ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2023; 9(1): 173-177

www.oraljournal.com
Received: 10-11-2022
Accepted: 15-12-2022

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Sports nutrition supplements: Current dental perspective

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DOI: https://doi.org/10.22271/oral.2023.v9.i1c.1679

Abstract
Introduction: Despite their frequent consumption, studies on oral cavity effects of sports supplements that have shown a positive effect on health or performance are scarce.
Methodology: Current literature review in the dental, medical and public health fields was carried out using the following databases: Pubmed, MedLine and Biblioteca UANL. Whey protein, creatine, magnesium and beta alanine were used from which those framed in the dates 2017-2022 were selected.
Results: Whey protein: When interacting with salivary proteins, they remove the lubricating saliva layer of the mouth and can directly influence the epithelial tissue; in acidic conditions they exhibit astringency which is perceived as increased oral friction or roughness. Creatine: Exhibits non-energy related properties, contributing as a possible direct and indirect antioxidant and eliciting anti-inflammatory effects. Magnesium: In the oral cavity, low dietary intake of magnesium or deficiency is associated with the prevalence of periodontitis. Beta Alanine: The only reported side effect is paresthesia, this can be attenuated by using lower divided doses (1.6 g) or by using a sustained release formulation.
Conclusion: It is important to investigate in the initial questioning of patients in the dental office about the possible use of sports nutrition supplements, since some of them could have repercussions on systemic and oral health. Its use should be taken hand in hand with a specialist since the recommended doses could vary depending on age, gender, requirement and general condition.

Keywords: Whey protein, beta alanine, creatine, magnesium

1. Introduction
Despite being consumed frequently, supplements that have shown a positive effect on health or performance are scarce [1]. Recently, a new class of dietary supplements called multi-ingredient pre-workout supplements has increased in popularity. The combination of these supplements may elicit a synergistic effect on acute exercise performance and training adaptations [2]. It is estimated that 20% to 60% of athletes suffer from stress caused by excessive exercise and inadequate recovery [3]. However, the effects of continuous supplementation concurrent with resistance training programs are less well characterized [4].
Due to dietary supplementation, the gut microbiota has recently been implicated in athletic performance by enhancing muscle function through the delivery of certain metabolites [5]. There is an oral detection of a variety of food flavors (e.g., carbohydrates, quinine, menthol, caffeine, liquid, acetic acid) and this may provide a central nervous system-derived boost to sports performance [6]. However, carbohydrates remain king and that carefully selected ergogenic aids (e.g. caffeine, creatine, sodium bicarbonate, beta-alanine, nitrates) can promote adequate performance [7].
We describe the four most commonly used sports nutrition supplements in use today, starting with Whey Protein (WP), a widely consumed nutritional supplement known to improve strength and muscle mass during resistance training regimens [8]. Next we have Creatine (methylguanidine-acetic acid) which is formed endogenously from reactions involving the amino acids arginine, glycine and methionine in the kidneys and liver [9]. Following this, Beta-alanine (BA) is a non-essential amino acid that can be synthesized in the liver and obtained from the diet, particularly from white and red meat.

It appears to improve perceived exertion and biochemical parameters related to muscle fatigue [10]. Finally, magnesium (Mg) observational studies have revealed a link between low Mg levels and inflammation [11]. This also leads to an improvement in certain parameters of iron status even in individuals with optimal levels of these indices [12].

There is currently insufficient research reporting on all possible side effects of the use of sports nutrition supplements, as well as their possible systemic and oral cavity involvement. Since numerous studies indicate that their use is safe, it is important that their dosage be indicated by a physician and that their continuous intake be monitored. Therefore, the objective will be to analyze the literature on the most currently used sports supplements.

2. Materials and Methods

Articles on the subject published through the PubMed, SCOPUS and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was evaluated using guidelines, i.e., identification, review, choice and inclusion.

The quality of the reviews was assessed using the measurement tool for evaluating systematic reviews. The search was performed using Boolean logical operators AND, OR and NOT; with the keywords: "sports nutrition supplements", "whey protein", "creatine", "magnesium", "beta alanine", "dental". The keywords were used individually, as well as each of them related to each other.

3. Results & Discussion

3.1 Whey Protein

3.1.1 Mechanism of action

WP is a by-product containing highly bioactive molecules, such as epidermal growth factor, colony stimulating factor, transforming growth factor α and β, insulin-like and fibroblast growth factor [13].

3.1.2 Benefits of its use

In recent years, this supplement has been used as a functional ingredient in various food applications due to its emulsifying, foaming and gelling properties [14]. This is why it is considered as an effective nutritional strategy to restore the acute loss of contractile function that occurs after strenuous physical exercise [15]. In the area of oncology, subfractions such as bovine alpha-lactoalbumin, bovine serum albumin and whey protein lactoferrin have been identified as having specific anticancer effects and have the potential to hinder tumor pathways [16].

3.1.3 Systemic involvement

In the oral cavity, protein fortification may cause negative sensory attributes such as dry mouth and may be increased in elderly patients [17]. Due to increased free thiols and hydrophobic regions are two factors known to increase mucoadhesive strength and thus increase oral retention of whey protein [18]. This happens because as WP interact with salivary proteins, they remove the lubricating saliva layer from the mouth and can directly influence the epithelial tissue; particularly in acidic conditions, exhibiting astringency that is perceived as increased oral friction or roughness[19]. Although their impact on lithogenic parameters is so far unknown due to the wide individual variation and the observed increases/decreases for urinary calcium, sodium and pH suggests the need for closer monitoring [20]. Numerous studies report that chronic and unprofessionally unguided use of WP can cause adverse effects, especially on renal and hepatic function [15].

