SUPPLEMENT GUIDE FOR STREET RUNNERS

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Ricardo Figueiredo Pinto

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INTRODUCTION

I am honored to present the digital e-book "Supplement Guide for Street Runners", a scientific production made through my PhD thesis in Public Health. This e-book was planned, developed and executed exclusively to fill a gap related to guidance on the consumption of supplements.

The e-book, as well as having the responsibility of adding to the knowledge of prescribing sports supplements, also brings together information aimed at a sport that is gaining new followers every year: street runners. It is ideal for those looking for quality guidance on supplements, but under no circumstances does it replace the professional qualified to prescribe them: the Sports Nutritionist.

Thus, in this e-book we have a thorough reading of current scientific literature, involved in the production process, distributed in ten supplements that provide information related to the types, indications, recommendations, and adverse reactions of the supplements most consumed by street runners, whose main justification for their consumption is to improve performance.

Finally, I would like to thank everyone who contributed in some way to making this guide happen. My advisor post-doctorate professor Ricardo Figueiredo Pinto for his guidance, competence, and professionalism. A special thank you to my family, my safe haven, for all the lessons of love, friendship, charity and dedication. I feel proud and privileged to have you. Thank you for making my dream our dream. Finally, to all those who have contributed, directly or indirectly, to the realization of this guide, my sincere thanks.

Therefore, I invite everyone to make the most of the contents of this work and to share this e-book with their peers, friends, professional colleagues, and academics.

Profa. Dra. Joseana Moreira Assis Ribeiro

INDICE


WHEY PROTEIN

WHEY PROTEIN

PRESENTATION

It is a protein derived from whey, the portion that is made when the cheese is being manufactured, in which there is 20% of the protein found in bovine milk, with a high content of essential amino acids. The amino acids present in whey proteins exceed the recommended doses for children aged two to five and adults, which makes this protein source the most concentrated in essential amino acids compared to other protein sources.

TYPES

As industry advances, particularly in membrane separation techniques such as microfiltration and ultrafiltration, and with new discoveries of the importance of milk proteins, there has been a great increase in research aimed at intensifying the use of these products (MULLER et al., 2014).

These new processing methods have led to the emergence of different whey protein fractions related to their content: Whey Protein Concentrate, Whey Protein Isolate and Whey Protein Hydrolysate. Whey Protein Concentrate can vary in protein content from 25 - 80%, while Whey Protein Isolate has around 90% protein.

INDICATION

Whey proteins play an important role in improving the body composition of physically active individuals. The effects of whey protein consumption on the body influence muscle synthesis, which occurs concomitantly with the loss of fat mass. It is well established that physically active people and athletes need more protein than sedentary individuals. The consumption of proteins and carbohydrates facilitates the process of preserving muscle glycogen, which is an essential substrate for improving physical performance (Nogueira; Souza; Brito, 2015).

WHEY PROTEIN

INDICATION

LMuscle hypertrophy is developed because of biological factors and external stimuli. Resistance training generates micro-injuries in the muscles and the repair process occur through protein synthesis, which can increase the size of the cells (hypertrophy) or increase the number of cells (hyperplasia), resulting in an increase in muscle mass. The process of building muscle mass involves two stages: the breakdown of muscle protein and its synthesis. These two processes occur naturally in our bodies and the use of muscles is what determines the prevalence of each (Nogueira; Souza; Brito, 2015).

In the context of street runners, its use is aimed at gaining muscle mass and muscle repair, making them stronger, and these are some of the main characteristics that cause athletes seek its use.

When used more frequently, protein synthesis is stimulated, resulting to increased absorption of this nutrient, and stimulating muscle cell hypertrophy. When used infrequently, there is a decrease in protein synthesis and consequently a reduction in muscle mass. Muscle hypertrophy is a constant process of adaptation, in which myofibrils replicate within muscle fibers, causing muscle growth (Villanueva; Schroeder, 2014).

Some factors associated with nutrition influence protein synthesis such as: source - vegetable or animal, dose - amount offered in a meal, time - ingestion before or after training, standard amino acid pattern of protein consumed according to dose and frequency; and the ingestion of macronutrients combined, such as: carbohydrates and/or lipids (Witard et al., 2016).

In addition, Whey Protein may have antioxidant characteristics due to the production of a peptide named glutathione which is composed of glutamate, cysteine and glycine which have an antioxidant effect, during physical exercise reactive oxygen species are released resulting in oxidative stress (Becker, et al, 2016).

WHEY PROTEIN

RECOMMENDATIONS

The human body undergoes repair processes daily, and the nutrient responsible for this process is protein. Protein plays a role in maintaining, repairing, and building tissues, for this reason it is so important to provide the body with the ideal amounts of this nutrient. Once ingested, protein is broken down into small units called amino acids during the digestion process. It is these amino acids that enter the cells, regroup, and promote tissue recovery, especially when they suffer micro-injuries caused by strength training (Kleiner; Robinson, 2016).

