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FOOD SUPPLEMENTATION IN THE PROCESS OF MUSCLE HYPERTROPHY: BENEFITS, RISKS AND THE NEED FOR REGULATION AND PROFESSIONAL MONITORING

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ABSTRACT

This study aimed to understand the role of food supplementation in the process of muscle hypertrophy. The current context reveals a significant increase in adherence to resistance training worldwide, due to its effectiveness in improving strength, power, muscular endurance and flexibility, in addition to being an adaptable and efficient method for body modeling. The problem addressed lies in the need to understand the impacts of food supplementation, especially creatine, whey protein and BCAA (Branched-Chain Amino Acids), on the optimization of physical performance and muscle mass gain. To this end, studies that relate these supplements to strength training were analyzed, seeking to evaluate their benefits and possible risks. The research was carried out through a qualitative literature review, using the deductive method to analyze the effects of supplementation on strength training. The results indicate that supplementation, when combined with adequate strength training, can provide significant gains in muscle mass, improved immunity and optimization of muscle recovery. In addition, it was observed that supplementation contributes to the conservation of muscles, promoting greater endurance and physical performance. It is concluded that food supplementation can be an effective strategy to improve the results of strength training, as long as it is used consciously and under the guidance of qualified professionals. The need for regulation and professional supervision becomes essential to avoid health risks and ensure the safety and effectiveness of consuming these supplements.

Keywords: Metabolism. Strength Training. Muscle Recovery. Performance Optimization.

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INTRODUCTION

The practice of physical activities has grown significantly in Brazilian gyms, being widely recognized for its benefits to metabolism. When performed regularly, it provides several improvements, such as reducing body fat, increasing muscle mass, accelerating metabolism, improving the lipid profile, reducing the risk of cardiovascular diseases, controlling blood pressure and improving physical conditioning. These factors, together, contribute directly to the improvement of the quality of life of practitioners (Ávila *et al.* 2025).

However, it is observed that many athletes and practitioners of physical activities believe that nutritional supplements help to improve sports performance, muscle recovery after intense training and even to compensate for any nutritional deficiencies. This type of product is often advertised as an essential resource for obtaining better results in sports practices. The growing search for quick results in bodybuilding leads many individuals to incorporate nutritional supplementation into their eating routine. For athletes and regular gym-goers, supplementation represents a potentially effective strategy to improve sports performance (Monteyne *et al.* 2023).

Given this scenario, it is essential to understand the factors that lead physical activity practitioners to consume food supplements, especially in the context of musculoskeletal hypertrophy. According to Lancha Jr. (2008), nutritional supplementation can be defined as the punctual intake of certain nutrients that may be in deficit in the body or not be consumed in sufficient quantities through the diet. The author points out that the objective of this practice is to achieve specific effects that exceed the recommended daily intake of various nutrients (Lancha Jr., 2008, p. 40).

To this end, the research adopts the deductive method, with a qualitative approach and based on a bibliographic review, seeking to understand the impacts of food supplementation on muscle development. The chosen methodology aims to deepen the analysis of the influence of nutritional supplementation and provide a theoretical basis for understanding its benefits and risks in the sports context.

Thus, the main objective of the present study was to identify the factors that lead physical activity practitioners to consume food supplements, considering their role in optimizing the process of musculoskeletal hypertrophy. In addition, it was intended to analyze the relationship between physical activity and nutrition, highlighting the importance of a balanced diet, containing all essential nutrients, such as carbohydrates, lipids, proteins, vitamins and minerals, as well as substances frequently used in supplementation, such as creatine, whey protein and BCAA. Finally, it is emphasized the need for any nutritional supplement to be evaluated by a qualified professional, ensuring that its consumption

complies with current health legislation and is appropriate to the individual needs of practitioners.

MATERIAL AND METHODS

The present study was based on a qualitative and descriptive approach, focused on a comprehensive literature review on food supplementation and its impact on the muscle hypertrophy process. The choice for this methodology is justified by the need to understand the interactions between nutrition, strength training, and the use of supplements, as well as the effects of this practice on sports performance and health (Fontenelle, 2021).

To ensure the scope and relevance of the theoretical survey, specific criteria were used in the selection of sources. First, the scientific literature published in the last 10 years was prioritized, seeking updated materials that directly addressed nutritional supplementation, muscle hypertrophy, and the physiological impacts of creatine, whey protein, and BCAA consumption. Classic and widely cited publications on the subject were also considered, given their importance in the theoretical basis (Mazucato, 2018).

