



Supplements or “Real Food”, What is the Indication for Healthy Adults who Practice Regular Physical Activity?

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Received Date: February 07, 2022; Published Date: February 23, 2022

Abstract

At the same time the number of people that practice physical activity grows throughout the country, the search to improve sports performance increases as well the use of the most varied types of food supplements. Food supplements can be a good option to complement the diet and increase physical performance. In this way, considering the concerns about the indiscriminate consumption of food supplements and aiming to contribute to the improvement of information, indication and scientific production, the objective of this study was to analyze the production of knowledge of nutritional needs in physical activity of a non-competitive, on the main food supplements marketed in Brazil. The literature review was carried out and the articles were accessed through the SciELO virtual library. Of the 254 articles selected, 43 remained and was fully analyzed and included in this study. This study demonstrated that the use of supplements should be an adjunct to the diet, based on truly food, preferably healthy and balanced.

Keywords: Food supplement; Supplementation; Diet and physical activity; Health and nutrition

Abbreviations: NCDs: Non-Communicable Diseases; LILACS: Latin American Literature in Health Sciences; RDA: Recommended Dietary Allowance; MCT: Medium Chain Triglycerides.

Introduction

Given the efforts of international organizations to encourage people to be more active for a healthier world, the demand for gyms has increased in recent years in Brazil. However, there is no evidence in the reduction of obesity and sedentary lifestyle in the country [1]. Being active is fundamental to health, a challenge for the modern world, largely due to the lack of city planning, communities not designed in the right way and the absence of local public policies to encourage [2].

In this way, at the same time the number of physical activities

adepts grows, the research to improve sports performance increases, mainly in the field of supplements, which include vitamins, formulas for muscle gain, isotonic drinks and protein bars [3]. According to the Brazilian Association of Nutritional Products Companies (Abenutri), the nutritional supplements market is increasingly diversified, with a turnover of R\$ 1.9 billion per year in the country.

For people between 18 and 64 years old, physical activity may include leisure activities such as dancing and gardening; means of transport, such as walking and cycling; or the practice of sports, such as swimming, volleyball and weight training. However, to improve cardiorespiratory and muscle functions, reduce the risk of Chronic Non-Communicable Diseases (NCDs) and depression, the individual should perform at least 150 minutes of aerobic activity per week with moderate intensity, or 75 minutes of vigorous intensity, or the equivalent combination of moderate and vigorous

activity [4].

However, to have a healthy and balanced life, it is essential to combine the practice of physical activity with an adequate and healthy diet. The National Food and Nutrition Policy (PNAN) defines as follows:

Adequate and healthy food is understood as the food practice appropriate to the biological and sociocultural aspects of individuals, as well as the sustainable use of the environment. That is, it must be in accordance with the needs of each stage of the life course and with special dietary needs; referenced by the food culture and by the dimensions of gender, race and ethnicity; physically and financially accessible; harmonica in quantity and quality [5].

Thus, when comparing data on the growth of amateur athletes in the country, data on the increase in obesity and the expansion of the use of dietary supplements, the account does not close [6]. The trend towards the consumption of supplements goes against to the recommendations of the Food Guide for the Brazilian Population, which values the expansion of in natura foods consumption, that is, real food, to the detriment of industrialized products, aiming to reduce the consumption of ultra-processed foods.

Food supplements can be a good option to complement the diet and increase physical performance, but only trained professionals should prescribed them. According to the Federal Council of Nutritionist, it is up to the nutritionist to prescribe supplements (CFN, 2006). Thus, supplementation should be chosen with caution, to suit the objective and macro and micronutrient replacement needs [7].

To keep the body healthy, a balanced diet is essential, with variety, which values the family and regional culture [8,9]. According to the Brazilian Society of Sports Medicine and Resolution nº 18/2010, a balanced diet, except in special cases, is usually sufficient to maintain health and allow good physical performance of individuals who practice exercises. For example, the bodybuilders, practitioners of intense physical activity and high energy demand for muscle mass gain, the protein recommendation is maximum a 1.8 g/kg/weight/day, which is obtained via diet, sufficient for adequate muscle mass synthesis [10].

