Current knowledge about sports nutrition

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REVIEW

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Abstract

The scientific literature contains an abundance of information on the nutritional demands of athletes. However, designing the most suitable sports diet is very difficult.
The principal aim of this article is to summarize knowledge about sports nutrition, especially the intake of macronutrients and dietary supplements.

Key Words
Sports nutrition, Carbohydrate, Protein, Fat, Dietary Supplements

Introduction

Designing the most suitable diet for an athlete requires an intimate knowledge of the relevant scientific literature, the training and competitive demands of the sport, the social situation and the individual athlete's preferences.[1] Studies have demonstrated that the timed ingestion of carbohydrate, protein, and fat may significantly affect the adaptive response to exercise. Dietary supplements can also play a meaningful role in helping athletes consume the proper amount of calories, carbohydrate, and protein in their diet. Many supplement products can improve performance.[2,3]

The aims of this article are to provide an overview of the current macronutrient requirements for athletes and provide some recommendations for dietary supplements intake.

Energy intake

The first component to optimize training and performance through nutrition is to ensure the athlete is consuming enough calories to offset energy expenditure. The components of energy expenditure are grouped in three categories: metabolic rate, thermic effect of feeding, and the energy spent in normal daily and exercise activities.[1] People who participate in a general fitness program (e.g. exercising 30–40 minutes per day, three times per week) can typically meet their nutritional needs following a normal diet (35kcals/kg/day).[4] However, athletes involved in moderate levels of intense training (e.g. 2–3 hours per day of intense exercise performed 5–6 times per week) or high volume intense training (e.g. 3–6 hours per day of intense training in 1–2 workouts for 5–6 days per week) need to take 50–80kcals/kg/day.[4,5] But the caloric needs for heavier athletes (e.g. 100–150 kg) are even greater.[6]

Maintaining an energy deficient diet during training often leads to weight loss (including muscle mass), illness, psychological and physical symptoms of overtraining and reductions in performance.[4] Studies indicate that athletes tend to eat several times a day, most commonly on 5–9 occasions.[7] Use of nutrient dense energy bars and high calorie carbohydrate/protein supplements provide a convenient way for athletes to supplement their diet in order to maintain energy intake during training.[8]

Carbohydrate

The fundamental component to optimizing training and performance through nutrition is to ensure that athletes consume the proper amounts of carbohydrate, protein and fat in their diet. Individuals engaged in a general fitness program can typically meet macronutrient needs by consuming a normal diet consisting of 45–55% carbohydrates (3–5g/kg/day), 10–15% proteins (0.8–1g/kg/day) and 25–35% fats (0.5–1.5g/kg/day).[4] However, athletes involved in moderate and high volume training need greater amounts of carbohydrate and protein in their diet to meet macronutrient needs.[2] Athletes undertaking 2–3 hours intense exercise per day, 5–6 times per week typically need to consume a diet consisting of 5–8g/kg/day of carbohydrate. Research has shown that athletes undertaking high volume intense training (e.g. 3–6 hours in 1–2 workouts for 5–6 days per

week) may need to consume 8–10g/kg/day of carbohydrate.[2,4] Some studies also suggest to the possibility of an even higher intake.[9]

The majority of dietary carbohydrate should come from complex carbohydrates with a low to moderate glycemic index (named "slow carbs"). Appropriate sources are whole grains, fruit, vegetables, legumes, etc. It is advisable to consume a carbohydrate-rich meal with a low glycemic index approximately 1–2 hours before training .[4,9] Athletes should not exclude simple carbohydrates with high glycemic index (absorbed more quickly and faster) from their diet. These should be taken immediately after awakening and within two hours after training. Simple carbohydrates are important for faster glycogen replenishment after overnight fasting and intensive exercise.[10]

Protein

Research over the last decade has indicated that athletes engaged in intense training need to ingest about two times the usual recommended daily allowance (RDA) of protein in their diet to maintain protein balance.[4,9] An insufficient amount of protein in the diet leads to the negative nitrogen balance, which can increase protein catabolism and can slow post-workout recovery. This may lead to muscle wasting, training intolerance and, certainly, overtraining.[4]

