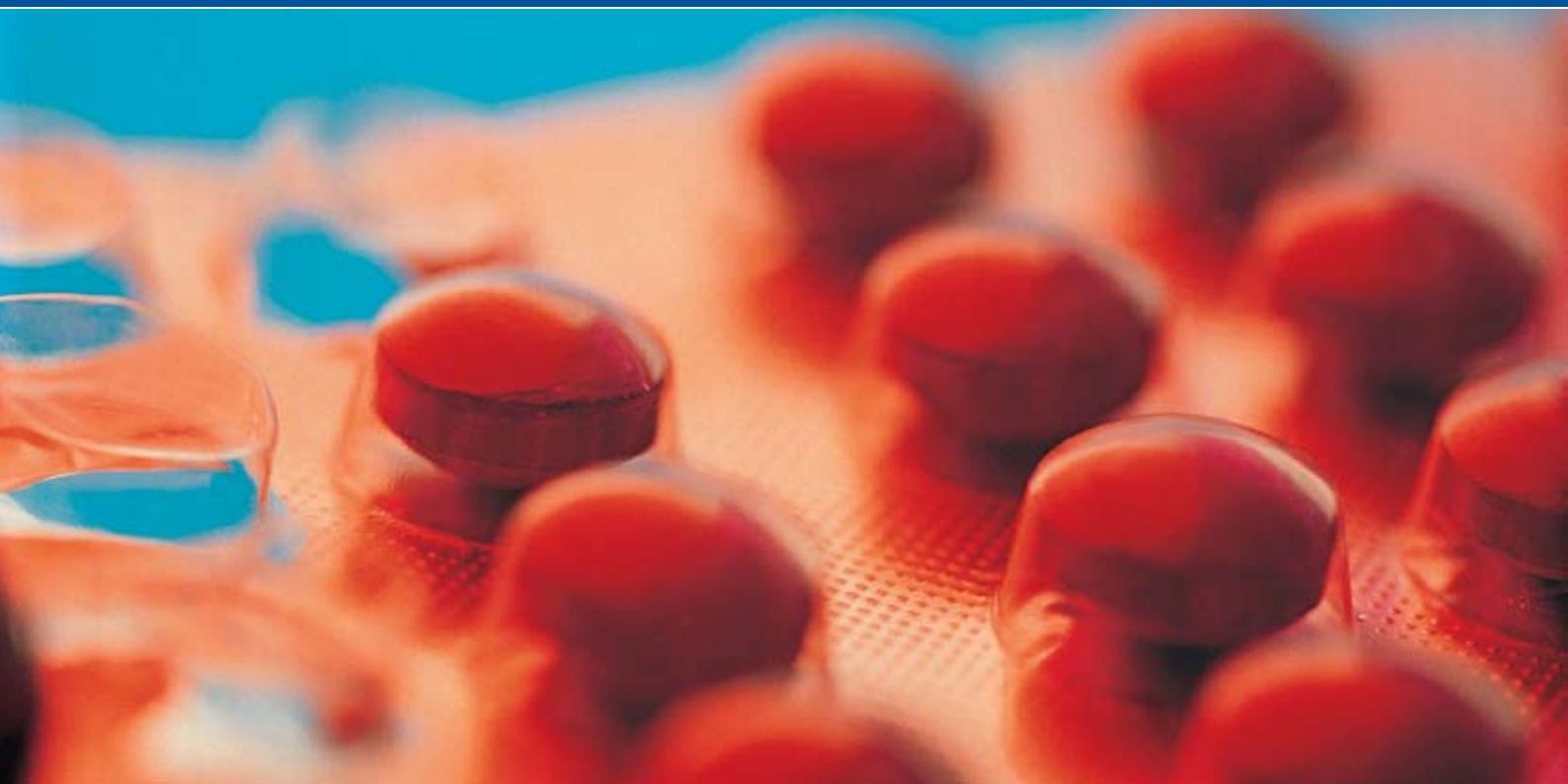


## ▶ SPORTS SUPPLEMENTS AND THE ASSOCIATED RISKS





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## ➤ Abstract

UK Sport recognises that athletes looking to maximise performance are in a very difficult position when it comes to supplements:

- **First there is an array of supplement products available on the market. Athletes have to distinguish between, on the one hand, the supplement products that can produce verifiable benefits not available from eating ordinary foods, and, on the other hand, the supplement products whose claimed benefits are unverified and speculative.**
- **Second, even once the group of efficacious and worthwhile supplements has been identified, elite athletes have to confront the undeniable and ever-present risk that products containing such supplements may also contain (on a contaminated and therefore undisclosed basis) substances that are banned from use in sport under the World Anti-Doping Code. The strict liability system used in that Code means that a positive test caused by a contaminated supplement will always lead to disqualification of all tainted results, irrespective of an athlete's lack of knowledge that he/she was ingesting a prohibited substance. In addition, unless an athlete can show that s/he used "utmost caution" to avoid such contamination, s/he is also likely to be banned from future participation in the sport for a significant period. On the current state of the case-law, the only sure way to demonstrate such "utmost caution" is not to take any supplement products at all.**

UK Sport has joined with the IOC, WADA and other anti-doping authorities in emphasising the risks attendant on the use of supplements by athletes. It has confirmed that the only way to avoid the risk is not to use supplements at all. However, it recognises that in the real world some athletes may feel that they have to consider the pros and cons of taking supplements, notwithstanding such risk. For that reason, UK Sport has produced this resource, which does the following:

In short, UK Sport has produced this resource to help athletes who are considering using supplement products to make a truly informed choice, based on a true assessment of the benefits of using such products against the disadvantages of using such products, including the unavoidable risk of being found to have committed a doping offence and potentially banned from the sport for a lengthy period if the product turns out to have been contaminated.

*Remember strict liability means that you are solely responsible for any prohibited substance in your system*

The area of supplements in sport is of great frustration for athletes, governing bodies, international federations and National Anti-Doping Organisations (NADOs) alike. World Anti Doping Association (WADA) have disseminated the view point of **strict liability** and regularly infer that supplements should not be taken by elite athletes.

This document is the first step in looking to put systems and processes in place for athletes, governing bodies, coaches and sports personnel to obtain information about assessing efficacious supplements and how to reduce the risk of consuming supplements that may contain substances that will give rise to a positive drugs test.

*Warning – athletes that use supplements may be at risk of a positive drugs test*

THIS DOCUMENT MAY BE SUBJECT TO CHANGE AND THE MOST RECENT VERSION WILL BE AVAILABLE AT [www.100percentme.co.uk](http://www.100percentme.co.uk)

UK SPORT WOULD LIKE TO THANK ALL THOSE WHO CONTRIBUTED TO THE DEVELOPMENT OF THIS GUIDE.

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## ➤ Background

Since the spate of Nandrolone findings in 1999, contaminated supplements have often been blamed for an adverse analytical finding, with athletes claiming that they were not aware of the potential for supplements to contain prohibited substances that were not disclosed on the product label. The inception of the World Anti-Doping Code and the implications of *strict liability* now mean that an athlete is held responsible for testing positive as a result of using a supplement even if they claim not to have been aware of the associated risks of contamination.

There is a great demand for supplements and a huge industry has developed to meet and encourage this demand. There are a few supplements that can provide benefits for high performance athletes. Even if a particular substance has been demonstrated to be effective, there is little regulation of supplement manufacturing processes to protect the elite athlete. Many commercially sold supplements may not contain the amount of the substance that is claimed and/or may contain ingredients that are not listed on the packaging, some of which may be dangerous or banned.

### *Are supplement advertising campaigns sensationalised?*

It is well known through reputable studies that many supplements have been found, whether inadvertently or through poor manufacturing and/or inaccurate labelling of products to contain unlabelled prohibited substances. In particular, in 2004, the results of an extensive research project were published, funded by the International Olympic Committee (IOC), using the then IOC accredited laboratory in Cologne to independently analyse a number of nutritional supplements. Of the 634 supplement products tested, 94 (15%) contained anabolic agents of one type or another which were not declared on the label. 16% of the 94 supplement products that were contaminated showed concentrations of anabolic agents at concentrations of 10 micrograms per gram or higher. These levels that are considerably greater than those required to give rise to a positive drug test.

