HONG KONG
SPORTS INSTITUTE
香港體育學院

The Use of Nutritional Supplements

Sport Nutrition Education Series XXII

The above information is provided by the Sport Nutrition Monitoring Centre of the Elite Training Science & Technology Division. All information is for reference only.

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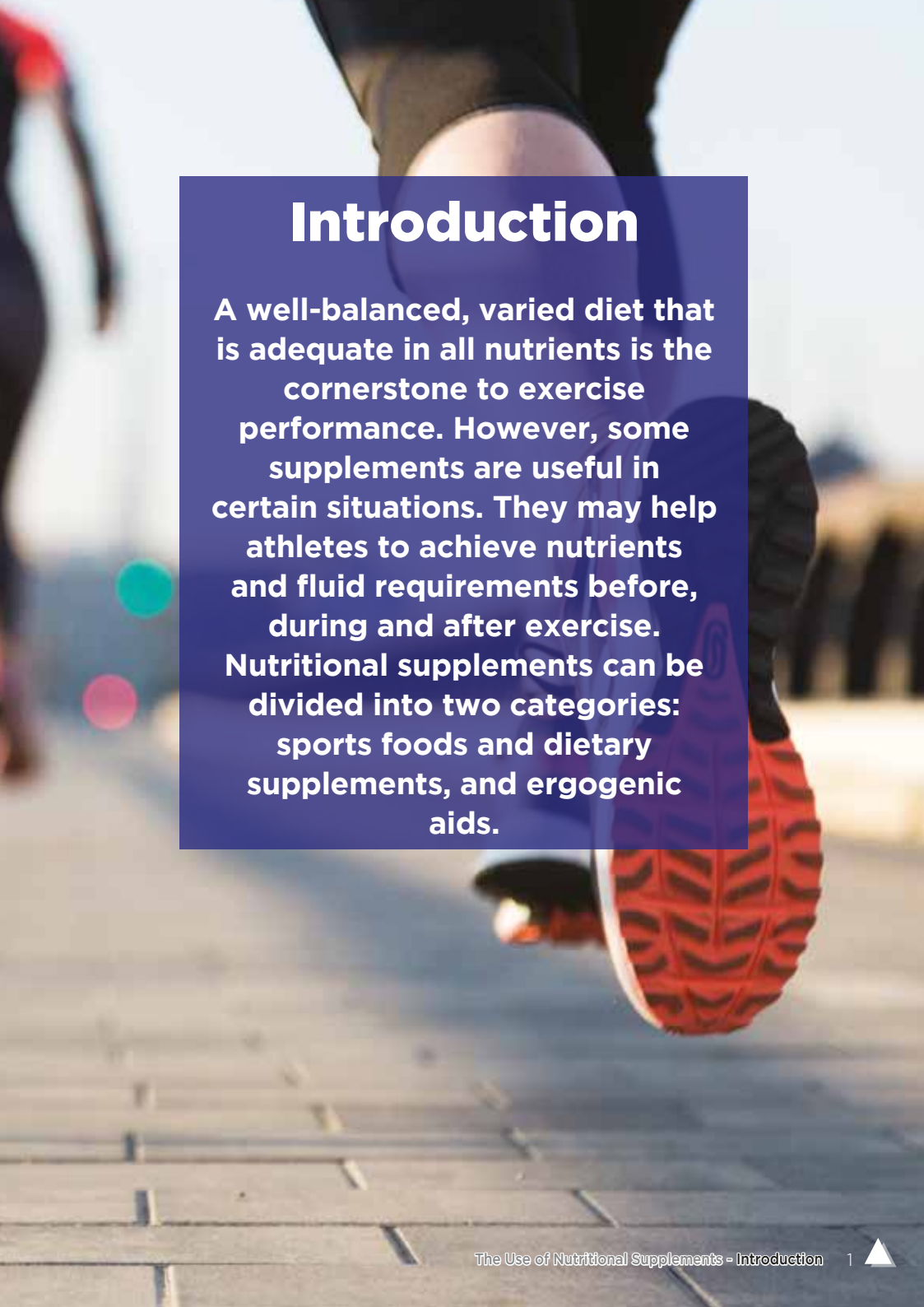


Introduction

A well-balanced, varied diet that is adequate in all nutrients is the cornerstone to exercise performance. However, some supplements are useful in certain situations. They may help athletes to achieve nutrients and fluid requirements before, during and after exercise. Nutritional supplements can be divided into two categories: sports foods and dietary supplements, and ergogenic aids.

