

PRACTICAL APPROACH TO DIETARY SUPPLEMENTS USED BY ATHLETES

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Abstract

Dietary supplements administration in athletes is a very used - and sometimes dangerous - practice, pushing the human performance to the physiological limits. The causes are multiple and derive from the observed or predictable need for adaptation, compensation and overcompensation, having as targeted effect the overload of the body with spare energy substances.

The line between medication and doping is crossed intentionally or, more often, unintentionally, out of ignorance or negligence, leading to tough penalties on athletes, according to international regulations. Dietary supplements are widely used by athletes and remain the only legal solution allowed to protect the body, maintain the health and improve physical performance. The common effort of institutions and organizations involved in cessation of excessive consumption of supplements is reflected in legislative actions and also in education and information programmes.

Thus, for the acquisition and management of ergotropic, trophotropic and recovery medication for athletes it is recommended to develop and maintain a close cooperation with competent authorities.

Rezumat

Administrarea de suplimente nutritive la sportivi este o practică utilizată și uneori foarte periculoasă, împingând performanța umană la limitele fiziologice. Cauzele sunt multiple și provin din necesitățile observate sau previzibile de adaptare, compensare și supracompensare, având ca efect specific supraîncărcarea organismului cu substanțe energetice de rezervă.

Granița dintre medicație și dopaj este traversată în mod intenționat sau, mai adesea, în mod neintenționat, din ignoranță sau neglijență, ceea ce duce la sancționări dure ale atleților, în conformitate cu reglementările internaționale. Suplimentele nutritive sunt utilizate pe scară largă de către sportivi și rămân singura soluție legală permisă de a proteja organismul, de a menține starea de sănătate și de a îmbunătăți performanța fizică. Efortul comun al instituțiilor și organizațiilor implicate în încetarea consumului excesiv de suplimente se reflectă în măsuri legislative și, de asemenea, în programe de educație și informare.

Astfel, pentru achiziționarea și gestionarea medicamentelor ergotropice, trofotropice și de recuperare pentru sportivi, se recomandă să se dezvolte și să mențină o strânsă cooperare cu autoritățile competente.

Keywords: dietary supplements, athletes, practical approach

Introduction

Dietary supplements administration in athletes is on the edge between empiricism, negligence and abuse on the one hand and scientific research conducted by specialists in the field, on the other hand. Besides the underfunding of the field, the explanation for this reality relies also on the decreasing number of sports medicine specialists [1]. Sports Medicine is an international well-defined medical specialty, globally represented by the International Federation of Sports Medicine. Our country's legislation clearly establishes the place and role of professionals involved in both performance and mass sport activities [2]. Participation of unauthorized or less trained persons in surveillance and health promotion is particularly dangerous and can have dramatic effects on both the domain and the population group directly involved in mass or competitive sport. The common effort of institutions and organizations involved in cessation of excessive consumption of supplements is reflected in legislative action and also in education and information programmes [3]. Surveillance of high performance athletes' health is realized through the National Institute of Sports Medicine, the network of Sports Medicine medical offices and the Romanian Society for Sports Medicine who work directly with National Anti-Doping Agency, Romanian Olympic and Sports Committee, national sport federations (Judo Romanian Federation), sport clubs etc. In this context, the acquisition and management of ergotropic, trophotropic and recovery medication is accomplished under close cooperation of these authorities [4]. The line between medication and doping is crossed intentionally or, more often, unintentionally, out of ignorance or negligence, leading to tough penalties on athletes, according to the international regulations and standards promoted by World Anti-Doping Agency/Agence Mondiale Antidopage – WADA/AMA, International Olympic Committee and international sport federations (International Judo Federation). These international standards were adopted also by Romanian legislation with some adaptations to our national specificity (Order No. 172/2011 regarding the approval of the list with prohibited substances for the year 2012; Law No. 104/208 for the dietary supplements; Anti-Doping World Code – updated in 2009; Prohibited List International Olympic Committee 2011, Anti-Doping Code 2011; International Olympic Committee Anti-Doping Role 2012). Dietary supplements aim to compensate for the lack of "efficient" medication, with immediate spectacular effects. Sports supplements have no rapid effects and therefore some of them are enriched

with ergogenic substances – prohibited (e.g. ephedrine) or allowed under restrictions (caffeine). Their market demand is increasing, due to the use at early ages, with the aim of rapid improvement in both athlete's image (muscle mass) and physical performance [5].

