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Understanding The Behavior And Attitude Of Professional Athletes In Saudi Arabia Toward Dietary Supplements

Sulaiman O. Aljaloud
North Carolina Agricultural and Technical State University

Understanding the Behavior and Attitude of Professional Athletes in Saudi Arabia toward Dietary Supplements

Sulaiman O. Aljaloud

North Carolina A&T State University

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Sulaiman O. Aljaloud

has met the dissertation requirements of
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Approved by:

Dr. Salam A. Ibrahim Major Professor	Dr. Abolghasem Shahbazi Committee Member
Dr. Angela M. Fraser Committee Member	Dr. Tammy Song Committee Member
Dr. Keith Schimmel Department Chairperson	Dr. Sanjiv Sarin Dean, The Graduate School

Biographical Sketch

Sulaiman Aljaloud was born in Al-Madinah al-Munawarah, Saudi Arabia, where he attended elementary and secondary schools. Sulaiman received his B.S. degree in Physical Education in March 1994 from Taibah University, Saudi Arabia. Sulaiman worked for teachers at the Royal Commission School in Jubail Industrial City from 1994 to 2007 and as an instructor at King Saudi University from 2008 to the present. Sulaiman earned his M.S. degree in Physical Education in Sports Medicine in March 2005 from University of Bahrain, Kingdom of Bahrain and another Master in Food and Nutritional Sciences from North Carolina A&T State University in 2009-2010.

Sulaiman is a member of several honor societies, such as Saudi Federation of Sports Medicine (2001–Present), Bahraini Federation of Sports Medicine (2003–Present), the Saudi Administration Society (2007–Present), the Saudi Educational and Psychological Sciences Society (2007–Present), Administrative Counsel, King Saud University Staff Club (2007), and Scientific Committee, Saudi Physical Education and Sports Federation (2007). While working on his Ph.D., he presented and published several scientific papers.

After finishing his Ph.D. degree, Sulaiman intends to continue his career in research on nutrition supplements for sport performance, improving health through school physical education, and obesity prevalence and trends in Saudi children.

Dedication

I would like to extend my sincerest thank to my parents (Omar & Khadijah) for their faith and belief in me. May Allah bless them for their loving support and patience during my life.

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Nomenclature

APC	Aerobic Plate Count
CDC	Centers for Disease Control and Prevention
CFU	Colony Forming Unit
DNA	Deoxyribonucleic Acid
E. coli	*Escherichia coli*
FDA	Food and Drug Administration
GRAS	Generally Recognized as Safe
BHI	Brain Heart Infusion
VRGBA	Violet Red Glucose Bile Agar
BPAB	Baird Parker Agar Base
XLD	Xylose Lysine Deoxycholate
MAC	MacConkey Agar
USDA	United States Department of Agriculture
WHO	World Health Organization
°C	Celsius
Ml	Milliliters
CFU	Colony forming units
CFU/ml	Colony forming units/ milliliters
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration
G	Grams
GI	Gastrointestinal tract

H	Hours
mg	Milligram
mins.	Minutes
µl	Microliters
Spp.	Species
w/v	Weight/ volume
SPL	Saudi Professional League
GNC	General Nutrition Centers
NHP	Natural Health Products
IRB	Institutional Review Board
DSHEA	Dietary Supplement Health and Education Act
U.S.	United States
USP	United States Pharmacopeia
SAS	Statistical Analysis System
NHP	Natural Health Products
QA	Quality Assurance

Abstract

A dietary supplement is defined as a product taken orally that contains a “dietary ingredient” (vitamins, minerals, herbs, amino acids, enzymes, etc.), and is intended to supplement one’s diet. Dietary supplements include plant extracts and concentrates from foods. Supplements help provide required nutrients to fulfill nutritional levels for daily training or competitive performance, and can help remedy nutritional deficiencies. Therefore, it is important that sports professionals have a thorough knowledge of these supplement products. However, athletes need to be informed about the use and possible benefits, side effects, and risks associated with the use of dietary supplements. Four objectives guided this study: (a) assess the use and attitudes of professional athletes in Saudi Arabia toward dietary supplements, (b) determine the availability of dietary supplements in Saudi Arabian markets, (c) identify the microbiological quality and safety of dietary supplements in Saudi Arabia, and (d) evaluate the impact of educational program on the knowledge and attitude of professional athletes in Saudi Arabia toward dietary supplements. In order to achieve the first objective, approximately 105 professional athletes were recruited as subjects from three different Saudi Arabian sports clubs. A questionnaire was designed to determine factors that influence professional athletes’ choices and use of dietary supplements. To achieve the second objective, twelve stores from each region of Riyadh were selected to assess the availability of dietary supplements on the market. In the third objective, approximately 80 different supplements from Riyadh were analyzed for microbial quality and product safety. The aim of the fourth objective was to develop a program to educate professional athletes in Saudi Arabia about the benefits of dietary supplements. Both pre- and post-assessments were used. The majority of athletes indicated that their use of supplements was for the purpose of improving health and performance. The availability of different supplements

ranged from approximately 23 to 97% according to the demand. In addition, of 80 most popular supplements selected for microbiology analysis, nine were shown to have contamination. Thus, this 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 informed decisions about their choices and use of dietary supplements.

CHAPTER 1

Introduction

Supplement use is a widely accepted practice by athletes. More so, there is a large variety of supplement types and brands available on the open market. Dietary supplements are products taken orally that contain one or more ingredients intended to supplement one's diet, and are not considered food. According to the United States' Dietary Supplement Health and Education Act (1994), dietary supplements are categorized as "product" (other than tobacco) intended to supplement a diet that bears or contains one or more dietary ingredients. Examples of dietary ingredients include a vitamin, mineral, herb or other botanical, amino acid, concentrate, metabolite, constituent, extract, or any combination of these ingredients. Also included are dietary substances for increasing the total dietary intake. Supplements can be classified according to their function (muscle building, immune boosting, fuel providing), form (pills, powders, foods, or drinks), availability (over-the-counter, mail order, Internet, multi-level marketing), and scientific merits of claim (well-supported, unsupported, undecided; L. Burke et al., 2006). In recent years, the area of sports nutrition and dietary supplementation has gained enormous popularity. A number of athletes and other sports professionals are looking for viable dietary ergogenic aids to enhance physical power and performance levels. People who consume supplements have the right to know the facts regarding dietary efficacy, including safety, impact on health, and any scientific research on products proper use (Juhn, 2003).

Athletes typically desire to enhance their endurance, strength, performance, and muscle mass, and use several types of ergogenic aids to achieve these goals (Jacobson, Sobonya, & Ransone, 2001). Most supplements and sports-foods provide advantages to athletic performance either by producing direct performance-enhancing (ergogenic) effects or by helping athletes meet

their nutrition goals. Many studies support the benefits of consuming sports drinks to supply carbohydrates and fluid during exercise (Coombes & Hamilton, 2000).

It is necessary to have a good nutrition and hydration practices, use of supplements and ergogenic aids in addition to the proper nutritional balanced foods (Medicine & Association, 2000). Overdosing of supplements can sometimes result in poisoning. Research supports documented cases of deaths and medical problems resulting from improper use of tryptophan supplements as well as products containing Ephedra and caffeine (Plye, 2006).

Protein is the most widely dietary supplement used by professional athletes for muscle building (Nissen & Sharp, 2003). The most commonly used supplements are sports drinks, sport bars, multivitamins and minerals, protein supplements, and Vitamin C (Schroeter, Anders, & Carlson, 2013). Potential side effects of nutritional supplements intake include toxicity, allergic reactions, side effects of caffeine-containing products, and many other unknown side effects. Since there is no universal system that controls and regulates sports foods and supplements products, countries differ in their regulation approaches. Knowledge of proper use and clinical safety of supplements is necessary before use. To date, scientific studies have identified a number of products that provide performance benefits and meets nutritional requirements.

1.1 Objectives

The overall goal of this project is to understand the behavior and attitude of professional athletes in Saudi Arabia toward dietary supplements. This study could provide the availability of supplements and their microbiological quality and safety. In addition, factors that influence professional athletes with regard to the use of supplements and the impact of an educational program on the knowledge and attitudes of professional athletes toward nutrition and dietary intake could be established. We believe this study could serve as scientific guidelines to educate

the athletes about the use of supplements. The specific objectives to be accomplished are as follows:

1. To assess the use and attitudes of professional athletes in Saudi Arabia toward dietary supplements.
2. To determine the availability of dietary supplements in Saudi Arabian markets.
3. To identify the microbiological quality and safety of dietary supplements in Saudi Arabia.
4. To evaluate the impact of educational program on the knowledge and attitude of professional athletes in Saudi Arabia toward dietary supplements.

1.2 Organization of Dissertation

Chapter 2 of this dissertation presents the information on different types of supplements with a focus on health benefits. Chapter 3 deals with the use and attitudes of professional athletes toward dietary supplements and factors influencing the use of dietary supplements by professional athletes. Chapter 4 provides the availability of dietary supplements' market. Chapter 5 presents the microbiological quality and safety of dietary supplements. Chapter 6 evaluates the impact of educational programs on the knowledge and attitude of professional athletes toward dietary supplements. Chapter 7 summarizes the conclusions and recommends future possibilities of this study.

CHAPTER 2

Literature Review

2.1 Dietary Supplements

United States law defines dietary supplements as products taken orally, and designed to supplement the diet by increasing total daily intake. These supplements may contain a vitamin, a mineral, an herb, or other botanical, amino acid, or substances such as enzymes, organ tissues, glandular, and metabolites (Thomson, 2010). Supplements are considered vitamins, minerals, herbal remedies, and other substances taken orally and regulated as foods, thus subject to the general provisions of the Food Safety Act of 1990, the Food Labeling Regulations of 1996, and the Trade Descriptions Act of 1968 (Petróczi et al., 2008). According to the DSHEA, dietary supplements are not drugs. However, new ingredients developed after 1994 have to undergo pre-market review by the FDA for safety before they can be legally sold (Kreider et al., 2004). Nutritional supplements can be grouped into three basic categories: dietary supplements, ergogenic aids, and sports foods (Dunford, 2010; Tian, Ong, & Tan, 2009). The use of nutritional supplements among athletes ranges from 46% to 100%. Partly, an explanation for this large variation is methodological differences, such as the definition of supplements, characterization of use, and mode of data collection.

In recent years, the use of supplements among athletes in a number of sports has been increasing to improve their performance. Therefore, it is important to understand how these products work and whether they provide worthwhile benefits while considering possible long term health effects. Nutritional supplements can also play an important part in helping athletes consume the correct amount of calories, carbohydrates, and proteins in their diet. However,

inappropriate use or contamination may cause health problems. Additionally, the athlete also risks flouting anti-doping regulations (Dunford, 2010; European, 2002; Tian et al., 2009).

2.2 Classification of Supplements

Supplements can be grouped into dietary supplements, ergogenic aids, and sports foods. Dietary or nutritional supplements are substances such as vitamins, minerals, trace elements, amino acids, proteins, and herbs intended to supplement a normal diet or to have health benefits for pill ingestion, capsule, tablet, powder, or liquid form. Some commonly used supplements in this category are shown in Table 2.1 (Tian et al., 2009).

Table 2.1

Types of Dietary Supplements and Frequency of Use among University Athletes in Singapore

Supplement	Mean Frequency of Competition Season	Use (per week) Off-season	No. of subjects	Percentage of users
Sports foods				
Sports drinks	4.1	1.9	57	90.4
Sports bars	3.4	1.1	13	20.6
Meal replacement	4.3	1.3	4	6.3
Dietary supplements				
Vitamin C	6.0	5.6	31	49.2
Multivitamins	6.3	5.5	19	30.2
Glucosamine sulphate	6.8	5.9	13	20.6
Calcium tablets	5.8	4.7	6	9.5
Fish oils	6.0	6.0	5	7.9
Vitamin E	6.3	6.3	4	6.3
Antioxidants	5.7	5.3	4	6.3
Iron tablets	5.5	5.5	3	4.8
Vitamin B complex	3.0	0	3	4.8
Ergogenic aids				
Red Bull energy drink	2.8	1.0	13	20.6
Protein powder/amino acids/weight gainers	5.0	2.5	6	9.5

Table 2.1 *(cont.)*

Supplement	Mean Frequency of Competition Season	Use (per week) Off-season	No. of subjects	Percentage of users
Ergogenic aids (cont.)				
Slimming products	7.0	7.0	2	3.2
Coenzyme Q10	7.0	7.0	1	1.6
Creatine	11.0	0	1	1.6
Herbals/traditional products				
Essence of chicken	4.5	3.8	7	11.1
Bird's nest	1.0	1.0	7	11.1
Ginseng products	4.0	3.5	3	4.8
Gingko biloba	3.0	3.0	1	1.6

2.2.1 Sports performance foods.

2.2.1.1 Sports energy drinks. Sports energy drinks do not hydrate better than water; however, due to the consumption of larger volumes of sports drinks, the ingestion of such fluids leads to better hydration. Sports drinks are available in attractive colors and flavors. These drinks can give a carbohydrate boost to the body in addition to electrolytes, which may be lost due to perspiration, and tend to offer lower calories than juice or soft drinks (O'dea & Rawstorne, 2000; Van Nieuwenhoven, Brouns, & Kovacs, 2005).

2.2.1.2 Sports bars or energy bars. Sports bars or energy bars are a convenient snack (easy to pack, lightweight, and nutrient-dense) for long exercise or leisure activities, especially when food is not readily available. Sports bars alone are not considered meal replacements. These foods are mainly beneficial for traveling athletes who have minimal facilities for food preparation, storage, and minimal time to eat between workouts. Especially when hunger is likely, and/or it is impractical to carry along substantial supplies of food, these sports bars provide an adequate source of energy. There are different varieties of bars on 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. Most of the bars provide 100–300+ calories per bar and contain plenty of fiber. Texture varies from hard, dense, and may take a while to chew (L. Burke et al., 2006). Sports/energy bars, nutritional supplements, and herbal remedies are not regulated by the European Commission or any other organization (Europenan & Union, 2002). These products may also contain ingredients like caffeine, ephedra, and other herbal stimulants. Fortunately, most are made with safe food ingredients such as soy, fruit, dairy, and wheat. Therefore, these sports bars are convenient and can be an appropriate "supplement" to an overall nutrition plan if used properly. They can be more expensive than whole foods and should be used for the specific conditions for which they are most suited rather than just being consumed as a general snack. Hence, athletes should be encouraged to practice proper use and assess tolerance during training before using sports bars in competition settings (Europenan & Union, 2002; Tian et al., 2009).