Sports Foods and Dietary Supplements

Sports foods and dietary supplements are specialised products used to provide a convenient source of energy and nutrients to achieve specific nutritional or sport performance goals. When athletes use sports foods, they should try them first during training to assess gut tolerance. Examples of sports foods and dietary supplements are balanced nutrition drinks, sports drinks, sports gels, sports confectionery, sports bars, recovery drinks, protein supplements, vitamin D and multivitamin / mineral supplements.

Balanced Nutrition Drinks

Example: Enercal Plus, Ensure, Nutren Optimum

Overview

- Composition: conforms to healthy eating guidelines, rich in energy (1 – 1.5kcal/ml) and carbohydrate, moderate protein and low to moderate fat. They come in either a powder or liquid form
- Provides a nutritionally compact and easily prepared meal replacement or energy supplement
- Provides a variety of vitamins and minerals
- Need to be used according to directions to ensure that energy and nutrient composition are adequate for achieving specific nutritional goals
- Check product information on whether the product is lactose free

Situations for Use in Sports

- Situations requiring high energy or nutrient requirements that cannot be met by the daily diet
  - Athletes aiming to increase lean body mass or body weight
  - Athletes coping with heavy training loads and have difficulty eating enough food
  - Young athletes undergoing growth spurts
  - Athletes suffering from appetite suppression
- Replacement of normal food intake to supply energy and nutrient needs while reducing gastrointestinal contents and body mass
  - Useful as pre-event meal for athletes with high risk of gastrointestinal problems during competition; however, it is recommended that the athlete is familiar with using this product before the competition
  - Useful as a low bulk meal for “making weight” or reducing body mass prior to competition
- Portable, non-perishable and easily prepared meal or snack
  - Useful for travel to countries with inadequate or hard-to-access food supply, or where food hygiene may be a concern

Concerns Associated with Supplement Use

- Over-consumption leads to unwanted weight gain
- Over-dilution may produce a drink that does not achieve the energy and nutrient profile needed for a specific dietary goal. Over-concentration may lead to gastrointestinal upset
- A lactose free product should be chosen where an athlete is lactose intolerant
- May replace other important food sources when it is over-consumed
  - Remember: food should always be considered as the first option for meals and snacks

Sports Drinks

Example: Pocari Sweat, SIS Go Electrolytes, High Five Energy Source, Gatorade, Lucozade Sport

Overview

- Composition: 6 – 8% carbohydrate with electrolytes (e.g. sodium and potassium)
- Carbohydrate source is usually glucose, maltodextrin and fructose
- Absorption is comparable to plain water
- Usually comes in a variety of flavors, and in powder or liquid form
- All sports drinks contain electrolytes which replace those lost in sweat during exercise, and also assist with thirst drive and fluid retention

Situations for Use in Sports

- Ideal fluid for hydration before, during and after exercise, allowing the athletes to replace fluid, electrolytes and carbohydrate all at once
- Suitable for exercise more than 90 minutes or exercise in high intensity or hot environments for more than 60 minutes
- For exercise more than 2.5 hours, it is better to use a mixture of glucose and fructose
- Useful for athletes after weigh-in providing an easily digestible carbohydrate for energy and fluid replacement

Concerns Associated with Supplement Use

- Over-consumption leads to unwanted weight gain
- Powdered sports drinks should be mixed properly to ensure that fluid content and concentration are appropriate
- Drinks should be kept cool (10 – 15°C) to promote palatability and encourage intake
- Practising fluid intake strategies in training helps to overcome problems such as dislike of taste, or gastrointestinal discomfort associated with the use of sports drinks

Sports Bars/Energy Bars

Example: Powerbar Natural Energy Cereal Bar, Powerbar Protein Plus, High Five Energy Bar, Nutrition X Pro X Protein Bars, SunRype Bonk Breaker

Overview

- Good source of energy, carbohydrate and protein
- Generally low in fat and fortified with vitamins and minerals
- Energy bars are a more concentrated form of carbohydrate than sports drinks and provide more energy

