

Dietary Supplements for Professional Athletes: A Great Potential for Saudi Arabia

Abstract

Dietary supplement is defined as any product taken orally containing a “dietary ingredient” (vitamins, minerals, herbs, amino acids, enzymes, etc.) that is intended to supplement one’s diet. Dietary supplement include plant extracts and food concentrates. Their main purpose is to provide the required nutrients and to fulfill the daily nutritional needs. Sports professionals should be aware of the possible benefits of the supplements as well as the side effects and associated risks towards taking advantage of the supplements for daily training and competitive performance. This article provides a comprehensive overview of dietary supplements mainly related to athletes’ health and performance. In addition we discuss recent studies related to the attitudes of professionals in Saudi Arabia toward dietary supplements and how to aid them in making more informed decisions and judicious choices of dietary supplements for gaining health benefits.

Keywords: Dietary supplements, Athletes, Performance, Saudi Arabia

Review Article

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Abbreviations: HMR: Health Management Resources; DV: Daily Value; GAG: Glycosaminoglycan; COOH: Carboxyl Group; EPA: Eicosapentaenoic Acid; DHA: Docosahexaenoic Acid; TCM: Traditional Chinese Medicine; BD: Butanediol; GBL: Gamma Butyrolactone; GHB: Gamma Hydroxybutyrate; NCAA: National Collegiate Athletic Association

Introduction

United States law defines dietary supplements as products taken orally and designed to complement the diet by increasing total daily intake. Generally, these supplements contain vitamins, minerals, herbs, botanicals and/or amino acids, or substances such as enzymes, organ tissues, glandular and/or metabolites. As they are taken orally, they regulated as foods and are subject to the general provisions of the Food Safety Act of 1990, the Food Labeling Regulations of 1996, and the Trade Descriptions Act of 19 [1]. According to the DSHEA, dietary supplements are not drugs. However, new ingredients developed after 1994 must undergo pre-market review by the FDA for safety before they can be legally sold [2].

In recent years, supplements usage among athletes has been increasing as they aid in improving the overall performance. Nutritional supplements can also play an important part in helping athletes consume the correct amount of calories, carbohydrates, and proteins. However, inappropriate use might result in health complications. Additionally, athletes also risk flouting anti-doping regulations [3,4]. This review will discuss major classes of dietary supplements as related to athletes’ performance.

Classification of Supplements

The literature review on dietary supplements lists different classifications. Table 1 highlights the classification based on the general composition, and Table 2 on the conferred health benefits.

In the current review, supplements are grouped based on general applications and health benefits associated with the supplements into: sport supplements, dietary supplements, ergogenic aids and herbals/traditional products. In addition to citing some common examples of each group, health benefits and possible target applications for professional athletes have also been elaborated.

Table 1: Classification of dietary supplements by group.

Group	Examples
Sport supplements	Sport Drinks, Sport Bar, and Meal Replacement
Vitamins	Vitamin C, Vitamin D, Vitamin E, Folic Acid, Vitamin B Complex, Multivitamin
Minerals	Iron Supplement, Calcium Tablets
Carbohydrate	Glucosamine Sulfate
Protein	Powder, Amino Acids, Ephedra, Weight Gainers
Fish Oils	Omega 3, Omega 6
Herbals/traditional products	Essence of Chicken, Ginseng Products, Gingko Biloba
Ergogenic Aids	Weight Gainers, Slimming Products, Coenzyme Q10, Caffeine and Creatine

Table 2: Classification of dietary supplements for athletes.

Supplement Groups	Examples
Endurance	Caffeine, Creatine
Strength and Power	Creatine, Beta-hydroxy- β -methylbutyrate
Health	Antioxidants, Glucosamine
Weight Reduction	Ephedra, Amino Acids

Sports Performance Foods

Sports energy drinks: It is important to note that sports energy drinks do not hydrate better than water; however, due to the consumption of larger volumes, ingestion of such fluids results in enhanced hydration. They are available in attractive colors and flavors. They can give carbohydrate boost to the body and increase levels of electrolytes, which could be lost due to perspiration. They also tend to be lower in calories than juice or soft drinks [5,6].