Therefore, people who exercise may need more protein than sedentary individuals. The more intense the training, the greater the need for protein to ensure muscle maintenance and development. The dietary ingestion of protein needed to restore and hypertrophy cells varies between 1.2 and 2.0 g/kg/day (Kleiner; Robinson, 2016).

ADVERSE REACTION

Whey Protein is the most consumed supplement in the sports world. It is recommended for consumption after strength training, as it provides the body with a vast amount of easily absorbed protein that is important for muscle recovery. This necessary protein ingestion can be obtained during a day of good nutrition, but the supplement offers a large portion at one go. In this case, it is important to beware of high protein concentrations, as improper use of Whey Protein can overload the renal system, so athletes need to be aware of the portion needed to achieve their goals without putting their body's health at risk (Freitas; Costa; Costa, 2017).


CREATINE

CREATINE

1 PRESENTATION

Creatine comes from amino acids found naturally in human tissues and is synthesized through a simple metabolic process involving two enzymes and three amino acids, namely arginine, methionine, and glycine (Zanelli et al., 2015). It is worth remembering that creatine is not classified as an essential nutrient due to its possibility of endogenous synthesis through the amino acids glycine, methionine and arginine (Stábile et al., 2017).

2 TYPES

Creatine can be found in various molecular forms, monohydrate, micronized, alkaline, etc., but it can also be in liquid, gel, powder, and pills (Andres, et al., 2016).

3 INDICATION

A word of Greek origin, meaning Kreas (meat), it has the function of regenerating adenosine triphosphate in the body, exercising an important role in providing rapid energy. Inside the mitochondria, because of reactions catalyzed by the enzyme CK (creatine kinase), creatine receives a phosphoryl group from ATP (adenosine triphosphate) and is transformed into phosphorylcreatine, which is then transported to the cytosol. When the cell's energy demand is fast and high, phosphorylcreatine, in association with a molecule of ADP (adenosine diphosphate) and a hydrogen ion (H+) react, in a reaction catalyzed by CK, and form a molecule of ATP and creatine (Pinto, 2015). However, it does not improve conditions when performing low-energy activities, as it does not reach the requisites for the expenditure of energy reserves (De Souza; Silva, 2022).

4 RECOMMENDATIONS

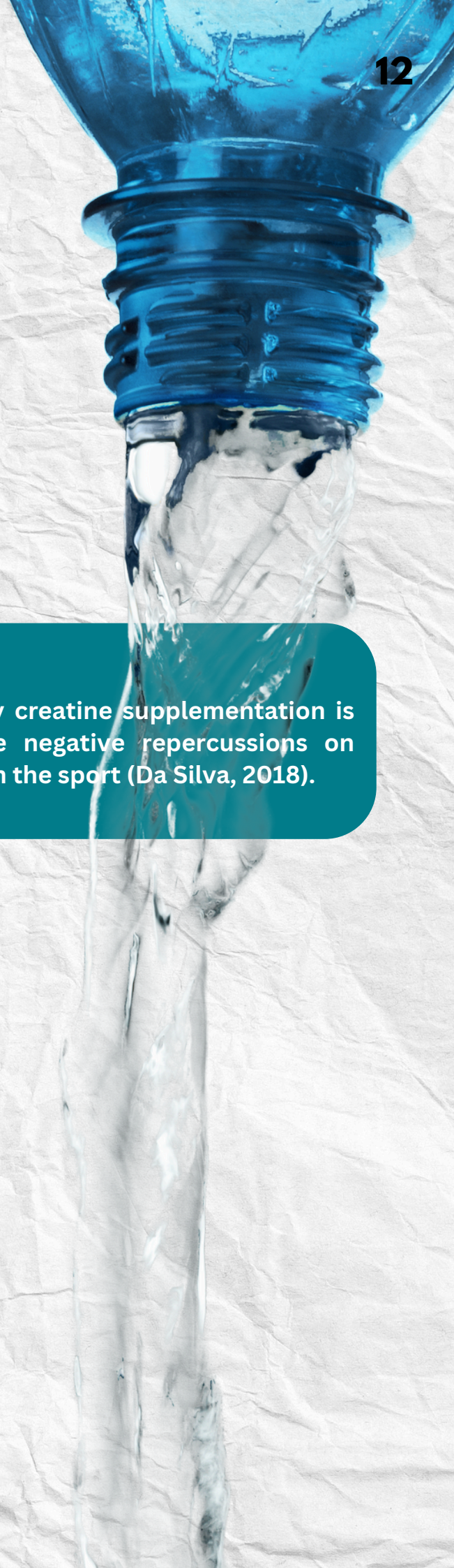
Creatine is present in many of the foods that compose the traditional diet. Its concentration is most common in foods of animal origin, which contain around 3 to 5g of creatine per kilogram of cooked meat. Consider that cooking processes can degrade a significant part of the creatine in food (Stábile et al., 2017).