Situations for Use in Sports

- Good source of energy and carbohydrate before and during exercise such as Powerbar Natural Energy Cereal Bar, Bonk Breaker or SunRype
  - Satisfies the feeling of hunger during prolonged exercise such as road cycling
  - Use between events or games in multi-event competition for recovery such as fencing, swimming, track cycling, and rugby sevens
- Post-exercise recovery supplement
  - Choose protein rich sports bars such as Powerbar Protein Plus, Bonk Breaker Protein, Nutrition X Pro X Protein bar after resistance training or high intensity training
- Compact and low fibre
  - Useful in making weight strategies – low residue snack
  - Useful as part of a pre-event meal for athletes at high risk of gastrointestinal problems during exercise
- Convenient, portable and non-perishable
  - Useful for athletes with busy schedules
  - Useful for travel to countries with inadequate or hard-to-access food supply, or where food hygiene may be a concern
  - As breakfast for early morning events such as triathlon, rowing, and swimming

Concerns Associated with Supplement Use

- Over-consumption may lead to unwanted weight gain
- Different products have different taste and texture; it is better to use during training to assess tolerance
- Some sports bars are soft and sticky under hot environment
- Some sports bars may contain allergens such as tree nuts and gluten therefore may need to be avoided by athletes who have allergies to these items

Sports Gels

Example: Power Gel, High Five Energy Gel,
SIS Go Isotonic Gel, Gu Gel, Hammer Gel

Overview

- Highly concentrated sources of carbohydrate (65 – 70%) in a gel form
- Sports gels are substantially more concentrated in carbohydrate than sports drinks to provide an energy boost in a single serve
- All sports gels contain electrolytes which replace those lost in sweat during exercise and also assist with thirst drive and fluid retention
- The types and quantity of carbohydrate provided in gels vary between products. Some sports gels contain multiple forms of carbohydrates such as a mixture of fructose and glucose which can increase carbohydrate uptake during exercise

Situations for Use in Sports

- Compact source of carbohydrate
  - Endurance athletes during exercise lasting more than 90 minutes such as road cycling triathlon, marathon. For an athlete who participates in ultra-endurance events for more than 2.5 hours, choosing a sports gel providing multiple form of carbohydrates can provide additional performance benefits
  - High intensity exercise ~1 hour without the need to intake large volumes of sports drink
  - Team sports during extended training or competition such as rugby sevens and soccer

- A low fibre and compact carbohydrate source for pre-event fueling for athletes who are unable to tolerate regular foods and fluids

Concerns Associated with Supplement Use

- Over-consumption leads to unwanted weight gain
- Different sports gels have different flavours, consistency, types and amount of carbohydrates. They may also have additional ingredients such as caffeine. Athletes are advised to practise the use of gels and assess tolerance during training if they wish to use during competition
- Gastrointestinal upset may occur due to the concentrated carbohydrate load; therefore, gels should always be consumed with adequate fluid to prevent gastrointestinal intolerance and to meet hydration needs
- Some sports gels contain caffeine. Athletes who are sensitive to caffeine should choose the non-caffeinated sports gels

Sports Confectionery

Example: Powerbar PowerGel Shots, Bonk Breaker Energy Chews, High Five Energy Gummies

Overview

- Highly concentrated sources of carbohydrate in a chewy jelly bean/jube form
- Provides an alternative or additional source of carbohydrate to sports drinks, sports bars and sports gels
- Provided in pouches to enable easy transport and consumption while undertaking exercise
- Includes electrolytes and other "active ingredients" such as caffeine

Situations for Use in Sports

- Suitable for the same situations of use as a sports gel; however they offer more flexibility with the timing of intake
- Endurance athletes during exercise lasting more than 90 minutes such as road cycling, triathlon and marathon
- High intensity exercise lasting ~1 hour without the need to take in large volumes of sports drinks
- Team sports during extended training or competition such as rugby sevens and soccer
- Over 1 hour skill-oriented sports such as billiard and archery
- A low fibre and compact carbohydrate source for pre-event fueling by athletes who are unable to tolerate regular foods and fluids

Concerns Associated with Supplement Use

- A small number of athletes will suffer from gastrointestinal issues. They should be consumed with adequate fluid to meet hydration needs and to improve gastrointestinal tolerance
- Some products contain caffeine. Athletes who are sensitive to caffeine should avoid caffeinated products
- Expensive alternatives to general jelly, regular food or gels
- Beware of athletes' over-consumption or over reliance

Protein Supplements

Example: Muscle Milk Whey Protein, SIS Advanced Isolate+ Protein Powder, SIS Overnight Protein, Nutrition X Nighttime Protein, Nutrition X Big Whey