Sports bars or energy bars: Sports bars or energy bars are convenient snacks that are easy to pack, lightweight, and nutrient-dense for long exercise or leisure activities, especially when typical meal food is not readily available. These are mainly beneficial for traveling athletes who have minimal facilities for food preparation or storage and shorter eating times between workouts. Especially when hunger is likely, and/or it is impractical to carry along substantial supplies of food, sports bars could form the adequate source of energy. There are different varieties available in the market fortified with a variety of vitamins, minerals, and natural herbs, as well as a wide range of macronutrients such as carbohydrates, proteins, and fats. Texture of the bar varies from hard to dense and may take a while to chew, and they provide 100-300 calories along with plenty of dietary fiber. These products may also contain ingredients like caffeine, ephedra, and other herbal stimulants, but are made with safe food ingredients such as soy, fruit, dairy and wheat, to name a few. However, sports/energy bars, nutritional supplements and herbal remedies are not regulated by the European Commission or any other organization.

Meal replacement drinks: Meal replacement drinks, by design, are substitutes for a solid food meal, usually for weight loss purposes. These are in a shake form and sometimes used by athletes to save food preparation time. They come in two basic forms: (a) liquids - administered by physicians, and (b) over-the-counter products - sold in grocery stores and drugstores. Doctor-prescribed comprehensive medical weight loss programs like Optifast and Health Management Resources (HMR) replace all meals and are used for seriously overweight patients. Over-the-counter products such as slim-Fast, Met-Rx, and Atkins Nutritionals contain about 200 calories per serving, in addition to a dose of vitamins and minerals sufficient to replace one to two meals a day. These are available in ready-to-drink cans or in powder packets and mixed with water or milk [7,8].

Vitamins

Vitamin C: Vitamin C, also known as ascorbic acid, is a water-soluble nutrient that is easily excreted from the body. It is very

popular and people are more familiar with its use as a dietary supplement.

Research indicates that more than 40% of older adults and 25% of all adults in the United States take Vitamin C supplements. It is also one of the popular supplements among the registered dietitians, and 80% of those dietitians who take vitamin C take more than 250 milligrams. As for athletes, Vitamin C plays a vital role in reducing the incidence of infectious disease, which is important for keeping them fit and able to play throughout the season [9].

Multivitamins: A multivitamin is a supplement comprised of vitamins, dietary minerals, and other nutritional elements. They are available in various forms, including tablets, capsules, pastilles, powders, liquids, and injectable formulations. The Codex Alimentary Commission (the United Nations' authority on food standards) recognizes multivitamins as a category of food [10]. Injectable multivitamin formulations are only available and administered under medical supervision. Multivitamin supplements are commonly provided in combination with other minerals and defined as a supplement containing three or more vitamins and minerals that do not include herbs, hormones, or drugs. Each vitamin and mineral is included at a dose below the tolerable upper level as determined by the Food and Drug Board, and does not possess any adverse health effects. Commonly used supplements in the United States contain at least 10 vitamins and 10 minerals with 100% of the recommended daily value (DV) for nutrients except calcium. How about Saudi Arabia? In the abstract it was mentioned that this review is more intended for Saudi Arabia and later to the rest of the world, thus get the statistics and include them.

Vitamin E: Vitamin E is a natural ingredient in some foods and is also available as a dietary supplement. It comprises a group of fat-soluble compounds with antioxidant activities and exists in eight chemical forms (alpha-, beta-, gamma-, and delta-tocopherol and alpha-, beta-, gamma-, and delta-tocotrienol) that have varied levels of biological activity. It protects Vitamin A and essential fatty acids from oxidation in the cells in the body, and prevents breakdown of body tissues. Typically, Vitamin E supplements provide only alpha-tocopherol, although "mixed" products contain other tocopherols and even tocotrienols. Most Vitamin E only supplements provide ≥ 100 IU of the nutrient, which are substantially higher than the RDA [11]. Explain RDA.

Vitamin D: Vitamin D is an essential fat-soluble vitamin. Vitamins in the form of pre-vitamin D₃ can be converted to Vitamin D₃ when human skin is exposed to UVB radiation. Both forms of Vitamins D₂ and D₃ are used as dietary supplements. Most foods do not contain enough Vitamin D to maintain a healthy body. Fatty fish such as salmon, tuna, sardines, kanad, shaour, and shrimp provide 200 to 350 IU of Vitamin D per 100g, while cereal products normally provide 40 to 50 IU of Vitamin D per cup. Thus, Vitamin D intake through food sources is not always sufficient, so athletes need supplements to fulfill the required amount. The two forms commonly consumed by athletes are ergocalciferol (Vitamin D₂) and cholecalciferol (vitamin D₃). Studies have shown that Vitamin D₂ is as effective as Vitamin D₃ in maintaining 25-hydroxyvitamin D status [9,28,29]. Usually, Vitamin D supplements are sold in combination with calcium (Ca). These are best absorbed

by the body when consumed prior to a meal that contains some type of dietary fats [12].

