Sports Nutrition and Health. From Nutrients to Performance

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Short description

Sports Nutrition and Health. From Nutrients to Performance explores the vital connection between nutrition and athletic performance. It covers essential nutrients like proteins, carbohydrates, fats, and phytonutrients, offering practical strategies for sustainable sports nutrition. The book delves into supplement use, energy metabolism, hormone regulation, and hydration. It also addresses emerging trends, such as insect-based foods and innovations in sports food packaging, while highlighting the role of nutrition in overall health, performance, and well-being. Featuring contributions from renowned experts, this book offers a wealth of knowledge and practical advice for athletes, coaches, nutritionists, and anyone passionate about sports and health. Whether you are a professional athlete, a coach, or a fitness enthusiast, *Sports Nutrition and Health. From Nutrients to Performance* is your essential book for achieving peak performance through optimised nutrition and holistic health practices.

Acknowledgement

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PART B: HEALTH AND SPORTS PERFORMANCE

1. PROTEINS: SOURCES AND STRATEGIES FOR BIOACTIVE AND SUSTAINABLE SPORTS NUTRITION

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Abstract
Proteins are crucial macronutrients essential for human nutrition and overall health. Their quality varies significantly based on factors like digestibility, amino acid profile, bioavailability, processing, and purity. Athletes require high protein intake to promote muscle protein synthesis, maintain a positive muscle protein balance, and counteract muscle breakdown. Proteins in the body consist of amino acids, making the synthesis of non-essential amino acids and adequate intake of essential amino acids vital for healthy protein turnover. Alternative protein sources, such as plants and mycoproteins, offer sustainable and bioactive benefits. Additionally, protein hydrolysis can enhance by-products like collagen, yielding bioactive peptides that improve athletic performance and address sport-related issues.

Keywords
Protein food; Nutritional value; Skeletal muscle protein synthesis.

1. Introduction

Nutrition and sports are vital components of a healthy lifestyle. Athletes should focus on consuming a well-balanced diet made from whole foods, ensuring adequate intake of energy, protein, and other nutrients to avoid deficiencies. Proteins are especially important in sports nutrition, and for some disciplines, the use of supplements, known as ergogenic aids, may be necessary to enhance performance. These supplements help improve endurance and overall fitness. Protein supplements can be a convenient way to meet protein intake goals, especially when access to

quality food is limited or time for meals is short. After digestion, amino acids from proteins are reassembled by the body to create essential human proteins like hair, skin, and muscle. Protein is an essential macronutrient and is the basic constituent of human and animal tissues [Welis, 2017]. The functional roles of proteins are maintaining bone health, increasing muscle mass in elderly individuals, and managing and satisfying additional nutrient requirements. Indeed, proteins act as bioactive compounds and form the basis of the immune system. They primarily constitute various enzymes in metabolic pathways, growth and maintenance, act as signalling molecules and hormones, maintain physiological pH and the immune system, and function as storehouses and transporters of molecules [Tomar et al. 2021]. It is a popular nutrient with increasing consumer demand obtained from plants and animals [Henchion et al. 2017]. High-protein foods are often recommended [Phillips et al. 2016]; thus, it is crucial to ascertain how high-protein diets affect metabolism when other elements of a healthy lifestyle are present, such as regular exercise and a weight-training regimen. The nutritional value of protein relies on its amino acid composition and the physiological use of an individual amino acid after absorption, digestion, and minimum obligatory oxidation rates. An adequate intake of proteins in the diet is important for maintaining a good health condition, and current evidence has suggested that athletes of some sports disciplines need to consume greater amounts of protein. Also, the need for protein depends on the sporting event. Athletes have a higher daily protein requirement because their muscle protein turnover is faster than that of sedentary individuals, and their muscular adaptations are at their peak. Therefore, the current recommended daily protein intake for healthy adults is 0.8–1.0 g/kg/day compared to athletic adults (1.2–2.0 g/kg/day) and, in particular, to stimulate skeletal muscle protein synthesis (MPS) and promote a positive protein balance [Jäger et al. 2017]. However, research showed even better results for muscle mass and strength if the protein dose taken in the evening before bedtime was slightly higher [Snijders et al. 2015]. Fig. 1 depicts all the various sections discussed in the current chapter.