Overview

- Protein plays crucial roles in the body such as muscle repair, enzyme and hormone formation, immunity and energy production
- Protein is found in foods such as meat, poultry, fish, dairy, eggs, nuts, tofu and legumes, and also in some sports drinks and sports bars
- Common commercial products provide 20 – 50g of protein in a single serve
- Protein supplements can be classified as whey and casein
  - Whey is rapidly digested and rich in branched chain amino acids especially leucine. Whey protein is better used after exercise
  - Casein is slowly digested and it is better used before sleep
- Research suggests that consuming 25 – 30g of protein after exercise can promote muscle protein synthesis
- Research suggests that 2 – 3g of leucine maximally stimulates muscle protein synthesis. It is better to choose a protein supplement which contains 2 – 3g of leucine per serving
- Vegan athletes can use soy protein supplements
- Some protein supplements also have additional ergogenic ingredients such as creatine and β-alanine. It is better to check the nutrition label before use

Situations for Use in Sports

- Useful for travel to countries with inadequate or hard-to-access food supply, or where food hygiene may be a concern
- Athletes undergoing hypertrophy training to gain lean body mass
- Can be used as a post-exercise recovery drink following key training sessions where adaptation requiring protein synthesis is desired

Concerns Associated with Supplement Use

- Over-consumption leads to unwanted weight gain
- Excessive intake of a protein supplement (>30g per serving) will not have additional benefit on muscle protein synthesis
- Excessive intake of protein supplement may lead to high blood urea level

Recovery Drinks

Example: SIS Rego Recovery, High Five Drink with Protein, Endurox R4, Tailwind Rebuild

Overview

- Rich in carbohydrate and electrolytes, moderate protein and low fat
- Provides athletes with a combination of carbohydrate and protein designed to meet recovery needs and also replace fluid and electrolytes during exercise

Situations for Use in Sports

- Athletes who have two sessions of training or competition in one day. They can take one serving within 30 – 45 minutes after training or competition
- Athletes who have poor appetite after training

Concerns Associated with Supplement Use

- Over-consumption leads to unwanted weight gain
- Powdered recovery drinks should be mixed properly to ensure that fluid and nutrient goals are met
- Some recovery drinks are rich in protein (~20g per serving) and are more suitable for use after high intensity or weight training sessions

Vitamin D

Example: Healthspan Elite Vitamin D3

Overview

- Vitamin D is essential for the absorption of calcium from the gut and for optimising bone health
- Emerging evidence suggests that vitamin D is also important in immune and inflammatory modulation and muscle function
- The main source of vitamin D is sunlight rather than diet
- Good food sources of vitamin D include oily fish such as salmon, mackerel, mushrooms, fortified products such as dairy products, orange juice and breakfast cereals

Protocol of Use

- There is no standardised dose of vitamin D supplement
- General recommendation is 2000 – 4000IU per day depending on vitamin D level and level of sunlight exposure

Situations for Use in Sports

- Athletes with low vitamin D levels

Concerns Associated with Supplement Use

- When taking vitamin D supplement, it is better to have regular blood tests to check vitamin D levels
- During supplementation, it is better to have moderate and safe sun exposure and include vitamin D containing foods
- Athletes should consult sports dietitians or nutritionists before use

Multivitamin / Mineral Supplements

Example: Centrum

Overview

- Vitamins and minerals are crucial for a variety of activities in the body such as energy production, blood formation, bone formation and maintaining immune function
- Most vitamins and minerals can be obtained from a varied and balanced diet
- Inadequate intake of vitamins and minerals may impair exercise performance

Protocol of Use

- There is no standardised dose of multivitamin / mineral supplements

Situations for Use in Sports

- Athletes who begin a new period of high volume and/or high intensity training
- Athletes who restrict their total energy intake or lack variety in their diet
- Athletes traveling overseas with inadequate or hard-to-access food supply, or where food hygiene may be a concern

Concerns Associated with Supplement Use

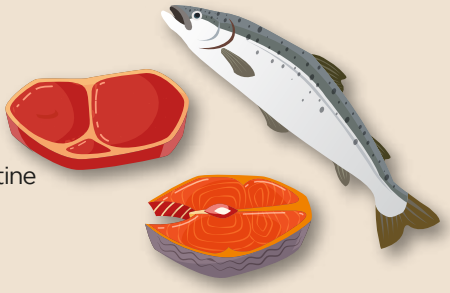
- Supplementation of multivitamins and multiminerals has not been proven to enhance exercise performance unless there is pre-existing deficiency
- Multivitamin and multimineral supplements only help to complement the nutrient deficit from main meal and they should not be used as a substitute for a balance diet
- Athletes should consult sports dietitians or nutritionists before use

Ergogenic Aids

Ergogenic aids are substances, foods, or training methods that enhance energy production or recovery and provide athletes with a competitive advantage. There are many nutritional supplements in the market that claim to enhance exercise performance.