2.2.1.3 Meal replacement drinks. Meal replacement drinks, by design, are substitutes for a solid food meal, usually for weight loss purposes. These drinks are in a shake form and sometimes used by athletes as a meal replacement to save food preparation time. Meal replacement supplements come in two basic forms: (a) liquid-only programs 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 usually prescribed 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 or two meals a day. These are available in ready-to-drink cans or in powder packets and mixed with

water or milk (Ashley et al., 2007; Heymsfield, Van Mierlo, Van Der Knaap, Heo, & Frier, 2003).

2.2.2 Vitamins.

2.2.2.1 Vitamin C. Vitamin C, also known as ascorbic acid, is a water-soluble nutrient that easily excretes from the body when not needed. Since it is more popular, people may be more familiar with its use as a dietary supplement. Past research indicates that more than 40% of older adults and 25% of all adults in the United States take Vitamin C supplements. Vitamin C is also one of the most popular supplements among some groups of registered dietitians, and 80% of the dietitians who take vitamin C take more than 250 milligrams (Waters et al., 2002). As for athletes, Vitamin C plays a vital role in reducing the incidence of infectious disease, which is important for keeping them fit and available to play throughout the season (Malm, Ekblom, & Ekblom, 2004).

2.2.2.2 Multivitamins. A multivitamin is a supplement comprised of vitamins, dietary minerals, and other nutritional elements. Multivitamins 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 (Ross, Taylor, Yaktine, & Del Valle, 2010). Alternatively, injectable formulations are only available and administered under medical supervision. These 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. Usually, 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 (Block et al., 2007; Lumley, Watson, Watson, & Bower, 2002).

2.2.2.3 Vitamin E. Vitamin E is a natural ingredient in some foods, and is available as a dietary supplement. Vitamin E is 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 different levels of biological activity. Vitamin E, a fat-soluble vitamin, 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 are available. Most Vitamin E only supplements provide ≥100 IU of the nutrient, which are substantially higher than the RDA (Daniele et al., 2004).

2.2.2.4. 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 (Holick et al., 2008). However, 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. Vitamin D intake through food sources is not always sufficient for the body. Athletes need supplements to fulfill the required amount of this essential vitamin. The two forms of Vitamin D supplements commonly consumed by athletes are ergocalciferol (Vitamin D2) and cholecalciferol (vitamin D3). Studies show that Vitamin D2 is as effective as Vitamin D3 in maintaining 25-hydroxyvitamin D status (9, 28, and 29). Usually, Vitamin D supplements are sold in

combination with Calcium (Ca). These supplements are best absorbed when consumed prior to a meal that contains some type of dietary fats (Azhar, 2009).

2.2.2.5 Vitamin B complex. Vitamin B complex contains several vitamins identified by various numbers such as asthiamine (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6), biotin (B7), folic acid or folate (B9), and cobalamin (B12). Members of the B-complex group have a typical structure and perform unique functions in the body. Vitamins B1, B2, B3, and biotin participate in different aspects of energy production; Vitamin B6 is essential for amino acid metabolism; and Vitamin B12 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 form, and can be purchased in grocery stores, health food stores, drug stores, or over the Internet (Ames, 2001).

2.2.2.6 Antioxidants. Antioxidants such as beta carotene, Vitamins C and E, selenium, and several phytochemicals are known to have potential health promoting properties (Clarkson & Thompson, 2000). Vitamins E, C, and beta-carotene are especially known to have potential health-promoting properties. Antioxidants are used to utilize oxygen in contracting muscles and preventing tissue damage in athletes (Barr & Rideout, 2004).

However, some studies suggested that antioxidant supplement use could sometimes have harmful effects. For example, Jazayeri and Amani (2004) 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 (Jazayeri & Amani, 2004).

2.2.3 Minerals.

2.2.3.1 Iron supplements. Iron supplements help the blood cells carry oxygen in the body. There are different iron products including different salts of iron (ferrous sulfate, ferrous gluconate, and ferrous numerate) and iron combined with other ingredients. Ferrous fumarate contains the most iron per mg and ferrous gluconate has the least. Foods such as lean red meat, chicken, turkey, and fish contain sufficient amounts of iron. People with anemia and childbearing women may benefit from extra iron, since they may have an iron deficiency and iron requirements are greater during pregnancy (Erdman, Fung, & Reimer, 2006). A multivitamin with iron gives the body additional amounts of this important mineral as needed, yet recent studies indicate that elevated levels of iron in the body may increase the risk for heart attack and cancer. This may occur because iron enhances the body's production of biologically damaging chemicals called free radicals.

2.2.3.2 Calcium. Calcium is important for people of all ages and is required for good health. Calcium is a mineral that helps form and maintain healthy bones and teeth. It is also needed for normal blood clotting, heart function, and muscle contractions. The calcium mineral is a dietary supplement used for bone health. Most people take an average of 400 mg to 1,000 mg on a daily basis. Calcium tablets taken as a supplement provide as much calcium and vitamin D as drinking three glasses of whole milk without the fat and calories. Calcium supplements may also reduce the risk of osteoporosis that affects middle-aged and older people. The most common form of calcium supplement is calcium carbonate, which is available as capsules, tablets, oral suspension, and chewable tablets. Calcium citrate is often sold as tablets; calcium glubionate often 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 (Gorsline & Kaeding, 2005).

2.2.4 Carbohydrates.

2.2.4.1 Glucosamine sulfate. Glucosamine sulfate ($C_6H_{13}NO_5$) is an amino sugar and a prominent precursor in the biochemical synthesis of glycosylated proteins and lipids (Erdman et al., 2006). Glucosamine is one of the most abundant monosaccharides produced commercially by the hydrolysis of crustacean exoskeletons, and by the fermentation of grain such as corn or wheat. In the United States, it 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-acetygalactosamine and glucronic acid) and found attached to proteins as part of a proteoglycan. Chondroitin sulfate has also become a widely used dietary supplement for the treatment of osteoarthritis (Geil & Shane-McWhorter, 2008). Glucosamine promotes joint health and can enhance structural integrity and resilience of cartilage. Soccer players can also benefit from the use of glucosamine because they suffer more knee and joint injuries than any other sport. Research shows that glucosamine and chondroitin are two popular substances being promoted for maintenance of joint health (Gorsline & Kaeding, 2005).

2.2.5 Protein powder/amino acids/weight gainers/ephedra.

2.2.5.1 Amino acids. Amino acids are a group of organic molecules that consist of a basic amino group (-NH2), an acidic carboxyl group (-COOH), and an organic R group side chain. They play major roles in building blocks of proteins and as intermediates 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 our body gains more nitrogen from protein than our body loses 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 (Sathivel et al., 2004). Therefore, a solution to prevent muscle wasting and gaining is to consume adequate amounts of protein. Amino acid supplements are available individually or in a number of combinations. The most popular on the market are arginine, tryptophan, tyrosine, glutamine, and lysine. A soy protein powder and whey protein powder are other commonly-used protein sources that provide adequate amount 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 (Webb, 2006).

2.2.5.2 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 show dietary intake of ephedra can be effective in facilitating short-term weight loss (J. T. Dwyer, Allison, & Coates, 2005; Shekelle et al., 2003). Furthermore, the effects of ephedra on body weight reduction can be exaggerated by the simultaneous ingestion of caffeine and aspirin (Dulloo, 2002; J. T. Dwyer et al., 2005). Guarana can also be used as a valid alternative. 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.

2.2.5.3 Fish oil. Fish oil supplements are an excellent source of Omega-3 and Omega-6 fatty acids. All eight members of the Omega-3 family are vitally important to our body and need to be complete and balanced. Supplements should have a balanced ratio of all eight Omega-3

fatty acids with no unlabeled oils or unknown ingredients present. Fish oil is obtained from eating fish or by taking supplements. Fish that are especially 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 Omega-3 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. Fish oil supplements often contain small amounts of Vitamin E to prevent 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) (Tsekos, Reuter, Stehle, & Boeden, 2004).

2.2.6 Herbal/traditional products.

2.2.6.1 Essence of chicken. Essence of chicken is a type of liquid nutritional supplement derived from cooking whole chickens into a liquid medium. Essence of chicken supports health, promotes healing, increases metabolism, and relieves fatigue (Zain & Syedsahiljamalulail, 2003). This supplement provides all the same nutrients found in chicken or chicken soup and can provide up to three times as many nutrients as a serving of chicken soup or a normal serving of chicken meat. Since fats and cholesterol are removed from essence of chicken, it is generally considered safe for people suffering from heart problems and high blood cholesterol (Mukherjee, 2002). However, sometimes it is combined with ginseng and other liquid supplements, which may have a stimulant effect. These added supplements are said to provide more health benefits than essence of chicken alone. Pure essence of chicken does not appear to have any negative side effects (Ikeda et al., 2001).

2.2.6.2 Ginseng products. Ginseng products may be helpful in treating diabetes and in preventing colds and the flu. The studies of Allen, McLung, Nelson, and Welsch (1998) found

five out of 11 ginseng supplements selected for testing contained less ginseng than expected from label claims or they were contaminated with lead and/or pesticides. One ginseng supplement had only 60.3% of its claimed amount of ginsenosides. 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 be a direct relation to the higher doses used in the United States in comparison to the dose used in TCM (Allen et al., 1998; Biondo et al., 2008).

2.2.6.3 Ginkgo biloba. Ginkgo biloba is an herb generally used to make extracts as medicine. Often ginkgo 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. The literature reports several adverse conditions of ginkgo biloba. Ginkgo fruit and pulp can cause severe allergic skin reactions and irritation of mucous membranes (Birks & Grimley, 2007). Ginkgo could also 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 and bleeding. A few people taking ginkgo reported bleeding in the eye and brain, and excessive bleeding after surgery. Ginkgo leaf extract can cause allergic skin reactions in some people. 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 (Radimer et al., 2004).

2.2.7 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 the past years (Juhn, 2003). Previous research indicated that approximately 50% of the general population, 76% of college athletes, and 100% of bodybuilders take supplements (Juhn, 2003).

2.2.7.1 Red Bull energy drink. Red Bull energy drink is a popular carbonated taurine drink with caffeine that claims to "vitalize the body and mind." The Red Bull energy drink is designed especially for moments of increased physical and mental stress and improves endurance, alertness, concentration, and reaction speed. The effectiveness of Red Bull energy drink is supported by quite a bit of scientific research, and endorsed by recognized sports professionals (Alford, Cox, & Wescott, 2001).

Nutrition facts: Serving Size: 8.3 fl. oz. servings per container: 1 Calorie: 10 Fat: 0g Sodium: 200mg, Total Carb: 3g Sugars: 0g Protein: less than 1g Niacin: 100% Vitamin B6: 250% Vitamin B12: 80% Pantothenic Acid: 50%.

Nutritional information: Carbonated water, sodium citrate, taurine, glucuronolactone, caffeine, acesulfame k, aspartame, inositol, xanthan gum, niacinamide, calcium pantothenate, pyridoxine hcl, vitamin B12, artificial flavors and colors (Forbes, Candow, Little, Magnus, & Chilibeck, 2007).

2.2.7.2 Weight gainers. Weight gainers are a very high calorie weight gain nutritional supplement for people wanting to gain weight and maintain weight management due to cancer and 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 can benefit from this to gain weight. This weight gain powder helps any underweight person to gain desired weight from 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 mixable with milk or water and is rich in vitamins and minerals, protein, fats, carbohydrates, sugars, and fiber. However, some of these products may contain hidden ingredients that can be harmful as well as compounds that have not been studied for efficacy or safety (Jeukendrup & Gleeson, 2004).

2.2.7.3 Slimming products. Slimming products are made of the extracts from plants and have been used for thousands of years. Plant extracts such as sweet potato fiber, cyamoposis gum, amor phallus konjac (extract from giant arum and jeruaslem artichoke), and alfalfa can make people feel full and thus restrain the appetite. These extracts can also reduce fat inside the body and thus make the body slimmer. 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 (Tharion et al., 2005).

2.2.7.4 Coenzyme Q10. Coenzyme Q10, also known as Co Q10 occurs naturally in the tissues of almost all plants and animals, including humans. Coenzyme Q10 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 (Sinatra & Aravot, 2004). Coenzyme Q10 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. The “Q” stands for quinone and the “10” stands for the number of isoprenoid units in the tail portion of the molecule. Generally, mammals have 10 isoprenoid units in the tail portion, but other non-mammalian species may have fewer units (Berman et al., 2004; Hodgson, Watts, Playford, Burke, & Croft, 2002).

2.2.7.5 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 (T. E. Graham, 2001; Magkos & Kavouras, 2004). The ergogenic effect of caffeine in endurance exercise performance is well established (C. S. Smith, Bottomley, Schulman, Gerstenblith, & Weiss, 2006). For recent reviews, see (Doherty & Smith, 2005; T. E. Graham, 2001; Magkos & Kavouras, 2004), which explains its extensive use by athletes. Caffeine intake with doses of between 5 and 13mg/kg body mass caused an improvement in endurance exercise capacity (Cox et al., 2002; Kovacs, Stegen, & Brouns, 1998). As caffeine is rapidly absorbed in human body, the performance effects will be maintained for the entire match (Bell & McLellan, 2002). However, intake of caffeine in the form of coffee yields smaller effects than intake of a similar dose of pure caffeine (T. Graham, Hibbert, & Sathasivam, 1998), and there may be some gastrointestinal distress associated with drinking strong coffee (Tarnopolsky, 1994). For soccer players, small doses of caffeine (1–2mg/kg body mass) can influence reaction time, alertness, and visual information processing,

which are crucial during the entire match (Haskell, Kennedy, Wesnes, & Scholey, 2005). However, overdosing can negatively affect reaction time and alertness (Tarnopolsky, 1994).