The databases consulted included SciELO, Google Scholar, ScienceDirect, and the CAPES Journal Portal. The keywords used in the searches were: "food supplementation", "muscle hypertrophy", "sports nutrition", "strength training" and "protein supplementation". The combination of these terms made it possible to identify relevant studies on the main effects of food supplements on hypertrophy and sports performance.

Additionally, the study incorporated a documentary analysis of nutritional guidelines and health regulations related to the use of dietary supplements. Secondary data from health organizations, scientific conferences on sports nutrition, and case studies on the effectiveness of supplementation in strength training were analyzed.

The data collected were categorized and analyzed in light of the study objectives. The deductive method was used to identify patterns and propose recommendations based on scientific evidence. Source triangulation was used to increase the validity of the conclusions, confronting information obtained from different authors and documents (Fontenelle, 2021).

This methodological approach allowed a detailed understanding of the effects of food supplementation on the muscle hypertrophy process, offering subsidies for the formulation of nutritional guidelines and recommendations for physical activity practitioners who seek to optimize their results with the safe and effective use of supplements.

LITERATURE REVIEW

REASONS THAT LEAD TO THE CONSUMPTION OF SUPPLEMENTS.

Nutrition is directly related to the practice of physical activity, being a determining factor for improving the body's performance. Through a balanced diet and adequate intake of nutrients, it is possible to optimize the capacity for physical performance. The use of food supplements has become increasingly common, either by indication of nutritionists and nutritionists or by decision of strength training practitioners, aiming to accelerate metabolism and improve the results obtained (Ribeiro & Morales, 2016).

In this context, it is observed that bodybuilders increasingly seek this resource to achieve satisfactory results in short periods of time. Ribeiro & Morales (2016, p.13) corroborate this statement by highlighting that:

> The use of dietary interventions and the consumption of nutrients in order to increase performance are ancient practices. This fact is not surprising, considering the highly competitive environment in which athletes are inserted and their motivation to win. The willingness of athletes to try nutritional interventions is a phenomenon that grows every day.

In addition, nutritional supplementation can be defined as the punctual intake of certain nutrients in order to supply nutritional deficits or enhance specific effects on the body. This practice becomes justifiable when the individual is unable to meet their nutritional needs only through food, something common among those who perform strength training, and it is essential to be accompanied by a physical education and nutrition professional (Godoi *et al.*, 2009 apud Carvalho; Hirschbruch, 2008).

Physical activity comprises any body movement resulting from muscle contractions that raises energy expenditure above the resting level. It is perceived as a behavior that directly influences physical fitness – a set of acquired or developed attributes that favor the performance of physical activities – and can be determinant for health and functional capacity.

Currently, the market offers a wide variety of food supplements, from micronutrients, such as zinc, to essential amino acids, which are marketed as ergogenic (Menon; Santos, 2012). Most consumers of these products are gym-goers who seek improvements in physical performance and body aesthetics (Souza Júnior *et al.*, 2007). To achieve these goals, many adopt different types of diets and diets, often without considering the risks involved (Menon; Santos, 2012). However, it is exclusively up to nutritionists to prescribe these supplements, ensuring adequate control of the amount ingested and the prevention of possible damage to health (Corrêa *et al.*, 2014).

Among the various functions of food supplements, their contribution to achieving daily nutrient recommendations and improving sports performance stands out. Its most recognized benefits include muscle mass gain, reduced body weight, more efficient muscle recovery, increased disposition, as well as reduced stress and physical fatigue.

BENEFITS OF USING CREATINE, WHEY PROTEIN AND BCAA FOOD SUPPLEMENTS

Food supplements are characterized by the consumption of nutrients with varying degrees of efficiency, promoting physiological adaptations and improvements in physical performance. In this sense, they can be considered ergogenic resources, contributing both to the increase of sports performance and to the improvement of health and aesthetic conditions, especially in the context of muscle hypertrophy.

Among the various types of supplementation available, some are widely consumed by bodybuilders, especially creatine, whey protein and BCAA. Although they share similar effects, each has unique characteristics that specifically influence muscle recovery and development.

It is essential to emphasize that the use of nutritional supplements must be carried out consciously, ideally being consumed on training days, especially in activities that involve weight lifting. Monitoring by health and sports professionals is essential to ensure proper use and avoid possible adverse effects.