As a result of such findings, UK Sport, the British Olympic Association, the British Paralympic Association, the IOC and the World Anti-Doping Agency were amongst the many sports authorities around the world to publish statements warning athletes about the risk of using supplements while competing in high performance sport. In addition, registered nutritionists and accredited sports dieticians argued that most athletes can obtain sufficient amounts of vitamins, minerals and other essential nutrients through their diet if energy intake is sufficient and an adequate variety of foods are consumed. Most importantly, the efficacy of many supplements is questionable and at present, supplements can be sold in the UK without prior demonstration of their efficacy or safety, resulting in athletes and support personnel becoming the target of marketing campaigns based on exaggerated and/or misleading claims rather than documented benefits.

Even in light of this information the fact remains that *some* supplements do have a place in high performance sport for *some* athletes, and the reality is that the majority of elite athletes believe that they need supplements to maintain their health and succeed in sport. This was indicated in a survey undertaken by UK Sport in 2005 where 60% of total respondents (n = 528) indicated that they used supplements.

**This document is split into three sections that are clearly addressing two different aspects of supplements in sport.**

- Part one explains how the anti-doping rules apply in the event of inadvertent consumption of a prohibited substance as part of a contaminated supplement product, as well as the difficulties in ruling out the possibility of such contamination, so that athletes can fully understand the ever-present legal risks involved in using any supplement products.
- Parts two and three identifies a group of substances (a) whose consumption has been proven to support athletic performance; and (b) that cannot always be derived from an ordinary healthy diet and therefore can to be consumed by means of supplements. It provides information about the advantages and disadvantages involved in the taking of such substances, so that athletes can make informed decisions about whether the advantages outweigh the disadvantages including the risk of undisclosed contamination by a prohibited substance.



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## ➤ Part 1 : Risk Assessment of Supplements

### The Realities of Supplements

Whenever highly talented, motivated and well trained athletes gather for elite competition, the margin between victory and defeat is small. Attention to detail can make that vital difference and an athlete's diet will affect both performance and health.

The reality is that many athletes do not eat a varied diet and/or their lifestyle/training may not allow sufficient time to be able to ingest sufficient food to meet energy needs. Therefore, there are times when nutritional supplements may be appropriate and useful during training, competition and recovery. For example, an athlete who suffers from iron deficiency anaemia will need to take an iron supplement to treat the anaemia and meet their physiological requirements.

Nevertheless, despite the clear and undeniable risks of doing so, nutritional supplements, including vitamins, minerals, herbal preparations and ergogenic aids are widely used by elite athletes in an attempt to maintain their health and improve their performance.

### Contamination of Sports Supplements

#### Is my Supplement safe?

#### *Caution: The WADA banned list is not definitive*

Athletes would like the sports authorities to find an analytical test that could **guarantee** that a particular supplement is **free** from any substances that could give rise to a positive test. This is not possible for the following reasons:

- A** The WADA Prohibited List is not definitive. By necessity the list does not specify every single substance that is prohibited, but instead identifies Classes of Prohibited Substances, such as anabolic agents and related substances and Prohibited Methods only. As a result, when analysing a supplement product for contaminants the Prohibited List is unable to act as a checklist of *all* prohibited substances with which to analyse against and an analysis cannot always guard against contamination using untried, untested and unknown designer drugs.
- B** Many analytical techniques applied for the analysis of a supplement product have a finite limit of detection below which the technique will not be effective. This means that the presence of a prohibited substance in a supplement product below these detectable levels may still result in a positive drugs test when ingested by an athlete.
- C** The sampling process for supplement testing is inherently inadequate for elite level sport as there will always be a large part of the product that is not analysed and it may be this part of the sample that contains the contaminant. This is particularly relevant for solid products such as powders, capsules, tablets and bars where the mixing of raw materials is likely to be variable; meaning that the contaminant may not be spread throughout the whole product. One might anticipate more effective mixing in the case of liquids, which means that the sample analysed would be more representative of what would be found in the whole product but even here no test can be definitive.

#### What are the Limits of Detection?

The relevant limits of detection for analysis at the manufacturing stage are smaller than those conventionally addressed by current quality control procedures in the supplements industry. In general, the relevant levels for detection used in anti-doping analysis are measured in **parts per billion** (i.e. 1 nanogram per gram); whereas the supplement manufacturing industry would generally use parts per **million** for detection of contaminants. This means that a urine or blood test is more likely to detect the presence of a prohibited substance than when a supplement is tested during the manufacturing process.

#### *What does "tested for prohibited substances" mean?*

The concentration levels expressed in terms of a standard unit (i.e. a gram in this case) are not as relevant as is the total intake of a supplement within a daily dose; which may vary from a few grams to perhaps over 100 grams depending on the product. For example, an athlete would consume a greater volume of the supplement taking one serving of creatine (2g-20g/day) than they would in taking one vitamin tablet (1/day). The more one takes, the higher the risk in having traces of a prohibited contaminant in your system. UK Sport believes there is scope to more clearly differentiate between an ergogenic aid and a health maintenance product. This is indicated in research conducted by UK Sport in 2005 where the majority of athletes (72%) were reported to be taking health maintenance supplements (e.g. Vitamin tablets) whilst a smaller number of athletes (28%) were opting for ergogenic aids. The majority of contamination was found to be in ergogenic aids (e.g. Protein powders, protein recovery drinks, fat loss products).

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The limits to analytical detection have profound implications on quality assurance programmes, demanding sensitivities in quality control processes that meet these exacting limits of detection by a WADA Accredited Laboratory. It is highly unusual for the manufacturing facilities used by supplement companies to have the capability to undertake such trace analysis, they concentrate instead on the verification of label listings of specified contents. In most cases, supplement manufacturers would be testing their products for other contaminants, such as toxic substances that may be harmful to the general population (e.g. faeces, glass) and not necessarily for those substances that may give rise to a positive drug test for a drug tested athlete.

Because of inadequate testing capabilities for high performance sport, supplement manufacturers aiming to provide quality assured products to elite level athletes are required to out-source the testing of raw ingredients and finished products as part of a quality control programme. To achieve the best possible quality assurance this testing would need to be done by a laboratory capable of testing in parts per billion and would need to be coupled with the highest quality manufacturing processes. With these two measures in place, it is possible for a manufacturer to **limit** the risk of contamination.

## *Contamination can occur from several sources*

### What case studies demonstrate the risk of contamination?

The following real-life case studies are useful in highlighting the potential risk of contaminated supplement products:

#### DEHYDROEPIANDROSTERONE (DHEA)

DHEA is a steroid and explicitly banned by WADA for use by elite athletes. It is freely available over the internet and over the counter in the USA.

News reports have called DHEA “the mother of all hormones.” A new book calls it a “superhormone” and it is billed as the “fountain of youth hormone.”

Advertising claims include:

- > **Increased life expectancy**
- > **Cancer prevention**
- > **Prevention of heart disease**
- > **Alleviate the effects of Alzheimer’s**
- > **Combat AIDS**

In one case, HFL tested 14 samples of different products made by the same manufacturer, each one “blind” (i.e. with no product identification), and drawn from a range of powders and liquids. **One of the products was supposed to contain DHEA; the others, all mainstream sports supplement products, were not. However, evidence of DHEA contamination was found in every one of the 14 samples, including one that was a tap water sample from the manufacturer’s men’s rest room.** This is a case of inadvertent contamination, and indicates the potential for cross-contamination between manufacturing lines within the same facility.

Prohibited by WADA, DHEA should not be present within the product range of supplements taken by an elite athlete. As part of the risk management process, athletes may decide not to use supplements from a supplement manufacturer that also produces pro-hormone supplements because the risks of inadvertent contamination are greater. In these situations products are particularly prone to cross-contamination and if a manufacturer is producing DHEA or other pro-hormone products, they should be completely isolated within the manufacturing process; ideally in a different building to avoid contamination.

#### RAW INGREDIENTS

The source of contamination could come from any stage of the production process. However it is noted that some suppliers of the associated raw materials from which a product is manufactured commonly do not implement the quality assurance programmes that would provide the required level of confidence in the final product. Therefore it is essential that all stages of the production process are assessed when addressing contamination of supplements.

#### CAPSULE CONTAMINATION

An encapsulated supplement tested positive for DHEA despite the contents of the capsule having been previously tested negative when analysed for prohibited substances. Upon further investigation, it became clear that the third party manufacturer of the supplement had recently purchased a second hand reconditioned encapsulation machine. This machine had been used 3 years earlier by the previous owner to manufacture DHEA products. Analysis of dust from the filter unit demonstrated traces of DHEA. In this scenario it was the machine and therefore the capsule that had been the source of the contamination. This further highlights how only low levels of contamination are needed to generate a positive finding.