2.2.7.6 Creatine. Creatine is normally a chemical found in the body, mostly in muscles. Creatine is made by the body, and can be obtained from certain foods. It is a natural guanidine compound occurring in meat and fish in concentrations between 3 and 7 g/kg (Villena, 2010). 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. Taking creatine can stimulate muscle creatine uptake and facilitate the disposal of ingested creatine into musculature (Villena, 2010). 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 creatine supplement is taken in combination with post exercise carbohydrate amino acid protein supplement (Green, Hultman, Macdonald, Sewell, & Greenhaff, 1996). Vegetarians (D. G. Burke et al., 2003) respond better to creatine supplementation than others with a high natural muscle creatine content due to the low initial muscle creatine content.

The International Olympic Committee, the National Collegiate Athletic Association (NCAA), and professional sports allow creatine. Americans use more than four million kilograms of creatine each year. 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. However, creatine is safe for most people when used at recommended doses. Many people who use creatine gain weight. This is because creatine causes the muscles to hold water, not because it actually builds muscle (Metzl, Small, Levine, & Gershel, 2001; C. S. Smith et al., 2006).

The literature review on different supplements and their classification revealed the most popular supplements, which were grouped as shown in Table 2.2. Conversely, Table 2.3 further classifies the dietary supplements based on their functions to enhance physical activities during performance.

Table 2.2

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	Red Bull Energy Drink, Weight Gainers, Slimming Products, Coenzyme Q10, Caffeine, and Creatine

Table 2.3

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

2.3 Benefits of Dietary Supplements for Athletes

2.3.1 Supplements for endurance. Endurance is a pivotal determinant of performance in soccer. A match in soccer can last 90 min and can increase to 120 min when extra time is played. During this period, players on average perform between 9 and 12 km of intermittent running exercise, of which about 10% is sprinting (Reilly, 2005). There is no doubt that adequate pre-match and half-time carbohydrate intake can substantially improve a person's endurance capacity as well as intermittent sprint power in the final stages of a match (Williams & Serratosa, 2006). The supplements to be considered are caffeine and creatine.

2.3.2 Supplements for strength and power. Athletes mainly soccer players must be able to generate high energy to perform well throughout the season. In addition to high endurance capacity, players should be able to tackle high level of power during the game (Reilly, 2005). Supplements such as amino acid-protein-carbohydrate play an important role in producing high strengths and power (Hawley, Tipton, & Millard-Stafford, 2006). However, creatine and 3-hydroxymethylbutyrate are considered major sources.

2.3.3 Supplements for health. Soccer players must be able to produce high power outputs. Supplements are required for the high endurance capacity to maintain running ability throughout a match. Long-term team performance in soccer depends largely on the degree of match participation by the better players. In this respect, some supplements might contribute to injury prevention or rehabilitation from injury, health maintenance, or prevention of fatigue and overtraining (Hespel, Maughan, & Greenhaff, 2006).

2.3.4 Supplements for weight reduction. Body weight gains can be a problem for some athletes, including soccer players. Excess body fat can impair endurance capacity and power output during soccer. The logical strategy to reduce body weight is to shift the balance of dietary

energy intake relative to energy expenditure towards a net deficit, primarily by reducing energy intake. Therefore, players often seek the assistance of “fat-burning supplements” to facilitate body weight reduction (Hespel et al., 2006).

2.4 Benefits of Supplements

Supplements such as ergogenic aids enhance an athlete’s physical power, mental strength, and mechanical edge by enhancing metabolic processes involved in energy production during exercise. For example, creatin, one of the most important ergogenic aids, is used to increase strength and power for athletes. Protein supplements enhance nitrogen retention and increase lean muscle mass to prevent protein breakdown during exercise. Protein also increases hemoglobin and mitochondria during aerobic exercise. Arginine helps to increase human growth hormone and insulin production by increasing muscle mass and strength. The amino acid tryptophan serves as a precursor of serotonin to increase tolerance to pain during heavy exercise. Vitamin supplements are recommended for athletes consuming a low calorie diet. Supplementation with various antioxidant vitamins prevents muscle tissue damage.

The effects of nutritional supplementation in children and adolescents have not been studied. According to an American study (Bethene Ervin, 2001; Ervin, 2001), nutritional supplementation was more likely to occur among females, children aged 1–5 years, whites, and those with a higher income, higher educational status, and greater self-reported health status. Studies of adolescent athletes (Sobal & Marquart, 1994). Show that nutritional supplement users expect better sports performance. Calcium is the most important nutrient for preventing osteoporosis. Clinical trials have shown that sufficient amounts of calcium from either diet or supplements can increase bone mineral density, and, if combined with vitamin D, reduce bone fractures (Dickinson, 2002). It was also reported that many women and girls consume less than

the required level of calcium, and therefore supplement intake is necessary to fulfill calcium needs (Siris et al., 2001). In another study conducted by R. P. Heany (2000), the results showed that increasing calcium intake can reduce age-related bone loss, or both. The Food and Drug Administration (FDA) has also approved a health claim about high intake of calcium and lower risk of osteoporosis (Bendich, Leader, & Muhuri, 1999; Roe, Levy, & Derby, 1999). Bendich et al. (1999) estimate that if people over age 50 consume over 1,200 mg of calcium, more than 130,000 bone fractures could be prevented. Metz, Karanja, Torok, and McCarron (1988), Bendich et al. (1999), and Bursey, Sharkey, and Miller (1989) reported that high amounts of calcium resulted in less weight gain in obese rats. Therefore, the addition of supplements to the dietary source would improve long-term health. However, despite the highest calcium density in addition to the supplement use for older adults, amount is still not sufficient in meeting recommended levels. Increasing the frequency and level of calcium supplement used to enhance calcium density in diets may be important in reducing osteoporosis risk among older Americans (Bursey et al., 1989; Heaney, 2001; Metz et al., 1988).

Vitamins are organic compounds and have very important roles in functioning, growth, and maintenance of the body. Antioxidant vitamins such as C and E enhance sports performance. Vitamins (B6, B 12, and folic) may reduce cardiovascular disease. Boushey, Beresford, Omenn, and Motulsky (1995) indicated that additional intake of folic acid could prevent arteriosclerosis and cardiovascular disease. A number of studies show that women who consume vitamin supplements containing folic acid have a reduced risk of giving birth to babies with neural birth defects such as spina bifida. The antioxidant vitamin E (alpha-tocopherol) helps protect against LDL oxidation and hence prevent coronary heart disease. Thus, increasing intake of Vitamin E could improve overall health and improve longevity (Ames, Elson-Schwab, & Silver, 2002).

Proyer (2000) reported that 100-400 IU per day supplementation of Vitamin E with heart healthy diet and exercise could prevent heart disease (Ames, 1998; Pryor, 2000). Similarly, multivitamins with minerals can protect health and prevent diseases. Clinical studies have indicated that sports training reduced minerals such as zinc and magnesium lead to reduction in strength and testosterone. Hence zinc and magnesium supplements are recommended to improve training adaptations in professional adaptations (Thomson, 2010). Most people eat very little, so the intake of omega 3 fatty acids is always deficient in their bodies. Intake of omega 3 fatty acids as a supplement can reduce the risk of sudden death from cardiac arrest (Leaf et al., 2005).

Supplements provide benefit to those people who have long-term illnesses and who require additional nutrients to fight off disease and/or infection. Women of childbearing age need to be sure that they are getting sufficient folic acid and vitamin B12 in particular, plus adequate iron. Older people absorb and utilize nutrients less efficiently and should consider a general multivitamin/mineral supplement. In particular, older people need sufficient vitamins D, C, B6, B12 and folic acid plus zinc, calcium, and magnesium. Supplements can be beneficial for people whose total caloric intake is too low to provide adequate vitamins/minerals as well as for those taking medications that interfere with vitamin/mineral absorption. People who have medical problems that affect absorption, digestion, or regulation of nutrients and anyone who fails to eat a balanced diet may benefit from multivitamin/mineral supplement, but supplementation does not take the place of a balanced diet. Regular use of multivitamins and other supplements could thus reduce health risk and improve overall health quality (Petroczi & Naughton, 2008).

2.5 Negative Effects of Supplements

Many supplements have not been studied for long-term safety. Consequently, people who are taking these supplements should be aware of the possible side effects. Consumption of

excessive amounts of various supplements causes side effects. Overdosing also increases the intake rate of contaminants possibly contained in the supplements. Ephedra, for example, has bioactive effects, and also has serious adverse effects (Shekelle et al., 2003). Supplements similar to ephedra, such as synephrine, are still on the market (Marcus & Grollman, 2003) and increase the risk for interactions with other medications as it has the potential for decreased effectiveness of oral contraceptives. A recent meta-analysis report (Hathcock, Shao, Vieth, & Heaney, 2007; Hayden et al., 2007) shows increased mortality with a high dose of vitamin E among participants having severe cardiovascular disease. Conversely, a possible protective effect was observed among those without cardiovascular disease.

Numerous reports on accidental consumption in very high doses of vitamin D showed causality in the cases with exposure levels far above those administered doses. Having unknowingly ingested doses of 2.4 million IU vitamin D over a four-day period, a two-year-old boy came down with resistant hypercalcemia and hypertension (Barrueto, Wang-Flores, Howland, Hoffman, & Nelson, 2005). The resulting symptoms included pain, conjunctivitis, anorexia, fever, chills, thirst, vomiting, and weight loss. Similarly, a 72-year-old man with a 10-day history of nausea, vomiting, and weight loss subsequent to a month of thirst, polyuria, and poor mental concentration was found to have consumed 15,000 g of vitamin D2/day for 21 days (Todd, Bailey, Espiner, & Lynn, 1987). Excessively high vitamin D intake has thus been associated with hypercalcemia (Hathcock et al., 2007). Therefore, consumption of excessive amounts of various supplements causes side effects. Overdosing also increases the intake rate of contaminants possibly contained in the supplements. Since the literature did not show any side effects, the recommended dosages are considered safe.

2.6 How Supplements Function in the Body

Since the exact functional mechanism of supplements is not clear, this section summarizes some of the theories proposed by various researchers. Intake of supplements containing calcium can bind the bile/fatty acids in the gastrointestinal tract (GI) and form an insoluble complex of calcium soaps. This lowers the cell damaging properties of acids in the colon and helps to repair the damaged cells. Calcium also helps to improve the cells' signal, thereby disintegrating cancerous cells (Anderson, Amarasinghe, Fisher, Mak, & Packer, 2000). Omega 3 fatty acids in the diet or as supplements can lower triglycerides and decrease the level of platelets aggregation, improve blood vessels dilation, and thus decrease the chances of thrombosis (Greenwood, 2010).

Antioxidants supplements such as flavonoids can offer protection from cardiovascular diseases and cancer. In vitro studies have shown that flavonoids, including flavonols, flavones, and anthocyanidins possess antioxidant activity. With the intake of such flavonoids, reactive oxygen species form during normal aerobic metabolism and can cause damage to DNA, proteins, and lipids, despite natural antioxidant defense systems. Flavonoids, in combination with antioxidants and vitamins C and E inhibit lipid peroxidation in the phospholipid bilayer caused by reactive oxygen species. Studies have shown many flavonoids to be effective antioxidants in a wide range of chemical oxidation systems, as evidenced by their ability to scavenge peroxyl radicals, alkyl peroxyl radicals, superoxide hydroxyl radicals, and peroxynite in aqueous and organic environments (Duthie & Crozier, 2000). Recent studies suggested that dietary flavonoids might also protect free-radical-induced damage to DNA by a mechanism other than direct free radical scavenging. Results from pulse radiolysis studies and a plasmid test system demonstrated that flavonoids can reduce the incidence of single-strand breaks in double-stranded DNA as well

as residual base damage through fast chemical repair (Cemeli, Baumgartner, & Anderson, 2009). In addition to free-radical scavenging properties, flavonoids can chelate some metal ions responsible for the generation of reactive oxygen species and therefore inhibit the initiation of the lipoxygenase reaction. Noroozi, Angerson, and Lean (1998) demonstrated that most flavonoids showed greater antioxidant capacity than vitamin C. The study of Funabiki, Takeshita, Miura, Shibasato, and Nagasawa (1999), after making adjustments for age, body mass index, and energy intake, found the total intake of flavonoids among women inversely correlated with plasma total cholesterol and low-density lipoprotein concentrations. The study's aim was to show the effects of dietary supplementation of water-soluble rutin derivative 4-glucopyranosylrun (G-rutin) in rats that significantly inhibited the accumulation of oxidative damaged DNA (Funabiki et al., 1999; Noroozi et al., 1998).

Figure 2.1 shows the main functions of the creatine-phosphocreatine (Cr-PCr) system in a muscle fiber (Greenwood, 2010). Maximum amount of ATP is generated via phosphagen (ATP, Pcr-Cr) during high intensity exercise which is mainly depend upon glycolysis as well as glycogenolysis systems. The availability of this PCr is important for the muscle force production and performance during intense physical activities.

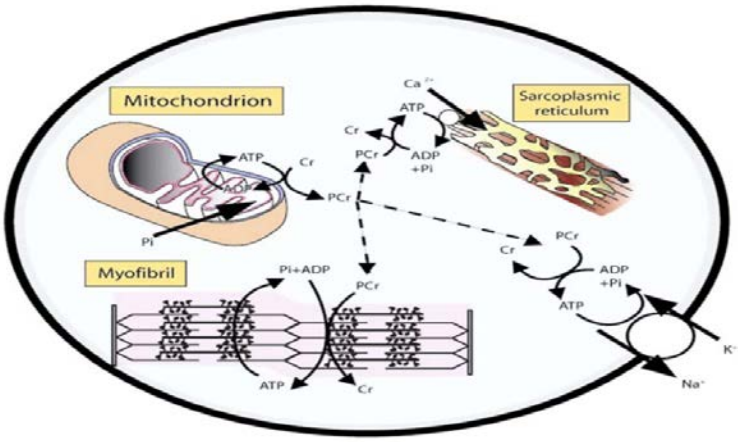

Figure 2.1. Diagram function of creatine-phosphocreatine.

