NATURE VET

ERGOGENIC AIDS

NUTRIENTS WHICH CAN HELP OPTIMISE ATHLETIC PERFORMANCE

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HOW ERGOGENIC SUPPLEMENTS HELP MUSCLES TO WORK MORE EFFECTIVELY

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 muscle cells and contributes to fatigue (Miller et. al., 1988). Ergogenic supplements can help reduce accumulation of lactic acid in exercising muscles.
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 bio-available 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 the fatty acid molecules into the mitochondria (cell 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 muscles plays a major role in determining the exercise capacity of 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 muscle fatigue. Supplementation has been shown to increase maximal work output (Siliprandi et. al., 1990) and VO2 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 blood (Dale et. al., 1987; Krieder et. al., 1990). The body cannot make phosphorus. It must come from the diet. Due to losses during exercise athletic animals need much higher phosphorus in the diet than non-athletic animals. Supplementing with phosphate has been shown to increase both blood and muscle phosphate levels (Lloyd et. al., 1992).
Phosphate has three main functions in muscle which are enhanced by supplementation:
(a) Buffering lactic acid accumulation in muscle cells (Krieder et. al., 1990; Miller et. al., 1991).
(b) 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 will adversely affect performance (Farber et. al., 1984).
(c) Enhancing the action of a number of phosphate-containing enzymes which are involved in energy production, and enhancing 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 VO2 max, and a delay in the onset of fatigue during exercise (Cade et. al., 1984; Stewart & McNaughton, 1990). In addition, they have shown an increase in maximum power output and a decrease in time to perform an exercise test (Krieder 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 all 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, minerals, and amino acids than non-athletic animals. Maximal exercise has been shown to reduce B vitamin levels, and suppress the blood counts of athletic animals. Many performance animals are slightly to moderately anaemic, which means they have low red blood cell counts. Less red blood cells means less oxygen carrying capacity and less oxygen going to muscles. This simply means that animals cannot perform at their peak. The B complex vitamins and the trace minerals, iron, copper, and cobalt, are required for the production of normal red blood cells.

Vitamins required at high concentration by athletic animals are:
B Complex Vitamins:

B2 (Riboflavin), 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 (Pantothenol), has many roles in energy metabolism. It is essential for the production of glucose and fatty acids which are the major energy sources for the body.

B6 (Pyridoxine), is present in co-enzymes 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 co-enzyme which controls amino acid metabolism. It is vital for the production of all cells, particularly red blood cells.
B12 (Cyanocobalamin), forms part of the co-enzymes which are essential for the production of all cells, particularly rapid turnover cells such as red blood cells.

Other Vitamins:

Biotin is an essential part of enzymes involved in the formation of glucose and fatty acids, the major energy sources for the body, and in an enzyme which builds new protein for the body.
Choline is an essential component of all cell membranes.
Inositol is part of the cell membranes, and is essential for calcium and insulin metabolism.

Essential Minerals:

Iron is an integral part of Haemoglobin, the red pigment in red blood cells which carries oxygen.
Copper forms part of many enzymes, and is an essential part of the enzyme which produces nor-adrenaline, a natural stimulant which is released during exercise.
Cobalt is 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 occur in tissue with low blood flow, and AMP acts as one of the body's signals for the need to increase blood flow to that particular tissue. Administration of AMP-5 results in a marked increase in blood flow in the coronary 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 to cause dilation (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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