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## MANUFACTURING CONTROL

Effective testing of a product and its raw materials can ensure a final product of higher quality. One supplier of sports supplements approached HFL with a product range to be tested. More than 30% of the products tested positive for substances prohibited according to the WADA regulations. The manufacturing process, as provided by a third party was analysed, and it was found that the quality control procedures were inadequate, not only in terms of the control of raw materials, but also the management of cross contamination within the manufacturing plant (i.e. where the same plant manufactures “clean” supplement products and products that contained substances banned by WADA). Unless the equipment is scrupulously cleaned between manufacturing runs, and batches are tested using the appropriate limits of detection, it is almost inevitable that the latter product range will cross-contaminate the former.

The supplements company that approached HFL did indeed use a range of testing technologies within a quality control programme, primarily targeted at the verification of the labelling. However, these measures were inadequate for elite athletes. What this highlighted was that the **mere existence** of quality control procedures is not the answer. These must be **appropriate to the requirements of athletes subject to drug testing**.

Third party manufacturers are common within the supplements industry and following discussions between the supplement company and the third party manufacturer in question, a long-standing partnership was eventually terminated. Selection of a new manufacturer followed, and the positive findings for contamination dropped to a negligible level.

As a direct result of working with HFL, supplement companies have been successful in identifying and then addressing sources of contamination from their product.

### Athlete examples

**ADAM DEAN:** *This young 17 year rugby star was achieving the highest honours at his age groups in rugby, receiving international caps at the under 18 age group. Following the pressures of being told he needed to be “bigger, faster and stronger”, Adam began the use of supplements to complement his training and diet. Although aware of having to adhere to the rules of the Prohibited List, the education Adam had received had not made him fully aware of the risk of potential contamination of supplements and he decided to make his decision based on his own research. Adam chose a supplement that did not have any prohibited substances on the product label, a product that also made claims of being “suitable for drug tested athletes.” Assuming that the information provided by the manufacturer was accurate and substantiated, Adam began to take supplements as part of his training regimen. Adam tested positive for 19-Norandrosterone and the only explanation Adam could comprehend was that the positive test was attributable to the supplements that he was taking. Adam was banned for 2 years from competitive rugby.*

**HANS KNAUSS:** *Hans Knauss, an elite-level skier, knew of the risks of contamination of supplements and therefore sought assurances from his supplier (“Ultimate Nutrition”) that the supplements he was being supplied (“super complete capsules”), which did not mention any prohibited substance in the list of ingredients, were not contaminated with any substance prohibited by WADA. His supplier gave him a written guarantee to that effect. When he subsequently tested positive for norandrosterone, he had the supplements tested and they were found to be the source of his positive result. The tribunal rejected Mr Knauss’s plea of No Fault or Negligence, noting that WADA and other sports federations had repeatedly warned of the risks of taking supplements, and therefore Knauss knew or should have known of the risks and therefore could not be said to be free of fault or negligence. The tribunal accepted that he had taken significant steps to protect against the risk of contamination, but noted that he could have taken further steps, including (ultimately) avoiding the risk altogether by simply not taking the supplements. As a result, it held that, although he could establish No Significant Fault or Negligence, triggering a discretion to reduce his ban to as little as 12 months, in fact his degree of fault justified a reduction of only six months, so he was banned from the sport for a total of 18 months.*

*Other high profile athletes who believe their supplements to be the source of their positive drug test include Mark Richardson, Dougie Walker, Jaap Stam, Edgar Davids and Ryan Hudson.*



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**NANDROLONE**

In 1999 a number of positive Nandrolone findings were attributed to the contamination of supplements that the athletes were using at the time. Although the findings in the table below do not indicate findings solely as a result of supplements, it highlights how this issue came to light.

**TABLE 1: Data from UK Sports Drug Testing on UK and Non UK competitors**

Year	Number of Positive Nandrolone Findings
1999	17
1998	4
1997	4
1996	3
1995	5
1994	1
1993	5
1992	1
1991	6
1990	2



**So What Can Athletes Do?**

**Are there alternatives?**

Supplements are often used as a replacement for food sources to provide the nutrients needed to fuel the body. In the vast majority of cases the optimum nutritional intake can be achieved through eating and drinking the correct amount of food and fluids at the appropriate time for training and competition. It may be that these food alternatives can also be consumed in a manner that is convenient and integrates well within an athlete's training programme. Further independent advice regarding food alternatives can be found at [www.performancefood.co.uk](http://www.performancefood.co.uk)

*Have you sought a food alternative?*

**How best can an athlete assess the risk?**

If, following expert nutritional advice and having explored alternative avenues, an athlete and their support personnel believe that a supplement is the most appropriate nutritional source for their needs then there should be careful assessment behind the choices made. The information provided in this document aims to help athletes understand the key issues so they can make more informed choices about the use of supplements in sport.

*What are the risks?*

If an athlete chooses to overlook the current advice given by the World Anti-Doping Agency, i.e. to nullify the risk of supplements by not taking them, then they must take a sensible and responsible approach to managing their diet by undertaking a risk/benefit analysis with regards to supplement use. Whilst the risk of using a contaminated supplement will never be eliminated, it may be possible for athletes to take steps to reduce that risk as much as possible, knowing at all times that the presence of a prohibited substance in their system, however it got there, will lead to a possible anti-doping rule violation.

The only way to be absolutely sure that supplements do not contain even trace amounts of any prohibited substance is to ensure that:

- A** No prohibited substance can be introduced as a by-product of any part of the manufacturing process
- AND
- B** The product (including its raw ingredients) is physically separate from potential sources of contamination at all stages of manufacture, processing, packaging and distribution.

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## *Caution must be taken when considering all dietary supplements*

Athletes must make informed choices while remaining mindful of the World Anti-Doping Code rule of Strict Liability that means they are solely responsible for any Prohibited Substance found in their system. In making an informed choice athletes must ensure they have the necessary information to undertake a proper risk/benefit analysis.

1. **Assess Efficacy:** Is there valid evidence that the supplement really works? Is it needed if the athlete already has a well-balanced diet? Are the advertising claims substantiated?
2. **Assess Quality Assurance:** Has the product been manufactured, packaged and distributed in such a way that will minimise the risk of a contaminated product reaching an athlete?
3. **Avoid** purchasing supplements from a manufacturer who also produces supplements that contain banned substances.
4. **Understand** the reason *why* some supplements could contain prohibited substances as contaminants.
5. **Understand what** supplement testing for prohibited substances is.
6. **Seek Expert Guidance** to assess your dietary and performance needs and supplement requirements.

Assessing all these points and the advice given throughout Part 1 will help athletes to understand the risks associated with using supplements.

## *Do you know what you're buying and from who?*

### Does the Manufacturer provide Quality Assurance, Quality Control and Certification Programmes?

Quality Assurance refers specifically to the collection of processes that assure that the quality of a product meets the defined expectations. In the context of sports supplements, it involves a combination of management processes, policies on the sourcing of raw materials, the definition of manufacturing processes and the associated checks, as well as the capability of the technical testing requirements throughout the process. Implementation of any testing process within a quality assurance programme is part of Quality Control.

In order to minimise the risk of contamination of supplements, a supplement provider should consider having a quality assurance programme with at least the following elements:

- a) A policy on sourcing of raw materials, with defined expectations on the quality assurance of those materials applied by the suppliers;
- b) Defined manufacturing practices that assess the risks of various sources of contamination (including raw materials), and then define the measures that will minimise those risks;
- c) A definition of the sampling and sensitivity requirements of any testing of materials within the process – from raw materials through to the finished product.
- d) Secure (independent) storage of samples on a batch to batch basis, permitting re-analysis in the event of a positive finding (taking account of any new doping agents that emerge later than the original analysis).

A quality assurance programme may also include involvement in an established and recognised independent product certification programme, which would set standards for the above approach to quality assurance. At a meeting on Sports Supplements convened by WADA in Leipzig in September 2005, the trade was encouraged to introduce its own certification programme for self-regulation. Although a positive step forward, self regulation is not a complete answer, is open to abuse and has no independent verification. In an effort to progress this further, UK Sport have developed this advice for athletes and will continue to work in a harmonised manner to tackle the issue of potential contamination of supplements in sport.