Drug administration in athletes is a very used - and sometimes dangerous - practice, pushing the human performance to the physiological limits. The causes are multiple and derive from the observed or predictable need for adaptation, compensation and overcompensation, having as targeted effect the overload of the human body with spare energy substances [6]. The purpose of this paper is to highlight the use of nutritional supplements by Romanian athletes, who have to constantly make efforts in order to keep within the weight category.

Materials and Methods

We applied a questionnaire aimed to identify the most commonly used substances in sport activities. The questionnaire was applied to a number of 100 athletes (N=100, 48 girls and 52 boys) in a weight categories – based on sport branch. Our subjects' age varied between 16 and 19 years old (mean age = 18.4 years old). The questionnaire was previously validated and included information regarding age, gender, branch of sport, experience in sports, dietary supplements used, who recommended and who managed the use of supplements. It was distributed along with an agreement of athletes to participate in the survey, being aware of the fact that all the information provided will be confidential.

In order to systematize our research on nutritional supplements, we introduced questions regarding the following substances:

- creatine: one of the most used substances, with the aimed effect to increase the performance in repetitive efforts, of high intensity in short time. The intended effect is to augment the muscle mass, and thus the strength developed. Hydrolysis of phosphocreatine rapidly generates the ATP necessary for muscle contraction; following this logic, storing a larger amount of creatine in muscles will cause a rapid mobilization of ATP molecules leading to increased phosphocreatine resynthesis. Creatine depletion limits the anaerobic effort, without any direct influences on the aerobic capacity and endurance. Therefore, creatine supplementation has beneficial effects on the anaerobic capability, observed in force increase, press squat, strength or power cleans. Ergogenic regimen usually associates creatine supplementation with Ca and Mg. Dosage: 5mg/kg body weight [7].

- chromium: oligoelement that could be useful for weight loss and blood glucose control in people with diabetes, and also for treating hyperlipidemia and hypercholesterolemia. Athletes use it to increase active muscle mass and decrease the adipose tissue. The effect of muscle mass augmentation is related to the involvement of chromium as co-factor in carbohydrates, proteins and lipids metabolism, through amino acids accumulation in muscles. The dosage is between 50 and 200 micrograms/day [8].
- ginseng: used for its stimulant, diuretic and antibiotic effects. In athletes it improves aerobic performance and decreases stress (increases the resistance to fatigue, improves myocardial metabolism and muscle oxygen extraction, increases muscle mitochondrial metabolism). Among reported side effects are depression, drowsiness, hypertension, nervousness. Recommended dose is 200 mg to 2 g/day.
- inosine: used to increase cardiovascular performance and body endurance. There are no reported side effects and the dosage is 5-6 g/day for athletes.
- lysine: used to improve the aerobic exercise capacity.
- L-glutamine: used to treat anxiety, depression, irritability, insomnia. There are no reported side effects and the recommended dosage is 20 to 30 g/day.
- carbohydrates are used to restore muscle glycogen after exercise and to maintain blood glucose during endurance efforts that are longer than 80 minutes.
- protein supplements: experts recommend 0.8 mg/kg body weight/day to prevent nitrogen imbalance and to stimulate muscle protein synthesis. Specialists recommend for aerobic efforts between 1 to 1.2 g/kg body weight/day.
- glycerol increases water retention. Recommended doses are 1 to 1.2 g/kg body weight administered with 1.5 l liquid, 1 to 2 hours before competition.
- glucosamine has chondroprotective effects. Due to frequent traumatic knee damage, glucosamine is used to reduce risk and progression of osteoarthritis.
- vitamin C is a water-soluble vitamin involved in collagen formation and maintenance of normal bone status. Side effects include hyperoxaluria, hematuria, hyperuricosuria, predisposing to urolithiasis at doses over 1 g/day. The dosage as dietary supplement is 70 - 90 mg/day (will be modified for osteoporosis or respiratory infections treatment) [5].
- vitamin E: a liposoluble vitamin, with rarely reported deficiency. Side effects include fatigue, weakness, gastrointestinal disorders, creatinuria. Recommended dose: 15 mg/day.
- coenzyme Q10: is co-factor in ATP production and has powerful antioxidant effects, enhancing the antioxidant action of vitamin E. It is

assumed that improves aerobic exercise capacity, hence the association with L-carnitine in some preparations. Side effects include gastritis, decreased appetite, and the recommended dosage is 100 - 150 mg/day.

- selenium: used in cardiovascular disease, prevention of cancer; has antioxidant effects.
- calcium: has a role in body growth and development, directly affecting bone health.
- iron: is frequently supplemented during trainings at high altitude, in hot conditions or in case of hematological disorders.
- multivitamin and multimineral supplements have placebo effect and offer a false sense of security to athletes. They are recommended especially for travels, dietary regime changes etc.