To ensure an even or positive nitrogen balance, it is necessary to consume sufficient amount of protein.[11,12] Competitive athletes require 1.5–2g/kg of protein daily.[4] Resistance exercise athletes, and particularly bodybuilders, often receive even higher amounts of protein to maintain a certain daily energy intake (e.g. during low-carbohydrate diets).[11,13]
The type of protein consumed will determine the efficiency of the conversion into myofibrillar protein. The biological value of a protein is assessed by measuring the efficiency with which a given protein is absorbed and assimilated into the protein of an organism.[4] The best dietary sources of low fat, high quality protein are light skinless chicken meat, turkey, beef, fish egg white and skimmed milk (casein and whey). The best sources of high quality protein found in nutritional supplements are whey, colostrums, casein, milk peptides and egg protein,[12] whereas plant sources (e.g. soy and soy products) have a relatively low value.[15,16]

Ideally, proteins should be consumed every 2.5–3 hours in portions of 30–40 g for 6–8 meals per day. It is sufficient to substitute individual food sources with protein drinks in those individuals who are not able to consume sufficient amount of proteins.[4]

Ingesting protein drinks following exercise may lead to greater training adaptations and protein synthesis. The best post-workout protein source is whey. Recent studies suggest that the most suitable formulations contain whey hydrolysates with very short oligopeptide chains (contains 2–3 amino acid units, named di- and tripeptides).[17] However, prior to sleeping consuming casein drinks (or curd) is preferable because casein is slowly digested. Thus it provides steady nutrition to the body during sleep.[18,19]

Fat

The dietary recommendations of fat intake for athletes are similar to or slightly greater than those recommended for non-athletes. Adequate consumption of essential fatty acids,[1,4] especially polyunsaturated fatty acids, are of great importance among athletes. The best sources of essential fatty acids are "fatty" fishes (salmon, tuna, mackerel), some seeds (flaxseeds, pumpkin seeds, walnuts) and oils (flaxseed oil, soy oil, olive oil).[20]

It is recommended that athletes consume a moderate amount of fat (approximately 30% of their daily caloric intake). Higher-fat diets appear to maintain circulating testosterone concentrations better than low-fat diets. However, for athletes attempting to decrease body fat it has been recommended that they consume 0.5–1g/kg/day of fat.[1,4]

Intake of mainly healthy fats is very important for good physiological functioning of every organism.

Dietary supplements

Dietary supplements are defined as a product taken orally that contains a dietary ingredient "intended to supplement the diet". Dietary ingredients may include vitamins, minerals, herbs or other botanicals, amino acids, and substances (e.g. enzymes, organ tissues, glandular, and metabolites). Dietary supplements may also be extracts or concentrates from plants or foods. They are available in the form of capsules, tablets, liquids, soft gels, powders and bars. But these dietary supplements are not drugs or replacements for a good diet.[4]

Supplements can generally be classified as convenience supplements, designed to provide a convenient means of meeting caloric needs, and/or managing caloric intake, which may be for weight gain, weight loss, and/or performance enhancement.[19]

We generally categorize nutritional supplements into three categories which are not strictly delineated, they are dietary supplements:
1. *supporting muscle mass growth,*
2. supporting weight loss and fat burning,
3. enhancing performance and endurance[4]
But not all dietary supplements are demonstrably effective.