In addition, HFL has recently developed a web-based portal for the sporting community that provides access to information about nutritional supplements tested by their supplement testing scheme, further enabling athletes to make educated choices [www.hfl.co.uk](http://www.hfl.co.uk)

**UK Sport does not guarantee that products meeting the requirements above are free of Prohibited Substances or beneficial to health or performance; but that in meeting these requirements a manufacturer aims to comply with good manufacturing practice and is doing as much as possible to reduce the risk of contamination.**

## *Your choice; your consequences*

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## ➤ Part 2 : Nutrition in Sport

**THIS SECTION PROVIDES SOME VALUABLE BACKGROUND TO NUTRITION IN SPORT. MORE DETAILED NUTRITION GUIDES AND RESOURCES HAVE BEEN PRODUCED PREVIOUSLY BY THE INTERNATIONAL OLYMPIC COMMITTEE AND ARE AVAILABLE ON UK SPORT'S 100% ME WEBSITE**

**[www.100percentme.co.uk](http://www.100percentme.co.uk)**

**WE RECOMMEND THAT THIS IS REFERRED TO FOR FURTHER NUTRITIONAL GUIDANCE**

Following an assessment of the risks involved with choosing to take supplements it is essential that an athlete is aware of the nutritional factors that will affect their performance and those supplements that may actually prove beneficial. The selection of supplements below are those agreed upon by a panel of experts in physiology and nutrition to have well documented evidence as to their efficacy and safety. There are other supplements available that at this stage UK Sport does not feel have sufficient evidence for their inclusion within this document. However, the risk assessments as highlighted in Part One should be applied to all supplements.

### Sports Nutrition

The primary adaptations to training come from the specifics of the regimen itself and an athlete's diet should be constructed to support training needs by providing appropriate amounts of the necessary nutrients at the right times. Nutrition plays a vital role in the periods before, during and after competition. The best food choices may not make a champion out of an athlete with inferior talent, but an inadequate diet can certainly prevent a talented athlete from reaching optimal training and performance levels. In general, choosing a variety of foods in amounts that will support the energy demands of training will provide the nutrients necessary for optimal training.

Many athletes do not eat a varied diet and/or may not be able to ingest sufficient food to meet energy needs. Therefore, there are times when sports supplements may be appropriate and useful during training and competition. For example, there are increased calcium requirements of an amenorrhoeic athlete.

As an area that has been extensively researched in the past, nutritional position statements have been released by a number of bodies including the International Olympic Committee (Appendix 1).

'These statements reflect the current consensus of a number of leading experts within the academic community and the world of sport. All athletes should know that they must complement their training with a well balanced diet. If we can combine this information with the ongoing efforts of UK Sport with regard to supplements, then I believe that the UK's athletes will be well equipped to make informed choices around supplements,' Professor Ron Maughan, Loughborough University.

### Health and Nutrition for Athletes

UK Sport wishes to provide practical and consistent expert advice on dietary supplements for sportsmen and women in the UK.

UK Sport has identified those supplements from which athletes may gain performance benefits, as identified by a panel of nutrition experts. This information has been developed as part of UK Sport's commitment to the ongoing support and management of athlete health, well being and performance.

This section provides some basic information about sports nutrition and Part 3 more specifically addresses information on supplements that have been shown through validated scientific research to be beneficial for athletes. The information below outlines compounds that have been shown to improve cognitive and physical performance in humans and will also discuss dietary practices that should enable an athlete to maintain optimal training workloads, as well as providing the necessary nutrients on a day-to-day basis. Specific nutrients that may be ingested as supplements will be discussed in the context of their use, in particular in situations immediately prior to, during, and after exercise. **The discussion will not include all supplements that maybe used by athletes but will be limited to those for which there is sufficient evidence to acknowledge the benefits.**

The composition of the foods that an athlete chooses is extremely important for athletic success. Each athlete should be aware of their nutritional goals and should choose foods accordingly in order to meet those nutritional needs.

There are three primary energy containing nutrients found in food; carbohydrate, protein and fat. It is necessary to consume appropriate amounts of each of these nutrients to provide the energy that is needed to support training. It is also important to vary the sources of these to ensure that other essential nutrients that are found in different foods are consumed.

Carbohydrate, protein and fat have additional characteristics that may influence adaptation to training and therefore contribute to competitive success. Additionally, fluid intake is another important nutritional consideration to maintain hydration status and finally, an adequate intake of vitamins and minerals must be ensured. Eating a varied diet to meet energy requirements will generally be the best strategy to ensure that nutrient intake is appropriate to support training, and will also provide the best conditions for training and performance.

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## Energy

The daily energy intake of an athlete contributes to body energy stores, as well as providing for immediate energy needs. Ideally, over the long term, energy intake should match energy demands during training. However, matching energy intake to expenditure may not be possible over shorter time periods or even desired when an athlete may be attempting to gain or lose weight. Too little energy intake over a lengthy time period may lead to nutrient deficiencies and impaired physiological and metabolic function and will likely interfere with the ability to train properly, thus leading to a decrease in performance. Eating too much may impair performance by increasing body fat and body weight.

There are situations during training when an individual athlete may want to alter energy intake to reach a specific goal. For example, an athlete may desire fat and/or weight loss, or increased muscle mass. Large reductions in body fat are best avoided during competitive seasons and should probably be restricted to off-season training.

## Carbohydrate

The importance of carbohydrate to support training and performance in competition has long been recognised. Carbohydrate foods include sugars and starches, which are broken down to form glucose. Glucose is the body's main source of energy during exercise, especially during intense exercise.

The main form of carbohydrate stored in the body is glycogen, which is found primarily in skeletal muscle and the liver. Muscle glycogen acts as a local fuel for the muscle during exercise, whereas liver glycogen is broken down to glucose and released to maintain glucose levels in the blood.

Athletes should include sufficient carbohydrate in their daily food consumption to support training demands. During training, carbohydrate stores, i.e. muscle and liver glycogen, are used as fuel by the muscles and these stores must be refilled from carbohydrate in the diet because the body's carbohydrate stores are small in relation to the daily requirements of an athlete. It is possible to make general recommendations about carbohydrate intake based on an athlete's size and training regimen. However, actual carbohydrate requirements are specific to each individual athlete and should therefore be adjusted according to individual training levels, as well as total energy intake.

If the training programme is of moderate duration and relatively low intensity, carbohydrate intake should be about 5-7g per kg body weight each day. Moderate to heavy endurance training requires higher carbohydrate intakes of about 7-12g per kg per day. Athletes undertaking extreme training regimens (generally considered 4-6+ hours per day) probably need about 10-12g per kg body weight per day. Total energy intake and the necessary intake of the other energy nutrients should be taken into account when determining the amount of carbohydrates to consume.

Optimising the stores of carbohydrate prior to a competition may provide advantages for the athlete competing in intense and/or prolonged events. The rate of glycogen resynthesis is greatest immediately following exercise. Thus, the athlete should try to ingest carbohydrates as soon after exercise as is practicable especially when the recovery time is short (less than 8 hours). If recovery time is less than 8 hours it is advisable to ingest a larger portion of carbohydrates that have a high glycaemic index (GI), however, in general, low/intermediate glycaemic index foods can also be used to replenish glycogen stores. GI refers to the blood sugar level in response to carbohydrate ingestion. The higher the GI of carbohydrate, the greater the increase in blood sugar after ingestion. High GI foods include sports drinks, potatoes, white/brown bread, easy cook rice, pasta, low fibre cereals, etc. It is important to note that the GI refers to the response when carbohydrates are ingested alone, and the overall response of blood sugar to an ingested carbohydrate is affected by the other components of a meal.

To maximise glycogen stores for a competition an athlete should eat a high carbohydrate diet and taper training to maximise the store of glycogen in the muscles. Maximal muscle glycogen stores will enable the athlete to maintain high intensity exercise as long as possible. It should be noted that glycogen storage is associated with storage of water, resulting in increased body weight that may not be desirable for some athletes.

## Fat

The past couple of decades have seen fats in the diet gain a bad reputation. However, fat is an important dietary component, particularly for an athlete. Dietary fats provide energy as well as essential fatty acids and fat-soluble vitamins (vitamins A, D, E, and K). Dietary fat comes in three forms:

- **Saturated Fat – found mostly in foods of animal origin**
- **Polyunsaturated fats – found in vegetable oils**
- **Monounsaturated fat – found in olive oils, avocados and nuts**

Carbohydrate is the main energy source used during exercise, but fat is also an important fuel for exercise. The body's fat stores are very large in comparison to carbohydrate stores. There are ample stores of fat in even the leanest athlete to provide energy for very prolonged periods, so it is not necessary to make a special attempt to increase fat stores by dietary measures. Endurance training leads to increased storage of fat within the muscle and an increased ability to use the body's fat stores. The best method to optimise the use of fat for exercise is through proper training.

