Supplements for sports performance

The consumption of dietary supplements is common practice in most sports participants; for example, it has been reported that greater than 60% of junior track and field athletes in the UK consume some form of supplement product and that these athletes consumed more than one product at a time.

But what is a supplement? Aligned to their general definition, the International Olympic Committee deem that supplements are products that are taken orally with the intention to *supplement* the diet by increasing the total dietary intake of vitamins and minerals and other non-vitamin non-mineral substances; therefore, the use of supplements has been recommended to support a balanced diet derived from primarily whole foods and only to be considered necessary where there is a demonstrated deficiency of an essential vitamin or mineral that an increased intake from food is not able to fulfil. That said, there are situations when the use of some sports supplements are warranted despite the lack of a deficiency being present. For example, it may not be feasible to consume adequate amounts of whole foods when competing on multiple occasions per day; therefore, specific strategies can be used to help the athlete. A brief description of some common sports supplements now follow.

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Creatine

Creatine is a naturally occurring amino acid derivative that forms a key component of dietary intake. The majority (about 95%) of the body's creatine is stored in skeletal muscle, of which 60 to 70% is involved in the anaerobic production of the body's energy currency; adenosine triphosphate (ATP). Following reports in the early 1990's that the body's creatine content could be increased by supplementation, creatine-monohydrate has become a popular nutritional supplement. It is used primarily to increase lean body mass and improve performances of single and repetitive high intensity, short-duration exercise tasks such as weightlifting and sprinting; however more recently creatine has been used for other purposes such as a method of hyperhydration to increase the tolerance of exercising in the heat due to its common side effects of increased body water content and it is believed that it may play a role in the regeneration of muscle glycogen stores post-exercise.

A number of creatine products are available on the market today and since the early 1990's the performance effects of creatine have been studied extensively. There is considerable support for the use of creatine in sport. Although the

research has tended to focus on shorter duration maximal cycling bouts to test the efficacy of this supplement, it is possible that it supplementation could enhance repeated intermittent exercise such as sprinting or swimming. However it should be noted that if creatine is taken, caffeine consumption should be limited due to the inhibitory effects of caffeine on the performance benefits associated with creatine supplementation.

Caffeine

Commonly found in tea, coffee and chocolate, caffeine is a potent central nervous system stimulant which has the temporary effects of reducing fatigue and improving mental focus; both of which are crucial to athletic performance.

The primary mechanism by which caffeine is thought to exert its effects is related to the structural similarities that is shares with a compound called adenosine. Apart from being an important mediator in the energy transfer processes of the body, adenosine is an inhibitory neurotransmitter that is believed to promote sleep. The structural similarity of caffeine to adenosine means that upon ingestion caffeine can bind to the receptors that adenosine is supposed to bind to without causing the inhibitory effects. By displacing adenosine, caffeine is believed to prevent the sleepiness usually caused by adenosine binding.

Besides from adenosine mediated effects, caffeine ingestion has been found to increase the rate of oxidation of carbohydrates by approximately 30%. This is believed to be due to the inhibitory effects it exerts on an enzyme known as phosphodiesterase which normally contributes to the break down of bonds in cyclic AMP (cAMP). cAMP is a secondary messenger that is primarily involved in the transferring of signals from outside to inside the. By preventing the breakdown of bonds, caffeine prolongs the effects of cAMP and thus enhances the rate of carbohydrate oxidation; the reason why caffeine is added to some carbohydrate gels or solutions.

Withdrawal from caffeine can give what is known as “tension headaches” in the 3-5 days following the cessation of caffeine intake. Increased caffeine consumption increases the number of receptors of adenosine (as remember the body thinks that adenosine is binding to them when in fact it is actually caffeine due to the structural similarities between the two). Consequently, the body becomes much more sensitive to adenosine when caffeine is withdrawn (due to the increase in receptors). As adenosine contributes to the dilation or enlargement of blood vessels; the increased sensitivity to adenosine results in an increase in blood volume in the head. As the blood vessels of the head are enclosed in the skull; this means that there is a build-up of pressure which leads to the headaches.

Carbohydrate

Decades of research support that sports drinks are superior to water at improving performance in specific types of exercise; it is therefore not surprising that carbohydrate-electrolyte solutions are amongst the most commonly used supplements in sport. The primary goals of consuming a carbohydrate-electrolyte beverage during competition are to replace the water and electrolyte losses incurred during exercise, whilst simultaneously providing energy to supplement the body's stores; both of which act to delay fatigue.
As glycogen is the major energy source for prolonged exercise, it is not surprising that reduced pre-exercise glycogen levels resulted in less intense exercise being completed thereafter. Ingesting a sports drink during exercise maintains blood glucose levels and promotes the uptake of carbohydrate into muscle cells. This in turn increases the use of carbohydrate as an energy source. There is also increasing evidence that consuming carbohydrate-electrolyte beverages can benefit the skilled as well as the physical performances involved in competitive sport and that the carbohydrates may not need to be swallowed to get a performance effect.

Carbohydrate and Protein Containing Electrolyte Drinks

More recent research indicates that drinking a carbohydrate and protein beverage during training can also enhance muscle synthesis, as well as maintain hydration and energy provision. Ingestion of a carbohydrate drink that contained a pre-digested form of protein lowered the whole-body protein breakdown rates that normally occur during intense exercise and also raised protein synthesis when compared to a carbohydrate-only drink. Additionally, the same drink also improved markers of hydration and core temperature in another research study. Therefore, it appears that addition of protein to carbohydrate containing electrolyte drinks may be of benefit to those athletes that compete on multiple occasions in a short time period.

Carbohydrate and Protein in Recovery

It has been said that the restoration of muscle glycogen stores following exercise is one of the most important factors determining the time needed to recover. Therefore careful manipulation of carbohydrate and protein consumption following exercise allows the simultaneous restoration of glycogen stores and facilitation of the growth and repair of cells.

Glycogen restoration following exhaustive exercise can be split into two distinct phases which relate to the mechanisms of action of nutrient uptake.

Phase 1: An initial rapid phase of glycogen synthesis that generally lasts between 30 and 60 minutes. This phase can proceed without the presence of insulin due to exercise causing extra transporters (i.e., GLUT-4) to move to the outer surface of the cells and increase carbohydrate uptake.

Phase 2: Following this rapid phase of glycogen synthesis, muscle glycogen synthesis occurs at a much slower rate and in the presence of carbohydrate availability and high insulin levels, this phase can last for several hours.

Therefore, recovery from exercise can be enhanced significantly by consuming carbohydrate and protein; the effects of this enhanced recovery may be most noticeable when two bouts of exercise or competition occur within a very short time period.

Summary

A number of sports supplements can be used effectively to increase sports performance or to enhance the recovery from exercise. However, a key thing to remember is that when considering the use of any supplement you must account for whether or not it has been tested for the presence of banned substances. Negligence is not an excuse for a positive result on a banned substance. If in doubt, do not use the product.