In this sense, it can be stated that adequate nutrition and regular and moderate physical exercise have beneficial effects on metabolism, as a balanced diet is associated with reduced body fat, increased lean mass, decreased risk of developing cardiovascular diseases, blood pressure and blood glucose control, improved physical conditioning, better balance and greater bone mineralization, in addition to modifications in the lipid profile and increased metabolism. Thus, trained individuals oxidize more fat and fewer carbohydrates than untrained individuals (Hirschbruch, 2014).

Thus, it is observed that supplementation for muscle mass gain must be associated with a disciplined training routine, adequate rest, and a balanced diet. According to Hirschbruch (2014), there is a significant relationship between nutrition and physical activity, in which the body's performance is improved through the balanced intake of carbohydrates, proteins, fats, vitamins and minerals. This nutritional approach optimizes results and contributes to superior performance. On the other hand, an inadequate diet can compromise sports performance and increase the risk of developing diseases, in addition to negatively impacting the metabolic rate.

Muscle strength performance depends not only on hypertrophy, but also on the efficiency of the nervous system in activating muscles appropriately. Neuromuscular control in strength exercises is a highly complex process, and introducing new exercises into the training program may initially improve performance. This effect can be explained, in part, by the adaptations of the nervous system, which refine muscle control and optimize the execution of movements.

ASPECTS OF CREATINE

Creatine, in turn, is a substance synthesized endogenously by the kidneys, liver, and pancreas. Also known as α-methyl guanidinoacetic acid, its synthesis occurs from the amino acids arginine and glycine. The rate of endogenous synthesis of creatine in the body is approximately 1 g/day, a value that, when added to food intake (also about 1 g/day), is equivalent to the amount catabolized daily, both in the form of creatine and phosphocreatine, being eliminated as creatinine through non-enzymatic reactions (Gualano *et al.*, 2010).

The use of creatine as a food supplement has several purposes, the main one being to improve physical performance and gain muscle mass. In addition, creatine supplementation can delay muscle fatigue, allowing for better performance in high-intensity workouts and physical activities (Hunger *et al.*, 2009).

Creatine acts as an energy reserve in muscle cells. During intense exercise, its breakdown releases energy that is used for the regeneration of adenosine triphosphate (ATP), a nucleotide essential for the storage and release of chemical energy in the body. Approximately 95% of the total creatine present in the human body is found in skeletal muscles, and its post-exercise regeneration is an oxygen-dependent process. Studies indicate that creatine supplementation can increase muscle creatine levels by 10 to 20%, and in vegetarian athletes this increase can reach up to 60% (Maham *et al.*, 2012). However, there are still controversies about the benefits and possible risks of supplementing this substance.

Organic creatine has two main sources: endogenous synthesis by the body itself, from three amino acids (arginine, glycine and methionine), and food intake, mainly through the consumption of red meat and fish. Despite its fundamental role in energy metabolism and muscle contraction, creatine is not considered an essential nutrient, as the body is able to synthesize it in adequate amounts for most people.

ASPECTS OF WHEY PROTEIN

The combination of bodybuilding and protein intake is an efficient strategy to maximize the expected results, as protein supplementation is associated with several metabolic functions, such as increasing the rate of protein synthesis, growing muscle mass, and developing strength. Whey protein, being easily absorbed, promotes rapid muscle reconstruction, especially when consumed right after training, a period in which the muscle strengthening effect is more intense.

Whey proteins are highly digestible and quickly assimilated by the body, stimulating the synthesis of blood and tissue proteins. Some researchers classify these proteins as fast metabolizing, being highly indicated for situations of metabolic stress, where the replacement of proteins in the body becomes essential. Whey proteins have almost all essential amino acids in concentrations higher than the recommendations, except for aromatic amino acids (phenylalanine and tyrosine), which appear at adequate levels, in addition to containing high amounts of tryptophan, cysteine, leucine, isoleucine and lysine (Sgarbieri, 2004).

The benefits of whey protein in muscle hypertrophy are directly related to its amino acid profile, especially leucine, rapid intestinal absorption, and its influence on the release of anabolic hormones, such as insulin. Whey protein has been widely used by practitioners of physical activities due to its composition rich in essential amino acids, especially leucine, considered one of the main agents in stimulating protein synthesis (Oliveira *et al.*, 2006).