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For athletes, fat intake generally should not be so high as to limit the amount of carbohydrate or protein that can be ingested and should maintain energy balance. High fat intake may, but won't necessarily, lead to excessive energy intake, as well as increased health risks. However, if carbohydrate and protein needs are met and energy intake is at the right level, dietary fat will not cause a great deal of harm for an athlete. It is generally advised to limit the amount of saturated fat in the diet, as it is associated with increased cholesterol levels and heart disease. Conversely, monounsaturated fats and possibly omega-3 fatty acids (found in large quantities in oily fish such as fresh tuna, salmon, mackerel, sardines, trout, herring and kippers, as well as nuts and seed oils) are associated with lower levels of heart disease and are a recommended part of an individual's diet refer to [www.food.gov.uk](http://www.food.gov.uk)

## Protein

Protein is a necessary component of the diet and has many roles in the body including:

- > **A structural component of muscles and other cells**
- > **Acts as a catalyst for biochemical reactions in the body**
- > **Serves as transporter molecules**

It can be used as a body fuel and its use for this purpose is increased during exercise however protein still does not provide a significant amount of energy for the body during exercise. Proteins have a key role in recovery for an athlete and are made of amino acids that are linked by chemical bonds. The exact composition and arrangement of the amino acids gives the form and function to the protein. In addition to serving as precursors for protein, amino acids also act as neurotransmitters and are used in the synthesis of DNA, RNA, and hormones.

A minimum amount of protein must be consumed to maintain body functions and even life. Good sources of protein include meat, fish, eggs and poultry, as well as milk and other dairy products. Some dairy products and some types of meat include a large amount of saturated fat along with the protein so low-fat choices are recommended. Many plant sources of proteins may be important as well, including legumes (peas and beans), nuts and soy products. Most foods, including vegetables and grain products will contribute to overall protein intake.

Athletes, coaches and many scientists believe that athletes need to consume more protein in their diet than the average person. Athletes must consume enough protein to meet training and competition demands, but in general it is not necessary to eat excessively large amounts of protein. It is a common notion that increasing protein intake will provide athletic advantage. This concept is especially common in athletes seeking to increase muscle size and strength. However, even at the highest estimates of protein requirements that have been determined by scientists, most athletes ingest enough protein in their diet to support their training and competition demands. On the other hand, some athletes, for example, those on limited energy intake, may need to pay special attention to ensure sufficient protein intake. If protein intake is too high, there may not be room in the diet for sufficient carbohydrates to support heavy training loads. At very high levels, usually thought to be above about 4g/kg body weight per day (for example, more than 280g per day for a 70kg athlete), protein intake may be harmful. It is rarely a problem for athletes to get sufficient protein from foods in their diet.

## Vitamins and Minerals

Vitamins and minerals are very important for the health and performance of athletes. Relative to carbohydrates, fats, and proteins, vitamins and minerals are needed in small amounts. Vitamins and minerals do not supply energy but are necessary to assist many biochemical processes throughout the body. Minerals also serve other functions in the body, such as structural parts of bone (calcium) and transporting oxygen (iron).

Adequate vitamin and mineral intake is crucial. As with the energy nutrients, the best way to ensure adequate vitamin and mineral intake is to consume a varied and wholesome diet. Most athletes can obtain sufficient amounts of vitamins and minerals in their diet if energy intake is sufficient and a variety of foods are consumed. However, if an athlete does not have a balanced nutrient intake or is in a phase of energy restriction, then supplementation with a multi-vitamin and mineral tablet on a daily basis may be desirable after making the appropriate risk assessment. Generally, large doses of particular vitamins and minerals are unnecessary and may lead to health or performance problems. Mega dosing on one vitamin or mineral can affect the absorption of another and is generally not recommended. There are situations in which targeted supplementation with a vitamin or mineral may be necessary. These situations should be identified by health professionals and/or nutrition experts and supplementation should be monitored.

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## Hydration

Water is an essential part of the athlete's diet. Mild dehydration is not harmful, but severe dehydration is harmful to both health and performance. Where high sweat losses are anticipated, athletes should begin exercise well hydrated by ensuring they drink plenty of fluids in the few hours beforehand. During exercise, where opportunities permit, athletes will benefit from drinking enough to prevent severe dehydration from developing. Sweat losses vary greatly between individuals and some athletes need to drink more than others. Sweat losses also vary with weather conditions, exercise intensity, exercise duration and fitness levels.

Athletes must take responsibility for assessing their own fluid needs, being cautious not to drink too much. Looking at urine colour is a good way to assess hydration. Before training or competition, the urine colour should not be too dark: if it is, drink more next time. During training or competition, the aim should be to drink enough to limit the weight loss to not more than about 1-2% of the initial body weight. In warmer weather, the loss should be at the lower end of this range (2-3%), but on cold days (when sweat losses may still be high) more dehydration can be tolerated without a loss of performance. There is NO situation where an athlete should need to drink so much that weight actually increases during the event.

To follow these guidelines, athletes should get into the habit of weighing themselves before and after training and adjusting their drinking schedule accordingly. After a while, this will no longer be necessary as a routine should be established.

**TABLE 2: Target hydration weight post exercise**

Pre-exercise weight	Target post-exercise weight range	
	Cold day	Hot day
50 kg	48.5-49 kg	49-49.5 kg
60 kg	58.2-58.8 kg	58.8-59.4 kg
70 kg	67.9-68.6 kg	68.6-69.3 kg
80 kg	77.6-78.4 kg	78.4-79.2 kg
90 kg	87.3-88.2 kg	88.2-89.1 kg
100 kg	97-98 kg	98-99 kg

As well as water, athletes need to replace the salts lost in sweat. For this reason sports drinks containing carbohydrate and salts (especially sodium) are generally more effective than plain water. If exercise is greater than 1hr carbohydrates will need to be replaced and salts will also need to be replaced if the exercise duration is greater than 2 hours. There is some evidence that "salty" sweaters may be at greater risk of muscle cramps and that this risk can be reduced by taking drinks with more salt.



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## ➤ Part 3 : Supporting Nutritional and Performance Requirements

**THIS SECTION IS DESIGNED TO PROVIDE INFORMATION AROUND SUPPLEMENTS THAT HAVE DEMONSTRATED EFFICACY IN SCIENTIFICALLY VALID STUDIES. THESE SUBSTANCES MAY PROVIDE SOME ATHLETES WITH PERFORMANCE BENEFITS HOWEVER IT IS ESSENTIAL THAT ANY ATHLETE WISHING TO TAKE ANY SUPPLEMENT SHOULD CONSULT WITH A REGISTERED NUTRITIONIST OR ACCREDITED SPORTS DIETICIAN. [www.senr.org.uk](http://www.senr.org.uk) WHO IS ABLE TO TAKE INTO ACCOUNT THEIR INDIVIDUAL NEEDS WITHIN THE FRAMEWORK OF THEIR CURRENT TRAINING SCHEDULE AND DIETRY INTAKE. THIS ASSESSMENT WILL IDENTIFY ANY REQUIREMENTS FOR USING A SUPPLEMENT. A THOROUGH RISK ASSESSMENT SHOULD BE UNDERTAKEN BEFORE THE DECISION TO USE SUPPLEMENTS IS MADE (SEE PART 1)**

### Caffeine

#### What is caffeine?

Caffeine is found in coffee, tea, some soft drinks, some over-the-counter cough/cold and pain-relieving medications and in some herbal/nutritional supplements. Some energy drinks also contain caffeine or guarana. Guarana is frequently found in herbal or nutritional supplements and is reported to contain up to 5% caffeine whereas other sources of caffeine, such as coffee, tea and chocolate, contain around 1-4% caffeine.

#### Why take caffeine?

Caffeine is the most commonly used drug in the world. Caffeine improves alertness and decision making (especially in complex tasks) and allows you to be less distracted and more focussed. Caffeine has been shown to improve endurance performance, and it may also have beneficial effects on strength and power. Large doses of caffeine can raise an athlete's metabolic rate, body temperature, blood pressure, and blood sugar and lipid levels. For this reason, caffeine is sometimes used to achieve weight loss in combination with reduced energy intake and aerobic training.

#### Why not take caffeine?

Caffeine is a stimulant drug but it is not currently banned, so athletes may consider using it in training or competition. Caffeine use is monitored by WADA and overuse could pose a risk to an athlete's health and performance. The response to caffeine and its effects on performance can vary from person to person. At high doses, caffeine can cause nausea, diarrhoea, insomnia, trembling, headaches, and nervousness. In addition, taking too much can increase anxiety and impair performance. It may also cause difficulties in falling asleep at night and this is a commonly reported problem among athletes using caffeine.