Thus, considering the concerns about the indiscriminate consumption of nutritional supplements, and aiming to contribute to the dissemination of accurate information, the objective of this study was to analyze the production of knowledge about nutritional needs in physical activity, of a non-competitive nature, aiming to offer subsidies that allow reflections for indications of food supplements marketed in Brazil.

Methodology

There are countless ways to reflect on the production of knowledge in an area. In this study, we obtained a literature review carried out from a qualitative approach. Literature review is the process of searching, analyzing and describing a field of knowledge, aiming to answer one or more specific questions [11].

Revision types are defined the according to the elaboration method. The literature review has two main purposes, which are the construction of a contextualization for the problem and the analysis of the possibilities present in the literature consulted for the design of the theoretical framework of the research [12]. The subject of review must be clearly and specifically defined, with conclusions that are easily identifiable and applicable [13].

Due to the amount and complexity of information in the health area, there is a need for review methods that allow the search, critical evaluation and synthesis of available evidence on the investigated topic. The final product will be the updated state of knowledge on the subject, the implementation of effective interventions in health care and cost reduction. As well as the identification of gaps, that guide the development of future researches in health [11].

The synthesis of multiple publications on a given topic allows interaction and greater clarity about what been produced so far. Thus, this research included articles published in the last 10 years, in Portuguese, English and Spanish, performed in National Library of Medicina (PubMed), Scientific Electronic Library Online [14] and Latin American Literature in Health Sciences (Lilacs) databases (2019). Publications should be available electronically and free of charge, including those available on the CAPES/MEC Journal Portal, using the following keywords in title or abstract: 'supplementation'; 'food supplement'; 'physical activity'; 'diet and physical activity'; 'nutritional recommendations' and 'health eating'. A review may be subject to bias due to the study selection process, therefore, it is important that the inclusion and exclusion criteria defined based on the scope of the review, clearly explained and followed during the search process [15]. Initially, the articles were selected through the titles and abstracts which responded to the research problem, later the articles were read in full and those that were in accordance with the objective of the study were included.

The criteria used, in addition to the source, period, language and keywords, was works dealing with the investigated relationship, physical activity, supplementation and diet, and targeting to healthy adults, between 18 and 64 years of age. The exclusion criteria was works that do not have a very clear methodology and correlated with some comorbidity

or special condition. As a high demand for studies can make the construction of the review unfeasible or introduce biases, articles with a socioeconomic bias, when dealing with populations with restricted access to food or other specific conditions were also excluded.

Of the 537 articles found with the search strategy used, 43 were analyzed by title and abstract and 18 were included in this study, aiming to confront the nutritional recommendations currently established by food with the need for nutritional supplementation in the practice of physical activity of adults at the non-competitive level. While the inclusion of studies with different research designs can complicate the analysis, the greater variety in the sampling process has the potential to increase the depth and breadth of the review's findings. The richness of the sampling process can also contribute to a comprehensive portrayal of the topic of interest.

As reference for the recommended values of daily dietary intake, the compilation of the Dietary Reference Intakes was used, as the national guide's uses, which is conventionally called DRI [16]. The DRI is the daily intake level of a nutrient considered sufficient to meet the requirements of 97-98% of healthy individuals, based on the North American population. DRIs are usual to plan diets, define labeling and plan nutritional counseling programs.

Results

The recommendations of the Food Guide for the Brazilian Population take into account the type of processing that food went through before reaching the consumer's hands. There are four categories, defined according to this criterion, explained below. In natura or minimally processed foods, obtained directly from plants or animals, undergo little or no change after leaving nature. Minimally processed foods are those in natura that undergo processes such as removal of inedible or undesirable parts, fermentation, pasteurization or freezing, and the changes are minimal. Processed foods receive salt, sugar, vinegar or oil to last longer and manufacturing techniques include cooking, fermentation, brining, among others. Ultra-processed foods are industrial formulations made from substances extracted from food or synthesized in the laboratory.

According to the characteristics of each category, food supplements are classified as ultra-processed foods, despite not being specifically mentioned in the Food Guide. The supplement industry is in high growth and can be an ally for sports practice and performance improvement, but supplementation is not mandatory. The nutritional prescription will consider individual needs, restrictions and goals, combined with the indication of each food supplement.

Another important issue is to think about food allied to the impact that its forms of production, distribution, marketing and consumption have on culture, social life and the environment. The evolution of the industry and trade of supplements was faster than the dissemination of knowledge about good nutrition, especially due to the high investment in advertising and because they are profitable, moving billions of dollars a year [17].