Once synthesized, creatine is metabolized into phosphocreatine, which is a very important storage form used by the brain, heart, testicles and contractile muscles (De Souza; Silva, 2022).

Creatine has various effects when it enters the muscle. For this reason, muscle function is optimized during exercise. Thus, numerous mechanisms have been proposed for the increased performance after creatine ingestion (Gualano et al., 2010).

Since creatine was described and started to be used as a source of supplementation, protocols have been structured for its correct use, where for athletes it should contain between 1.5 and 5g of creatine in the portion defined by the manufacturer. In the saturation protocol (20g divided into 4 or 5 times), over 5 to 7 days, the total content of this substance in the muscle rises by around 10 to 20% (Zanelli et al., 2015).

CREATINE



5 ADVERSE REACTION

The only adverse effect caused by creatine supplementation is water retention, which has some negative repercussions on physical performance depending on the sport (Da Silva, 2018).


GLUTAMINE

GLUTAMINE

PRESENTATION

It is a known supplement on the market, sometimes popularly referred to as the "immunity shot". It consists of a non-essential amino acid, which is normally synthesized by our body and is freely available in plasma and muscle tissue, being essential for various metabolic processes, such as protein synthesis (Agostini; Biolo, 2010).

However, even though it is synthesized in large quantities, when the individual's body goes through hypercatabolic conditions after intense training or restrictive diets, the process of synthesizing this amino acid becomes deficient, which can compromise the individual's immune system (Agostini; Biolo, 2010).

INDICATION

The glutamine, when used in supplementation, is expected be largely absorbed extent in the small intestine. As a result, the amino acid becomes essential for maintaining intestinal homeostasis and can be used in place of glucose as an energy source. Glutamine also provides the necessary substrates to help the proliferation of intestinal cells, guaranteeing the absorption of other nutrients, preventing damage to the intestine, and balancing the permeability and basal conditions of this organ. Another essential function of glutamine has been its role as a potentiator for immune cells. This means that it can be indispensable for the body's defense against diseases and infections (Growth, 2022).

The main tissue responsible to produce glutamine in adults is the skeletal striated muscle, meaning that its role is fundamental for the metabolism and regulation of glutaminemia (Rowbottom et al., 1995).

GLUTAMINE

RECOMMENDATIONS

LGlutamine is the most concentrated amino acid in the body and is considered a conditionally essential amino acid, meaning that although it is synthesized by the body, under certain conditions its consumption in the diet becomes necessary. The negative nitrogen balance created by various situations leads to an intracellular depletion of glutamine. During periods of health recovery, all amino acids return to their normal baseline values, except for glutamine, which maintains a significant reduction, this being used as a quantitative response to the catabolic state (Schöler; Krause, 2017).

In relation to glutamine supplementation and physical exercise, there is an increase in circulating glutamine during intense and short-term exercise and a reduction during exhaustive and prolonged exercise, which can be explained by the concomitant transient immunodepression. To avoid this condition, the oral use of glutamine during or immediately after exercise is suggested to re-establish adequate levels, due to the greater availability of this amino acid for immune cells, resulting in a reduction in infections (Schöler; Krause, 2017).

ADVERSE REACTION

The supplement can indirectly affect food ingestion and absorption through discomfort in the digestive system, such as nausea, vomiting, anorexia, abdominal pain, diarrhea, fever, stomatitis, mucositis, and food aversion (Silva; Pinheiro, 2017).


MALTODEXTRIN

MALTODEXTRIN

PRESENTATION

It is a supplement rich in carbohydrate derived of starch. Despite being a complex carbohydrate, it is easily absorbed by the body and due to this characteristic, it is the most consumed supplement among those rich in this nutrient (Freitas; Costa; Costa, 2017).

INDICATION

Maltodextrin has an important function in the process of optimizing the use of energy in the process of muscle contraction, decreasing the subjective perception of effort which reflects in delaying fatigue due to the elevation of plasma glucose, and the decrease in plasma lactate and cortisol (Lima; Silva, 2020).

In turn, carbohydrates have been associated with a reduction in the increase in cortisol response during exercise, which represents a process called immune regulation factor, becoming interesting for athletes to supplement with carbohydrates, taking into account the duration of training, intensity, loss of body fluids, drop in blood glucose levels and depletion of muscle glycogen reserves (Nascimento, 2018).

MALTODEXTRIN

RECOMMENDATIONS

Maltodextrin is a glucose polymer widely used in the manufacture of sports drinks, which are produced commercially in a synthetic form from the controlled hydrolysis of starch. Its concentration can vary between 5% and 20%, although stronger or weaker concentrations can be controlled from the powder formulation (Costa, et al., 2010).

The supplement contributes to performance. It can be consumed before or after prolonged training, and is related to efficiency in muscle glycogen resynthesis, as well as improving the athlete's recovery.

Significant improvements in performance were observed when maltodextrin was consumed before a workout, regardless of variables such as time, concentrations and intensity and duration of exercise, and no episodes of rebound hypoglycemia were reported (Coletta; Thompson; Raynor, 2013).

