ERGOGENIC AIDS: NUTRIENTS WHICH CAN HELP OPTIMISE ATHLETIC PERFORMANCE

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HOW ERGOGENIC SUPPLEMENTS HELP MUSCLES TO WORK MORE EFFICIENTLY.

An ergogenic aid supplies a nutrient which improves the way muscles function, some examples are;
1. Inhibiting lactic acid build-up; Lactic acid is produced in muscles during exercise as a by-product of energy supply. The more strenuous the exercise the greater the lactic acid production. Increasing lactic acid within cells inhibits the contractile ability of cells and contributes to fatigue (Miller, et al 1988). Ergogenic supplements can help reduce accumulation of lactic acid in exercising muscle.
2. Inhibiting ammonia build-up; Ammonia is another by-product of energy production in muscle cells (Brodan, et al 1974). Ammonia is toxic to all cells and inhibits the energy cycle. High blood ammonia levels result in poor performance (Wilkerson, et al 1977). Ergogenic supplements can help reduce ammonia accumulation.
3. Supplying bioavailable phosphorus; During exercise phosphate is lost from muscle cells into the blood (Dale, et al 1987). Phosphate acts as one of the major buffers of acid build-up within muscle cells. Phosphate lost during exercise must be replaced for optimal muscle cell function. Athletic animals may have insufficient dietary phosphorus to replace losses during daily strenuous exercise. An ergogenic supplement may be a source of bioavailable phosphorus.
4. Stimulating red blood cell production; Oxygen supply is vital for muscles to function and to grow with training. The key limiting factor for supplying oxygen to muscle is red blood cells. Increasing the number of red blood cells increases oxygen supply to muscles. Ergogenic aids which supply nutrients for red blood cell production will assist performance.

Some useful, readily available ergogenic supplements are;

1. L-CARNITINE

L-carnitine plays a vital role in muscle metabolism during exercise. L-carnitine forms the transport system that moves fatty acid molecules into the mitochondria (furnaces) of the cell where they are burned for fuel (Strack, et al 1964). L-carnitine also inhibits the build-up of lactic acid in muscles, which helps delay the onset of fatigue (Brevetti, et al 1988). L-carnitine also helps with the oxidation (burning) of pyruvate and branched chain amino acids in the energy cycle (Bremer 1983) It also prevents the build-up of fatty complexes within cells, which can damage muscle cell membranes (Stumpf 1985).

The level of L-carnitine in the muscles plays a major role in determining the exercise capacity of the muscles. L-carnitine is also essential for normal heart function and L-carnitine supplementation is recommended for patients with heart failure (Kosolcharoen, et al 1981).
Human athletes take L-carnitine supplements to enhance fat metabolism and to improve performance (Strack, et al 1964, Cooper, et al 1986). L-carnitine supplementation has been shown to enhance both sprint and endurance performance. L-carnitine increases endurance ability (Canale, et al 1988), as fat is the main energy source for endurance exercise. During sprinting L-carnitine plays an important role in carbohydrate metabolism by buffering lactic acid and thus delaying the onset of fatigue. Supplementation has been shown to increase maximal work output (Siliprandi et al 1990) and VO_2 max during sprint exercise (Marcone, et al 1985, Angeline, et al 1986). The rationale for supplementing human athletes applies equally to the performance horse, which has very high energy requirements. There is evidence that L-carnitine levels in equine plasma increase with training (Foster, et al 1989) thus the effect of L-carnitine supplementation will be enhanced during training. High fat diets are recommended for exercising horses as they have a very high energy content and have been shown to improve racing performance (Eaton 1994). The utilisation of a high fat diet will be enhanced by supplementing with L-carnitine.