Food supplements, in sports practice, allow greater practicality in day-to-day, control of the intake of isolated nutrients and calories. However, it is important to consider some aspects in the use of supplements such as lifestyle, food preferences and aversions, laboratory tests, clinical history, sports modality, goals to be achieved, training schedule, adequate dose and specificity that the adaptive mechanism requires. Evaluate several factors is important when beginning to counsel individuals who regularly complete exercise training.

First, complete a clear understanding of the goals and the time with which they have to meet those goals, addition an evaluation of the individual's diet and training program should also. To accomplish this, one should make sure the athlete is eating an energy balanced, nutrient dense diet. Far too many people or coaches focus too heavily upon supplementation and neglect these key fundamental aspects. Following this, Kerksick, et al. suggest that only supplements in category I should be indicated, 'Strong Evidence to Support Efficacy and Apparently Safe'. If someone is interested in trying supplements in category II, 'Limited or Mixed Evidence to Support Efficacy', they should make sure they understand these supplements are more experimental and may or may not see the type of results claimed. Other than that, there are supplements in category III, 'Little to No Evidence to Support Efficacy and/or Safety', that should not be prescribed by health professionals.

SBME showed concern with the growing consumption of food supplements and anabolic steroids when in its first publication on the subject, in 2003, in view of the increasing use of substances without professional prescription. As for the authorities responsible for regulating and supervising the trade of these substances in Brazil, there is still a timid action.

Nutritional assessment is the starting point for knowing eating habits and detecting weaknesses. A careful anamnesis allows establishing a nutritional program that optimizes sports performance, allied to health, respecting the preferences and goals of each individual. Nutritional needs is calculated through appropriate protocols, being estimated by the individual characteristics of each patient [18].

Moreira and Rodrigues found in a local study that the participants' diet was hypoglycemic, hyperproteic and hyperlipidic for most who used some type of food supplementation. There was a statistically significant relationship between the use of dietary supplements and protein consumption above the percentage recommended by the Recommended Dietary Allowance (RDA). In addition, the average expenditure was R\$ 100.00 (BRL), with approximately 90% aimed at increasing muscle mass, with amino acids or protein concentrates cited as the most used, followed by supplements rich in carbohydrates and vitamins or vitamin complexes. Bailey, et al. [19] found the most frequently reported type of supplement taken is multivitamin-mineral products, followed by calcium and ω -3 or fish oil.

The Brazilian Society of Exercise and Sport Medicine establishes that the use of protein food supplements is beneficial for high-performance athletes. The recommendation for practitioners of physical exercises, without major concerns about performance, is that protein needs be replaced through food, noting that additional consumption does not determine muscle mass gain, nor does it promote increased performance.

From the nutritional assessment, it is possible to estimate the daily caloric consumption and, given the objective, determine the amount of macronutrients, proportionally, essential in the maintenance or improvement of the physical performance and health of the human body [20]. According to RDA concept, is the level of daily intake sufficient to meet the needs of a nutrient for nearly all (97% to 98%) healthy individuals [16].

In relation to micronutrients, vitamins, minerals and trace elements, when present in a varied diet, they are sufficient for the demand required by practitioners of regular physical activity, leaving supplementation for special occasions, such as people with iron deficiency anemia and pregnant women [21].

Another important reference value is the Tolerable Upper Intake Level (UL), which is the highest level of daily intake of a nutrient without posing a risk of an adverse health effect. The establishment of the UL emerged with the growth of the practice of fortification of foods and the use of food supplements, however, it is not yet established for all nutrients [16].

In this sense, it is very important that food supplements complement the diet, both to prevent weight gain and to prevent damage to health, as result of high levels of a particular nutrient in the body, either chronically or acutely. In addition, the deficient nutritional status will prevent good sports performance, favoring the appearance of various health problems, such as osteoporosis, amenorrhea, anemia, cancer and cardiovascular diseases.

Food supplements are divided into ergogenic supplements, which help the athlete's performance, thermogenic supplements, which help with caloric expenditure, and anabolic supplements, which are agents that favor protein synthesis and muscle hypertrophy. According to this review, the most used supplements (Table 1) are proteins and amino acids and, in most cases, with the aim of increasing muscle mass and improving post-workout recovery [22].