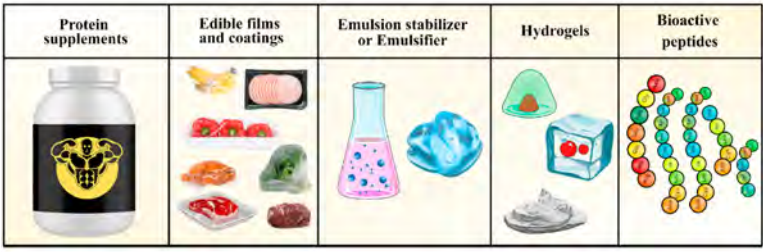

Fig. 1. Application of proteins for diverse purposes, such as protein supplements, food packaging, emulsifiers, bioactive peptides, and hydrogels [Manoj et al. 2022]

This chapter will discuss the need for high amounts of protein in enhancing muscle mass and performance, the quality of protein, the most used amino acid supplements, and the security for athletes when using increased amounts of protein and amino acids.

2. Protein sources

2.1. Milk proteins

Casein proteins make up around 80% of milk proteins and include several types, such as α-s1, α-s2, ß, and κ-casein, each with distinct amino acid compositions and functional properties. These proteins are suspended in milk as micelles, which have an open structure due to their high proline content. Caseins contain a high phosphate content, enabling them to bind with calcium and form calcium phosphate salts, thus providing a rich calcium source in milk. Micellar casein, a slow-digesting protein derived from milk, releases amino acids gradually, making it ideal for prolonged muscle nourishment. Unlike other proteins, micellar casein forms a gel in the stomach, extending digestion time and offering a sustained supply of amino acids to muscles. In muscle building, micellar casein shines as a night-time protein. Its slow-release property aids muscle repair and growth during sleep, a critical recovery period for athletes. Unlike whey protein, which is rapidly absorbed for immediate muscle synthesis, micellar casein works

over several hours, reducing muscle breakdown and supporting long-term muscle health. This makes it a perfect complement to whey protein and whey protein isolate (WPI), often used post-workout for immediate muscle recovery [Dangin et al. 2001]. A study by Soop et al. 2012 reported that when blended with other proteins, casein's contribution resulted in significantly greater amino acid accretion rates when measurements were extended for several hours. In addition, another study reported favourable results for a blend of whey, casein, and soy on their impact on increasing muscle protein synthesis (MPS) [Reidy et al., 2013]. Meanwhile, the assimilation of micellar casein is more progressive and will take up to 7 hours [Lacroix et al. 2018].

Whey proteins (WHPs) represent around 20% of milk proteins. The serum (whey) protein family consists of approximately 50% ß-lactoglobulin, 20% α-lactalbumin, blood serum albumin, immunoglobulins, lactoferrin, transferrin, and many minor proteins and enzymes. WHPs are quickly digested and are totally absorbed in about 3 hours. WHPs are widely considered the highest quality natural protein and a rich source of bioactive peptides, which may play a role in the dietary management of chronic diseases [Wolfe, 2000]. WHPs are generally marketed in three forms: whey protein concentrate, whey protein isolate, and whey protein hydrolysate [Sousa et al. 2012]. Also, the isolate is made of 90% protein [Hayes and Cribb, 2008], the concentrate has fat and lactose along with the quintessential proteins (29–89%) [Bounous, 2000], and the hydrolysate is the semi-digested form of the protein [Kanda et al. 2013]. WHPs contain different protein types, including β lactoglobulin (βLG), α lactalbumin (αLA), immunoglobulins (Igs), Bovine serum albumin, protease-peptones, lactoferrin, lactoperoxidase, and glycomacropeptide [McHugh and Krochta, 1994]. However, the β-lactoglobulin-derived peptides have been characterised to possess immense functionalities [Power et al. 2014]. Also, glycomacropeptide is a peptide constituent of WHPs derived from casein and has multifarious benefits. The functional multiplicity of this peptide is illustrated in Fig. 2. WHPs have all the essential amino acids in higher concentrations compared to various vegetable protein sources, which have an integral role in muscle metabolism and