Vitamin B complex: Vitamin B complex contains several vitamins identified by various numbers and includes asthiamine (B_1), riboflavin (B_2), niacin (B_3), pantothenic acid (B_5), pyridoxine (B_6), biotin (B_7), folic acid or folate (B_9), and cobalamin (B_{12}). Members of this group have a typical complex structure and perform unique functions in the body. Vitamins B_1 , B_2 , B_3 and biotin participate in different aspects of energy production; Vitamin B_6 is essential for amino acid metabolism, and Vitamin B_{12} and folic acid are required for cell division. Most multivitamin-mineral products contain B-complex along with the other essential vitamins and minerals. Since they are more complete than B complex vitamins alone, multiple vitamin-mineral supplements are recommended for improving overall micronutrient intake and preventing deficiencies. Supplements that contain several B vitamins in combination with other nutrients are available in pill forms and can be purchased in grocery stores, health food stores, drug stores or online [13].

Antioxidants: Antioxidants such as beta carotene, Vitamins C and E, selenium, and several phytochemicals are known to have potential health promoting properties. Antioxidants are used to utilize oxygen in contracting muscles and preventing tissue damage in athletes [14]. However, some studies have suggested that antioxidant supplement use could sometimes have harmful effects. For example, Jazayeri and Amani [15] recommend that antioxidant supplements should not be used to prevent cardiovascular disease until more clinical trials are conducted to investigate the impact on CVD end points.

Minerals

Iron supplements: Iron supplements help the blood cells to carry oxygen in the body. There are a variety of products including different iron salts (ferrous sulfate, ferrous gluconate, and ferrous fumarate) and iron combined with other ingredients. Ferrous fumarate contains the most of iron and ferrous gluconate has the least amount. Foods such as lean red meat, chicken, turkey and fish contain sufficient amounts of iron. A multivitamin with iron gives the body additional amounts of this important mineral; however, recent studies indicate that elevated levels of iron in the body may increase the risk for heart attack and cancer.

Calcium: Calcium helps in the formation and maintenance of healthy bones and teeth, and is important for people of all ages. It is also essential for normal heart function and muscle contractions as well as reducing the blood clotting. Most people take an average of 400 mg to 1,000 mg of calcium per day. Tablets taken as supplement provide as much calcium and vitamin D as three glasses of whole milk but without the fat and calories. The most common form is calcium carbonate and is available as capsules, tablets, oral suspension and chewable tablets. Calcium citrate is often sold as tablets, calcium gluconate as syrup; calcium gluceptate and calcium gluconate as oral solutions, calcium gluconate as tablets and chewable tablets; calcium lactate as calcium lactate-gluconate; dibasic calcium phosphate as tablets; and tribasic calcium phosphate as tablets [16].

Carbohydrates

Glucosamine sulfate: Glucosamine sulfate is an amino sugar and a prominent precursor in the biochemical synthesis of

glycosylated proteins and lipids. It is one of the most abundant monosaccharides produced commercially by the hydrolysis of crustacean exoskeletons and by the fermentation of grains such as corn or wheat. In the United States, glucosamine sulfate is one of the most common non-vitamin, non-mineral dietary supplements used by adults.

Chondroitin sulfate is a sulfated glycosaminoglycan (GAG) composed of a chain of alternating sugars (N-acetylgalactosamine and glucuronic acid) and found attached to proteins as part of a proteoglycan. It is also widely used as dietary supplement for the treatment of osteoarthritis. Glucosamine promotes joint health and can enhance the structural integrity and resilience of cartilage. Soccer players in particular can benefit from glucosamine as they typically suffer more knee and/or joint injuries than other athletes. Research shows that glucosamine and chondroitin are two popular substances being promoted for the maintenance of joint health.