Positive effects on the replenishment of muscle glycogen stores were observed with maltodextrin supplementation both immediately after training and over the next few hours after exercise, thus avoiding the use of protein as an energy source, resulting in efficiency in the muscle recovery process (Becker et al., 2016).

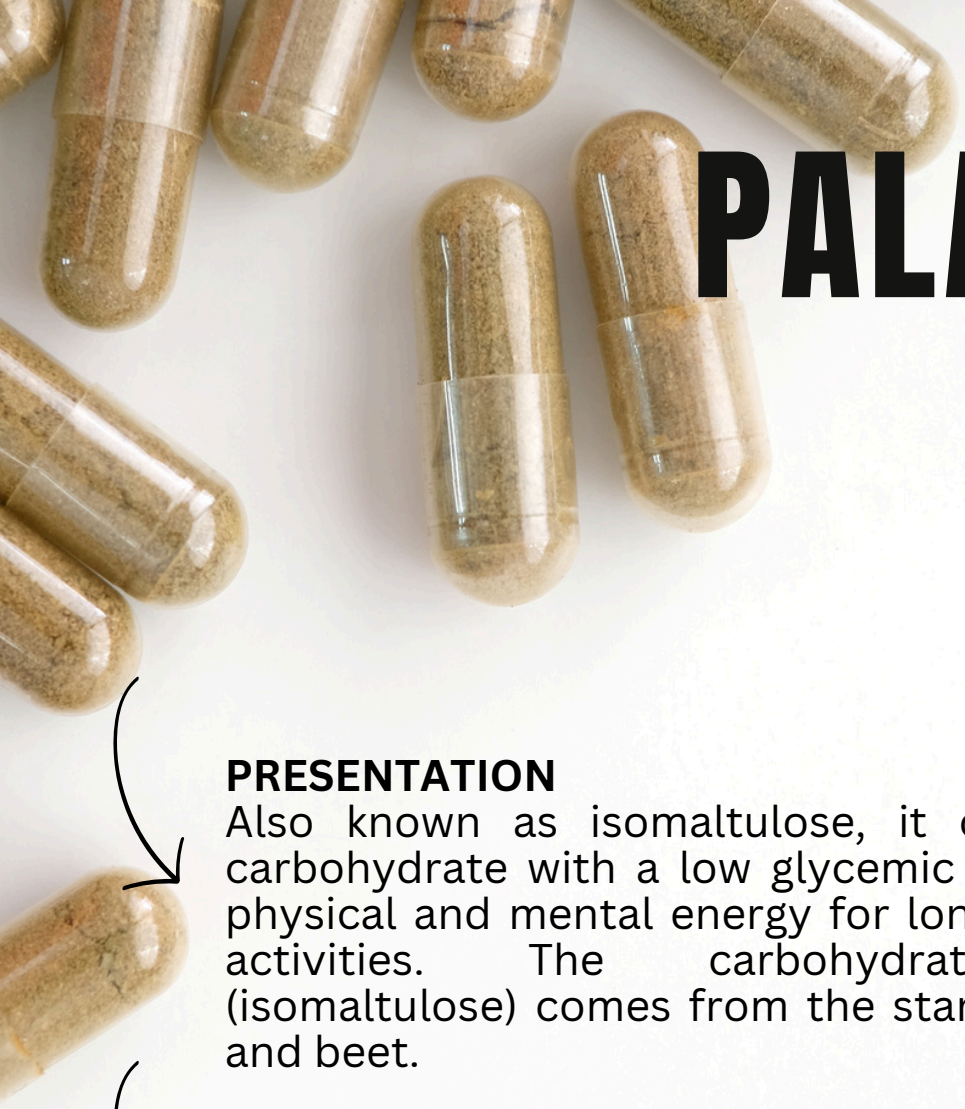
The main properties of carbohydrate forms for consumption are practicality of use, their purpose and gastric emptying and intestinal absorption times, which depend on various factors, such as: osmolarity; volume; intensity and type of exercise; pH; temperature and the athlete's level of dehydration. Among the various forms available, drinks such as sports drinks have a higher gastric emptying rate and are used when there is a need for rapid energy release, followed by semi-solids such as gels and solids such as bars, which are indicated when there is a need for gradual carbohydrate release and absorption (Pereira et al., 2012).

MALTODEXTRIN

ADVERSE REACTION
Long-term maltodextrin supplementation is associated with an elevated renal glycogen concentration after continuous aerobic exercise (Verdan; Dos Santos; Junior, 2021).

PALATINOSE

PALATINOSE



PRESENTATION

Also known as isomaltulose, it consists of a natural carbohydrate with a low glycemic index, which provides physical and mental energy for longer when carrying out activities. The carbohydrate-rich supplement (isomaltulose) comes from the starch, honey, sugar cane and beet.