Dietary supplements supporting muscle mass growth

The most effective supplements from this category are proteins (powders or ready to serve drinks) ,[21] powders and drinks named "weight gainers" which have more carbohydrates than proteins (70-90% : 10-30%),[4] creatine (monohydrate, ethyl-ester, kre-alcalyn),[9,22] essential

amino acids (EAA),[17] branched-chain amino acids (BCAA),[18,19,21] and in young athletes also β-hydroxy β-methylbutyrate (HMB).[22,23]

The optimal intake of protein drinks is in the morning after awakening (whey), up to 30 minutes post-exercise (the best is whey hydrolysate) and prior to sleeping (casein).[19] In the muscle mass increasing phase "weight gainers" are the best choice. They should be consumed up to 30 minutes post-exercise.[4] A typical creatine load consists of consuming at least 5g of creatine monohydrate 30 minutes before exercise and 5g post-exercise.[9,24] Recent studies have indicated that ingesting 3–6g of EAA,[24] 5–10g of BCCA[4] and 1.5–3g of HMB prior to and/or following exercise stimulates protein synthesis.[4,22,23]

Dietary supplements supporting weight loss and fat burning

In the general population, many people may attempt drastic diets and/or take "miraculous" tablets in attempt to lose weight and/or burn fat. Athletes also often do not have adequate knowledge of the theories underlying safe and effective weight loss and fat burning.

The most effective substances from this category of supplements are diet replacements with higher protein and fibre content and lower carbohydrate and fat content.[4]
Thermogenics are supplements designed to stimulate metabolism thereby increasing energy expenditure and promote weight loss. Thermogenesis supporting supplements are e.g. caffeine (300mg 30 minutes prior to exercise)[19] and green-tea extract (1500mg two times per day). Some research suggest the positive effects of conjugated linoleic acid (CLA) and meals rich dietary fibre in weight loss.[4]

Dietary supplements enhancing performance and endurance

Effective supplements for enhancing performance and endurance are sports drinks with the ideal content and balance of carbohydrates and minerals,[2] and/or the above mentioned creatine,[4,9] caffeine,[19] EEA,[17,25] and BCAA. Recent studies showed a sustained positive effect of β-alanine on athletes' performance.[4] Better recovery and adaptation to training occurs after the intake of drinks containing protein and carbohydrate rather than after protein or carbohydrate drinks alone.[24]
Hard-exercised athletes, of course, should not forget to an increased intake of vitamins and minerals.

Conclusion

This article demonstrates that designing the most suitable diet for an athlete is not impossible, or even difficult. Maintaining an energy balance and a nutrient dense diet, undertaking prudent training, appropriately timing nutrient intake, and obtaining adequate rest are the cornerstones to enhancing performance and/or training adaptations. Use of a limited number of nutritional supplements that research has supported can help to improve energy availability (e.g. sports drinks, carbohydrate, creatine, caffeine, β-alanine, etc.) and/or promote recovery (carbohydrate, protein, essential amino acids, etc.) and thus can provide additional benefit in certain instances.
The topic of sports nutrition is very broad. Therefore it is necessary to seek results from a broad range of studies and to ensure these results are applicable to each individual situation.

References

1. Broad EM, Cox GR. What is the optimal composition of an athlete's diet? Eur J Sport Sci 2008, 8 (2): 57–65.
2. Kerksick C, Harvey T, Stout J, Campbell B, Wilborn C, Kreider R *et al*. International Society of Sports Nutrition position stand: Nutrient timing. J Internat Soc Sports Nutr 2008, 5: 17–28.
3. Willoughby DS, Stout JR, Wilborn CD. Effects of resistance training and protein plus amino acid supplementation on muscle anabolism, mass, and strength. Amino Acids 2007, 32: 467–77.
4. Kreider RB, Wilborn CD, Taylor L, Campbell B, Almanda AL, Collins R *et al*. ISSN exercise & sport nutrition review: research & recommendations. J Internat Soc Sports Nutr 2010, 7: 7–49.
5. Sundgot-Borgen J, Torstveit MK. Aspects of disordered eating continuum in elite high-intensity sports. Scand J Med Sci Sports 2010, 20 (2): 112–21.
6. Kreider RB. Physiological considerations of ultraendurance performance. Int J Sport Nutr 1991, 1 (1): 3–27.
7. Burke LM, Slater G, Broad EM, Haulka J, Modulon S, Hopkins WG. Eating patterns and meal frequency of elite Australian athletes. Internat J Sport Nutr Exerc Metab 2003, 13: 1–19.
8. Brown EC, DiSilvestro RA, Babaknia A, Devor ST. Soy versus whey protein bars: Effects on exercise training impact on lean body mass and antioxidant status. Nutr J 2004, 3: 22-6.
9. Tarnopolsky MA. Building muscle: nutrition to maximize bulk and strength adaptations to resistance exercise training. Eur J Sport Sci 2008, 8 (2): 67–76.
10. Kreider RB, Earnest CP, Lundberg J, Rasmussen Ch, Greenwood M, Cowan P *et* al. Effects of ingesting protein with various forms of carbohydrate following resistance-exercise on substrate availability and markers of anabolism, catabolism, and immunity. J Internat Soc Sports Nutr 2007, 4: 18–28.
11. Tipton KD. Protein for adaptations to exercise training. Eur J Sport Sci 2008, 8 (2): 107–18.
12. Lowery L, Forsythe CE. Protein and overtraining: potential applications for free-living athletes. J Internat Soc Sports Nutr 2006: 3 (1): 42–50.
13. Phillips SM. Protein requirements and supplementation in strength sports. Nutrition 2004, 20: 689–95.
14. Hulmi JJ, Lockwood ChM, Stout JR. Effect of protein/essential amino acids and resistance training on skeletal muscle hypertrophy: a case for whey protein. Nutr Metab 2010; 7: 51.