2. PHOSPHATE LOADING;

During exercise large amounts of muscle phosphate are lost from the muscles into the blood (Dale, et al 1987, Kreider, et al 1990). The body cannot make phosphorus it must come from the diet. Due to losses during exercise athletic animals need higher phosphorus in the diet than non-athletic animals. Supplementing with phosphate has been shown to increase both blood phosphate and muscle phosphate levels (Lloyd, et al 1992).
Phosphate has three main functions in muscle which are enhanced by phosphate supplementation;
1 Buffering lactic acid build-up within muscle cells (Kreider, et al 1990, Miller, et al 1991).
2. Increasing the level of 2,3-DPG, which helps maximise oxygen supply to muscles (Cade, et al 1984, Stewart & McNaughton 1990). Phosphate is part of a chemical, 2,3-DPG, which helps red blood cells off-load oxygen into muscle cells. If levels of 2,3-DPG decline so do muscle oxygen levels which decreases performance (Farber, et al 1984).
3. Enhancing the action of a number of phosphate-containing enzymes, which are involved in energy production, and the utilisation of glycogen for fuel (Chasiotis 1988).
Phosphate loading; supplementing with bioavailable phosphorus/phosphate for three days prior to exercise has been shown to improve both sprinting and endurance performance in humans. Studies have measured an increase in VO_2 max and a delay in the onset of fatigue during exercise (Cade, et al 1984, Stewart & McNaughton 1990).
An increase in maximum power output and a decrease in time to perform an exercise

test (Kreider, et al 1992). The effects of phosphate supplementation have been measured in human athletes, however muscle physiology is similar in all mammals, thus phosphate supplementation should be equally valid for athletic animals.

3. VITAMINS, MINERALS and AMINO ACIDS;

Athletic animals should be given a range of vitamins, minerals and amino acids in their diet to maintain optimal health. Athletic animals, which exercise regularly and strenuously, have far greater requirements for vitamins, amino acids and minerals than non-athletic animals.
Maximal exercise has been shown to reduce B vitamin levels and suppress the blood counts of athletic animals. Many athletic animals are slightly anaemic, which means they have a low red blood cell count. Less red blood cells means less oxygen going to the muscles which means they cannot perform at their maximum level. The B complex vitamins and trace minerals iron, copper and cobalt are required for the production of normal red blood cells.
Vitamins required at high concentration by athletes are;
B COMPLEX VITAMINS:
B2 (Riboflavine); Helps the mitochondria (furnaces) of muscle cells produce energy.
B3 (Nicotinamide); Works in the glycogen energy cycle and assists the oxidation of fatty acids for energy.
B5 (Panthenol); This vitamin has many roles in energy metabolism; it is essential for the production of glucose and fatty acids, which are the main energy sources of the body.
B6 (Pyridoxine); Is present in coenzymes which function at all levels of protein and amino acid metabolism, thus it is essential for muscle building and in making red blood cells. It is also an essential component of the enzyme which breaks down glycogen for fuel.
B8 (Folate); Is a vital transport coenzyme which controls amino acid metabolism, it is vital for the production of all cells, particularly red blood cells.
B12 (Cyanocobalamin); Forms part of coenzymes which are essential for the production of all cells, particularly rapidly turning over cells, such as red blood cells.

OTHER VITAMINS;
BIOTIN; An essential part of enzymes which are involved in formation of glucose and fatty acids, the major energy sources of the body, and in an enzyme which builds new proteins.
CHOLINE; An essential component of all cell membranes.
INOSITOL; Part of cell membranes, essential for functioning of calcium and insulin metabolism.

ESSENTIAL MINERALS;
IRON; An integral part of hemoglobin, the red pigment in red blood cells which carries oxygen.
COPPER; Forms part of many enzymes, essential part of the enzyme which produces nor-adrenaline, the body's own stimulant which is released during exercise performance
COBALT; An essential part of Vitamin B12.

4. ADENOSINE-5-MONOPHOSPHATE (AMP)

Energy production involves the breakdown of ATP to AMP, which is then reconverted to ATP. Increased AMP levels may occur in tissues with low blood flow, AMP may be the body's signal for the need to increase blood flow to that tissue. Administration of AMP-5 results in a marked increase in blood flow in the coronary (heart) and peripheral arteries due to vasodilation (increasing blood vessel diameter) of the small arteries (Feigl 1983). Circulating AMP acts directly on receptor sites of the surface of the blood vessel walls (Berne and Rubio 1983).
AMP-5 has been used as a vasodilator in humans. AMP-5 results in increased blood flow to the heart and the muscles and is recommended in the prevention of cramping in greyhounds (Gannon, 1998) and racehorses (Rose, 1999).

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