

Creatine and doping in athletes

1. Creatine is a small molecule derived from an amino acid; it is synthesized by the liver and released into the blood stream.

2. Some of the creatine carried by the blood is transferred to the muscles, where it is transformed into phosphocreatine, a molecule with high energy potential which serves as 'fuel' during muscle contraction.

3. Oral creatine supplementation is intended to increase muscle mass, and improve recovery after physical effort. However, only a very low proportion of the creatine will penetrate effectively into the muscle and can be transformed into phosphocreatine. It has been noted that creatine supplementation has negligible effects on metabolism, and does not lead to any improvement in performance in trained athletes.

by Claude-Louis Gallien*

4. The risks of pathogenic side effects from creatine food supplements are real, but limited in so far as most of the creatine that is ingested does not go beyond the walls of the intestine and is excreted in stools. On the other hand, intravenous injection of creatine, which increases creatine levels in the blood considerably, may lead to serious nephropathies and metabolic imbalances which could even threaten the life of the subject.

5. The debate on the effectiveness of creatine in improving sports performance could be a smoke screen to hide real doping practices. The masking properties attributed to creatine in the context of anti-doping controls really do exist, but the prac-

tice cannot withstand serious examination and can easily be exposed. Products sold under the name of creatine are sometimes a mixture of doping substances (anabolic steroids in particular) in which creatine itself only plays an excipient role. These preparations can be used, consciously or not, by sportsmen, which could explain the outbreak of athletes testing positive for anabolic steroids since 1998.

Finally, the effects attributed to creatine could be optimized in the context of very complex physical preparation strategies, coupling very heavy training sessions with the use of various doping products. This formula has certain similarities with the 'stone soup' recipe, the creatine then being no more than a pretext for implementing a proven doping programme.

6. In the economic context of 'market sport', creatine can be seen as a productive source of profit, provided that the target consumers are not limited to a small number of elite athletes. The aim is rather to open the market as widely as possible to those who practise sport.

The development and the media coverage of the controversy surrounding the effects of creatine can be considered as excellent advertising support, given that the general public tends to go on the principle 'that there is no smoke without fire', and that whatever is good for elite athletes is also good for amateurs. The commercialization of preparations containing creatine, but supplemented with doping products might help give credibility to the 'effectiveness' of the product.

* Vice-president of the French NOC.

Nandrolone

The heads of the 27 IOC-accredited laboratories reaffirmed their earlier positions on nandrolone and unlicensed "nutritional supplements" during their meetings that took place from 21 to 25 February in Cologne. After extensive discussion, the laboratory heads released the following statement:

At the XVIII Manfred Donike Workshop held in Cologne, new research data on nandrolone, its precursors, and its metabolites were presented and discussed. These studies reconfirm the validity of the current levels used by IOC-

accredited laboratories, above which they will report on. Furthermore, several presenters gave examples of the problem of mislabelled nutritional supplements which continue to put athletes at risk of contravening the rules. We, therefore, repeat the statement we made last October: We strongly advise governmental authorities to take measures to prohibit the sale, manufacture, and importation of unlicensed preparations of nutritional supplements containing prohibited substances, whether labelled or not.

Olympic Movement Anti-Doping Code

In accordance with the provision made in Chapter, Article 4 of the Olympic Movement Anti-Doping Code, the list of prohibited classes of substances and prohibited methods has been updated on 1 April 2000.

I. PROHIBITED CLASSES OF SUBSTANCES

A. Stimulants

Prohibited substances in class (A) include the following examples:

amineptine, amiphenazole, amphetamines, bromantan, caffeine*, carphedon, cocaine, ephedrine, fencamfamin, meso-carb, pentetrazol, pipradrol, salbutamol***, salmeterol***, terbutaline***, ... and related substances.**

* For caffeine the definition of a positive is a concentration in urine greater than 12 micrograms per millilitre.

** For cathine, the definition of a positive is a concentration in urine greater than 5 micrograms per millilitre. For ephedrine and methylephedrine, the definition of a positive is a concentration in urine greater than 10 micrograms per millilitre. For phenylpropranolamine and pseudoephedrine, the definition of a positive is a concentration in urine greater than 25 micrograms per millilitre.

*** Permitted by inhaler only to prevent and/or treat asthma and exercise-induced asthma. Written notification of asthma and/or exercise-induced asthma by a respiratory or team physician is necessary to the relevant medical authority.

NOTE: All imidazole preparations are acceptable for topical use. Vasoconstrictors may be administered with local anaesthetic

agents. Topical preparations (e.g. nasal, ophthalmological, rectal) of adrenaline and phenylephrine are permitted.

B. Narcotics

Prohibited substances in class (B) include the following examples:

buprenorphine, dextromoramide, diamorphine (heroin), methadone, morphine, pentazocine, pethidine, ... and related substances.