Creatine

Example: Cytosport Monster Creatine, Muscle Pharm Creatine, SIS Creatine



Overview

- Creatine is a naturally occurring compound present mostly in muscle
- Creatine can either be obtained from food such as salmon, tuna, beef and pork or be synthesised in the human body
- Strict vegetarians or vegans have negligible creatine intake
- Studies have shown that ingesting a creatine supplement could increase creatine stores thus increasing the rate of phosphocreatine resynthesis, thereby enhancing short-term and high intensity exercise

Protocol of Use

- Rapid load: 5g, 4 times per day for 5 – 7 days
- Slow load: 3 – 5g per day for 28 days
- Maintenance dose (after rapid/slow load): 3 – 5g per day
- Creatine uptake can be enhanced by concurrent consumption with a mixed carbohydrate source

Situations for Use in Sports

- Athletes who undertake resistance training programs to increase lean muscle mass
- Athletes who participate in sports with repeated brief, high intensity efforts with short recovery periods such as throwers and sprinters
- Athletes who participate in sports with intermittent work patterns such as rugby sevens and racquet sports

Concerns Associated with Supplement Use

- No negative health effects are noted with long-term use (up to 4 years)
- Creatine loading may cause weight gain (1 – 2 kg) due to fluid retention
- Excessive creatine loading protocols do not enhance exercise performance
- People with a predisposing liver and kidney problem should avoid taking a creatine supplement
- Anecdotal reports of muscle cramps, strains and tears but little evidence to substantiate an increased risk of these events

β-alanine

Example: Powerbar Beta Alanine, SIS Beta Alanine

Overview

- β-alanine is an amino acid that is naturally made by the body but also found in animal products, especially in chicken breast meat and fish
- β-alanine is important in the production of a protein called carnosine which can buffer (neutralise) acid by-products produced during high intensity exercise. This can result in increased time to fatigue and potentially increase training capacity and performance

Protocol of Use

- Total daily ingestion of 3.2 – 6.4g per day over a range of 4 – 10 weeks
- Commercial tablet/capsule dose is between 0.8 – 1.6g
- It is better to split the daily dose over two doses (e.g. morning and evening)

Situations for Use in Sports

- Short (1 – 7 minutes) sustained high intensity sports such as rowing, track cycling, 100 – 200m swimming and middle distance running
- Sports that involve repeated high intensity efforts of exercise such as resistance training, sports rugby sevens and racquet sports
- Sports that involve high intensity efforts at the end of prolonged exercise which victory is often decided in a final sprint such as road cycling and distance running

Concerns Associated with Supplement Use

- Some athletes report skin tingling (paraesthesia) but this seems to be reduced with slow release preparations or split dosing strategies

Caffeine

Example: Power Gel (Caffeine), High Five Gels (Caffeine)
SiS Go Energy + Caffeine

Overview

- Caffeine is a naturally occurring stimulant found in leaves, nuts and seeds
- Athletes consume caffeine regularly over the day in varying amounts from coffee, tea, cola, energy drinks and caffeinated sports products
- Caffeine is becoming increasingly popular in sports to help improve performance
- The main performance benefits of caffeine appear to come from its influence on the central nervous system resulting in reduced perception of effort (exercise "feels" easier) and/or reduced perception of fatigue
- Previous beliefs that caffeine increases fat use during exercise and spares glycogen are now considered unlikely to be the main pathway of performance enhancement

Protocol of Use

- 1 – 3mg/kg body weight taken before and during exercise
- There is no evidence of a dose-response relationship to caffeine (more is NOT better)
- Some studies show that there are a variety of protocols of caffeine intake that can enhance performance. These include consumption before the exercise, spread throughout the exercise, or late in exercise as fatigue is beginning to occur

Situations for Use in Sports

- Caffeine provides enhancement of performance in:
  - Endurance sports (>60 minutes)
  - Brief sustained high intensity sports (20 – 60 minutes)
  - High intensity and short duration exercise (1 – 5 minutes)
  - Stop and go events such as rugby sevens and racquet sports
- The effect of caffeine is unclear in:
  - Skill sports involving low intensity exercise such as billiard and archery
  - Single efforts involving strength or power such as lifts and throw

