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Nutritional Supplements – A Risk Assessment 
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Introduction
Several studies have demonstrated that there is a considerable risk that dietary supplements may contain not only what is declared on the label, but also substances prohibited by the International Olympic Committee/World Anti-Doping Agency. It remains unknown whether the reason is bad production control or intentional addition. The Norwegian Olympic Committee and Confederation of Sport has, in co-operation with Det Norske Veritas (DNV), prepared guidelines for attitude and advice connected to nutrition and use of dietary supplements, as well as a risk assessment for dietary supplements which is meant to be advisory for the athletes. Analytical findings at the Norwegian Doping Control Laboratory, Aker University Hospital, support the risk assessment, in agreement with previous results [1-6].

Guidelines for athletes
Elite athletes affiliated with Olympiatoppen, the organisation for olympic sports on a top level in Norway, are instructed to follow guidelines concerning the use of dietary supplements. The guidelines are summarized below:

Nutrition: An optimised diet promotes health and performance. Elite athletes undertake to optimise their diet and training methods before, and while, using dietary supplements, if any.

Competence: Knowledge of the connection between diet, health, restitution, performance is of vital importance.

Dietary Supplements: Dietary supplements must only be used after an individual assessment and medical examination.

Responsibility: All use of dietary supplements and the possible consumption of banned substances through dietary supplements are the responsibility of the athlete.

Marketing: Elite athletes are role-models for children and young people. All should be aware of the responsibility and not take part in distribution, sale and marketing of dietary supplements, unless approved by the federation.
Risk assessment
The purpose of the risk assessment is to provide athletes with information concerning
the risk that different types of dietary supplements may contain prohibited substances
and so help to reduce the risk of inadvertently consuming prohibited substances. A
summary of the risk assessment is presented in Table 1. The list is not exhaustive or
final. It will be reviewed continuously and changed if new information so dictates.

Analytical results
The Norwegian Doping Control Laboratory, Aker University Hospital, has
established an analytical method based on GC-MS for the analysis of nine different
pro-hormones in nutritional supplements. The procedure was carried out according to
Geyer et al [2]. Method parameters and validation parameters are presented in Table
2. A number of nutritional supplements were analysed. These supplements were
obtained from the Internet, mainly from “suspicious” producers, companies and
products that either previously were connected to a positive doping case for
norandrosterone, or from companies that offer prohibited substances on their web site.
The results are presented in Table 3. In 20 of 25 nutritional supplements different pro-
hormones were found, which were not declared on the label. The amounts ranged
from ten nanograms to several hundred micrograms per gram. Four of these
“positive” nutritional supplements were subjected to excretion studies, and two gave
rise to levels of norandrosterone above the reporting threshold.

Conclusion
The risk that nutritional supplements may contain substances prohibited by the
IOC/WADA depends strongly on the quality control during manufacturing. The risk
can be considerably reduced when the manufacturers (including the suppliers of raw
material) and distributors comply with the demands to document good manufacturing
practice (GMP) or other adequate requirements in every link of the producing chain.
Analytical results confirm that under poor production control, the risk for
contaminated supplements that may lead to a positive doping test is considerable. It
seems like the risk is increased, when purchasing dietary supplements from suppliers
that also provide products that are prohibited by the IOC/WADA. In relation to
athletes it is important to focus on nutrition in preference to dietary supplements as
well as to contribute to an awareness of the risk for contamination of supplements. In
the end, the responsibility for intake of prohibited substances through contaminated
nutritional supplements rests on the athlete himself.
References


<table>
<thead>
<tr>
<th>Health supplements</th>
<th>CoQ10 supplements</th>
<th>Cofactors (e.g., choline, citrus bioflavonoids, green tea extract)</th>
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<td>High risk to consume</td>
<td>Low risk to consume</td>
<td>Safe if taken as directed</td>
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<td>Banned substances</td>
<td>Banned substances</td>
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<td>Pre Amino Acids</td>
<td>Free Amino Acids</td>
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<td>Ginseng β-Adrenochrome</td>
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<td>DHEA</td>
<td>Red Bull</td>
<td>&gt; 150 mg/1</td>
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<td>Nootropic substances</td>
<td>Promote learning and memory</td>
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<td>TRH (Thymus Releasing Hormone)</td>
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<td>Compound</td>
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<td>5-Androstene-3,7,17-triol</td>
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<sup>a</sup>Molecular weight of bis-O-TMS-derivative, except Androstentriol, tris-O-TMS-derivative

<sup>b</sup>m/z monitored in SIM acquisition mode; ions for quantitation are underlined

<sup>c</sup>Retention time

<sup>d</sup>Relative retention time to 19-Noretiocholanolone

<sup>e</sup>Limit of detection

<sup>f</sup>Not validated
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**Table 3. Analysis of nutritional supplements from selected producers**