Protein/Amino Acids	Whey Protein, Vegan Protein, albumin, branched-chain amino acid (BCAA), arginine, glycine and methionine (Creatine), lysine, ornithine, tryptophan, aspartates and glutamine.
Carbohydrates	Hypercaloric, shakes, maltodextrin, dextrose, palatinosis, carbohydrates in gel and sucrose.
Fats	Omega-3, fish oil and medium chain triglycerides (MCT).
Vitamins	Antioxidants, multivitamins, pantothenic acid, complex B vitamins, vitamin D, ascorbic acid (Vit. C) and vitamin E.
Minerals	Isotonic drinks, calcium, phosphate, chromium, selenium, iron, zinc and magnesium.
Plant Extracts	Anabolic phytosterols and Ginseng.
Thermogenics	L-carnitine e caffeine

Table 1: Most used supplements cited in the literature review articles.

For practitioners of physical activity who want hypertrophy, it is important to increase protein intake. In this case, supplements such as whey protein, casein, soy protein are widely used [23]. Therefore, it is possible to offer 20g of protein, for example, through a dose of 30g of concentrated whey protein supplementation (118 kcal; 20g PTN ; 3.7g CHO ; e 2.2g FAT), which is equivalent to five whites eggs (82

kcal; 20g PTN; e 0.15g FAT), or 70g grilled chicken (123 kcal; 20g PTN; 0.18g CHO; e 4.3g FAT). In case of vegans people, 250g of tofu (182 kcal; 20.25g PTN; 1.75g CHO; e 10.5g FAT).

In endurance activities (running, swimming, cycling), over one hour of training, there is a need to replace about 30g of carbohydrate per hour [24]. Carbohydrate is one of the

main sources of energy for the human body and in prolonged exercise, muscle glycogen levels are markedly reduced. It is important to maintain it at adequate levels for better exercise performance and its replacement can be done through supplementation [21].

After performing more exhausting exercises, the recommendation is the ingestion of simple carbohydrates between 0.7 to 1.5 g/kg of weight in a period of four hours, which is enough for the full resynthesis of muscle glycogen. It is estimated that daily carbohydrate intake is 60 to 70% of total caloric intake [22]. In cases of difficulties with adequate carbohydrate intake, due to several factors, carbohydrate-based supplements, such as maltodextrin, are indicated.

A sachet of carbohydrate gel (maltodextrin + fructose) contains 92 kcal/23g CHO, equivalent to 25g of brown sugar (88 kcal; 22.7g CHO) or a silver banana (92 kcal; 22g CHO; 1g PTN). Thus, both in this example, as in the previous one, it is possible to observe that the nutritional demands generated by physical activity of a non-competitive nature are achievable in a simple way, with food, which preserve, in addition to flavor, other important nutrients for the human organism, such as vitamins, minerals and fiber.

Among the most used supplements, some of them do not present consistent data in the literature, not justifying consumption for ergogenic purposes, such as branched-chain amino acids (leucine, isoleucine and valine), popularly known as BCAA. As well, there is not enough scientific evidence demonstrating that glutamine, an amino acid that serves as a nutrient for rapidly dividing cells, such as intestinal and immune cells, alters physical and muscular performance.

Other concerns are important for dietary supplementation, such as time of intake, dose, duration, and route of administration. Ornithine and arginine are amino acids that

produce greater secretion of growth hormone when offered by intravenous infusion, however, their consumption orally is ineffective. Therefore, supplementation of these amino acids is not recommended [21].

According to this review, the Table 2 brings together the main dietary supplements analyzed by daily dose, nutritional value, mechanism of action, potential side effects, cost and consistency of findings. For this purpose, the daily recommendation for a person who exercises at moderate to intense intensity was considered. For example, a 70 kg young man consuming 1.2 - 2 grams of protein per kilogram of body weight, considering all protein sources (meat, egg, milk, chicken, cheese) and not just whey protein, should eat between 84 and 140 grams of protein per day, and the supplement can enter to help reach that number. Many experts recommend that you consume at most one dose of whey protein per day (about 20 g to 30 g) and the rest of the nutrient is obtained through food.