INDICATION

Discovered and developed in Germany in the Palatinate region, it is a carbohydrate with a low glycemic index (GI = 32), in other words, there is no release of a high concentration of insulin (peak), but rather in a more constant and prolonged form, and it is therefore used for longer activities such as running. Because it has this characteristic, there is an increase in the use of fat as an energy source, which benefits body composition, as well as improving performance, due to the saving of glycogen in the body (Santinoni; Rosa, 2015).

A disaccharide with a slow absorption rate, it has been shown to have an impact on post-meal glucose levels, satiety, and the accumulation of adipose tissue, as well as improving the lipid profile (triglycerides and free fatty acids) due to peripheral lipolysis because of low insulin concentrations, but it provides the same number of calories as other carbohydrates (Suklaw et al., 2015).

PALATINOSE

RECOMMENDATIONS

Contributing to performance, consumption can be carried out before and after prolonged training, being related to an efficiency in the resynthesis of muscle glycogen, in addition to improving the athlete's recovery (Sardá et al., 2018).

In food, palatinose comes in a low concentration, making it impractical to consume half a kilo of beet before running. According to a study by researchers at the University of Freiburg, when comparing fat burning after consuming drinks with palatinose and a high glycemic index drink with maltodextrin, it was shown to be lower than maltodextrin.

ADVERSE REACTION

The use of carbohydrates must be very carefully evaluated, as excessive use can cause the accumulation of body fat. The body has a limited capacity to use stored glucose for energy. Once cells have reached their maximum capacity for storing glycogen, excess sugar is readily transformed and stored in the form of fat. Excessive carbohydrate ingestion can therefore lead to weight gain and an increase in body fat percentage.


CAFFEINE

CAFEÍNA

PRESENTATION

Caffeine belongs to the methylxanthine group (1,3,7 trimethylxanthine) and is a pharmacologically active alkaloid. Naturally produced by a variety of plants, it is present in foods and drinks such as guarana, green tea, coffee, Coca-Cola, chocolate, among others. It is a substance that is rapidly absorbed by the intestine, reaches its maximum concentration in the blood 45 minutes after oral ingestion, has an effect for 5 hours and is degraded in the liver and excreted (in small quantities) in the urine (Da Mata; Fialho; Setaro, 2020).

INDICATION

Gender, diet, body weight, genetics, hydration status and training are factors that affect the metabolism of caffeine, mainly related to excretion. It is often consumed acutely, pre-workout, to prevent fatigue and, consequently, improve performance in medium and long-term activities (Behrens, et al., 2015).

It has a pharmacological effect on the central nervous system, on fat metabolism, leading to an increase in the mobilization of fatty acids, and consequently weight loss, as well as saving muscle glycogen, reducing sensitivity to pain, speeding up muscle contraction by increasing calcium release, in addition to all these benefits are related to increased performance in both aerobic and anaerobic exercise. However, although the WHO considers its use to be safe, as it is a stimulant drug, it warns that it can cause addiction (Azevedo, et. al., 2016).

It is an important ally for improving performance, as it alters the perception of cognitive aspects of pain and fatigue, as well as increasing muscle contraction, in short races, but in long races the gains would be associated with reduced fatigue and pain, due to its action on the central nervous system, improving focus and concentration (Silva et al., 2018).
Caffeine also has antioxidant, anti-inflammatory and diuretic functions, and a preventive effect against some diseases, such as diabetes and Parkinson's (Pubchem, 2021).

RECOMMENDATIONS

It is considered a doping drug by the International Olympic Committee (IOC) when its urinary concentrations are above 12mg/L. The use of caffeine at a dosage of 3 to 6mg/kg of weight contributes to performance during exercise, provides more energy, prevents fatigue, and can help with weight loss.

ADVERSE REACTIONS

Excessive consumption (more than 600 mg per day) can cause reactions such as anxiety, irritability, insomnia, headache, arrhythmia, tachycardia, cardiovascular disease and gastrointestinal problems (Turnbull et al., 2017).

CARNITINE

CARNITINE

PRESENTATION

It is an amine synthesized in the kidneys, liver, and brain, but found in foods of animal origin. It promotes the transport of long-chain fatty acids from the cytosol to the mitochondria by B-oxidation, as well as maintaining adequate levels of free CoA.

INDICATION

Helps to improve sports performance in healthy individuals through various mechanisms: increased fatty acid oxidation, changes in glucose homeostasis, improved acylcarnitine construction and a reduction in the appearance of muscle fatigue (Mendes; Brito 2007). In addition, carnitine's course in oxidative metabolism has been shown to have an ergogenic effect during long-term exercise, thus increasing the rate of fatty acid oxidation and saving glycogen (Becker et al., 2016).

As it is associated with the reduction of body fat, this substance is often found in thermogenic supplements, giving rise to the hypothesis that carnitine has an effect (mobilization of fatty acids as an energy source) both at rest and during physical exercise, but there are still many disagreements about these effects (Coelho et al., 2010).