Athletes are often advised to avoid caffeine because it stimulates urine output leading to dehydration. This effect, however, is not seen at doses that improve athletic performance. There is evidence that sudden withdrawal from regular consumption of caffeine may produce side effects such as headaches in some individuals.

#### How to take caffeine?

Factors such as weight, body size, metabolic rate, hydration and what you have recently eaten will affect the level of caffeine in the body. Small amounts of caffeine (as little as 60mg/one cup of coffee) have been shown to have effects on decision making, alertness and reaction time. Amounts of 1-3mg/kg bodyweight have been shown to enhance endurance performance. Caffeine in coffee may be less effective than the same amount of caffeine taken in other forms. Higher doses of caffeine (more than 5mg/kg bodyweight) do not seem to have greater effects on performance than smaller dosages, so it is not worth the risk of unwanted effects. You should also be aware that the amount of caffeine in each product can vary (Table 4). Due to differences in individual responses to caffeine, athletes that choose to use caffeine are advised to experiment in training; beginning with low doses.

#### When to take caffeine?

It takes about one hour before caffeine reaches its maximum concentration in the blood. Therefore it is recommended to consume caffeine approximately one hour before an event. However, caffeine may have effects as soon as 5-10 minutes after ingestion.

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## Caffeine in products

Many foods and drinks contain small amounts of caffeine. An athlete should calculate the amount of caffeine they require and then choose appropriate products that can provide these requirements. Athletes should get in to the habit of checking the label for the product content regarding the ingredients and quantities of ingredients.

**TABLE 3: Caffeine dose calculator for different body weights**

Weight (Kg)	1mg/kg	2mg/kg	3mg/kg
40	40	80	120
45	45	90	135
50	50	100	150
55	55	110	165
60	60	120	180
65	65	130	195
70	70	140	210
75	75	150	225
80	80	160	240
85	85	170	255
90	90	180	270
95	95	190	285

**TABLE 4: Average caffeine content of some products**

Product	Average caffeine content per 200ml serving
Tea from tea bags	65mg
Tea from loose tea	20mg
Instant tea	37mg
Decaffeinated tea	<4mg
Instant coffee	58mg
Filter/percolated	104mg
Grande size starbucks	May contain 600mg caffeine
Decaffeinated	2mg
Chocolate drinks	1-8mg
Cola drinks – standard and sugar free	7-43mg
'Energy' drinks	58mg
Coca cola	32mg per 330ml can
Diet coke	43mg per 330ml can
Red bull	80mg per 250ml can
Pro plus	50mg per tablet (no more than 2 tablets per hour – as stated on instructions)

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## Carbohydrates

### What is carbohydrate?

Carbohydrate is the term given to a broad category of sugars and starches that are broken down to form glucose, which is the body's primary source of energy during exercise. Optimising carbohydrate storage and availability is vital to achieving training adaptations and performance goals. Carbohydrate is present in a variety of foods, and appropriate food choices should form part of any well planned training programme. Carbohydrate supplements, rather than foods can, however, be a very practical, effective and easy way of optimising carbohydrate availability before, during and after exercise, particularly in athletes involved in moderate to heavy endurance training programmes.

### Why take carbohydrate?

Carbohydrate is quantitatively the most important fuel during moderate to intense exercise, as it is the fuel of choice by muscle under these conditions. If the body's store of carbohydrate becomes depleted (after about 1-3 hours of continuous or discontinuous exercise), the rate of energy delivery from carbohydrate cannot be maintained, or compensated for, by increasing fat and protein use, and therefore work intensity declines (i.e. fatigue occurs).

Optimising liver and muscle glycogen storage over the days before competition can have a marked positive effect on performance and therefore it is vital that appropriate training and food choices are made during this period. Glycogen 'loading' of muscle is neither necessary, nor beneficial, to performance of submaximal exercise of shorter than 45 minutes duration, or to the performance of a single bout of maximal or supramaximal exercise.

As there is a continuous degradation of the liver and muscle glycogen stores during heavy, prolonged exercise, the ingestion of carbohydrate supplements immediately before and during exercise will help ensure carbohydrate availability is maintained. Furthermore, muscle and liver are better able to store carbohydrate after exercise, so supplements provide a mechanism to ensure that a large quantity of carbohydrate is delivered to these organs soon after exercise, thereby maximising the restoration of the body's carbohydrate store.

### Why not take carbohydrate?

Glycogen increases tissue water storage, resulting in an increase in body weight which may be undesirable to some athletes.

There are some situations where high dietary carbohydrate intake is difficult to achieve (e.g. diabetes and celiac disease or when daily energy expenditure is extremely high), but even under these conditions carbohydrate balance is achievable with appropriate consultation and good planning. It is in these situations where the use of carbohydrate supplements, rather than foods, can be very useful. Athletes should contact a registered nutritionist or accredited sports dietician to receive advice about maximising their carbohydrate intake.

### How to take carbohydrate supplements?

Carbohydrate supplements take the form of powders, gels and drinks that are palatable and easy to ingest. Most supplements come in the form of simple sugars, but powders also come in the form of glucose polymers that are less sweet and generally therefore allow a larger quantity of carbohydrate to be delivered in one serving. It is also important to understand when to take carbohydrate supplements (and the type to consume) when attempting to maximise carbohydrate availability and storage.

### When to take carbohydrate supplements?

The ingestion of a supplement containing about 1-4g/kg of carbohydrate 2-3 hours before prolonged exercise will ensure that liver glycogen levels are 'optimal' prior to exercise, and can improve performance. This carbohydrate can be in the form of food or a supplement containing simple sugars or a glucose polymer.

Drinking 30-60g per hour of a carbohydrate solution during exercise lasting longer than one hour will delay the development of fatigue by maintaining blood glucose delivery to muscle. Drinking a concentrated carbohydrate solution during exercise may be detrimental to performance. In addition to carbohydrate availability, fluid balance will influence exercise capacity during prolonged activity, and evidence is available to show that a weak carbohydrate and electrolyte solution (~2g of sodium per 100ml) will be most beneficial to exercise performance by promoting intestinal absorption of both carbohydrate and fluid.

During the initial 2-3hours of recovery from prolonged exercise, it is beneficial to ingest simple sugars (high GI) in a more concentrated form (10-20g per 100 ml), as this will maximise the rate of muscle and liver glycogen storage when the capacity of these tissues to transport and store glucose is highest. In this situation, the ingestion of 750-1500ml of a concentrated solution is desirable. If this is too sweet, using a glucose polymer solution may be more palatable and will still be effective. Lower GI foods may also be used for recovery and are particularly useful if athletes are trying to reduce their body fat levels as insulin levels are lower which allows mobilisation of fat stores.

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## Creatine

### What is creatine?

Creatine is a normal component of muscle and is found in the diet in meat and fish. The body needs about 0.3g/kg of creatine per day to replace the amount that is broken down and utilised in the energetics of muscle contraction. Vegetarians have little dietary creatine intake, but meat eaters typically get about 1g per day from the diet. The rest of what is needed is synthesised from amino acids supplied by the diet.

### Why take creatine?

Creatine phosphate is an important energy source in high intensity exercise and is especially important in rapid recovery between explosive bouts of exercise. There is evidence that using creatine supplements can increase the amount of creatine in the muscles above the levels that can be achieved by diet alone. This can improve performance in some strength and power events. It is also often, but not always, associated with a rapid gain in body weight of about 1-4kg, which may be an advantage in some events (e.g. throws) but may be a disadvantage in others (e.g. jumps). Creatine can promote glycogen storage when taken in combination with carbohydrate following endurance exercise: this may be helpful in maximising the rate and amount of muscle glycogen storage.

### Why not take creatine?

The acute weight gain is a problem for some athletes, but not everyone experiences this. Caution is advised, as with all dietary supplements, and athletes contemplating the use of creatine should discuss this with a registered nutritionist or accredited sports dietician. There is evidence of contamination of creatine with prohibited steroids, so risk assessment is needed and an informed choice made regarding the use of a reputable source (See Part 1). The use of creatine is not prohibited in sport. The legal status of creatine can vary from country to country; it is illegal to sell in France.