2.7 Use of Dietary Supplements among Professional Athletes

Many athletes use dietary supplements, especially acrogenic aids such as Red Bull energy drink, slimming products, Coenzyme Q10, and creatine to enhance physical performance and tolerate pain (Naylor, Gardner, & Zaichkowsky, 2001). Thus, use of dietary supplements among athletes is a key to success. Sometimes players use excessive amounts of dietary supplements to perform better, which could lead to serious health consequences (Schroder et al., 2001). Some supplements are even implicated as the cause of death and disability when used improperly. Therefore, the amount of dietary supplements consumed should be within the recommended range for that particular product. Sometimes athletes are tempted to use or overuse certain supplements. For example, the use of high amounts of creatine is due to their beliefs and attitude that these supplements may work to enhance their strength (Dunn et al., 2001).

Massad, Shier, Koceja, and Ellis (1995) reported a correlation between the use of dietary supplements and gender. The study concluded that there is a correlation between greater knowledge of dietary supplements and reduced consumption. The ratio between dietary supplement and gender was slightly higher in male athletes compared to females. Athletes involved in contact sports such as soccer had used supplements in higher amounts (Dunn et al., 2001; Massad et al., 1995), as such intensive sports require increased muscle mass and strength on behalf of participants. Information on the use of supplements is usually provided by athletes' coaches and doctors (Jonnalagadda, Rosenbloom, & Skinner, 2001), who reported the use of supplements among college football players and found 42% using dietary supplements and 36% reported using creatine. In the same study, more than 50% believed that protein supplements are necessary for muscle growth and development. Additionally, 65% of the players surveyed believed that other factors motivate athletes to use supplements, including television advertising,

radio, books, and magazines. Usually, local players and individuals influence or motivate professional athletes to consume dietary supplements. The players look up to professionals as role models. Athletes carry a lot of performance pressure and want to be competitive. As a result, they may misuse sports supplements to gain an advantage over opponents. Due to the lack of regulations on increasing consumption of supplements, it is very important to understand behavioral factors that may influence consumption of these products. Therefore, it has become necessary to educate athletes by providing better knowledge about the risks and benefits of consuming dietary supplements. To avoid a health risk from the improper use of supplements, physicians, coaches, athletic trainers, parents, health educators, and other sports professionals should guide and inform supplement users about unproven results and potential harm of such dietary supplements.

2.8 Supplements in Saudi Arabian Markets

This section summarizes market trends and market growth analyses of the dietary supplement and vitamin industry in Saudi Arabia. In addition, the study will explore in detail the changing shape and potential growth of the supplement industry in Saudi Arabia. The research on dietary supplements and vitamins in the Saudi Arabian market is mainly focused on an analysis of key supply-side and demand trends, detailed segmentation of local and international products, historic volumes and values, and company and brand market shares. Various factors have contributed to this strong performance including demographic factors, developments in the retailing landscape (especially concern with health food shops), and changes in the lifestyle of consumers, increasing obesity, and health problems such as Vitamin B12 deficiency (Maughan, Depiesse, & Geyer, 2009). For example, General Nutrition Centers (GNC) stores offer a very wide variety of vitamins and dietary supplement products with a particular emphasis on dietary

supplements, in which supplements account for the leading retail value share of 17% in 2009 (Report, 2010).

The literature reports Vitamin D as an important oil soluble dietary compound among the vitamin group. Kanad, shaour, and sardines are consumed mostly in the eastern province of Saudi Arabia, but they are not as popular in the western province cities such as Mecca. Eggs contain approximately 20 IU of vitamin D/egg (Antonio et al., 2008). Typical vitamin D-fortified foods include milk, buttermilk, and yogurt. Each of these dairy products is found in Saudi Arabia and provides 400 IU of vitamin D/cup. More and more families are changing their lifestyles to lead a healthy life. Today's educated younger generation in the Middle East continuously increases their consciousness of healthcare, which has triggered the demand for health supplements. After doing research on the Middle Eastern market, Homart Pharmaceuticals started distributing these supplements products into nine countries in the Middle East. Some of the commonly available supplements in the Saudi Arabia market include Russian Bear 5000, designed for beginners or competitors, hardcore bodybuilders, and professional athletes in all sports. Pure L-Glutamine supplement in crystalline powder form has become more prominent as it contributes to protein synthesis (muscle growth), anti-proteolytic functions (prevents muscle tissue breakdown), and an increase in growth hormone. Nitro GH is a comprehensive growth hormone stimulant combination of selected vitamins, minerals, herbs, amino acids, and pro-hormones that help to boost and balance body hormone levels. Amino fuel 2000 is an amino acid supplement containing 2,000 mg of amino acids per tablet, which contains a more concentrated source of peptide-bonded amino acids, branched chain amino acids, and L-carnitine. Cell-Tech Hardcore Pro Series is another supplement designed especially for elite bodybuilders and athletes. However, in Saudi Arabian markets, there is still a lack of awareness of the proper use

of these available supplements, despite the continuing demand for these products. Therefore, extensive research and studies are required to educate the target consumers on the proper use and benefits of these products.

In the United States, the Food and Drug Administration (FDA) regulates all foods and drugs including nutritional supplements as mandated by the Food Drug and Cosmetics Act of 1938 (Mueller, 1999). The Dietary Supplement Health and Education Act (DSHEA) was passed by Congress on October 15, 1994 for further regulation of dietary supplements. Since then, the dietary supplement marketplace has grown enormously with new products in United States markets. Every dietary ingredient on the market before October 15, 1994 is recognized as an old dietary ingredient and considered to be safe; the ingredients marketed after October 15, 1994 are new dietary ingredients requiring Food and Drug Administration (FDA) pre-market review for safety (Noonan & Patrick Noonan, 2006). Thus, it is important to know the difference between these two dietary ingredients to market supplements products in the United States. In the United States consumer markets, there is a dietary supplement for a number of health problems that could require nutritional support such as supplements for joint health, cognitive function, vision, skin, and heart. According to the Nutrition Business Journal, in 2003 American consumers spent about $19.5 billion on nutritional products that included $15.5 billion on vitamins, minerals, amino acids, and other dietary supplements (Srinivasan, 2006). In the United States, people take supplements of vitamins, minerals, amino acids, fatty acids, botanicals, and other types of products for the prevention of chronic diseases. In 2005, sales of supplements reached over $20 billion (Roseland et al., 2008). Consumption of higher intake of such supplements ultimately lead to the increase sales in the markets. Supplements intake also contributes to a larger proportion of micronutrient intake than intake from foods alone (J. Dwyer, Picciano, & Raiten,

2003). The United States Pharmacopeia (USP) verification mark is given only to products that meet the required standard which assures health care professionals that the product label is accurate, contains the ingredients in right amount, meets the product purity standard, and have been manufactured with USP and FDA standard (Abdullah & Mal-Allah, 2011; Srinivasan, 2006). Table 2.4 provides a list of the most commonly used supplements in the United States and recommended dosages for adults (Najm & Lie, 2008; Wilson et al., 2006).

Table 2.4

Supplements in United States Markets

Conditions and Product	Products Used (Examples)	Form Used	Common Dosages (Adults)	Efficacy	Safety
Common cold	Echinacea	Capsule	500–1000 mg three times daily 5–7 days	0	+
		Tea	4 g Echinacea in water for 5 days	0	+
Urinary tract infection prophylaxis	Cranberry	Juice	90–480 mL cocktail or 15–30 mL unsweetened 100% juice daily	+	+
Cancer prevention – breast and prostate	Grapes		230 g/d	+	+
Cancer (general)	Fish oil		No established dose	0	+
Gastrointestinal–Constipation	Flaxseed		Same dose as lipoprotein profile	+	+
Inflammatory bowel disease	Fish oil		No established dose	0	+
Cardiovascular disease–general	Red grape		600 mg	+	+
Nausea/vomiting	Ginger	Tablet	1 g	+	+
Memory enhancement (healthy adults)	Gingko	Tablet	120 mg twice daily	-	+
Cancer (general)	Green tea	Tea	1–10 cups/d	+	+
Cardiovascular disease	Green tea	Tea	No established dose	0	+

CHAPTER 3

Use of Dietary Supplements among Professional Athletes in Saudi Arabia

3.1 Introduction

Dietary Supplements in the United States, as defined by the Dietary Supplement Health and Education Act of 1994, are defined as any “product” (other than tobacco) intended to supplement the diet that bears or contains one or more dietary ingredients (DSHEA, 1994). Dietary supplements include vitamins, minerals, herbs, meal supplements, sports nutrition products, natural food supplements, and other related products used to boost the nutritional content of the diet (L. Burke et al., 2006; Juhn, 2003). Many athletes use different dietary supplements for a variety of reasons. Among the most popular products are ergogenic aids such as Red Bull (an energy drink), slimming products, Co-enzyme Q10, and creatine to enhance physical performance and to tolerate pain (Naylor et al., 2001). Thus, the use of dietary supplements among athletes is a key to success. Some players use excessive amounts of dietary supplements to enhance performance. This excess has been known to lead to serious health consequences (Schroder et al., 2001). Some supplements have even been implicated as the cause of death and disability when used improperly. For example, the use of high amounts of creative by athletes is due to their beliefs and attitude that these supplements may work to enhance their strength (Dunn et al., 2001). Therefore, the amount of dietary supplements consumed should be within the recommended range for that particular product.

Massad et al. (1995) reported a correlation between greater knowledge of dietary supplements and reduced consumption. The ratio between dietary supplements and gender was slightly higher in male athletes compared to females. Athletes involved in contact sports such as soccer had used supplements in higher amounts (Dunn et al., 2001; Massad et al., 1995) as such

intensive sports require increased muscle mass and strength. Information on the use of supplements is usually provided by the athletes' coaches and doctors (Jonnalagadda et al., 2001), who reported on the use of supplements among college football players and found that 42% were using dietary supplements and 36% reported using creatine. In the same study, more than 50% of the football players believed that protein supplements are necessary for muscle growth and development. Additionally, 65% of the players surveyed believed the information coming from media sources such as television advertising, radio, books, and magazines motivated athletes to use supplements. Typically, local players and individuals influence or motivate professional athletes to consume dietary supplements. The players look up to professionals as role models. Athletes carry a lot of performance pressure and want to be competitive. As a result, they may misuse sports supplements to gain an advantage against opponents. Due to the lack of regulations and the increasing consumption of supplements, it is very important to understand behavioral factors that may influence the consumption of these products. Therefore, it has become necessary to educate athletes by providing better information about the risks and benefits of consuming dietary supplements. To reduce the risks from the improper use of supplements, physicians, coaches, athletic trainers, parents, health educators, and other sports professionals who have a stake in the health of these professional athletes should inform supplement users about unproven results and provide warnings about the potential harm of such dietary supplements (Bishop, 2010; Hespel et al., 2006). Our daily meals are not enough to boost our strength in intense sports activities. Sports supplements can provide an easy way to improve our health, and build and maintain muscle mass, endurance, and power. Using carbohydrate diets containing electrolytes can hydrate the body during sporting events. Injury prevention and enhanced recovery are important benefits of using sports nutrition supplements (Dickson, 2002).

Saudi Arabia supervises 153 soccer clubs. These clubs include various grades and age groups, which range from 12 years of age to 15, to adult teams. The main objectives of the Saudi football leagues are to promote a spirit of competition and to promote a strong base for the sport in Saudi Arabia. The Saudi Professional League is the primary football organization in Saudi Arabia (SAFF, 2013). Despite being active in sports activities, no previous survey studies have been conducted by the SPL to know whether the players are receiving accurate information regarding the use of dietary supplements. Since supplements are an integral part of players' lives, they must use these supplements properly in order to avoid negative health consequences. Therefore, the objective of this study was to understand the usage and beliefs about dietary supplements among professional athletes in Saudi Arabia through multiple choice survey questionnaires.

3.2 Materials and Methods

The Institutional Review Board (IRB) of North Carolina Agricultural & Technical State University approved this study and questionnaire (Appendix E). The survey method was discussed with professional athletes in the capital city of Saudi Arabia, Riyadh. The questionnaires were designed to understand perceptions of supplements among professional athletes in Saudi Arabia. A consent form was placed on top of the survey for the sports and health department policy on using human subjects along with a description of subject's specifications and the nature of the survey.

3.2.1 Sampling method. One hundred and five professional soccer players were recruited as subjects from three different sports teams (Al Hilal, Al Nasr, and Al-Shabab) in Riyadh, Saudi Arabia. All subjects were professional soccer players between the ages of 20 and 30 who were either Saudi or foreign nationals. Each team was assigned to a coordinator who had

the role of organizing recruitment efforts. The recruitment process included advertisement of the study via word of mouth, email, posters, and announcements at weekly training meetings. The date and location of the survey meeting was communicated in the recruitment information. All methods and materials used in this study were approved by the “The Saudi Professional League” of Saudi Arabia Riyadh Human (Appendix L; SAFF, 2013).

3.2.2 Translation of questionnaire. The questionnaire was constructed in English. However, the participants in this study did not have the ability to read the English version. Therefore, an Arabic version of the questionnaire was developed (Appendix C and Appendix D). Dr. Sami Siraj, who is the Assistant Professor at Taibah University in Saudi Arabia and Dr. Osman H. Hassan, research scientist at the University of North Carolina Agricultural & Technical State University reviewed the Arabic version of the questionnaire.

3.2.3 Survey questionnaire. A questionnaire was developed to collect data per the objective. The questionnaire consisted of 16 questions divided into the following four categories: use of supplements, reason for consumption, personal beliefs, and behavior (Appendix A and Appendix B). Overall, the survey questions pertained to the frequency of supplement purchases as well as factors that might be considered by professional athletes when purchasing these supplements. Factors for the latter set of questions included cost/serving, cost/g of supplement, total cost of the supplement, taste, perceived results, ease of use, grams of supplement/serving, and other nutritional content such as protein (e.g., whey, casein, egg, or soy), or other forms of proteins, fats, amino acids profile, and carbohydrates. The survey also sought to determine the subjects’ primary sources of information about supplements, such as magazine advertisements, an athletic trainer, strength and conditioning coach, nutritionist/dietitian, internet website, friend, family member, or health food store employee.

