while other circumstances such as sleep, rest and stress reduction are optimal).

The more advanced you are as an athlete, and/or the more intense and longer in duration your training sessions are, the more important the timing of nutrients becomes for an optimal recovery (Academy of Nutrition and Dietetics, Dietitians of Canada & The American College of Sports Medicine, 2016). Timing may also be of importance for athletes who have to make weight.

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5 It is often thought that casein is the best protein source before sleep, but research reveals that this is not (always) the case. Animal based protein enhances protein synthesis more when compared to plant-based-proteins, but the type of animal protein does not seem to matter (Thomas, Erdman, & Burke, 2016).
References