### How to take creatine?

The effective dose of creatine seems to be about 20g per day, taken in four separate doses of about 5g as a loading dose for 4-5 days followed by about 2-3 grams per day as a maintenance dose. This procedure can maintain high muscle creatine levels for 3-4 weeks, possibly longer. Equally, the same effect can be achieved by taking about 3-5g per day for 30 days. This protocol may have the advantage of avoiding sudden increases in weight. During the first 2-3 days of the loading phase most creatine is taken up by the muscles and therefore taking high doses of creatine for more than a few days will have no further benefit.

The accumulation of muscle creatine will be 30% greater when each 5g dose of creatine is ingested with at least 90g of glucose, which has the effect of raising blood insulin levels and promoting uptake by the muscles. Other studies have shown that 1g/kg glucose taken twice a day during the period of creatine supplementation will have an adequate effect. The glucose was taken 30 minutes after the ingestion of the 2nd and 4th creatine doses. Some athletes do not respond to creatine if it is taken without carbohydrate. *Creatine Serum' is ineffective and should not be used.*

*Creatine serum is ineffective and should not be used*

### When to take creatine?

It used to be thought that creatine provided a sudden boost in the few days before competition, but it is now recognised that if an athlete chooses to take creatine it is probably better to take this in training over the winter or spring. Faster recovery and higher quality training should give better adaptations to the training programme. It is probably not a good idea to take creatine continuously as muscle will become desensitised. A break of a few weeks every six weeks or so is advised. Endurance athletes and games players seeking to maximise muscle glycogen stores might consider using a combination of creatine and carbohydrate in the last few days before competition, or between events when these are close together. As with all new strategies, athletes should experiment in training or in minor competition before trying this at an important event.

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## Melatonin

### What is melatonin?

Melatonin is a hormone produced in the brain with peak levels reached during the middle of the night. Melatonin reduces body temperature and increases sleepiness, reinforcing sleep at night. Light suppresses melatonin production and so secretion of the hormone is inhibited during the daytime.

Synthetic melatonin promotes sleep if taken at times when levels of melatonin produced by the body are low. Melatonin also has effects on the timing of body rhythms. These rhythms are normally synchronised to the 24-hour day-night cycle, so that the peak and trough of a body rhythm, such as body temperature, occur at about the same time each day. If melatonin is taken in the late afternoon or early evening then the timing of body rhythms will be advanced so that the peak and trough of each rhythm occurs at an earlier time of day. This is because melatonin is being taken before the body begins to secrete its own melatonin in the late evening, and before body temperature reaches its minimum, which is usually between 4a.m. and 6a.m. If melatonin is taken in the morning after the body temperature has risen past its minimum, it delays the timing of the body's rhythms so that the peak and trough of each rhythm occurs at a later time of day. In the UK Melatonin is a prescribed drug only.

### Why take melatonin?

Melatonin may help to reduce the symptoms of travel fatigue and jet-lag by promoting sleep and speeding the adaptation of the athlete's body rhythms to a new time zone. As the body clock becomes synchronised with the local time cues, it will function more effectively during the daytime and the athletes' performance and alertness will return to the levels normally experienced in their home time zone.

### Why not take melatonin?

Melatonin causes sleepiness and impairs performance immediately after it has been taken and these effects may persist even after a period of sleep. If melatonin is taken at an inappropriate time in relation to your body clock, it may disturb your sleep pattern and could shift your body rhythms in the opposite direction to that desired.

Information on possible adverse effects of melatonin and interactions with other drugs or dietary supplements is lacking as studies to examine safety have not been carried out. Therefore, caution is required whenever using melatonin, especially if taking other medications or dietary supplements.

At doses of 10mg or less, the most frequent effect is sleepiness, with the following unwanted effects also being reported: headache, nightmares, diarrhoea, nausea, abdominal pain, and a change in blood pressure. However, melatonin has been available for sale over the counter in the US for several years. Melatonin has inhibitory effects on some aspects of the reproductive system at doses above 10mg, and so melatonin should not be taken if trying to conceive, or if pregnant or breast feeding. Melatonin is not suitable for individuals who have had or currently have any of the following:

- > **Migraines/severe headaches**
- > **Epilepsy/seizures**
- > **Depression**

Athletes should always consult a medical professional before using melatonin.

### Using Melatonin

Melatonin is available in capsules or tablets and is taken in doses of up to 5mg by mouth, with or without food. In the UK, melatonin is regarded as a medicine. You will need to consult with your doctor who can obtain it from a licensed manufacturer, provided it is considered suitable for you to use. In the US and via the internet, melatonin is sold in health food stores as a dietary supplement, but the safety, content and purity of these preparations cannot be guaranteed.

### When to take Melatonin?

After an eastward time zone change of at least five hours, a dose of up to 5mg melatonin taken at bedtime on the first four nights may assist in adaptation to the new time zone. In addition, some researchers believe that it may be useful to take melatonin between 6p.m. and 7p.m. on the day before the flight.

After a westward time zone change of at least six hours, a dose of up to 5mg melatonin taken at bedtime (provided this is no earlier than 11p.m.) on the first four nights may assist in adaptation to the new time zone. However, melatonin may be less effective in shifting body rhythms after westward than eastward travel.

Athletes should remember that melatonin is only one of the strategies to help cope with travel fatigue and jet lag. Seek additional expert advice for alternatives.

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## Protein and amino acids

### What are protein and amino acids?

Protein is an essential, energy-providing nutrient. There are many functions for protein in the body; it provides structure to all cells, including muscle; they act as catalysts for biochemical reactions; are transporters; provide an energy source; and, many other functions. Amino acids are the building blocks for protein. Each protein has its own unique amino acid composition that determines its shape and function. Amino acids are also components of other important compounds in the body, including neurotransmitters, hormones, and DNA.

Common protein supplements include whey protein, casein, egg protein, soy protein and even wheat proteins. Supplements may be made up of one or a combination of these types of proteins. Supplements also may be termed an isolate or a hydrolysate, e.g. whey protein isolate or whey protein hydrolysate. These terms refer to the way in which the protein has been processed. At this time, it is not possible to state if one type has advantages over another. Amino acids may be sold in free form as individual amino acids, such as glutamine, lysine, leucine, arginine, etc., or as combinations. Recently, amino acids have been sold as linked pairs or triples called di- and tri-peptides, respectively.

### Why take protein and amino acids?

Dietary protein helps build and repair muscle after training by stimulating protein synthesis. Protein supplements have never been shown to be superior to the protein found in regular foods; however, it may be more convenient for athletes to get their protein in a supplement form. At this time, the main reason to consume protein supplements is for convenience and quicker protein digestion.

### Why not take protein and amino acids?

There is no evidence to suggest that ingesting protein supplements is better than ingesting protein in the form of foods. Generally, protein and amino acid supplements are more expensive than protein contained in foods. Isolated protein and especially free amino acids do not taste good, at least without sufficient flavouring to mask the taste. It is possible for certain free amino acids to be toxic at high levels. Protein and amino acid supplements may not include other nutrients found in food sources of protein thus reliance on supplements could lead to deficiencies. Some protein supplements have been found to contain banned substances.

### How to take protein and amino acids?

Protein supplements may be desirable for reasons of convenience but only following a thorough risk assessment. Protein supplements may come in the form of solids, i.e. protein bars, or in powder form to be mixed with fluid and consumed in liquid form. Amino acids also come in powder form, but it is difficult to make them palatable. Amino acids can also be found in high protein bars.

### When to take protein and amino acids?

Protein is consumed with most meals. There is some evidence that taking as little as 10g of protein immediately before exercise may be advantageous. There is also evidence that ingesting a similar amount of protein within two hours of exercise is advantageous for muscle growth and repair. Ingesting protein, along with at least 30-50g of carbohydrate, following exercise also inhibits protein breakdown and increases replenishment of muscle carbohydrate stores that were lost during heavy exercise. Thus, consuming protein soon after exercise may help recovery of both muscle proteins and muscle carbohydrate stores.

**TABLE 5: The protein availability in bars, shakes, powders and foods and the associated costs**

Product	Protein Content (gms per product/serving)	Price (per product)	Average cost (per 30 gms Protein)
Protein recovery drinks (4 brands)	5.0 / 35.0 gms	£1.29 - £3.20	£3.48
Protein bars (9 brands)	13.0 / 34.0 gms	£1.19 - £3.08	£2.67
Protein shakes and meal replacement drinks (4 brands)	15.0 / 52.0 gms per pouch	£1.32 - £2.27	£1.49
Protein powders (9 products from 7 brands)	between 19.5 per 25 gms serving and 30.0 gms per 30 gm serving	£11.99 - £39.99	£1.17
Fresh milk (1 and ½ pints)	30 gms	£0.29 per pint	£0.39

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## Sodium Bicarbonate

### What is sodium bicarbonate?

Sodium bicarbonate is one of a number of buffers that can neutralise the acidity that results from lactic acid production during exercise. It is the major ingredient of most antacids that are used for the treatment of excess stomach acidity. Other buffers, including potassium bicarbonate and sodium citrate may also be effective but have been less well studied. Any chemist or supermarket will supply sodium bicarbonate.