3.2.4 Data collection (survey administration). The researcher traveled to Riyadh, Saudi Arabia to collect the data for this study. This study took approximately three months to administer the surveys and collect the data from the participants. During the summer of 2012, the survey was given to each sports team. The time and location for each survey was arranged and announced at least two weeks in advance. All professional players attended and participated in the survey that took place in the club classroom at 9:00 am on Monday Saudi Arabian time. Approximately 10 minutes were needed to distribute surveys and provide information, while it took about 45–50 minutes to complete the survey questionnaires.

3.2.5 Statistical analysis. To measure athletes' behavior and attitude, there are sixteen questions in the survey. Three soccer clubs randomly selected from Riyadh (Capital of Saudi Arabia). Questionnaires covering four categories about supplements, reason for consumption, personal beliefs, behavior, and attitude distributed to the above-mentioned athletes. The dependent is the attitude, while the independent variables were the professional athletes' response. Because answers are categorical variables, they were analyzed using chi-square tests with a significance level of 0.05. The Statistical Analysis System (SAS Inc., Cary, NC, USA) package used to compute the data statistics for this study.

3.3 Results

This study focused on the use of dietary supplements by professional athletes in Saudi Arabia and those athletes' attitudes toward these supplements. Three different soccer teams in Saudi Arabia's capital, Riyadh, were selected to provide the necessary data for this study. We also chose these soccer teams based on their location in Riyadh and their willingness to participate in this study. During the initial study, we found that each team had at least 45 players. In order to make our study statistically valid and representative, we needed at least 10% of the

total team members. Therefore, this study included a total of 105 professional soccer players. Table 3.1 shows the number of players from each team that participated in the survey. The teams consisted of male soccer players from Riyadh with ages ranging from 20 to 30 years of age. The number of players from Al Hilal was 44 (42%) followed by Al-Shabab with 33 players (31.54%) and Al Nasar with 28 players (26.54%). The survey contained sixteen questions ranging from frequency of use of supplements to personal information such as age and level of education.

Table 3.1

Teams that Participated in the Survey

	Participants	
Team Name	*n*	%
1. Al Hilal	44	41.90
2. Al Nasr	28	26.56
3. Al-Shabab	33	31.54
Total	105	100.00

Table 3.2 lists the survey questions related to the reason each athlete used dietary supplements. In the first question, we asked if the professional players involved in this study took dietary supplements. Of the 105 athletes surveyed, we found that only 98 athletes were currently taking dietary supplements (mean age and standard deviation were 25.74 ± 2.90). Thus, we decided to focus on those 98 athletes who were taking dietary supplements and eliminated the other seven. Responses showed that a high percentage of athletes (93.3%) were using different dietary supplements throughout the season.

In the question relating to the main reason for using dietary supplements, results showed a high percentage of athletes (n = 98; 93.3%) used different dietary supplements throughout the season and for different reasons. 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%) athletes reported buying supplements from trainers or physicians, and less than 5 (5.10%) reported purchasing supplements from online stores or from other sources. Similarly, maximum of 45 athletes (45.92%) reported physician as the main source of information provider on dietary supplements followed by nutritionist 28 (28.57%), and coach 11 (11.22%). However, less than 10% athletes reported their sources of information as journals, magazines, and online resources.

Table 3.2

The Usage of Dietary Supplements among Professional Athletes (n = 105)

Response	*n*	%
1. Do you currently take dietary supplements?		
No	7	6.67
Yes	98	93.33
2. What is the main reason of using dietary supplements?		
Improve my health	32	32.65
Prevent injury	9	9.18
Recovery	3	3.06
Physical appearance	11	11.22
Performance	43	43.88
3. Where do you usually buy your dietary supplements?		
Retail store or pharmacy	11	11.22
Athletic trainer or physician	64	65.31
Nutritionist or dietician	18	18.37
Online store	4	4.08
Other	1	1.02
4. From whom do you get information about dietary supplements?		
Coach	11	11.22
Physician	45	45.92
Nutritionist or dietician	28	28.57
Academic journals	4	4.08
Online	8	8.16
Magazine	2	2.04

Table 3.2 *(cont.)*

Response	*n*	%
5. Age		
< 25 years old	43	43.88
> 26 years old	55	56.13
6. What is your highest level of education?		
Less than high school	8	8.16
High school	47	47.96
Some college	23	23.47
Bachelor's degree	13	13.26
Graduate or Professional degree	7	7.14
7. How long have you been a professional soccer player?		
< 9 years	80	81.63
> 10 years	18	18.36

Note. These results showed the response does differ significantly ($p < 0.0001$) indicating reasons for taking dietary supplements differ from each individual.

Of the total of 98 participants who take supplements, all were males, 43 (43.88%) were under the age of 25, and most of the players in survey ($n = 55$; 56.13%) were older than 26. Nearly 47 (47.96%) had a high school degree, followed by 23 (23.47%) who had some college degree, 13 (13.26%) who held a bachelor's degree, 8 (8.16%) with less than high school degree, and approximately 7 (7.14%) had a graduate or professional degree. Most of these players ($n = 80$; 81.36%) have been involved in the sport for less than nine years.

Table 3.3 lists the questions regarding the perception of dietary supplements and usage among professional athletes in Saudi Arabia. Questions 8 to15 in the study dealt with athletes' perceptions regarding the use of supplements. A majority of athletes ($n = 81$; 82.65%) agreed that supplements were a healthy choice, and 66 (67.35%) believed that supplements improved endurance.

Regarding the safety of dietary supplements, a majority (*n* = 44; 44.90%) somewhat agreed that the supplements they used were safe, while 41 (41.84%) believed that supplements are a safe product in general. Athletes agreed that supplements were a good source of energy (*n* = 66; 67.35%), and support longer training sessions (*n* = 44; 44.90%). Similarly, 58 (59.18%) reported that dietary supplements increased their strength. A majority of players (*n* = 30; 30.61%) indicated that supplements were taken as a pain reliever during training sessions, and 42 players (42.86%) used supplements to enhance concentration during the game.

Table 3.3

Perception of Dietary Supplements and Usages among Professional Athletes (n = 98)

Response	*n*	%
8. Dietary supplements make me healthier.		
Agree	81	82.65
Somewhat agree	13	13.27
Neither agree nor disagree	4	4.08
9. Dietary supplements improve my endurance.		
Agree	66	67.35
Somewhat agree	16	16.33
Neither agree nor disagree	12	12.24
Somewhat disagree	4	4.08
10. Dietary supplements are safe to use		
Agree	41	41.84
Somewhat agree	44	44.90
Neither agree nor disagree	8	8.16
Somewhat disagree	3	3.06
Don not know	2	2.04
11. Dietary supplements provide me with more energy		
Agree	66	67.35
Somewhat agree	25	25.51
Neither agree nor disagree	6	6.12
Somewhat disagree	1	1.02

Table 3.3 *(cont.)*

Response	*n*	%
12. Dietary supplements increase the amount of training I can undergo		
Agree	44	44.90
Somewhat agree	32	32.90
Neither agree nor disagree	20	20.41
Somewhat disagree	1	1.02
Disagree	1	1.02
13. Dietary supplements increase my strength.		
Agree	58	59.18
Somewhat agree	21	21.43
Neither agree nor disagree	16	16.33
Somewhat disagree	3	3.06
14. Dietary supplements increase my ability to cope with pain.		
Agree	30	30.61
Somewhat agree	31	31.43
Neither agree nor disagree	28	28.57
Somewhat disagree	7	7.14
Disagree	2	2.04
15. Dietary supplements improve my concentration.		
Agree	42	42.86
Somewhat agree	23	23.47
Neither agree nor disagree	25	25.51
Somewhat disagree	5	5.10
Disagree	2	2.04

Note. These results showed the response does differ significantly ($p < 0.0001$) indicating reasons of taking dietary supplements differ for each individual.

In our study, we were also interested in knowing more about the types of supplements that were being used among these athletes. Table 3.4 shows the list of supplements athletes reported using during the session. Athletes 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 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%).

Table 3.4

Type of Dietary Supplements and Frequency of Use among Professional Athletes (n = 98)

	No	Yes
Category of Supplements	n (%)	n (%)
Sport supplements		
Sport Drinks	11 (11.23)	87 (88.77)
Health Bar	40 (40.82)	58 (59.18)
Red Bull Energy Drink	73 (74.49)	25 (25.52)
Vitamins		
Vitamin C	17 (17.35)	81 (82.65)
Vitamin D	55 (56.13)	43 (43.87)
Vitamin E	72 (73.47)	26 (26.53)
Vitamin B	58 (59.18)	40 (40.82)
Multivitamin	47 (47.96)	51 (52.04)
Minerals		
Iron Supplement	42 (42.86)	56 (57.14)
Calcium	31 (31.64)	67 (68.36)
Carbohydrate		
Carbohydrate electrolyte beverage	31 (31.64)	67 (68.36)
Fructose Syrup	84 (85.72)	14 (14.28)
Protein		
Amino Acids	72 (73.47)	26 (26.53)
Ephedra	85 (86.74)	13 (13.26)
Weight Gainers	76 (77.56)	22 (22.44)
Fish Oils		
Omega 3	53 (54.09)	45 (45.91)
Omega 6	80 (81.64)	18 (18.36)
Herbals		
Ginseng	70 (71.43)	28 (28.57)
Gingko biloba	88 (89.70)	10 (10.30)
Ergogenic Aids		
Slimming Products	70 (71.43)	28 (28.57)
Coenzyme	75 (76.54)	23 (23.46)
Caffeine	41 (41.84)	57 (58.16)
Creatine	82 (83.68)	16 (16.32)

Note. Since the *p* value is 0.0001, we can conclude that there is statistically significant difference between the frequencies of use of dietary supplements among professional athletes.

3.4 Discussion

Professional soccer has been popular in Saudi Arabia. Improvement in players' performance is closely scrutinized. These players are always under pressure to perform well, win the match, and to be part of the national team. Therefore, athletes are always in need of dietary supplements to enhance their performance. Since doping is illegal, these players need legal nutritional during a sporting event. Each year new supplements are appearing in growing Saudi Arabia markets and intake of supplements among athletes is also increasing. It is important to know the use of supplements by professional athletes. There is a little published information regarding the consumption of dietary supplements in Saudi Arabia. To the best of our knowledge, information on availability and use of supplements among professional athletes in Saudi Arabia has never been accomplished. There is an inherent need to improve knowledge of dietary supplements use among consumers.

Nutritional supplements can be grouped into three basic categories: dietary supplements, ergogenic aids, and sports foods (Dunford, 2010; Tian et al., 2009). Dietary or nutritional supplements include vitamins, minerals, trace elements, amino acids, proteins, and herbs intended to supplement a normal diet or to provide health benefits. Supplements come in the form of pills, capsules, tablets, powders or liquid form. Some commonly used supplements in this category are shown in Table 3.4 (Tian et al., 2009).

The use of specific nutritional supplements among athletes ranges from 46% to 100% (Tian et al., 2009). This wide variation can be attributed to different methodological differences, purpose of use, and mode of data collection. Our study shows that the prevalence of use of dietary supplements among professional athletes in Saudi Arabia is similar to nutritional supplement use among university athletes in Singapore (Tian et al., 2009). From our research, it

is believed that over 90% of the athletes in Saudi Arabia a use dietary supplement which is 10% higher compared the study conducted among German athletes by Braun et al. (2009).

In our study, the most popular products were sports drinks and vitamin /mineral supplements similar to the Singapore study. The use of sports drinks in our study is close to that shown in the study earlier reported by (Froiland, Koszewski, Hingst, & Kopecky, 2004; Kristiansen, Levy-Milne, Barr, & Flint, 2005). Seventy-three percent of the athletes reported using energy drinks, and 61% reported using calorie replacement products including drinks, bars and powders (Krumbach, Ellis, & Driskell, 1999). Similarly, the use of vitamins and multivitamins ranges from 26–82% among athletes. The use of multivitamins and vitamin C is higher than 50% and 80%, respectively (Baylis, Cameron-Smith, & Burke, 2001; Burns, Schiller, Merrick, & Wolf, 2004; Krumbach et al., 1999). The reasons these athletes use vitamins are primarily to stay healthy and to prevent illnesses during the game season (Sobal & Marquart, 1994).

Similarly, there has been a study involving German athletes where the intake of sports drink was lower (69%) when compared to the intake percentage (87%) of our study. Likewise, those athletes who took vitamins comprised of 81% of the Saudi athletes while Germans lagged behind at 76%. However, when it came to mineral intake, Germans consumed 87% while Saudis athletes consumed 60%. Carbohydrates ranked evenly with Germans taking in 64% compared to the Saudi's 67% (Braun et al., 2009).

We also found in our study that the use of other dietary supplements such as Ephedra, Omega-6, creatine, and Ginkgo biloba were lower. The use of the most popular supplement, creatine, is only 16.32%, which is very low when compared to the western countries including the United States (L. M. Burke & Read, 1993; Jacobson et al., 2001). Jonnalagadda et al. (2001)

reported 36-37% of athletes used creatine, which was higher compared to our study (16.32%). In recent years, the use of supplements among athletes in a number of sports has been increasing to improve performance. In our study, the majority of the players reported that supplements are safe and can be consumed without any harm. However, in our microbiological examination we determined some of the commonly used supplements contain harmful microorganisms (Aljaloud, Ibrahim, Fraser, Song, & Shabazi, 2013; Aljaloud, Song, Fraser, & Ibrahim, 2009). Therefore, it is important to understand how these products work and whether these products provide worthwhile benefits while considering possible long term health effects.

During our survey we have divided the questionnaires into four categories: use of supplements, reason for consumption, personal beliefs, and behavior. Of the 105 athletes surveyed, we found that only 98 (93.33%) are currently taking dietary supplements. Survey results showed that a majority of athletes use different dietary supplements throughout the season either to enhance performance or simply to improve their health. In earlier studies (Jacobson et al., 2001; Krumbach et al., 1999), it has been noted that the use of supplements among male athletes is primarily to enhance performance. Use of vitamin and mineral supplements are often used by athletes as ergogenic aids to improve performance, as described by (Sobal & Marquart, 1994).

Nutritional supplements can also play an important role in helping athletes consume the correct amount of calories, carbohydrates, and proteins in their diet. However, inappropriate use or contamination may cause health problems (Tian et al., 2009).

We found that most of the athletes had received their information about supplements either from physicians or nutritionists. A total of 45 (45.92%) surveyed athletes out of 98

received the information from their physicians, which is similar to the study conducted by Braun et al. (2009).