RECOMMENDATIONS

The ingestion of 2g of carnitine twice a day, in the study by Oliveira, Tavares and Dal Bosco (2015), for one week, increased the performance of swimming athletes and in the study by Gamze and Nevin (2013) with professional soccer athletes, showed a significant reduction in heart rate in addition to the postponement of exhaustion, with the consumption of 3 - 4g of L - carnitine.

ADVERSE REACTION

The diffusion of free fatty acids from the blood into the interstitial spaces of muscle fibers may be the greatest limitation to their use during exercise (Gomes; Tirapegui, 2000).


B-ALANINE

B-ALANINE

PPRESENTATION

It consists of an amino acid produced by the liver, and together with other amino acids has the function of relieving fatigue. It is a substance found in protein foods of animal origin such as poultry, meat, and pork, but it is not absorbed in its complete form because the enzyme carnosinase hydrolyzes it very quickly. According to the FDA's classification of supplements, beta-alanine is considered a class A supplement according to the level of evidence, related to its beneficial effects on sports performance, in high-intensity exercise lasting from 6 to 60s, due to the increase in carnosine synthesis, this being a dipeptide composed of beta-alanine and L-histidine (Cabral; Minakawa, 2021).

INDICATION

Because the human body is unable to absorb carnosine directly, beta - alanine supplementation is effective in increasing the reserves of this dipeptide, which has a significant function in regulating pH, causing muscle fibers to be sensitive to calcium, resulting in muscle contraction (Jones, et al., 2017).

Beta - alanine supplementation has been gaining prominence as a popular nutritional ergogenic resource, due to the increase it brings about in the concentration of carnosine in the muscle, with the availability of beta - alanine therefore being a limiting factor in the intramuscular synthesis of carnosine (Furst, et al., 2018).

According to Saunders et al. (2018), the combination of beta - alanine supplementation with sodium bicarbonate leads to additional gains in the tamponade process and in exercise.

RECOMMENDATIONS

Since beta-alanine was described and began to be used as a source of supplementation, protocols have been structured for its correct use, with a recommendation of 4.8 - 6.4g / day divided throughout the day (0.8 to 1.6 every 3 to 4h) over a period of 5 - 6 weeks in which an increase of 40% to 60% in muscle carnosine content can be observed (SAUNDERS et al., 2018). And when this protocol is combined with adequate nutrition, a potentiating role in increasing muscle carnosine levels can be observed (Stegen, et al., 2013).

ADVERSE REACTION

Regarding the possible side effects of beta - alanine supplementation, studies cite symptoms lasting 60 minutes after consumption of hot flushes, redness, and tingling sensation on the skin with the consumption of 40mg (Roverattl et al., 2019).