From a healthy eating perspective, the Food Guide suggests that recommendations for healthy individuals should be based on food rather than nutrients. Thus, it is relevant to think of interventions also as preventive measures for diseases such as obesity, diabetes, cancer and osteoporosis. The proposal of a diet for the Brazilian population also has two other assumptions: the rescue of healthy eating habits typical of Brazilian food; and the identification of foods, or food groups, whose consumption should be encouraged, rather than formulating prohibitions.

However, there are supplements that depending on the indication of use, it is not viable only through food. For example, creatine and beta alanine, which act by saturating the molecule in the body, as well as supplements of continuous use to stimulate and protect the immune system, such as glutamine and probiotics.

Supplement	Serving size	Nutritional source	Type	Mechanism of action	Potential side effects	Cost per month	Evidence	Real food equivalent
Whey Protein	30g	122.4 kcal	concentrated, isolated and hydrolyzed	Offers all the essential amino acids for the repair and construction of muscle mass.	Excessive intake (above 2.5 gr per kilogram of body weight) can cause overload on the liver and kidneys and, in the long term, trigger diseases, especially kidney stones.	\$ 60.00	high	meat, egg, milk, chicken, cheese
		24.4g PTN						
		2.4g CHO						
		2.6g FAT						

BCAA	5g	20kcal	2:1:1; 5:1:1 and 10:1:1	Essential substances for muscle building and recovery.	Reports of varied symptoms after consumption, such as bloating, nausea, diarrhea, difficulty in digestion and headache, however, these adverse effects have not been scientifically proven to be directly related to BCAA so far.	\$ 25.00	low	egg, milk and derivatives, meat, chicken, fish
		5g PTN						
		0g CHO						
		0g FAT						
Creatine	3g	12kcal	monohydrate, micronized and alkaline	Involved in ATP's production, a source of energy used by muscles in predominantly high-intensity, short-duration exercises. By being stored in the muscles along with water, the substance leads to an increase in muscle volume.	Some people may experience gastrointestinal problems like diarrhea, stomach pain, and nausea when consuming creatine.	\$ 50.00	high	meat, fish, chicken, egg, seafood, milk and derivatives nad human body produces about 1g per day
		3g PTN						
		0g CHO						
		0g FAT						
Beta-alanina	2g	5kcal	x	Increases muscle carnosine synthesis, improving muscle capacity and reducing muscle fatigue. The buffering action of beta-alanine translates into its ability to stabilize intracellular pH.	There is no scientific evidence that the consumption of beta-alanine brings risk or harm to health	\$ 25.00	moderate	beef, pork, chicken and fish
		2g PTN						
		0g CHO						
		0g FAT						

Caffeine	400mg	0kcal	x	Powerful stimulant of the central nervous system, the bioactive compound generates several effects in the body, such as improving concentration, alertness and sports performance, in addition to stimulating bronchodilation and increasing the activity of enzymes that make stored fat available in the bloodstream.	When consumed in large quantities, it can cause insomnia, irritation, headache, nausea, tachycardia, extremity tremors and even an anxiety crisis.	\$ 20.00	high	coffee, soft drinks, mate tea, green tea, chocolate powder and energy drinks
Maltodextrin	50g	188kcal	x	Ensures the rapid supply of glucose to the muscles, especially during long-term activities.	There is no evidence of adverse health effects in general, but the supplement should be consumed based on the calculation of total calories for the day, otherwise it may contribute to weight gain.	\$ 30.00	high	rice, potato, cassava, honey, brown sugar and coconut sugar
		0g PTN						
		47g CHO						
		0g FAT						
Medium Chain Triglycerides (MCT)	3g	27kcal	x	A smaller size in the carbon chain, they are metabolized faster and guarantee lasting satiety.	Despite being a safe supplement, it can cause diarrhea, nausea, vomiting, irritability, stomach discomfort and gas.	\$ 27.00	low	coconut oil and dairy products
		0g PTN						
		0g CHO						
		3g FAT						

Omega 3	2g	18kcal	Docosahexaenoic acid (DHA), Eicosapentaenoic acid (EPA), Alpha-Linolenic Acid (ALA) and Stearidonic acid	Anti-inflammatory action.	Generally well tolerated, but consumption of high doses can reduce the immune system's responses to inflammation and even lead to bleeding. Other effects described are: bad breath, headache and gastrointestinal symptoms.	\$ 40.00	moderate	fish, flaxseed, chia, chestnuts and algae
		0g PTN						
		0g CHO						
		2g FAT						

Table 2: Supplements that depending on the indication of use.