According to a study by (Froiland et al., 2004), male athletes were more likely to obtain information about use of supplements from a store nutritionist, fellow athletes, friends, or from a coach. These results were similar to ours. Similarly, in a study by (Kristiansen et al., 2005), health professionals and the Internet were the most common information sources, while friends and colleagues often recommended the use of supplements. Regular use of supplements among athletes would thus indicate that a regular diet alone is not sufficient to provide necessary nutrients and energy during sports performance. Sports such as soccer rely primarily on a combination of the phosphagen system, anaerobic glycolysis, and aerobic metabolism (Kristiansen et al., 2005). To enhance performance, strength, and for the overall improvement of health, it is important to meet all these metabolic demands by taking different supplements. Therefore, athletes should be better informed and educated about the benefits associated with the consumption of supplements.

3.5 Conclusions

Our study showed that the use of dietary supplements varies with each individual professional athlete for several reasons. According to the survey we gave, when asked about their use of supplements and their reasons for consumption, the majority of athletes expressed their desire to improve health and performance. Our survey results also showed the types of supplements used by athletes during the training season.

3.6 Acknowledgements

The research work was funded through the King Saud University, Riyadh Saudi Arabia. We would like to thank The Saudi Professional League and 105 professional soccer players who

were surveyed from three different sports teams (Al Hilal, Al Nasr, and Al-Shabaab). We would also like to thank presidents of Al Hilal, Al Nasr, and Al-Shabaab sports team.

CHAPTER 4

The Availability of Dietary Supplements in Saudi Arabian Markets

4.1 Introduction

The market for the dietary supplement and vitamin industry in Saudi Arabia has been growing as the general population has become more aware of the need to remain healthy and fit. We explored in detail the changing shape and potential growth of the supplement industry in Saudi Arabia. The research on dietary supplements and vitamins in the Saudi Arabian market of Riyadh is mainly focused on analysis of key supply-side and demand trends. This analysis also shows detailed segmentation of international and local products, historic volumes and values, and company and brand market shares. Various factors have contributed to this strong performance including demographic factors, and developments in the retailing landscape. Many sports organizations and federations have obtained substantial sponsorships from supplement companies. The administration of sports supplements has become an increasingly standard procedure, often promoted by team physicians, coaches, and even the parents of young players (Pillitteri et al., 2012). More and more families are changing their lifestyles to lead a more healthy life. Today's educated younger generation in the Middle East has continuously increased their awareness of the importance of healthcare, and this has triggered the demand for health supplements (Khoury & Jonville, 2012). In our study, we have reported the availability of supplements in the different market of Riyadh, Saudi Arabia in great detail.

After doing research in the Middle Eastern market, Homart Pharmaceuticals started distributing supplements into nine countries in the Middle East (Homart, 2008). One of the more commonly available supplements in the Saudi Arabian market includes Russian Bear 5000, designed for beginners or competitors, hardcore bodybuilders, and professional athletes in all

sports. Pure L-Glutamine supplement in crystalline powder form has also become more prominent as it contributes to protein synthesis (muscle growth), anti-proteolytic (prevents muscle tissue breakdown) functions, and an increase in growth hormone. Nitro GH is a comprehensive growth hormone stimulant combination of selected vitamins, minerals, herbs, amino acids and pro-hormones that help to boost and balance body hormone levels. Amino fuel 2000 is an amino acid supplement that contains a more concentrated source of peptide-bonded amino acids, branched chain amino acids and L-carnitine. Cell-Tech Hardcore Pro Series is another supplement designed especially for elite bodybuilders and athletes. However, in Saudi Arabian markets, there is still a lack of awareness of the proper use of these available supplements despite the continuing demand for them. Therefore, extensive research and studies are required to educate the target consumers on the proper use and benefits of these products (Report, 2010).

In the United States, the Food and Drug Administration (FDA) regulates all foods and drugs including dietary supplements as mandated by the Food Drug and Cosmetics Act of 1938 (Mueller, 1999). The Dietary Supplement Health and Education Act (DSHEA) was passed by Congress on October 15, 1994 to further regulate dietary supplements. Since then, the dietary supplement marketplace has grown enormously with new products in United States markets (DSHEA, 1994; Noonan & Patrick Noonan, 2006). Every dietary ingredient on the market before October 15, 1994 is recognized as an old dietary ingredient and considered to be safe; the ingredients marketed after that time are new dietary ingredients requiring Food and Drug Administration (FDA) pre-market review for safety (Roe et al., 1999; Noonan & Patrick Noonan 2006). Thus, it is important to know the difference between these two dietary ingredients to market supplements products in the United States. In the United States consumer markets , there

is a dietary supplement for a number of health problems that could require nutritional support such as supplements for joint health, cognitive function, vision, skin, and heart. According to the Nutrition Business Journal, in 2003 American consumers spent about $19.5 billion on nutritional products that includes $15.5 billion on vitamins, minerals, amino acids and other dietary supplements (Srinivasan, 2006). In the United States, people take vitamins, minerals, amino acids, fatty acids, botanicals and other types of products for the prevention of chronic diseases. Nearly 80% of increased in sales of dietary suppleness was observed in US market from 1994 to 2000, from $8.8 billion to $15.7 billion (Blendon et al., 2001). Approximately 40% of the U.S. population is reported to use some form of dietary supplement (Matthews et al. 1999 and Messerer et al. 2001) indicating the increased interest in the use of the dietary supplements. Increased use of dietary supplements and the trend is thought to be similar in many parts of the world including Sweden and Australia (Komesaroff 1998 and Messerer et al. 2001).

In 2005, supplements sales reached over $20 billion (Roseland et al. 2008). Supplement intake also contributes to a larger proportion of micronutrient intake than intake from foods alone (J. Dwyer et al., 2003). The United States Pharmacopeia (USP) verification mark is given only to those products that meet required standards which assures health care professionals that the product label is accurate, contains the ingredients in the correct amounts, meets the product purity standard, and has been manufactured with USP and FDA standards (Srinivasan, 2006; Abdullah & Mal-Allah, 2011). The market for the dietary supplement and vitamin industry in Saudi Arabia has been growing as the general population has become more aware of the need (Aljaloud et al., 2009). It is necessary to document the market and availability of dietary supplements in Saudi Arabia. Therefore, in this study, we have reported the availability of dietary supplements in the local markets of Riyadh city of Saudi Arabia.

4.2 Materials and Methods

In this study, Riyadh, the capital of Saudi Arabia, was selected to determine the available supplement products and market brands. In order to manage the sampling collection for the available supplement products, the city was further divided into five major regions (Figure 4.1) (Riyadh Principality, 2012).

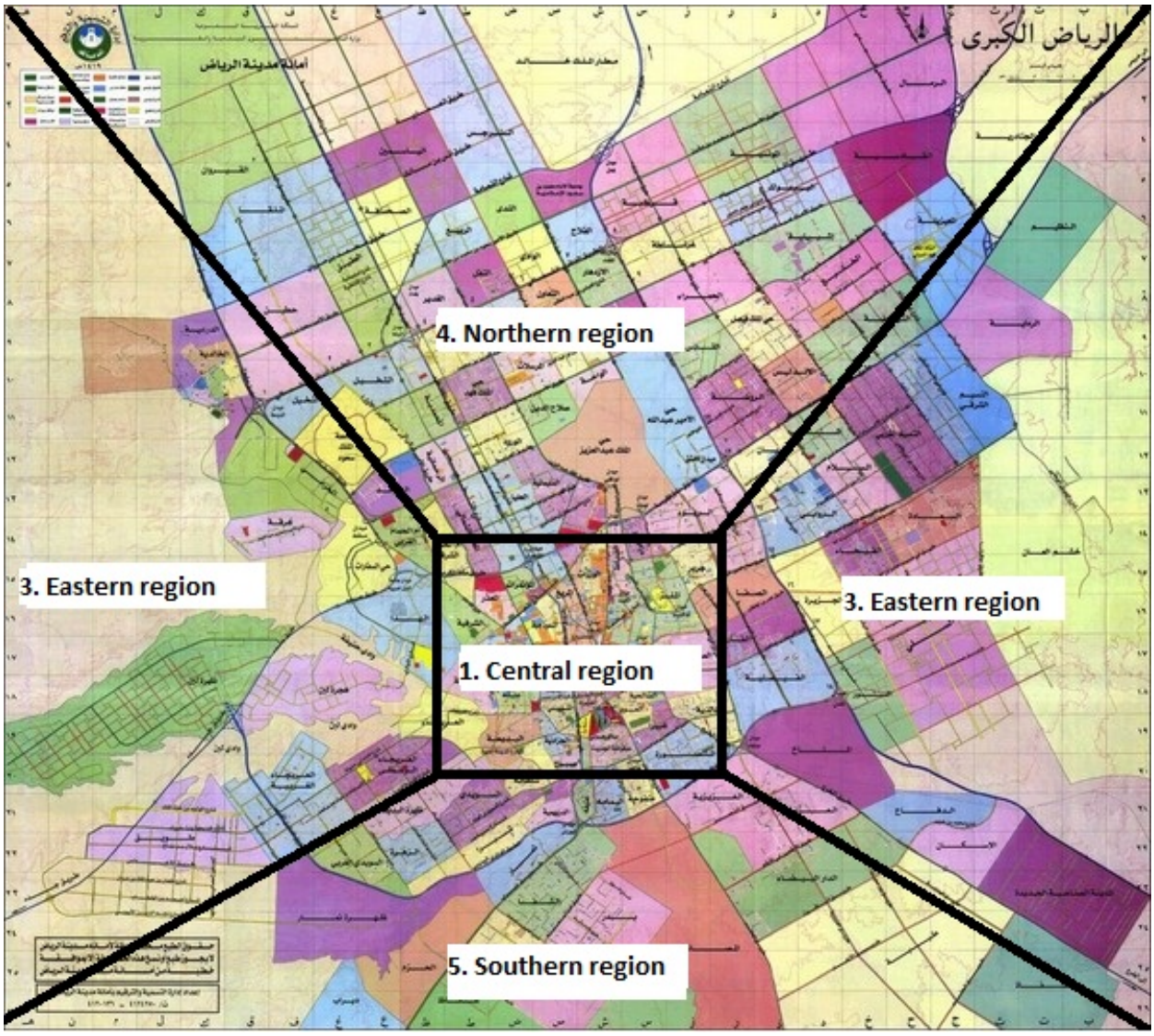

Figure 4.1. Map of Riyadh.

The five major regions are:

1. Central region (Al Malaz, Aldeirah,Al fajriah,AlJeradeh,Al Mansourah,AlManfouhah).
2. Western region (King Saud University, Area of Embassies, Al Hada, Al frejae, Al Dir'iya, Al Khalidiya).
3. Eastern region (Al slie, Al salam, Al orabi, The new industrialcity, Al Faisaliah, AlFahah, Al Jazeerah).
4. Northern region (Al Andalusia, Area of KingAbdulaziz, Al Sulaymaniyah, Al Rabow, Al Rayyan).
5. Southern region (Al Shafa, Alhazam, Area of Factories, Al Marwah, Shubra, Okaz, Dirab).

Approximately ten percent of the stores in each region were selected in order to determine availability of dietary supplements. These stores were chosen based on location and accessibility to the public. In each store, information was gathered about products available in the market. Based on the information obtained from Objective 1, products that were most popular among professional athletes were selected for further study.

4.2.1 Sampling procedure. Location: ½ mile radius from shopping centers which include malls and store fronts. Stores that were focused on included general Nutrition stores, pharmacies, and supermarkets within these centers.

We chose at least 10% of total stores from each region, as follows:

1. There were 24 malls. For example: Al Qasr Mall, Al Gargar Mall, Al Qthaim Mall, FaisaliahShoppeing Mall, Sahara Mall, le Mall, La Centeria Mall, Nujood Mall, Hyat Mall, Silicone Mall, Locoloizer Mall, Al Azizia Mall, Olaya Mall, Marina Mall, Al

Jazeera Mall, Shifa Mall, Royal Mall, Dana Mall, Al- Batha Mall, Bin Suliman Mall, Al QarawiGallary, Almajd Mall, and Alshellah Mall.

2. There were 12shopping centers. For example: Euromarche Shopping Center, Rimal Center, Granada Center, Kingdom Center, Alfaysaliya Center, AlMousa Center, Al habdan Center, Mursalat Center, Al badeya Shopping Center, Al Othim Shopping Center, Maaquliya Commercial Center, tamimi Safeway S.C.
3. Other stores located within ½ mile of Shopping Centers and Malls such as General Nutrition Centers (GNC), pharmacies, and supermarkets were included.

Table 4.1

Types of Different Stores for the Availability of Dietary Supplements in Riyadh, Saudi Arabia

Store Types	Store Names	Sampling size (at least 10%)
Total of (22) General Nutrition Centers (GNC).	Alhabdan Center, Al Hamra Market, City Market, Dana Mall, Hayatt Mall, Mohammed Sultan AlZamil, Mursakat Center, RabwaTamimi, TaKhsusi Plaza, Abdullah Benrashed Al-Kl, Granada Center, Tamimi market (Safway), Al TamimiSafwaySuperma, Al-badeya Shopping Center, Al-Batha Mall, Al-Othaim Shopping Center (King Fahad Road) Al-Othim Shopping Center (Kharaj Road), Alfaysaliya Center, Armal, bin Suliman Mall, Maaqliya Commercial Center, TamimiSafway S.C.	1-2 of stores from each region.
Total stores (90) of Pharmacies	Abdul Rahaman Pharmacy Al NaseemDit, Abdul Ahab Ibrahim Pharmacy Al Pharmacy Shifadist, Abdullah Bin Mohammed A. Al Shabaib East AzizyahDist, Abdullah pharmacy ShifaDist, Abeer Pharmacy King Abdulla Dist, , Maathar St. Ahmed omarZadah Pharmacy Adhwaaa Al Seha Pharmacy Al Ma'azer Dist, Ahmed A. Yousif Pharmacy Tahliah Street, Ahmed omarZada Pharmacy Olaya Main St. Ahmed Saad Pharmacy WeidyDist, Airport Pharmacy SulimanyiaDist, Ajfan Pharmacy Makkah Road, Al Aboudi Pharmacy UlayaDist, Al Alam Pharmacy Makka Road, Al Amin Pharmacy Maathar St., Al Amjad Pharmacy Sweidy Dist. Al Barrak pharmacy Eraija Dist., Al Baterji National Pharmacies Al Washm St., Al Batha Pharmacy Al Ta'aown Dist.	6-7 of stores from each region.