This protein is present in all types of milk, and in bovine milk it represents about 20% of the total protein, while the remaining 80% is composed of casein, with varying amounts according to the origin of the milk (Devries; Phillips, 2015; Haraguchi *et al.*, 2006). Whey protein proteins are absorbed faster than other protein sources, resulting in high concentrations of plasma amino acids soon after ingestion, promoting greater muscle anabolism (Devries; Phillips, 2015). In addition, there is a significant increase in plasma insulin, facilitating the entry of amino acids into the muscle cell, reducing protein catabolism and, consequently, enhancing muscle synthesis (Haraguchi *et al.*, 2006).

Another relevant benefit of whey protein is its ability to contribute to the reduction of body fat, attributed to its high concentration of calcium and branched-chain amino acids, which can positively influence lipid metabolism, favoring body composition and athletic performance.

ASPECTS OF THE BCAA

According to Alves (2002), BCAA is the acronym for "Branched Chain Amino Acids", which comprise three essential amino acids: leucine, isoleucine and valine. These amino acids are mainly found in animal-based protein sources and play a key role in protein synthesis and muscle recovery.

In healthy humans, nine amino acids are considered essential as they cannot be synthesized by the body and therefore need to be obtained through the diet. Among these essential amino acids, BCAAs stand out, responsible for approximately 35% of the composition of striated muscles. These amino acids are abundant in protein-rich foods such as meat, eggs, and dairy products (Haluch, 2018; Rogero; Tirapegui, 2008).

Research has explored the benefits of BCAA supplementation, investigating its anti-catabolic action, its role in muscle hypertrophy, glycogen preservation, postponement of central fatigue and strengthening the immune system (Alves, 2002). Branched-chain amino acids play an essential role in the regulation of several cellular processes, not only acting as muscle signals, but also modulating gene expression and phosphorylation cascades involved in protein synthesis. In addition, they perform essential functions in the metabolic pathways responsible for cell health, growth, maintenance, and reproduction.

Essential amino acids, especially BCAAs, favor anabolism and reduce protein catabolism, promoting muscle strength gain and minimizing muscle mass loss during weight loss processes. In addition, they contribute to the improvement of muscle performance by increasing glutathione concentrations, reducing the action of oxidizing agents in skeletal muscles (Van Loon, 2007).

BCAA is one of the main constituents of muscle fibers and, although the body is able to synthesize it in small amounts, supplementation can be beneficial in situations of aerobic and high-intensity exercise. Deficiency of these amino acids can lead to loss of muscle mass and impairment of the immune system, making their adequate intake essential for maintaining health and physical performance.

THE EFFECTS OF STRENGTH TRAINING ON MUSCLE HYPERTROPHY, AS AN IMPROVEMENT IN FACTORS FOR A HEALTHY LIFE.

Muscle hypertrophy is the process by which muscle mass increases, and resistance exercise is one of the most effective stimuli for this development.

Currently, weight training, also called resistance training or weight training, is widely used by people of different ages and genders, both to improve sports performance and to maintain quality of life. According to Geraldes (2003), strength training, also known as

resistance training, resistance training or bodybuilding, is a term used to describe various approaches aimed at the development of strength, endurance or muscle power, especially in modalities such as bodybuilding and weightlifting.

In this way, strength training has been consolidated as one of the most popular practices to improve physical fitness, promoting benefits such as maintaining health, delaying aging and reducing the incidence of diseases associated with a sedentary lifestyle, in addition to contributing to body aesthetics.

Food supplements can be defined as products formulated from vitamins, minerals, tissue extracts, proteins, amino acids and other substances, being consumed with the purpose of improving health and preventing diseases. According to Coromona (2006), the main factors that lead to the beginning of the practice of strength training, regardless of age, are related to quality of life and health, including weight control or loss, in addition to reducing the risk of developing or recurrence of diseases, especially cardiovascular diseases.

In this context, physical activity requires athletes to maintain a delicate balance between energy demand and macro- and micronutrient intake, making adequate nutritional support essential. According to Assumpção *et al.* (2010) apud Bompa (2002), resistance training promotes muscle growth, as well as the increase in the cross-sectional area of the muscle, due to factors such as the increase in myofibrils, the increase in protein synthesis and the increase in the number of muscle fibers.

Muscle strength performance depends not only on hypertrophy, but also on the nervous system's ability to activate muscles efficiently. Neuromuscular control plays a crucial role in strength training exercises, being a complex process. When a new exercise is introduced into the training program, an initial increase in performance may occur, justified, in part, by neuromuscular adaptations that optimize the control and activation of the muscles involved in movement.