Protein Powder/Amino Acids/Weight Enhancers/Ephedra

Amino acids: Amino acids are a group of organic molecules that consist of a basic amino group ($-NH_2$), an acidic carboxyl group ($-COOH$), and an organic R group side chain. They play major roles in the building blocks of proteins and as intermediaries in metabolism. The body continually breaks down proteins into individual amino acids and then reassembles them in chains to form numerous proteins and enzymes. Our body synthesizes about 10 out of the 20 nonessential amino acids. Protein is also an important element for building muscle tissue, but muscle growth can only happen if the human body gains more nitrogen from protein than the regular loss through nitrogen-excretion. Bodybuilders and athletes are especially at risk for muscle loss due to heavy exercise that leads to increased nitrogen loss and muscle breakdown, and the preventable solution is consumption of adequate amounts of protein. Amino acid supplements are available individually or in a number of combinations. The most popular amino acid supplements on the market are arginine, tryptophan, tyrosine, glutamine, and lysine. Powders of soy protein and whey protein are commonly-used protein sources that certainly provide adequate amounts of protein in the diet for better muscle building. A single amino acid supplement can be taken as a pill or taken by the teaspoon or tablespoon.

Ephedra: Ephedra is an herbal equivalent of ephedrine that can increase resting energy expenditure by virtue of activation of the sympathetic nervous system, which also results in an increased heart rate. Research has shown that dietary intake of ephedra can be effective in facilitating short-term weight loss. In addition, the weight reduction could be exaggerated by the simultaneous ingestion of caffeine and aspirin. Guarana can also be used as a valid alternative to ephedra. Adverse documented events include nausea, vomiting, psychiatric symptoms, autonomic hyperactivity, and cardiac arrhythmias. Moreover, cases of myocardial infarction, cerebrovascular accident, serious psychiatric pathology, and even death have been reported [17].

Fish oils

Fish oil supplements are an excellent source of Omega-3 and Omega-6 fatty acids. There are eight members in this family are

vitality important to human health. Supplements should have a balanced ratio of these fatty acids with no unlabeled oils or unknown ingredients. These benefits could be obtained from consuming fishes as well. Fishes that are rich in Omega-3 fatty acids include: mackerel, tuna, salmon, sturgeon, mullet, bluefish, anchovy, sardines, herring, trout, and menhaden. These provide about 1 gram of fatty acids per 3.5 ounces of fish. Usually, fish oil supplements are made from mackerel, herring, tuna, halibut, salmon, cod liver, whale blubber, or seal blubber. These supplements often contain small amounts of Vitamin E too for preventing spoilage, and may be combined with calcium, iron, or Vitamins A, B₁, B₂, B₃, C, or D. Two of the most important Omega-3 fatty acids contained in fish oil are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) [18].

Herbal/Traditional Products

Essence of chicken: Essence of chicken is a type of liquid nutritional supplement derived from cooking whole chicken in aqueous medium. It supports health, promotes healing, increases metabolism and relieves fatigue [19]. Chicken meat or chicken soup could provide around three times nutrients compared to usual supplements. Since fats and cholesterol are removed from chicken essence, it is generally considered safe for people suffering from heart problems and high blood cholesterol [20].

Ginseng products: Ginseng products may be helpful for treating diabetes and in preventing colds as well as flu. Panax ginseng has many alternate names and had been used medicinally for almost 2,000 years, and continues to be one of the most popular herbal medicines today. Although ginseng is thought of and promoted as a stimulant herb, the Traditional Chinese Medicine (TCM) approach employed ginseng as a calming herb. Today, in modern China, ginseng is often utilized for cardiovascular conditions. The difference in usage may have a direct relationship to the higher doses used in the United States in comparison to those used in TCM [21,22]. The commercial products contain varied amount of the functional compound. For example, in one ginseng supplement only 60.3% of ginsenosides was found. Similarly, studies found that five out of 11 ginseng supplements were found to be contaminated with lead and/or pesticides [21].

Ginkgo biloba: Ginkgo biloba is an herb generally used to make extracts as medicine. It is used for memory disorders including Alzheimer's disease and for conditions seemingly due to reduced blood flow in the brain, especially in older people. There are also multiple forms of ginkgo biloba on the market. There reports of adverse reactions of ginkgo biloba. For example, ginkgo fruit and pulp could cause severe allergic skin reactions and irritation of mucous membranes [23]. It also could cause an allergic reaction in people who are allergic to poison ivy, poison oak, poison sumac, mango rind, or cashew shell oil. Since ginkgo thins the blood and decreases its ability to form clots, there is some concern that ginkgo leaf extract might increase the risk of bruising, bleeding and allergic skin reaction. Also, there are some reports about bleeding in the eye and brain, and excessive bleeding after surgery. Therefore, it is better to avoid taking ginkgo with herbs and supplements that can increase the risk of seizure, including herbs and supplements such as butanediol (BD), cedar leaf, Chinese club moss, EDTA, folic acid, gamma butyrolactone (GBL), gamma hydroxybutyrate (GHB), glutamine, huperzine A, hydrazine sulfate, hyssop oil, juniper, L-carnitine, melatonin, rosemary, sage, wormwood, and others [24].