Table 4.1 *(cont.)*

Store Types	Store Names	Sampling size (at least 10%)
Total stores (30) of Supermarkets	Azizia Panda Supermarkets and hypermarkets across, Carrfour the International Hypermarkets chain, Farm Supermarkets Food Store (SAMCO), the Al ASad group, Lulu Hypermarkets, Al Othaim Markets Company, Al Danube Company hypermarkets, AlTamimi Supermarkets, Al Sadhan supermarkets.	2-3 of stores from each region.

4.2.2. Statistical analysis. The Statistical Analysis System (SAS Inc. Cary, NC. USA) was used to compute the data from this study. The dependent variable was the types of different stores for the availability of dietary supplements in Riyadh, Saudi Arabia that consisted of general stores such as supermarket, drug stores (pharmacy) and the GNC divided into the 5 regions. The independent variables were the response of the dietary supplements availability. Results were analyzed using chi-square tests with a significance level of 0.05.

4.3 Results

In Saudi Arabia there are basically two types of stores for supplements. There are general stores such as supermarket and pharmacies, and there are specialty stores for supplements such as GNC. These stores are located in big cities, especially in the capital city, Riyadh. Figure 4.2 show the classification of stores in Riyadh that sell supplements. The availability of supplements in each region in different stores is grouped as: Central (Supermarkets 2, Pharmacy 9, GNC 1), Western (Supermarkets 2, Pharmacy 9, GNC 1), Eastern (Supermarkets 3, Pharmacy 7, GNC 2), Northern (Supermarkets 2, Pharmacy 8, GNC 2), and Southern (Supermarkets 2, Pharmacy 9, GNC 1). The percentage indicates the growth of dietary supplements in recent years. Pharmacies dominated with a percentage above (70%), followed by GNC stores and supermarkets occupying less than (30%) of total supplement sales. We found higher numbers of drug stores were the

major suppliers of these dietary supplements while supermarkets and GNC stores lag behind by comparison. Recently, due to the higher demand for supplements, GNC brand products are also continuing to grow offering a wide variety of dietary supplements. Similarly, Figure 4.2 shows the total stores available in Riyadh.

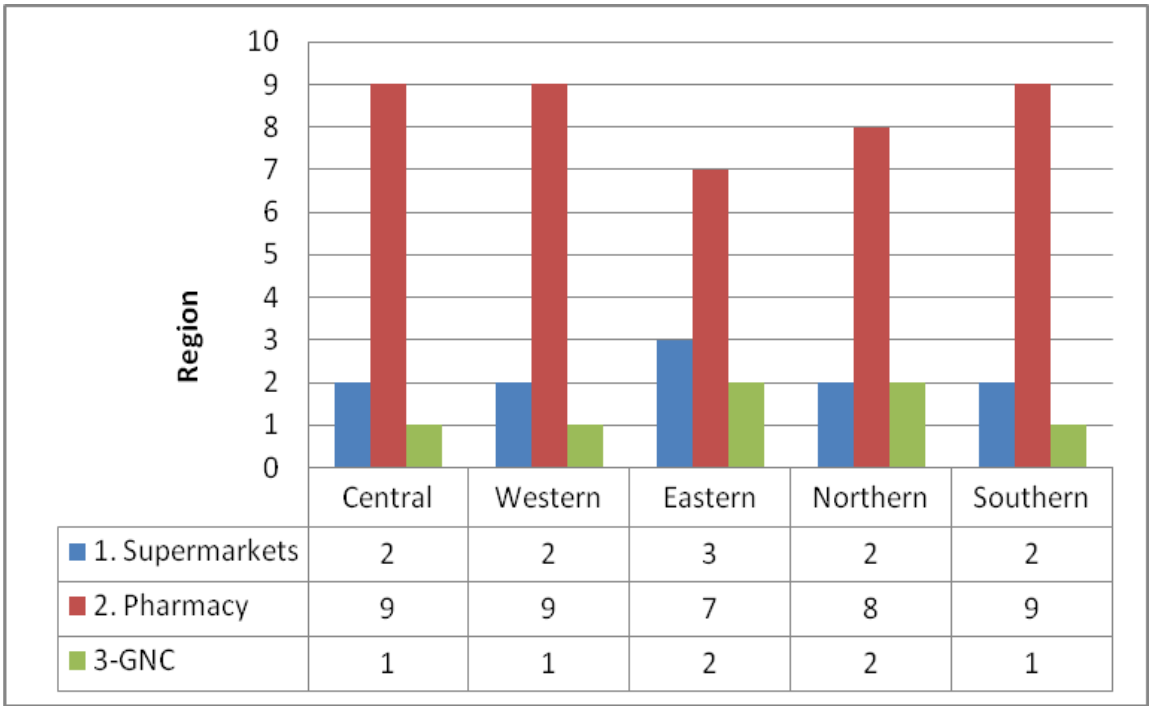

Figure 4.2. Classification of stores in five regions in the Riyadh, Saudi Arabian market.

Table 4.2 shows the classification of stores in all regions. All the stores are located in Riyadh. Among three types of stores, the majority (70%) are pharmacies followed by supermarkets (18.33%) and GNC (11.67%). Table 4.3 shows the availability of seven groups of supplements from different regions in Saudi Arabia markets. The availability of supplements ranges from 23 to 97%. All of these markets seem to be dominated by minerals (97%), fish oils (81.33%), herbs (78.67%) vitamins (75.27%), and carbohydrate products (63%). However, the availability of ergogenic aids (41.50%) and protein supplements was lower (23%) and was thus the least available source of supplements in these selected markets.

Table 4.2

Classification of Stores in Riyadh, Saudi Arabia Market of Dietary Supplements

Name of Stores	Number of Stores	Percent of Stores
1. Pharmacy	42	70.00
2. GNC	7	11.67
3. Supermarkets	11	18.33
Total	60	100.00

Table 4.3

Available of supplements in Saudi Arabia markets (%)

Supplement Number	Product Name	Classification of Region					
		1. Central	2. Western	3. Eastern	4. Northern	5. Southern	Average of product (%)
1	Sport supplements (Ergogenic aids)	35.00	40.00	41.25	38.75	52.50	41.50
2	Vitamins	71.82	73.64	75.45	73.64	81.82	75.27
3	Mineral	100.00	100.00	90.00	95.00	100.00	97.00
4	Carbohydrate	50.00	50.00	70.00	65.00	80.00	63.00
5	Protein	16.67	16.67	25.00	23.33	33.33	23.00
6	Fish oils	76.67	63.33	93.33	80.00	93.33	81.33
7	Herbals	70.00	90.00	73.33	70.00	90.00	78.67
	Average of each Region	60.02	61.95	66.91	63.67	75.85	

Table 4.4 shows the list of availability/unavailability (total %) of different supplements in Saudi Arabian markets (n = 60 stores). The availability of 36 different supplements from different types of stores in each region varies. Products such as Ginseng, iron tablets, and Vitamin C (81.67%), calcium tablets (80%), and folic acid (76.67%) were available in greater numbers. However, supplements such as ephedrine, glutamine, whey protein, and ribose were (6.67%), (15.00%), (8.33%), and (3.33%) respectively, indicating a lesser presence in the marketplace.

Table 4.4

The Availability of Dietary Supplements in Saudi Arabian Markets (n = 60)

Dietary Supplements	Available *n* (%)	Unavailable *n* (%)
Sport supplements		
Red Bull Energy Drink	12 (20.00)	48 (80.00)
Vitamins		
Vitamin C	49 (81.67)	11 (18.33)
Vitamin D	41 (68.67)	19 (31.33)
Vitamin E	36 (60.00)	24 (40.00)
Vitamin B Complex	42 (70.00)	18 (30.00)
Thiamine B1	19 (31.67)	41 (68.33)
Riboflavin B2	22 (36.67)	38 (63.33)
Vitamin B 6	35 (58.33)	25 (41.67)
Vitamin B 12	38 (63.33)	22 (36.33)
Folate acid	42 (70.00)	18 (30.00)
Folic Acid	46 (76.67)	14 (23.33)
Ribose	2 (3.33)	58 (96.67)
Multivitamin	45 (75.00)	15 (25.00)
Antioxidants	34 (56.67)	26 (43.33)
Minerals		
Iron Supplement	49 (81.67)	11 (18.33)
Calcium	48 (80.00)	12 (20.00)
Carbohydrate		
Carbohydrate electrolyte beverage	12 (20.00)	48 (80.00)
Glucosamine sulfate	29 (48.33)	31 (51.67)
Protein		
Protein powder	8 (13.33)	52 (86.67)
Amino Acids	24 (40.00)	36 (60.00)
Ephedra	4 (6.67)	56 (93.33)
Weight Gainers	13 (21.67)	47 (78.33)
Whey protein	5 (8.33)	55 (91.67)
Fish Oils		
Omega 3	38 (63.67)	22 (36.33)
Omega 6	38 (63.67)	22 (36.33)
Fish Oils	46 (76.67)	14 (23.33)

Table 4.4 *(cont.)*

Dietary Supplements	Available *n* (%)	Unavailable *n* (%)
Herbals		
Gingko Biloba	40 (66.67)	20 (33.33)
Herbals	31 (51.67)	29 (48.33)
Ginseng products	49 (81.67)	11 (18.33)
Ergogenic Aids		
Slimming Products	41 (68.33)	19 (31.67)
Coenzyme Q10	34 (56.67)	26 (43.33)
Caffeine	24 (40.00)	36 (60.00)
Creatine	7 (11.67)	53 (88.33)
Glutamine	9 (15.00)	51 (85.00)
Glutamine L	10 (16.67)	50 (83.33)
Ergogenic Aids	11 (18.33)	49 (81.67)

Note. These results showed the response is highly significant (p-value <0.0001) indicating the availability of dietary supplements in Saudi Arabia market.

4.4 Discussion

To our knowledge, this is the first study designed to determine the availability and use of supplements among professional athletes in Saudi Arabia. There is little published information regarding the consumption of these products in Saudi Arabia which has thus generated a need to determine consumers' use of the products as well as the availability of these supplements in the marketplace.

Most sales of supplements occur directly in pharmacies, supermarkets, and general nutrition stores (GNC). As mentioned earlier, there are some supplements for which solid evidence exists justifying their value; examples include vitamin D, calcium, and fish oil. Each of these costs around $3 to $4 per month. But a large part of the marketing of supplements is the diametric opposite in terms of cost-effectiveness (Temple 2010). In 1994, the U.S. Congress passed a law regulating the marketing of dietary supplements: the Dietary Supplement and

Health Education Act (DSHEA). This law allows Food and Drug Administration (FDA) to monitor and ensure the safety of dietary ingredients used in dietary supplements(DSHEA, 1994; Noonan & Patrick Noonan, 2006). Similarly, in Canada a new organization, the Natural Health Products Directorate, was established with the mandate of regulating dietary supplements. When fully implemented, all manufacturers, importers, packagers, and labelers of natural health products must have site licenses, and any new NHP must have a product license. These regulations require a premarket review of products to assure that label information is truthful and that health claims are supported by appropriate types of scientific evidence. It would appear, however, that the same standard of truth would apply in the United States as well as Canada (Temple, 2010). Similar studies have also been done in Europe and South Africa on probiotic and prebiotic supplements, and it was reported the irregularities in production and marketing of these supplements. Health claims of these supplements are misleading and are not scientifically sound and do not follow the safety regulations (Brink et al., 2005).

Recently, in Saudi Arabia, soccer is becoming more and more popular. At the same time, athletes are trying to increase muscle mass, strength and endurance in order to perform better. Every year, new international stores are opening and the sales of supplements are growing as athletes are relying on supplements for better performance and stamina. However, supplements in Saudi Arabia are not strictly regulated and marketed as in the western world, and the safety of these supplements is still a concern. Detailed study on markets and availability of these dietary supplements has not been conducted yet. Sales of supplements in the Saudi Arabian market are increasing not only due to demand by professional soccer players, but average Saudi men are also starting to work out more in order to keep themselves fit. Similar growth in the market for dietary supplements is being seen in other countries as well, including the United States, Europe,

and Japan on a daily basis (Brink et al. 2005). According to research done by Kaufman, there are over 3,400 varieties of dietary supplements, and 40% of the American population take vitamins and mineral supplements on a regular basis (Kaufman et al., 2002; Peters et al., 2004). The higher demand of supplements ultimately has led to larger number of supplement markets. There are approximately 142 pharmacies, GNCs, and supermarkets in Riyadh. In our survey we found that vitamins, minerals, and carbohydrate products are the major available supplements sold in Riyadh, accounting for approximately (75%), (97%), and (63%) of supplements sold, respectively. Even though Protein is the most commonly consumed dietary supplement among athletes, but in our study the availability of protein accounts less (23%). Although in recent years there has been a big push for Ephedrine-free products, Ephrata still accounts for (7%) of the entire industry's sales (Gregory, 2007). These findings are also reflected in our research in Saudi Arabia.

4.5 Conclusions

It is strongly evident that there is an increase for the concern in nutrition in today's society. This realization especially is seen in today's athletes who not only maintain a healthy diet, but also include a regiment of dietary supplements according to their individual needs. Results from the present study provide valuable information about the availability of dietary supplements in Riyadh, Saudi Arabia. Our results revealed that these supplements are mainly available in pharmacies, supermarket and GNC stores. Vitamin C, iron, and fish oils were available in higher number while supplements such as whey protein, creatine, and protein powder were found to be in lower number. Since protein sources of supplements play an important role in athletic performance, there is a need to expand protein markets as dietary supplements.