The second objective of the research we conducted was to depict how the ergotropic or trophotropic regimen influences athlete's performance. For this, we developed an experimental study on a sample of 35 athletes divided in a control group (N = 19) of athletes without dietary supplements and an experimental group (N = 16) of athletes who used ergotropic or trophotropic diet (for exercise and recovery, depending on the training stage).

Results and Discussion

Questionnaires were completely filled in and information was processed and the resulted data are presented below. We also used findings and records from official documents; for the respect of privacy, only general aspects could be presented. In general, experimental studies conducted on athletes as well as medications are confidential. Pharmacological associations for effort and recovery medication are confidential if addressed to Olympic and national sport teams and represent a professional secret (according to applying legislation).

Regarding the administration of dietary supplements, our findings are the following:

- The wide use of creatine by the athletes is due to the lack of significant side effects, but in the case of a sport based on weight categories, it is indicated to carefully monitor the weight, because of fluid retention. Athletes frequently report muscle cramps, but without highlighting a direct relations between their frequency and the administration of creatine.
- Carnitine has positive effects in prolonged aerobic efforts. It contributes to the conservation of the glycogen stores in the body and has an impact on performance by improving endurance or aerobic capacity.

- Vitamin C is used to increase immunity, for prevention of respiratory infections and for antioxidant effects. It is used to treat hypertension, osteoporosis, for rehabilitation after injuries and support of iron absorption from the gastrointestinal tract.
- Vitamin E is used for its antioxidant effects in cardiovascular prophylaxis, neuromuscular pathology, anti-aging.
- Coenzyme Q10 is frequently administered for the treatment of cardiovascular disorders, increasing body's immune response and exercise tolerance.
- Although selenium effectiveness is uncertain, the selenium supplementation is frequently used in athletes.
- The aimed effects of chromium administration are, among others, the decrease of appetite and the modulation of insulin secretion. Athletes prefer it for possible anabolic effects, but attention should be paid to adverse reactions which include: anemia, interstitial nephritis, gastrointestinal disorders, and cognitive impairment.

These substances have been identified as the most commonly used, as the table I illustrates.

Table I.
Substances used in sports with weight categories

Type of products	Substances used
Dietary supplements well-known and widely used	Creatine
	Vitamins: C, E
	Minerals: Cr, Se, Zn etc.
	Their combinations
Dietary supplements known and used only by recommendation	Amino acids
	Coenzyme Q10
	Ginseng
	Tonotil [®]
	L-carnitine
	Lecithin
Dietary supplements less known and rarely used	Their combinations
	Ginkgo biloba
	Glucosamine
	Inosine
	Arginine
	Lisine
	L-glutamine
Their combinations	

- Ginseng is usually administered in association with other substances, for its effects of increasing aerobic performance and muscle oxygen extraction.

- Inosine is used to improve cardiovascular performance and endurance of the body. There are no reported side effects and dosage is 5-6 g/day for athletes.
- Lysine is used to improve aerobic exercise capacity. Studies show controversial results, but in general the ergogenic effect is not accepted. Side effects include hypercalcemia and interstitial nephritis.
- L-Glutamine is used primarily to stimulate the body's immune response to prolonged effort.
- Carbohydrates are generally included in supplements to maximize the muscle reserves of glycogen for long endurance efforts, usually accompanied by glycogen depletion. There are several favorite schemes to improve glycogen reserves, which vary function of the amount administered and the number of days before exercise, but also by combination with proteins.

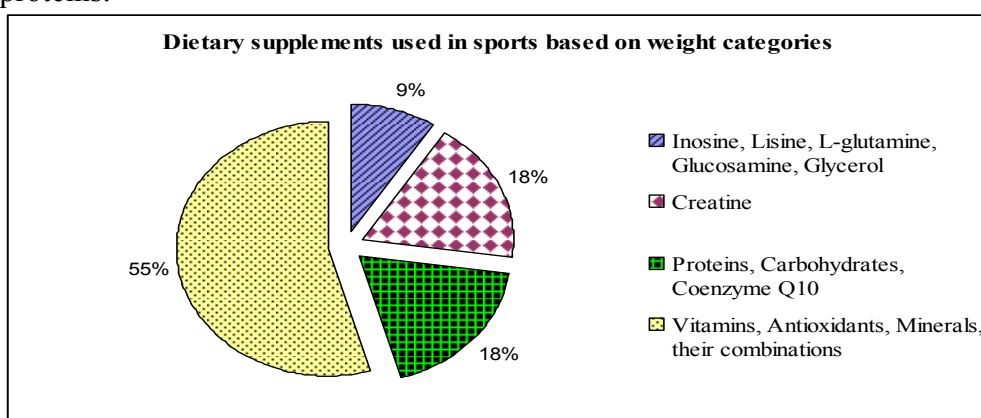


Figure 1

Dietary supplements used in sports based on weight categories

- Protein supplements are used mainly in intensive efforts, for the muscle growth effect and increased strength. Their administration requires the control of renal function.
- Glycerol increases water retention and is used to prevent dehydration.
- Glucosamine is relatively rarely used for its anti-inflammatory effects.