ISOTONIC DRINKS

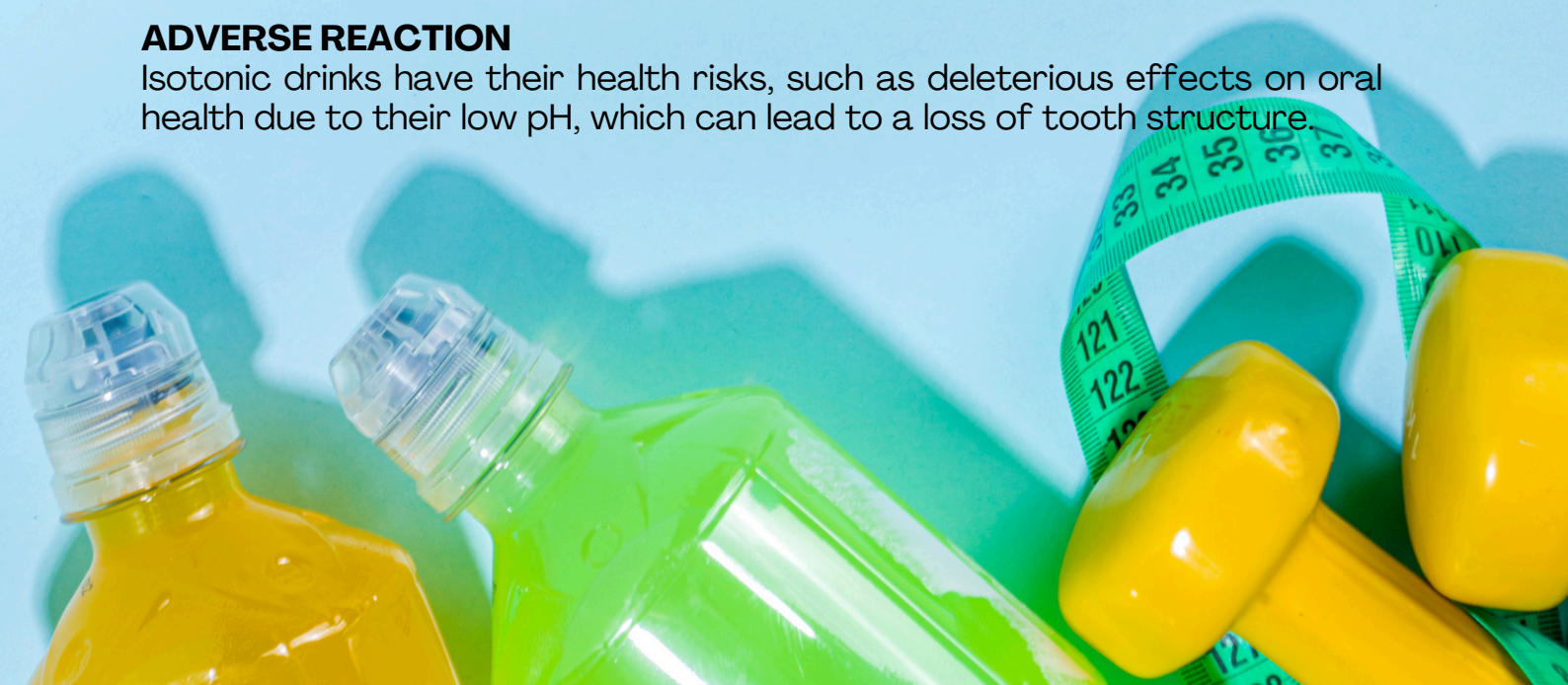
ISOTÔNICOS

PRESENTATION
These are mineral and carbohydrate replenishing drinks made up of 4 to 8% carbohydrates, such as glucose, sucrose, maltodextrin and fructose, and electrolytes (sodium and potassium). They should contain varying concentrations of sodium, chloride and carbohydrates, and may also contain potassium, vitamins and/or minerals in concentrations similar to those found in organic fluids.

INDICATION
Its purpose is to hydrate (replenish fluids) and replenish minerals, as well as glycogen, which are depleted during physical exercise. It is indicated for long-term exercise and has important benefits for athletes and sportspeople, such as: replenishing fluids lost during training or competition, thus avoiding dehydration, improving blood glucose and rapid absorption by the body (BECKER et al., 2016).
In a general and broad context, ergogenic resources such as those mentioned are aimed at muscle hypertrophy and muscle development.

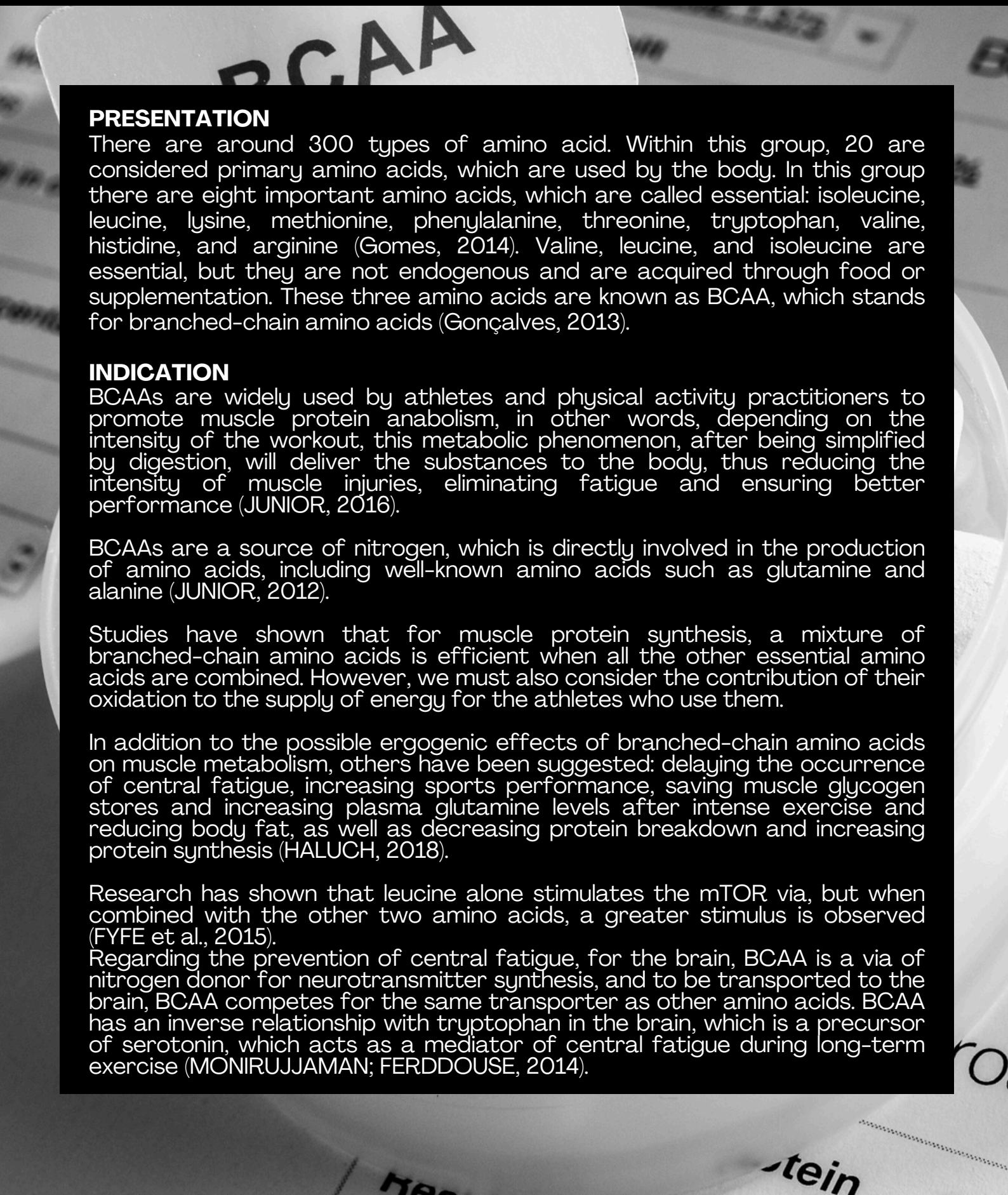
RECOMMENDATIONS
Isotonic drinks have electrolyte concentrations similar to human blood. They are consumed before and during sports practice with the aim of raising blood glucose to keep the body hydrated during training and to improve performance.
It is recommended to consume isotonic drinks with an osmolarity of less than 270 mOsm/L minutes before the start of activities at a concentration of 0.5 to 0.7 g sodium/L, which may contain 4 to 6% CHO, preferably between 15 and 20°C, and also during training, every 15 or 20 minutes in an average volume of 150mL, preferably between 15 and 20°C (SOARES et al., 2020).