A healthy and adequate diet must be understood by athletes as the starting point to obtain good performance in the chosen activity. Nutritional manipulations, on the other hand, characterize a complementary strategy [21]. Faced with this wide spread of food supplements and supplements, many people began to replace much of their diet with supplementation. However, given many aspects such as cost, bio efficiency, bioavailability, digestibility and other factors, is this substitution advantageous?

Food supplements can be potential allies when it is not possible to provide ergogenic nutrients through food. In fact, these supplements would not even be food, but ergogenic, per se. This is the case with caffeine, creatine and others. For example, to reach the recommendation of 300mg of caffeine/day, it would be necessary to consume around 300ml of strong coffee, while one or two supplement capsules would be sufficient [25].

However, Domingues and Marins, in 2007, found that the search for qualified professionals, such as nutritionists or sports doctors, for the prescription and guidance on the use of food supplements has been replaced by unsafe sources, such as friends, salespeople, the internet or professionals of physical education. Then, they concluded that:

In view of the diagnosis made by this study, it is concluded that a significant index of the sample uses these products, often consuming them without knowledge of their ergogenic action, in addition to the possible deleterious effects caused by their use [26].

Regarding the famous antioxidants, according to the review by Hernandez and Nahas, the regulatory mechanisms promoted by the combined or isolated intake of vitamins C,

A and E, the minerals copper and zinc and coenzyme Q10, produce antioxidant effects. However, its supplementation is reserved for high performance athletes, in which the supply of these nutrients through a balanced diet proves to be insufficient. High doses may not have the expected effects and still bring harm to health [27].

Given the promises of increased sports performance and other gains offered by the supplement market in the country, the scientific literature provides evidence for a limited number of supplements, such as whey protein, creatine and caffeine [28]. Thus, the sports nutrition specialist must keep up to date on the role of nutrition in exercise, so that they can provide honest and accurate information to their patients regarding the ergogenic effects of nutritional supplements on physical and sports performance.

Conclusion

The results from this study confirm the negative nutritional profile of ultra-processed food and document their largely negative impact on food quality in the Brazilian population, particularly considering the increase of the diet's energy density, levels of sugar, saturated and trans fat and the decreasing levels of fiber and potassium. The diet of the most practitioners of physical activity in Brazil exceeds consumption recommendations for energy density, protein and sodium and is insufficient regarding fiber [29].

Literature review is a valuable method for the health area, as professionals often do not have time to update available scientific knowledge, due to the volume and speed of production, in addition to the difficulty in performing critical analysis of the content. In this way, the literature review can reduce uncertainties about recommendations, allow more

information that is precise and facilitate decision-making. This results in the most effective and cost-effective care [30-32].

In addition, the development of knowledge and support for research, innovation and technology in the field of food and nutrition in public health enable the generation of evidence and instruments necessary for the implementation of the PNAN. It allows professional action closer to the recommendations proposed in national and international guides on healthy eating and the Brazilian population.

This study demonstrated that the use of supplements should be an adjunct to the diet, based on real food, preferably healthy and balanced. Nutritional supplements are foods that serve to supplement with certain nutrients and calories, when the diet alone cannot meet the daily or specific needs of some nutrient. It is worth mentioning that trained professionals must prescribe these products.

This review also highlights that high-quality research on the correlates of supplement consumption is needed, as the supply of these industrialized products is increasing, in line with the Food Guide recommendations. There are several types of food supplements for each objective, so many of these still lack studies to prove the real effectiveness and adverse effects.

Even supplements with greater evidence regarding their effectiveness and recommendation, such as protein supplements, should be used with caution, as excessive use can cause health risks. Food supplements can help and be of great help in the diet. However, the use of solid foods should be our primary focus in the search for good results.

Despite the increasing popularity of food supplements, many consumers are unaware of the potential concerns associated with their use. As manufacturers do not need to provide any evidence of safety, efficacy, or even quality prior to sale, it is imperative that consumers approach all supplements with caution. An evidence-based approach to the use of an individual supplement should include research on PPIES: purity, potency, interactions, efficacy, and safety.

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