RESULTS AND DISCUSSIONS

The research analyzed the importance of the nutrition professional in the guidance and prescription of food supplements, highlighting their relevance to the health and physical performance of physical activity practitioners. The discussion among the authors consulted reinforces the need for adequate follow-up, considering that nutritional supplementation, when used without proper guidance, can lead to several health problems.

According to Alves (2002), nutrition is a determining factor for improving sports performance, as a balanced intake of macronutrients and micronutrients is essential to

optimize performance and avoid nutritional deficits. This corroborates the findings of Hirschbruch (2014), who highlights that a balanced diet and regular physical exercise result in improved metabolism, reduced body fat and increased lean mass. In this sense, the intervention of a qualified nutritionist allows the adaptation of diets and supplementation plans according to the individual needs of each practitioner.

The study by Sgarbieri (2004) highlights the importance of the protein profile of supplements such as whey protein, pointing out that the rapid absorption and high content of essential amino acids favor protein synthesis and muscle recovery. In addition, Oliveira *et al.* (2006) reinforce that leucine, present in whey protein and BCAA, plays a crucial role in stimulating protein synthesis, justifying the importance of supplementation under professional prescription.

In addition, research by Van Loon (2007) indicates that branched-chain amino acids (BCAAs) favor anabolism and reduce protein catabolism, contributing to strength gain and muscle mass preservation, especially in periods of caloric deficit. These findings converge with the contributions of Haluch (2018), who highlights that about 35% of striated muscles are made up of BCAAs, evidencing their importance in muscle metabolism.

Creatine, in turn, has been widely studied by Gualano *et al.* (2010), who point out that its supplementation can increase the muscle pool of creatine by up to 20%, resulting in improvements in physical performance, strength and muscle hypertrophy. Maham *et al.* (2012) complement this analysis, demonstrating that, in vegetarian athletes, this percentage can be even higher, reaching 60%.

The need for professional follow-up is also emphasized by Assumpção *et al.* (2010) apud Bompa (2002), when they indicate that resistance training promotes muscle hypertrophy, but depends on the adequate intake of proteins and other nutrients to optimize their effects. Without proper supervision, the absence or excess of certain nutrients can compromise muscle recovery and athletic performance.

Thus, it is understood that the nutrition professional plays an essential role in the guidance, monitoring and appropriate food prescription for each practitioner of physical activity. The presence of this specialist ensures that supplementation is done correctly, safely, and effectively, avoiding health risks and optimizing the expected results. In addition, its performance enables continuous monitoring, adjusting strategies according to the evolution and individual goals of the practitioner.

Therefore, it was concluded that nutritional supplementation should be carried out with scientific basis and professional guidance, and the support of the nutritionist is

essential to avoid nutritional imbalances and promote effective benefits for health and sports performance.

FINAL CONSIDERATIONS

In view of the investigation carried out, it is concluded that nutritional supplementation should be understood as a complement to diet and physical training, and not as a substitute for adequate nutritional bases. The study allowed us to respond to the central problem, showing that the consumption of food supplements can optimize muscle hypertrophy and sports performance, as long as it is carried out in a guided way and based on individual needs.

In addition, it was found that supplementation, when associated with planned training, respecting rest times and adequate stimuli, can promote significant gains in strength and muscle mass, in addition to helping to reduce body fat. As discussed, the literature analyzed reinforces the effectiveness of the use of whey protein, creatine and BCAA to improve sports performance, as long as consumption is properly guided by a qualified professional.

Another crucial point identified is the need for specialized nutritional monitoring. The research showed that the absence of a qualified professional can lead to errors in the prescription and misuse of supplements, leading to health risks. In this way, the presence of the nutritionist proved to be essential to ensure a balanced eating plan aligned with the needs of each individual.

In addition, the practice of physical activities has been confirmed as an essential factor for quality of life, bringing benefits not only aesthetically, but also metabolically and functionally. Nutritional supplementation, combined with well-structured training and a balanced diet, enhances these benefits, but it must always be used responsibly.

Finally, this research reinforces that supplementation is not an isolated solution, but a strategic resource that, when well applied, can optimize results and contribute to the improvement of physical performance. Thus, it is recommended that future studies explore in more depth the impacts of supplementation in different populations and sports contexts, expanding the understanding of its effects and practical applications.

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