Concerns Associated with Supplement Use

- Although caffeine is a diuretic, American College of Sports Medicine (ACSM) stated that a small dose (<180mg/day) is not likely to increase daily urine output or cause dehydration
- The effects of caffeine vary between individuals. Each athlete should try in their daily training to assess tolerance
- At high intakes, caffeine may cause
  - Increases in heart rate
  - Tremor
  - Over-arousal (interfering with recovery and sleeping pattern)
  - Anxiety
  - Restlessness
  - Irritability
  - Gastrointestinal distress
  - Headache

Nitrate/Beetroot Juice

Example: Beet-it-Sport

Overview

- Nitrate (NO_3^-) is found in our diets and also produced within our body
- The main dietary sources of nitrate are vegetables such as beetroot, beetroot juice, spinach and celery
- Dietary nitrate is converted in the mouth and stomach to nitric oxide (NO). Nitric oxide plays many roles to enhance exercise performance via enhanced function of type II muscle fibres; a reduced energy cost of muscle force production; an increased efficiency of mitochondrial respiration; and an increased blood flow to the muscle
- Increase dietary nitrate intake can increase nitric oxide production

Protocol of Use

- Effective dose is 6 – 8 mmol of nitrate which is about 500ml natural beetroot juice or 70ml concentrated form
- This should be ingested 2 – 3 hours before exercise
- Recent studies showed that chronic ingestion (up to 15 days) has shown more effective than a single acute dose

Situations for Use in Sports

- Nitrate supplementation appears to be ergogenic in continuous submaximal activity of 5 – 25 minutes duration
- Effects on long-term endurance exercise performance has not been established
- Supplementation may also be of assistance as training support, especially during periods of exposure to hypoxic conditions such as altitude training

Concerns Associated with Supplement Use

- Mild gut discomfort in some athletes (particularly in concentrated form and larger doses)
- Pink coloured urine and stool, although this is a harmless side effect

Probiotics

Overview

- Probiotic supplements that contain live microorganisms which when administered in adequate amounts can confer a health benefit on the host
- Probiotics can be obtained from foods such as cheese, yoghurt, miso and kimchi
- Many studies have stated that probiotics can reduce the risk of upper respiratory tract infections (URTI)

Protocol of Use

- There is no standardised dose of probiotic supplements
- Take a daily dose of probiotic containing at least ~10^{10} (10 billion) live bacteria
- Probiotics need to be taken for several weeks before positive health effects can be expected

Situations for Use in Sports

- Athletes with a prior history of gastrointestinal problems during periods of heavy training or around the time of competition might benefit from a course of probiotics
- Useful for travel to countries where food hygiene may be a concern
- For preventive reason, an individual needs to commence daily supplementation ~14 days before travel, competition, or elevated training load to allow for colonisation of bacteria in the gut

Concerns Associated with Supplement Use

- Some athletes report mild symptoms of stomach rumbles, increased gas or changes in the stool, during the first week of supplementation
- Some of the probiotic products need to be kept in the fridge after they have been opened. Athletes should check the label before use

Avoid Using Nutritional Supplements Contaminated with Banned Substances

It is well known that supplements can be contaminated with doping substances and athletes using the contaminated supplements can result in positive doping tests. The available data show that 15% of tested supplements contained banned substance to cause a positive result. None of these products had any identification on the label that they contained banned substance. Unfortunately, under the World Anti-Doping Code, ignorance is not an excuse. Athletes are responsible for checking the status of all medication and supplements they use. Therefore, it is recommended that athletes should only use supplements which have been tested for prohibited substance by an independent company such as Informed Sport, Informed Choice, NSF, Trusted Sport, or HASTA. Supplements screened by these companies cannot offer a 100% guarantee that an athlete will not test positive, but they are significantly less risky than other supplements.

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Conclusion

Nutritional supplements and ergogenic aids may aid athletes in meeting their nutritional and/or performance needs in various situations. They may help athletes to achieve energy requirement for weight gain, maintain energy levels during exercise or replenish energy loss quickly after exercise. However, athletes need to consider the risk of contamination in the products and weigh the benefits and concerns before use. In addition, nutritional supplements cannot replace a healthful diet. Athletes should always strive to achieve sound eating habits as a foundation to achieving nutritional needs.

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