NOTE: codeine, dextromethorphan, dextropropoxyphene, dihydrocodeine, diphenoxylate, ethylmorphine, pholcodine, propoxyphene and tramadol are permitted.

C. Anabolic agents

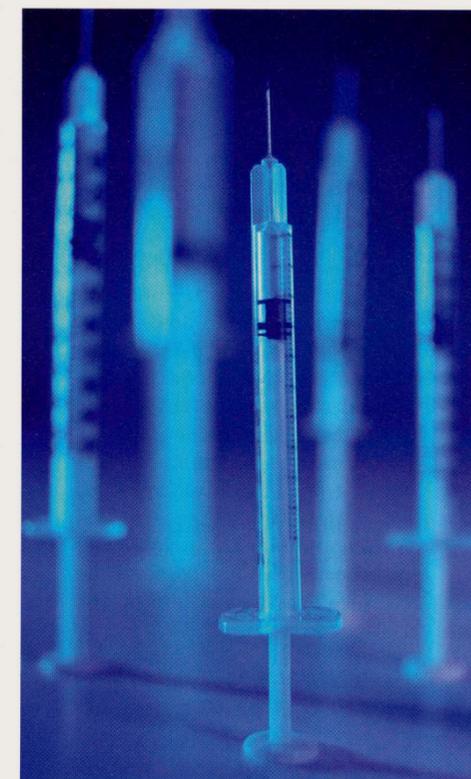
Prohibited substances in class (C) include the following examples:

1. **Anabolic androgenic steroids**
a. clostebol, fluoxymesterone, metandienone, metenolone, nandrolone, 19-norandrostenediol, 19-norandrostenedione, oxandrolone, stanozolol, ... and related substances.

b. androstenediol, androstenedione, dehydroepiandrosterone (DHEA), dihydrotestosterone, testosterone*, ... and related substances.

Evidence obtained from metabolic profiles and/or isotopic ratio measurements may be used to draw definitive conclusions.

* The presence of a testosterone (T) to epitestosterone (E) ratio greater than six (6) to one (1) in the urine of a competitor constitutes an offence unless there is evidence that this ratio is due to a physiological or pathological condition, e.g. low epitestosterone excretion, androgen producing tumour, enzyme deficiencies.



Doping

In the case of T/E greater than 6, it is mandatory that the relevant medical authority conducts an investigation before the sample is declared positive. A full report will be written and will include a review of previous tests, subsequent tests and any results of endocrine investigations. In the event that previous tests are not available, the athlete should be tested unannounced at least once per month for three months. The results of these investigations should be included in the report. Failure to cooperate in the investigations will result in declaring the sample positive.

2. Beta-2 agonists

bambuterol, clenbuterol, fenoterol, formoterol, reproterol, salbutamol*, salmeterol*, terbutaline*, ... and related substances.

*Authorized by inhalation as described in Article (I.A.).

For salbutamol the definition of a positive under the anabolic agent category is a concentration in urine greater than 1000 nanograms per millilitre.

D. Diuretics

Prohibited substances in class (D) include the following examples: **acetazolamide, bumetanide, chlortalidone, etacrynic acid, furosemide, hydrochlorothiazide, mannitol*, mersalyl, spironolactone, triamterene, ... and related substances.**

* Prohibited by intravenous injection.

E. Peptide hormones, mimetics and analogues

Prohibited substances in class (E) include the following examples and their analogues and mimetics:

1. **Chorionic Gonadotrophin (hCG)** prohibited in males only;
2. **Pituitary and synthetic gonadotrophins (LH)** prohibited in males only;
3. **Corticotrophins (ACTH, tetracosactide);**
4. **Growth hormone (hGH);**
5. **Insulin-like Growth Factor (IGF-1);** and all the respective releasing factors and their analogues;
6. **Erythropoietin (EPO);**
7. **Insulin;** permitted only to treat athletes with certified insulin-dependent diabetes. Written certification of insulin-dependent diabetes must be obtained from an endocrinologist or team physician.

The presence of an abnormal concentration of an endogenous hormone in class (E) or its diagnostic marker(s) in the urine of a competitor constitutes an offence unless it has been proven to be due to a physiological or pathological condition.

II. PROHIBITED METHODS

The following procedures are prohibited:

1. Blood doping;
2. Administering artificial oxygen carriers or plasma expanders;
3. Pharmacological, chemical and physical manipulation.

III. CLASSES OF PROHIBITED SUBSTANCES IN CERTAIN CIRCUMSTANCES

A. Alcohol

Where the rules of a responsible authority so provide, tests will be conducted for ethanol.

B. Cannabinoids

Where the rules of a responsible

authority so provide, tests will be conducted for cannabinoids (e.g. Marijuana, Hashish). At the Olympic Games, tests will be conducted for cannabinoids. A concentration in urine of 11-nor-delta 9-tetrahydrocannabinol-9-carboxylic acid (carboxy-THC) greater than 15 nanograms per millilitre constitutes doping.