**Note: Sodium carbonate (washing soda) is not a nutritional supplement and is poisonous.**

*Note: Sodium carbonate is soap powder and a health risk*

### Why take sodium bicarbonate?

In high intensity exercise lasting from a few seconds to a few minutes, an important part of the energy supply comes from the breakdown of carbohydrate without the muscles using oxygen. The major end product of this process is lactate, commonly referred to as lactic acid. The acidity arising from this process causes the characteristic pain in the muscles and is a major limitation to performance. Contrary to what most athletes believe, producing lactate is a positive sign. Without the lactate, there would be no pain, but also no speed or power. The body's natural buffers cope up to a point, but are overwhelmed when lactate levels are high leading to the athlete becoming fatigued. Ingesting sodium bicarbonate boosts the body's buffering capacity, allowing more lactate to be produced and removed before the acidity levels become so high that the muscles fatigue. This results in an increased ability for athletes to increase the duration of their power and strength task.

### Why not take sodium bicarbonate?

Some athletes experience gastrointestinal problems - wind, vomiting, diarrhoea - when taking sodium bicarbonate and give up after trying it only once. The taste of the sodium bicarbonate is also very unpleasant – not something you want shortly before competing.

### How to take sodium bicarbonate?

The effective dose of sodium bicarbonate is about 0.3g per kg body weight; ~ 18g for a 60kg athlete, or ~ 24g for an 80kg athlete. Women, who may be more susceptible to gastrointestinal problems than men and who may have a higher percentage of body fat, may want to consider a slightly smaller dose (0.25g/kg). To minimise the taste problems associated with sodium bicarbonate it can be recommended that it is taken in gelatine capsules. The gelatine dissolves in the stomach, releasing the sodium bicarbonate, and there is no taste. Each capsule holds about 1g, meaning an 80kg athlete would require 24 capsules. This might mean taking 4 or 5 capsules at 3 hours, 2½ hours, 2 hours, 1½ hours and 1 hour before an event. Lighter athletes will have fewer capsules to take. It is not important that each capsule contains exactly the same amount or that timings are exact because within the human metabolic system the desired effects will still be achieved. Each capsule should be swallowed with water as this helps dilute the bicarbonate in the intestine, again reducing the risk of gut problems.

### When to take sodium bicarbonate?

The best option is to take it in small doses over a period of a couple of hours, starting about three hours before race time and finishing about an hour before racing starts. These times and amounts are not fixed and some variation to take account of travel, warm-up times etc., will make no real difference.

If you choose to use sodium bicarbonate, this is something to experiment with in training, before use during competition, but it is not something to use on a regular basis. Please seek appropriate advice from a registered nutritionist or accredited sports dietician.

### Who should/ should not take sodium bicarbonate?

Sodium bicarbonate is likely to be beneficial only in events requiring maximum effort over a timescale lasting from about 30 seconds up to about 8-10 minutes. In practice this means track races at 400-3000m, rowing, some cycling events and some swimming events. There is not likely to be a benefit in events that are not predominantly anaerobic and power based.

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## Summary

Identifying that some supplements may contain contamination at levels that could generate an adverse analytical finding under WADA regulations, and recognising that many supplement companies have generally failed to install the appropriate quality assurance programmes to control this contamination, it is not surprising that the authorities recommend that elite athletes do not include supplements within their diet. A zero tolerance approach is invoked and responsibility will remain to be solely that of the elite athlete.

However it is clear that some supplements that are not prohibited in sport can have a beneficial impact upon elite performance and could provide assistance to an athlete as part of a carefully formed diet.

If an athlete **assesses the alternatives** and still wishes to take supplements against the warnings issued by WADA and other anti-doping organisations; then UK Sport in association with its key stakeholders provide **athletes with information in this document through which they can consciously manage the risks associated with taking supplements.**

As part of this commitment to providing responsible and reliable advice to the sporting community, UK Sport hosted the 2006 Supplements Symposium and Open Day at HFL in June and produced this document as the first step to further and better educate our British athletes about supplements in sport.

UK Sport will regularly review, research and consult on proven efficacy of supplements, continue to provide up to date information on the prohibited status of substances, and educate athletes on relevant anti-doping topics. Independently, HFL will offer testing services to manufacturers to quantify any levels of contamination in supplement products and provide a secure storage facility for tested batches of supplements. They will also provide an auditing service, purchasing products through standard retail channels (web, fitness gyms, stores) to identify if, through a random sampling of products, if any contaminants are identified. The associated information is published on a website [www.hfl.co.uk](http://www.hfl.co.uk), with links to the work of other doping control laboratories around the world in relation to the issue of supplements in sport.

The above information should provide the high performance sport community with information that may help to reduce the risks associated with taking supplements in elite level sport. In providing this information, this does not diminish the responsibility that the athlete has for any prohibited substance found in their system.

*No guarantee can be given about the safety of a supplement*

*“Athletes contemplating the use of supplements and sports foods should consider their efficacy, their cost, the risk to health and performance and the potential for a positive doping test.”*

IOC Statement

*Athletes are solely responsible for any prohibited substance found in their system so should be extremely cautious about which medications and supplements they use.*

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## Appendix

### IOC Position Statement

The amount, composition and timing of food intake can profoundly affect sports performance. Good nutritional practice will help athletes train hard, recover quickly and adapt more effectively with less risk of illness and injury. Athletes should adopt specific nutritional strategies before and during competition to help maximise their performance. Athletes will benefit from the guidance of a qualified sports nutrition professional who can provide advice on their individual energy and nutrition needs and also help them to develop sport-specific nutritional strategies for training, competition and recovery.

A diet that provides adequate energy from the consumption of a wide range of commonly available foods can meet the carbohydrate, protein, fat and micronutrient requirements of training and competition. The right diet will help athletes achieve an optimum body size and body composition to achieve greater success in their sport. When athletes restrict their food intake, they risk nutrient deficiency that will impair both their health and their performance.

Athletes should aim to achieve carbohydrate intakes that meet the fuel requirements of their training programmes and also adequately replace their carbohydrate stores during recovery between training sessions and competition. This can be achieved when athletes eat carbohydrate rich snacks and meals that also provide a good source of protein and other nutrients. A varied diet that meets energy needs will generally provide protein in excess of requirements. Muscle mass is maintained or increased at these protein intakes, and the timing of eating carbohydrate and protein may affect the training adaptation.

A high carbohydrate intake in the days before competition will help enhance performance, particularly when exercise lasts longer than about 60 minutes. Dehydration impairs performance in most events, and athletes should be well hydrated before exercise. Sufficient fluid should be consumed during exercise to limit dehydration to less than about 2% of body mass. During prolonged exercise the fluid should provide carbohydrate. Sodium should be included when sweat losses are high especially if exercise lasts more than about 2 hours. Athletes should not drink so much that they gain weight during exercise. During recovery from exercise, rehydration should include replacement of both water and salts lost in sweat.

Robust immunity and reduced risk of infection can be achieved by consuming a varied diet adequate in energy and micronutrients, ensuring adequate sleep and limiting other life stress. Attention to dietary intake of calcium and iron is important in athletes at risk of deficiency but use of large amounts of some micronutrients can be harmful. Female athletes with menstrual disorders should be promptly referred to a qualified specialist physician for diagnosis and treatment.

Athletes are cautioned against the indiscriminate use of dietary supplements. Supplements that provide essential nutrients may be of help where food intake is normally only a short term option. The use of supplements does not compensate for poor food choice and an inadequate diet. **Athletes contemplating the use of supplements and sports foods should consider their efficacy, their cost, the risk to health and performance and the potential for a positive doping test.**



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© UK Sport 2006. This Guide does not constitute legal advice, nor does UK Sport accept any liability for the consequences of an athlete taking any supplement product. An athlete who chooses to take a supplement product, notwithstanding UK Sport's clear advice that the only way to avoid the risk of contamination of supplements is not to take supplements, thereby assumes the risk that the supplement taken is contaminated with a supplement prohibited by WADA.