WP have been used for many years due to their nutritional benefits. However, it has been observed that the main side effect in the oral cavity is the drying of the mouth that can trigger periodontal disease and caries by not allowing proper lubrication by saliva.

3.2 Creatine

3.2.1 Mechanism of action

In the human body, creatine supplementation is relatively well tolerated, especially at recommended doses (i.e., 3-5 g/day or 0.1 g/kg body mass/day) [9]. The efficacy of creatine may be due to the fact that anthracyclines reduce the expression of the creatine transporter and to the pleiotropic antioxidant properties of creatine [21].

3.2.2 Benefits of its use

It has been shown to increase intramuscular creatine concentrations, which may help explain the observed improvements in high-intensity exercise performance leading to greater adaptations to training [22]. Systemically, creatine has been found to exhibit non-energy related properties, contributing as a potential direct and indirect antioxidant and eliciting anti-inflammatory effects [23]. It may also play a role in preventing and/or reducing the severity of injuries, improving injury rehabilitation and helping athletes tolerate heavy training loads [22].

3.2.3 Systemic involvement

Creatine is identified as capable of reducing neuronal damage, protecting against the effects of cellular energy crisis and improving cognitive and somatic symptoms [24]. It has also shown promise in attenuating symptoms of concussion, mild traumatic brain injury and depression, but appears to have no effect on neurodegenerative diseases [25]. Because most studies have focused on young athletic individuals, there is limited knowledge about the effects of creatine in children or the elderly [26]. However, creatine should not be used in individuals with chronic kidney disease or using potentially nephrotoxic medications [27].

Creatine has been shown to have anti-inflammatory effects and is currently identified as a safe supplement systemically and without oral cavity conditions so far, further studies are needed to demonstrate its long-term use.

3.3 Magnesium

3.3.1 Mechanism of action

Mg is an essential element that also has pleiotropic effects in humans (Van and *et al*, 2019). Oral supplementation with Mg reduces insulin resistance and improves indicators of glycemic control among patients with type 22 diabetes [28]. Mg is a natural calcium antagonist, which exerts neuroprotective effects through several mechanisms [29].

3.3.2 Benefits of its use

Mg has been introduced as one of the micronutrients with several metabolic benefits, mainly anti-inflammatory properties [30]. In recent years, the benefits of intraoperative Mg supplementation during general anesthesia and postoperative pain have been reported [31].

3.3.3 Systemic condition

Mg is a cofactor of SpxB catalytic activity and supplementation increases H2O2 production in vitro, the

ability of H2O2 to antagonize susceptible oral bacterial species, including caries-associated Streptococcus mutans, as well as several periodontal pathobionts, has been confirmed [32]. That is why in the oral cavity, low dietary magnesium intake or deficiency is associated with the prevalence of periodontitis [33]. Recently, an association has been demonstrated between low serum Mg concentrations or Mg intake and increased atherosclerosis, coronary artery disease, arrhythmias and heart failure [34]. Mg deficiency may negatively influence bone and muscle health. In the presence of lower values are related to the presence of osteoporosis, and that about 30-40% of subjects (mainly menopausal women) have hypomagnesemia [36]. However, it is currently unclear whether mild hypermagnesemia confers a survival benefit, especially in subjects with decreased renal function [28].

Mg in low concentrations is associated with periodontal disease, bone and cardiovascular disease. It is important to emphasize that numerous studies indicate the benefits of this supplement in reducing postoperative pain due to its anti-inflammatory properties.

3.4 Beta Alanine

3.4.1 Mechanism of action

Supplementation with BA is one of the most widely used sports supplements in the world, and its use as a nutritional strategy is increasing, due to evidence of ergogenic and therapeutic pleiotropic benefits [37]. This supplement shows effects on metabolic participation (aerobic and anaerobic) and exercise performance through possible buffering of blood acidosis [38].

3.4.2 Benefits of its use

The popularity of BA derives from its ability to enhance intracellular muscle buffering capacity, which delays fatigue during high-intensity exercise by increasing muscle carnosine content [39]. By counteracting the deficits in executive function that accompany endurance exercise, the aging population can more safely maintain the benefits of exercise [40]. BA supplementation may improve cognition and mitigate symptoms of anxiety and depression associated with aging, neurological disorders and physical exertion [41]. It can also reduce fasting glucose and fasting insulin in humans; this compound shows potential as a therapeutic agent to improve glycemic control and insulin resistance [42].

3.4.3 Systemic condition

The only reported side effect is paresthesia (tingling), but studies indicate that this can be attenuated using lower divided doses (1.6 g) or using a sustained release formulation [43]. However, chronic supplementation with BA can increase intramuscular carnosine content, the most commonly cited functions of carnosine being that of intramuscular pH buffer and calcium regulator [44].

BA has benefits in sports performance due to muscle buffering and so far the only side effect described that should be taken into account when attending the dental office is paresthesia, however, it is preventable by reducing the dose.

4. Conclusions

Creatine is currently the supplement with the most scientific evidence supporting its safe use and its contraindication is limited to patients with renal disease. Beta alanine was reported to have anti-inflammatory benefits in postoperative patients. The two supplements that could affect the oral cavity would be whey protein due to the astringency it produces and magnesium in low levels is related to periodontitis.

5. Conflict of Interest

Not available

6. Financial Support

Not available

7. References

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How to Cite This Article
Alva MAC, Cepeda SEN, Longoria JAG, Silva JYG, Quintana GM, Maria de los AMB, *et al*. Sports Nutrition Supplements: Current dental perspective. International Journal of Applied Dental Sciences. 2023;9(1):173-177.