Ergogenic aids

Ergogenic aids include activities and products that enhance an individual's energy use, production, or recovery. For example, stretching and weight training are physical ergogenic aids, visualization and hypnosis are mental ergogenic aids, and lighter weight running shoes and better designed golf clubs are mechanical ergogenic aids. The availability and use of ergogenic aids as supplements have risen in recent years. Previous research indicated that approximately 50% of the general population, 76% of college athletes, and 100% of bodybuilders take supplements [25-27].

Weight enhancers: Weight enhancers are a very high calorie nutritional supplements for people wanting to gain and maintain weight especially patients of cancer treatment, irritable bowel syndrome, anorexia, or HIV and AIDS. SupliMed was developed for patients with weight loss due to illness; however, healthy people of all ages could also benefit from this product. This weight gain powder helps any underweight person to gain desired weight by consuming shakes with high calories and nutrients essential to a weight gain diet. SupliMed Substi-meal can provide over 660 calories/ 8-oz serving and over 2,600 daily calories. This product is a flavorful powder that is mixable with milk or water and is rich in vitamins and minerals, protein, fats, carbohydrates, sugars, and fiber [25-28].

Slimming products: Slimming products are made from the extracts from plants and have been used for thousands of years [27-29]. Plant extracts such as sweet potato fiber, cyamopos gum, amor phallus konjac (extract from giant arum and jerusalem artichoke), and alfalfa can make people feel full and thus inhibit the appetite. These extracts can also reduce body fat. Acai berry is another excellent example of a currently marketed dietary supplement with high concentrations of antioxidants including the fat-breaking resveratrol and anthocyanins, Omega 3, 6 and 9 fatty acids, amino acids, fiber, and other nutrients [29].

Coenzyme Q10: Coenzyme Q10, also known as CoQ10 occurs naturally in the tissues of almost all plants and animals, including human. The "Q" stands for quinone and the "10" stands for the number of isoprenoid units in the tail portion of the molecule. CoQ10 is recognized as a crucial component in the process in the mitochondria that converts the energy in carbohydrates and fatty acids into the fuel necessary to drive cellular machinery and synthesis in the body. This fat-soluble substance is used by cells to extract energy from food [27-28]. It is a two-part compound that is composed of a long fat-soluble isoprenoid tail and a quinone that is capable of accepting and transferring electrons through a portion of the respiratory chain. Generally, mammals have 10 isoprenoid units in the tail portion, but other non-mammalian species may have fewer units [30,31].

Caffeine: Caffeine is contained in coffee, tea, chocolate, and many other caffeinated food sources like cola and is considered a popular stimulant used by most athletes. Even though the physiological mechanisms of action of caffeine are not well understood, caffeine beneficially affects performance by reducing the perception of fatigue, enhancing central drive, and/or improving exercise capability [32]. The ergogenic effect of caffeine in endurance exercise performance is well established. Recent reviews [32-34] highlighted the extensive use of caffeine by athletes. Caffeine intake with doses between 5 and 13mg/kg body mass causes

improvement in endurance exercise capacity [35]. Caffeine is rapidly absorbed in the human body and the performance effects will typically be maintained for longer durations, for example the entire match (pure water solution of caffeine). However, intake of caffeine in the form of coffee drink yields smaller effects than the pure water solution [36], and there may be gastrointestinal distress associated with drinking strong coffee. For soccer players, small doses of caffeine (1-2mg/kg body mass) can influence the reaction time, alertness, and visual information processing, which are crucial during the entire match [37].