ADVERSE REACTION
Isotonic drinks have their health risks, such as deleterious effects on oral health due to their low pH, which can lead to a loss of tooth structure.




BCAA

BCAA
(BRANCHED-CHAIN AMINO ACIDS)



PRESENTATION
There are around 300 types of amino acid. Within this group, 20 are considered primary amino acids, which are used by the body. In this group there are eight important amino acids, which are called essential: isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine, histidine, and arginine (Gomes, 2014). Valine, leucine, and isoleucine are essential, but they are not endogenous and are acquired through food or supplementation. These three amino acids are known as BCAA, which stands for branched-chain amino acids (Gonçalves, 2013).

INDICATION
BCAAs are widely used by athletes and physical activity practitioners to promote muscle protein anabolism, in other words, depending on the intensity of the workout, this metabolic phenomenon, after being simplified by digestion, will deliver the substances to the body, thus reducing the intensity of muscle injuries, eliminating fatigue and ensuring better performance (JUNIOR, 2016).

BCAAs are a source of nitrogen, which is directly involved in the production of amino acids, including well-known amino acids such as glutamine and alanine (JUNIOR, 2012).

Studies have shown that for muscle protein synthesis, a mixture of branched-chain amino acids is efficient when all the other essential amino acids are combined. However, we must also consider the contribution of their oxidation to the supply of energy for the athletes who use them.

In addition to the possible ergogenic effects of branched-chain amino acids on muscle metabolism, others have been suggested: delaying the occurrence of central fatigue, increasing sports performance, saving muscle glycogen stores and increasing plasma glutamine levels after intense exercise and reducing body fat, as well as decreasing protein breakdown and increasing protein synthesis (HALUCH, 2018).

Research has shown that leucine alone stimulates the mTOR via, but when combined with the other two amino acids, a greater stimulus is observed (FYFE et al., 2015).
Regarding the prevention of central fatigue, for the brain, BCAA is a via of nitrogen donor for neurotransmitter synthesis, and to be transported to the brain, BCAA competes for the same transporter as other amino acids. BCAA has an inverse relationship with tryptophan in the brain, which is a precursor of serotonin, which acts as a mediator of central fatigue during long-term exercise (MONIRUJJAMAN; FERDDOUSE, 2014).

BCAA
(BRANCHED CHAIN AMINO ACIDS)

RECOMMENDATIONS
When working with BCCA supplementation in the practice of running to exhaustion, a previous supplementation of 77 mg/Kg was carried out, but no significant differences were observed in fatigue and in the concentration of lactate, ammonia and glucose when compared to other groups. According to the study by Falavigna et al. (2012), in a study of animal models using BCAAs, around 4% of the animals that underwent chronic supplementation showed signs of increased endurance and longer swimming times compared to the control group.
The recommendation of the World Health Organization (WHO) proposes that the ingestion should be in the proportion of Leu (14mg/Kg/day), Val (10mg/Kg/day) and Ile (10mg/Kg/day), also citing the DRI which is based on the Recommended Dietary Allowance (RDA) which recommends that an adult should have an in in the proportion of Leu (42mg/Kg/day), Val (24mg/Kg/day) and Ile (19mg/Kg/day), respectively.

ADVERSE REACTION
Consumption of three times the recommended amount can lead to adverse effects, such as the destruction of metabolic enzymes involved in the transamination process (Gois et al., 2015).

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