Sources of energy to replenish ATP

Each of the three energy systems (ATP/PC, lactic acid and aerobic) uses fuels for ATP re-synthesis. These fuels can be derived from both a chemical and a food source. Which one is used depends predominantly on the intensity and duration of exercise

Carbohydrates

Carbohydrates are stored as glycogen in the muscles and liver, and converted into glucose during exercise. During high-intensity anaerobic exercise, glycogen can be broken down without the presence of oxygen (main fuel at 50–70% of VO_2 max) but it is broken down much more effectively during aerobic work when oxygen is present. Stores of glycogen are much smaller than stores of fat and it is important during prolonged periods of exercise not to deplete glycogen stores, as some needs to be conserved for later when the intensity could increase, for example, the last kilometre of the marathon.

ATP

ATP is an energy-rich compound found in all cells in the body. It is in limited supply — the body only has enough for around 2–3 seconds of activity, e.g. a power lift or a sprint start. ATP is constantly being re-synthesised to ensure a continuous supply of energy. However this re-synthesis requires energy, which is obtained from the food that we eat.

Protein

Protein is predominantly used for muscle growth and repair but approximately 5–10% of energy used during exercise comes from proteins in the form of amino acids. It tends to be used when stores of glycogen are low.

Phosphocreatine

Phosphocreatine is an energy-rich phosphate compound found in the sarcoplasm of the muscles. It is used to re-synthesise ATP in the first 10 seconds of intense exercise. It is easy to break down and store within the muscle cell, but its stores are limited. Many power athletes take creatine supplements to make the ATP/PC system last longer so they can experience greater strength gains. Red meat and fish are good dietary sources of phosphocreatine.

Fats

Fats are stored as triglycerides in the adipose tissue and converted to fatty acids when required. When we are resting, two-thirds of our energy requirements can be achieved through the breakdown of fatty acids. This is because fat can produce more energy per gram than glycogen (1 g of fat produces 9.1 kcal of energy, whereas 1 g of glycogen produces 4.1 kcal of energy).

Fat is the predominant energy source for low-intensity aerobic work such as jogging. However, the breakdown of fats to free fatty acids requires around 15% more oxygen than is required to break down glycogen, so glycogen will be the preferred source of energy during high-intensity exercise when oxygen is in limited supply.

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