C. Local anaesthetics

Injectable local anaesthetics are permitted under the following conditions:

- a) bupivacaine, lidocaine, mepivacaine, procaine, and related substances, can be used but not cocaine. Vasoconstrictor agents may be used in conjunction with local anaesthetics;
- b) only local or intra-articular injections may be administered;
- c) only when medically justified.

Where the rules of a responsible authority so provide, notification of administration may be necessary.

D. Glucocorticosteroids

The systemic use of glucocorticosteroids is prohibited when administered orally, rectally, or by intravenous or intramuscular injection.

E. Beta-blockers

Prohibited substances in class (E) include the following examples:

acebutolol, alprenolol, atenolol, labetalol, metoprolol, nadolol, oxprenolol, propranolol, sotalol, ... and related substances.

Where the rules of a responsible authority so provide, tests will be conducted for beta-blockers.

Doping

Summary of urinary concentrations above which IOC accredited laboratories must report findings for specific substances

caffeine	> 12 micrograms/millilitre
carboxy-THC	> 15 nanograms/millilitre
cathine	> 5 micrograms / millilitre
ephedrine	> 10 micrograms / millilitre
epitestosterone	> 200 nanograms / millilitre
methylephedrine	> 10 micrograms / millilitre
morphine	> 1 microgram / millilitre
19-norandrosterone	> 2 nanograms /millilitre in males
19-norandrosterone	> 5 nanograms/millilitre in females
phenylpropanolamine	> 25 micrograms / millilitre
pseudoephedrine	> 25 micrograms / millilitre
salbutamol (as stimulant)	>100 nanograms/millilitre
(as anabolic agent)	> 1000 nanograms/millilitre
T/E ratio	> 6

IV. OUT-OF-COMPETITION TESTING

Unless specifically requested by the responsible authority, out-of-competition testing is directed solely at prohibited substances in class I.C. (Anabolic Agents), I.D. (Diuretics), I.E. (Peptide Hormones, Mimetics and Analogues), and II (Prohibited Methods).

LIST OF EXAMPLES OF PROHIBITED SUBSTANCES

CAUTION: This is not an exhaustive list of prohibited substances. Many substances that do not appear on this list are considered prohibited under the term "and related substances".

Athletes must ensure that any medicine, supplement, over-the-counter preparation or any other substance they use does not contain any Prohibited Substance.

STIMULANTS:

amineptine, amfepramone, amiphenazole, amphetamine, bambuterol, bromantan, caffeine, carphedon, cathine, cocaine, cropropamide, crotethamide, ephedrine, etamivan, etilamphetamine, etilefrine, fencamfamin, fenetylline, fenfluramine, formoterol, heptaminol, mefenorex, mephentermine, mesocarb, methamphetamine, methoxyphenamine, methylenedioxyamphetamine, methylephedrine, methylphenidate, nikethamide, norfenfluramine, parahydroxyamphetamine, pemoline, pentetrazol, phendimetrazine, phentermine, phenylephrine, phenylpropanolamine, pholedrine, pipradrol, prolintane, propylhexedrine, pseudoephedrine, reproterol, salbutamol, salmeterol, selegiline, strychnine, terbutaline.

NARCOTICS:

buprenorphine, dextromoramide, diamorphine (heroin), hydrocodone, methadone, morphine, pentazocine, pethidine.

ANABOLIC AGENTS :

androstenediol, androstenedione, bambuterol, boldenone, clenbuterol, clostebol, danazol, dehydrochlormethyltestosterone, dehydroepiandrosterone (DHEA), dihydrotestosterone, drostanolone, fenoterol, fluoxymesterone, formebolone, formoterol, gestrinone, mesterolone, metandienone, metenolone, methandriol, methyltestosterone, mibolerone, nandrolone, 19-norandrostenediol, 19-norandrostenedione, norethandrolone, oxandrolone, oxymesterone, oxymetholone, reproterol, salbutamol, salmeterol, stanozolol, terbutaline, testosterone, trenbolone.

DIURETICS

acetazolamide, bendroflumethiazide, bumetanide, canrenone, chlortalidone, ethacrynic acid, furosemide, hydrochlorothiazide, indapamide, mannitol (by intravenous injection), mersalyl, spironolactone, triamterene.

MASKING AGENTS

bromantan, diuretics (see above), epitestosterone, probenecid.

PEPTIDE HORMONES, MIMETICS AND ANALOGUES

ACTH, erythropoietin (EPO), hCG*, hGH, insulin, LH*, clomiphene*, cyclofenil*, tamoxifen*.

* prohibited in males only

BETA BLOCKERS

acebutolol, alprenolol, atenolol, betaxolol, bisoprolol, bunolol, carteolol, celiprolol, esmolol, labetalol, levobunolol, metipranolol, metoprolol, nadolol, oxprenolol, pindolol, propranolol, sotalol, timolol.