Creatine: Creatine is a chemical found in the body, mostly in muscles. It is made by the body but can also be obtained from foods such as beef and fish. It is a natural guanidine compound occurs in meat and fish in concentrations between 3 and 7 g/kg. Synthetic creatine supplements exist as creatine monohydrate or various creatine salts, such as creatine citrate or creatine pyruvate. Creatine is one of the most widely used sports supplements on the market today. In addition, it is one of the most common food supplements used by professional and amateur athletes for improving exercise performance and increasing muscle mass in athletes and older people. Dietary creatine supplementation is important among soccer players who reported increased muscle strength and power. Creatine can stimulate muscle creatine uptake and facilitate the disposal of ingested creatine into the musculature [38]. Creatine salts (creatine monohydrate) are easily soluble and stable in solution and thus could be included in sports drinks or gels. On the other hand, creatine monohydrate must be consumed soon after it is brought into solution. Muscle creatine retention can be enhanced by elevated insulin concentrations when the supplement is taken in combination with post exercise carbohydrate amino acid protein supplements [39]. Vegetarians respond better to creatine supplementation than others due to the low initial muscle creatine content [40].

The International Olympic Committee, the National Collegiate Athletic Association (NCAA), and professional sports all allow creatine use among participating athletes, and Americans use more than four million kilograms of creatine each year. However, creatine does not seem to improve performance in aerobic exercises, or benefit older people. Furthermore, creatine does not seem to increase endurance or improve performance in highly trained athletes. Nevertheless, creatine is safe for most people when used at recommended doses. Many people who use creatine gain weight as it causes the muscles to hold water [41].

Current Issues with Dietary Supplements in Saudi Arabia

Our group has recently assessed the attitudes of professional athletes in Saudi Arabia toward dietary supplements as well as the actual usage of supplements [42-46]. Approximately 105 professional athletes were recruited as subjects from three different Saudi Arabian sports clubs. Of this cohort, we found that only 98 athletes were currently taking dietary supplements. We then designed a questionnaire to determine factors that influence their choices and use of dietary supplements. We learned that the majority of athletes use supplements for the purpose of improving health and performance. For example, 43 athletes (43.88%) reported using supplements for performance, whereas 32 (32.65%) believed that improvement in health was a reason

for using dietary supplements. Nearly 64 (65.31%) were buying supplements from trainers or physicians while less than 5 (5.10%) obtained from online stores or other sources. Similarly, 45 athletes (45.92%) reported that their physicians were the main source of information about dietary supplements, 28 (28.57%) mentioned as their nutritionists, and 11 (11.22%) as coaches. However, less than 10% reported journals, magazines, or online as their sources of information.

We are also interested in knowing more about the types of supplements that these athletes were using. The athletes in this study used a total of 23 different products. Our results showed that sports drinks were the most popular supplement used ($n = 87$; 88.77%), followed by vitamin C ($n = 81$; 82.65%), calcium ($n = 67$; 68.36%), health bars ($n = 58$; 59.18%), and multivitamins ($n = 51$; 52.04%). Meanwhile, those supplements ranking among the least used included omega 6 fatty acid ($n = 18$; 18.36%), creatine ($n = 16$; 16.32%), and Ginkgo biloba ($n = 10$; 10.30%) [43]. We believe that our study provides a better understanding of factors that influence the attitudes of professional athletes with regard to the use of dietary supplements. The study identifies dietary supplements available in the Saudi Arabian market, and, more importantly, provides analyses to differentiate the quality among these products. The overall effect of this research is that professional athletes in Saudi Arabia and athletes worldwide will be able to make more informed decisions about their choices and use of dietary supplements. There is, indeed, a great potential for dietary supplements in the Saudi Arabia market, and our study could help the dietary supplement industry to better target consumer needs with quality products.

Conclusion

Many athletes use dietary supplements as part of the regular training or competition routine. Supplements commonly used include vitamins, minerals, protein, creatine, and various "ergogenic" compounds. In Saudi Arabia, these supplements are often used without a full understanding or evaluation of the potential benefits and risks associated with them and without consultation with a sports nutrition professional. For example, supplements such as creatine in enhancing performance in high-intensity exercise, however the evidence is related to specific athletic events. Our review presents major classes of dietary supplements as related to athletes' performance, the review also present recent study related to the attitudes of professional athletes in Saudi Arabia toward dietary supplements. Based on our current work, we believe that dietary supplements have great potential among athletes in the Saudi Arabia as well as around the world; however there is a need to have a comprehensive understanding of the health benefit of each supplement and the target purpose. In addition, we have noticed that most of the studies conducted in this field use human subjects with a short term effect. However, this could be a limiting factor. We also believe that the future research should focus on comprehensive assays that targeting key elements in human physiology which impact athletes performance.

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