The results of the experimental study on the effects of dietary supplementation on exercise performance were analyzed and interpreted using SPSS software (version 15.0). For the statistical significance of our findings we used Chi-square Test, with 95% confidence interval. The evaluation of anaerobic exercise capacity was performed by field tests (e.g. Sargent) and by laboratory functional explorations (e.g. TTR 10''– Total Labor Performed, test described by Szogy-Kerebetiu). For the anaerobic

capacity we used outdoor tests like Ruffier and laboratory tests like Astrand Ryhming for estimating the maximum oxygen uptake ($VO_2\max$). Our recordings showed heterogeneous values for TTR 10" and $VO_2\max$ for the control group, while for the experimental group they varied between 75.79% - 84.92% (TTR 10"), corresponding to the training stage and between 74.79% - 89.92% ($VO_2\max$) corresponding to the training stage. We found that the use of nutritional supplements has the effect of increasing the efficiency of athletes' preparation for exercise. In both groups progresses have been recorded in improving aerobic and anaerobic exercise capacity, but statistical significance ($p < 0.05$) was recorded only for the experimental group. This can be explained by the training plan that followed the same elements and objectives, but also by athletes' monitoring and concentration on the concordance between physiological and effort parameters.

Conclusions

The most commonly used drug combinations were of vitamins, minerals and amino acids. Dietary supplements are widely used by athletes and remain the only legal solution allowed in order to protect the body, maintain the health status and improve the physical performance.

In order to stimulate the active muscle mass, the most commonly used preparations were based on Tonotil and L-Carnitine. Among the most used antioxidants are Vitamin C, Vitamin E and Coenzyme Q10. Following the administered doses, we can conclude that the maximum allowed dosage is not respected, probably due to overlapping products with the same content but different commercial names.

The lack of specialists in sports medicine is the most common cause that leads to self-medication, errors or major mistakes in administration of ergotropic medication in athletes. There is no constant concern of policy makers to correctly inform and properly educate the athletes and technical teams. Most often, the purchase of pharmaceutical products for athletes is done without a medical specialized advice or recommendation.

References

1. Mottram, D., *Drugs in sport*, 3rd Sport Edition, Routledge, 2003, Taylor and Francis Group, 64-90.
2. Vijjala, Gabriela, *Analiza substantelor interzise in sport*, Editura Renaissance, 2006, Bucuresti, 56-70.
3. Georgescu, Luminita, *Prim ajutor si traumatologie sportiva aplicata*, Editura Universitaria, 2006, Craiova, 110-118.
4. Dragan, I., *Medicina sportiva*, Editura Medicala, 2002, Bucuresti, 514-540.
5. Burke, Louise, *Practical sports nutrition*, Human Kinetics, 2007, Australia 42-68.

6. Gabriel Pițigoi, Cătălin Păunescu, Niculina Mitrea, Daniela Baconi, Mihaela Păunescu, Claudia Burcea, Andreea Letiția Arsene. New approaches regarding the dynamics of the doping pharmacologic agents in sports, *Revista Farmacia*, 2012, 60, 1, 111-119.
7. Cascuas, S., Rousseau, V., Alimentation pour le sportif, de la sante a la performance, Amphora Publishing House, 2005, Paris, 108-120.
8. Ofelia Crișan, Health claims in food supplement advertising, *Farmacia*, 2012, 60(1), 138-142.
9. World Anti-Doping Agency, The World Anti-Doping Code. The 2012 Prohibited List - International Standard, available for 2012.
10. Micheli, L.J., Pigozzi, F., Chan, K.M., Frontera, W.R., Bachl, N., Smith, A.D. and Alenabi, S.T., *F.I.M.S. Team Physician Manual*, 3rd Edition, Routledge, 2012, 208-216.
11. David, P., *Aguide to the World Anti-Doping Code*, 2008, Cambrige University Press, 123-140.
12. Moller, V. , *The Ethics of Doping and Anti-Doping*, 2009, Routledge, 156-160.

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