15. Morifuji M, Ishizaka MI, Baba S, Fukuda K, Matsumoto H, Koga J *et al*. Comparison of different sources and degrees of hydrolysis of dietary protein: Effect on plasma amino acids, dipeptides, and insulin responses in human subjects. J Agric Food Chem. 2010; 58(15): 8788-97..
16. Manninen AH. Protein hydrolysates in sports nutrition. Nutr Metab. 2009; 6: 38–42.
17. Paddon-Jones D, Westman E, Mattes RD, Wolfe RR, Astrup A, Westerterp-Plantenga M. Protein, weight management, and satiety. Am J Clin Nutr. 2008; 87: 1558–61.
18. Hulmi JJ, Kovanen V, Selänne H, Kraemer WJ, Häkkinen K, Mero AA. Acute and long-term effects of resistance exercise with or without protein ingestion on muscle hypertrophy and gene expression. Amino Acids. 2009; 37: 297–308.
19. Petróczi A, Naughton DP, Mazanov J, Holloway A, Bingham J. Performance enhancement with supplements: incongruence between rationale and practice. J Internat Soc Sports Nutr. 2007; 4: 19–26.
20. Varga Zs. Az omega-3 többszörösen telítetlen zsírsavak az atherosclerosis megelőzésében. Orv Hetil. 2008; 149 (14): 627–37.
21. Stoppani J, Scheett T, Pena J, Rudolph Ch, Charlebois D. Consuming a supplement containing branched-chain amino acids during a resistance-training program increases lean mass, muscle stranght and fat loss. J Internat Soc Sports Nutr 2009; 6(1): 1–2.
22. Holecek M, Muthny T, Kovarik M, Sispera L. Effect of beta-hydroxy-beta-methylbutyrate (HMB) on protein metabolism in whole body and in selected tissues. Food Chem Toxicol. 2009; 47: 255–9.
23. Zanchi NE, Gerlinger-Romero F, Guimarães-Ferreira L, de Siqueira Filho MA, Felitti V, Lira FS *et al*. HMB supplementation: clinical and athletic performance-related effects and mechanisms of action. Amino Acids. 2010. Online First. Doi: 10.1007/s00726-010-0678-0.
24. Vieillevoye S, Poortmans JR, Duchateau J, Carpentier A. Effects of a combined essential amino acids/carbohydrate supplementation on muscle mass, architecture and maximal strength following heavy-load training. Eur J Appl Physiol. 2010; 110(3): 479-88.
25. Goston JL, Correia MITD. Intake of nutritional supplements among people exercising in gyms and influencing factors. Nutrition 2010, 26: 604–11.

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CONFLICTS OF INTEREST

There is no conflict of interest to be declared.