4.6 Acknowledgements

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CHAPTER 5

Microbiological Quality and Safety of Dietary Supplements in Saudi Arabia

5.1 Introduction

The global market for dietary supplements has gained momentum in the past decade, and demand is increasing every year. Likewise, there is an increased awareness of the importance of supplement safety. The popularity of traditional herbs and botanicals is due in large part to the fact that they are safer to consume because of their organic natural occurrence and cost effectiveness (Ravindran & Duraisankar, 2012). It is also increasingly evident that consumers are becoming more aware of functional foods and supplements and the potential role these products play in a balanced diet and in ensuring good health (Brink et al., 2005). As a result, the use of dietary supplements is a widely accepted practice by athletes. There is a large variety of supplement types and brands available on the open market. Dietary supplements are products taken orally that contain one or more ingredients intended to supplement one's diet, and are not considered as food. According to the United States' Dietary Supplement Health and Education Act (DSHEA) of 1994, dietary supplements are categorized as any "product" (other than tobacco) intended to supplement a diet and bears or contains one or more dietary ingredients (DSHEA, 1994). Examples of dietary ingredients include vitamin, mineral, herb or other botanical, amino acid, concentrate, metabolite, constituent, extract, or a combination of these ingredients. Included also are dietary substances for increasing the total dietary intake. Supplements can be classified according to their function (muscle building, immune boosting, fuel providing), form (pills, powders, foods or drinks), availability (over-the-counter, mail order, Internet, multi-level marketing), and scientific merits of claims (well-supported, unsupported, undecided; L. Burke et al., 2006). In one study in the United Kingdom, thirteen probiotic

supplements were tested. Results showed that only six supplements had viable counts containing only the items stated; three contained only 10% and 25% of that count; and four were found to be grossly deficient in their claims (Hamilton-Miller et al., 1999). From these findings it is clear that there are serious problems in QA and in product labeling in many countries (Hamilton-Miller & Shah, 2002).

In recent years, the area of sports nutrition and dietary supplementation has gained enormous popularity. A number of athletes and other sports professionals are looking for viable dietary ergogenic aids to enhance physical power and performance levels. People who consume supplements have the right to know the facts regarding dietary efficacy, including safety, impact on health, and any scientific research on a product's proper use (Juhn, 2003).

There is an increasing concern about the quality of dietary supplements as these products have been found to contain varying amounts of active ingredients in addition to contaminants and adulterants (Angell & Kassirer, 1998; Borins, 1998). The accuracy and reliability of the contents of dietary supplements used in the treatment of prostate disease has been previously evaluated. in which samples of the medicinal herb Saw palmetto, Serenoa repens, were found to vary widely from the suggested ingredient label and consumption dose, with one-half of the products having less than 20%, and one-third of the products having less than 5%, of the claimed label content (Feifer et al., 2002). Of 260 dietary supplements analyzed by the California Department of Health Services, 32% of the supplements tested contained undeclared pharmaceutical compounds or heavy metals (Ko, 1998).

Athletes typically desire to enhance their endurance, strength, performance, and muscle mass, and use several types of ergogenic aids to achieve these goals (Jacobson et al., 2001). Most supplements and sports-foods provide advantages to athletic performance either by producing

direct performance-enhancing (ergogenic) effects or by helping athletes meet their nutrition goals. Many studies support the benefits of consuming sports drinks to supply carbohydrates and fluid during exercise (Coombes & Hamilton, 2000). Overdosing of supplements can sometimes result in poisoning. Research supports documented cases of deaths and medical problems resulting from improper use of tryptophan supplements as well as products containing Ephedra and caffeine (Roufs, 1992). Protein is the most widely dietary supplement used by professional athletes for muscle building (Nissen & Sharp, 2003). The most commonly used supplements are sports drinks, sport bars, multivitamins and minerals, protein supplements, and Vitamin C (Krumach et al., 1999). Potential side effects of nutritional supplements intake include toxicity, allergic reactions, side effects of caffeine-containing products, and many other unknown side effects. Since there is no worldwide system in place that controls and regulates sports foods and supplement products, countries differ in their approaches to regulation. Thus, consumers need to be informed about the proper use and clinical safety of supplements before using them. To date, scientific studies have identified a number of products that provide performance benefits and meet nutritional requirement. Published information regarding the quality and safety of these products in Saudi Arabian markets is all but non-existent. So, there is an obvious need to improve knowledge of the microbiological quality and safety of dietary supplements use among consumers in Saudi Arabia. The objective of this study was to identify the microbiological quality and safety of dietary supplements from Saudi Arabia.

5.2 Materials and Methods

Our preliminary data (Aljaloud et al., 2009) showed the contamination of dietary supplements sold in Saudi Arabia markets. Based on this study we further determined to analyze the microbiological quality of different dietary supplements available in the market. For this, 80

of the most popular supplements were selected. Each supplement was collected in duplicate from each store. Samples were then shipped to the Food Microbiology Laboratory at North Carolina Agricultural & Technical State University, Greensboro, NC, for microbial quality and product safety analysis.

5.2.1 Microbiological and safety quality test. From each commercial sample, three capsules or tablets were placed in 10 mL sterilized BHI broth and mixed thoroughly. Then, samples were incubated at 37 °C for 24 h to allow for microbial cell recovery if present. One milliliter from each sample was then withdrawn and diluted with 0.1% peptone water. The appropriate dilutions were plated onto duplicate selective agar medium. To obtain the total bacterial count, samples were plated on Brain-heart infusion agar (BHI). To test for coliform and *E. coli*, samples were plated on Violet red glucose bile Agar (VRBGA) and MacConky agar, respectively. Similarly, samples were plated on Xylose lysine deoxycholate (XLD) agar for *Salmonella,* and Baird-Parker agar base (BPAB) for *Staphylococcus aureus* count.

5.3 Results

Of the 80 dietary supplements tested for microbiological quality (Table 5.1), only nine showed contaminants (Table 5.2). Table 5.3 shows the overall presence or absence of microorganisms (total bacterial count, total coliforms count, *Staphylococcusa aureus, Salmonella,* and *Escherichia coli*) from tested samples. Table 5.2 shows the total bacterial count and *Staphylococcus aureus* after plating onto BHI and BPAB agar medium, respectively. The population level of bacteria ranged from 1.69 Log CFU/mL to 8.43 Log CFU/mL. The higher total count level (8.43 log) and *S. aureus* (8.39 log) were observed in supplement glutamine L. Similarly, other samples including amino acids, dynamisan, glucosamine sulfate, glucosaiene, creatine monohydrate, whey protein, and folate acid also showed the presence of bacterial

contamination. In pharmaton, we observed lower levels of total count (1.73 log) and *S. aureus* (1.69 log), respectively. In the past, there were some studies that traced the source of contamination in some supplements. However, based on our literature review, we were unable to locate any studies on the microbiological safety of such supplements.

Table 5.1

List of Dietary Supplements Tested for Microbiological Contamination

Supplement No.	Product Name	Test	Batch Control No. (Lot)	Expiration Date
1	Creatine	-	29861	8.2014
2	Whey Protein	+	A02C2151N	8.2013
3	Glutamine	-	35024/A	12.2012
4	Multivitamins	-	410392	2.2013
5	Pyridoxin 40 (Vitamins B-6)	-	O81	7.2014
6	Amino acids	+	1935DK7525	4.2013
7	Vitamin B-12	-	253	4.2013
8	Caffeine	-	25505C80555	5.2013
9	GinkoBilobatabrts	-	O1102062	6.2013
10	Thiamine	-	N/A	-
11	Riboflavin	-	L5K745	12.2012
12	Vitamin B-1 300mg	-	4635IJ2595	9.2013
13	Folate acid 5mg	+	E082	5.2014
14	Ephedrine	-	N/A	-
15	Dynamisan (Vitamins, Minerals, and Amino acids)	+	K10004	9.2013
16	Glutamine L	+	4690II4184	8.2013
17	Ribose	-	L5M675	1.2013
18	Antioxidants	-	1621CM1949	9.2014
19	Vitamin C	-	1KE454	1.2013
20	Ginkgo biloba Kordel’s	-	39628	2.2013

Table 5.1 *(cont.)*

Supplement No.	Product Name	Test	Batch Control No. (Lot)	Expiration Date
21	Vitamin D	-	1074580	12.2014
22	Vitamin E	-	395509-05	11.2015
23	Iron tablets	-	411359	1.2014
24	Calcium tablets	-	479066-01	11.2015
25	Vitamin B Complex	-	254	7.2013
26	Glucosamine sulfate 750mg	+	OO144	5.2013
27	Protein powder	-	79760112	4.2014
28	Vita-C	-	OKE446	8.2013
29	Weight gainers	-	0357J2A	11.2015
30	Fish oils	-	C L1776	6.2012
31	Omega 3	-	398112-03	6.2015
32	Omega 6	-	389109-03	5.2015
33	Methycobal 500mg	-	13A54M	1.2014
34	Ginseng products	-	1627CM3747	9.2014
35	Gingko biloba	-	1102067	7.2013
36	Neurorubine forte	-	62411	12.2013
37	Red Bull energy drink	-	161720132#6	10.2012
38	Slimming	-	1913GLB	11.2012
39	Coenzyme Q10	-	394342-04	11.2015
40	Guarana 250mg (Herbal Supplement)	-	E542598	9.2013
41	Viforcit 1000mg	-	402226	11.2013
42	Guarana	-	E540221	11.2012
43	WasserGlucoselcne	-	442992-01	3.2015
44	Creatine Monohydrate 700 mg (dietary supplements)	+	4595HK4260	8.2013
45	Amino 1000mg (dietary supplements)	-	A03A2222D	5.2014
46	Evit (NaturalAntioxidants)	-	1325004	6.2014

Table 5.1 *(cont.)*

Supplement No.	Product Name	Test	Batch Control No. (Lot)	Expiration Date
47	Pyridoxin	-	N/A	-
48	Navidoxin	-	33044	2.2015
49	pharmaton	+	9711902	7.2013
50	Tri_B (Vitamin B1,B6,B12,Folic Acid)	-	9101	3.2013
51	Centram (multivitamin Formula)	-	1057865	4.2014
52	Vitrite (Multivitamin and Minerals)	-	1072760	11.2014
53	Gineosan	-	97273001	9.2013
54	Methycabal	-	13A53M	1.2014
55	Vito-p (multivitamin and Minerals)	-	111060	6.2013
56	Redoxon	-	L5M672	1.2013
57	Joint care (Oil)	-	5600	11.2014
58	Joint care (Powder)	-	7341KM8934	11.2015
59	Glucosamine sulfate 1000mg	-	453450-07	7.2015
60	Dynamisan with Ginseng (Complete dietary supplements)	-	K10003	7.2013
61	Whey Protein isloates	-	A01A3491C	12.2013
62	Flax Oil 250mg Cold-Pressed & Unrefined dietary supplements	-	393811-03	10.2015
63	Arctic Cod Liver Oil237mg	-	LI776	9.2012
64	Folate acid 1mg	-	464708-03	3.2015
65	Glucosaiene	+	5746JK1965	4.2013
66	Chitosan Glucomannan	-	480450-01	12.2013
67	Solotron 50 Plus Dietary Supplement 90 caplets Multivitamin	-	2052050	11.2014
68	Gnc Triflex Dietary Supplement 120 Ea	-	6482JM2813	4.2015
69	Triple Strength Fish Oil Dietary Supplement 120 Softgels	-	393696-07	10.2015
70	Glucosamine 1000, Vegetarian Tablets 90	-	1072500	11.2014
71	Vitamin E 400, Softgel Capsules 100	-	4965HM	8.2015

Table 5.1 *(cont.)*

Supplement No.	Product Name	Test	Batch Control No. (Lot)	Expiration Date
72	Natural Brand Lutein, 40mg, Softgel Capsules	-	N/A	-
73	Herbal Plus Grape Seed Extract, 100mg, Vegetarian Capsules	-	5151HM1980	8.2015
74	Gnc Melatonin 3 (Gnc)	-	5409HM1090	9.2015
75	Vitamin D	-	1051035	4.2013
76	Green Tea Extract	-	1054B	2.2013
77	Spirulina	-	6996JM4568	11.2015
78	Glucosamine Chondroitin Joint Health	-	465596-02	1.2015
79	Dynamic Health	-	KI0005	10.2013
80	Calcium Complete with Magnesium, Softgel	-	4599HL	8.2013

Note. + indicates the samples tested are positive for microbial contamination; - indicates the samples tested are negative for microbial contamination. N/A: not available.

Table 5.2

Bacterial Population (Log CFU/mL) Present in Different Supplements Plated on BHI and BPAB Agar

	Bacterial population (Log CFU/mL)	
Product	Total count	*S. aureus*
Amino acids	7.54	7.38
Dynamisan	5.9	4.93
Glutamine L	8.43	8.39
Glucosamine sulfate	7.53	7.66
Glucosaiene	7.47	7.2
Pharmaton	1.73	1.69
Creatine Monohydrate	4.85	4.98
Whey Protein	6.2	5.54
Folate acid 5mg	4.6	4.36

Table 5.3

Bacterial Presence in Tested Samples

Tested organisms	Limit per mL
1. Total bacterial count	present
2. Total coliforms count	absent
3. *Staphylococcusa aureus*	present
4. *Salmonella*	absent
5. *Escherichia coli*	absent

Analyses performed by the FDA (Kulynych, 1999) on samples of bulk raw material labeled as plantain, showed potentially contaminated plantain. This raw material was also reported to be positive for cardiac glycosides. The FDA had posted press releases twice on the FDA's website to warn consumers against the consumption of certain botanical dietary supplements labeled as containing the ingredient plantain. We tested a total of 80 supplements as listed in Table 5.1 in 5 different media: BHI, VRGBA, MacConky, XLD, and BPAB agar for Total count, coliform, *E. coli*, *Salmonella*, and *Staphylococcus aureus*, respectively, and only nine tested positive.

5.4 Discussion

Quality assurance and standardization are two important key factors in the growth and development of any product. To identify the microbiological quality and safety of dietary supplements, tests need to be conducted to ensure their microbiological quality. Medicinal plant materials should be entirely free from visible signs of contamination by molds or insects, and other animal contamination. Medicinal plant materials carry a great number of bacteria and molds often originating in soil, while a large range of bacteria and fungi occur naturally on the surface of herbs. Harvesting, handling and production may also cause additional contamination

and microbial growth in such source of plant ingredients. Selection of plant materials based on quality, standardization, methods of preparation, and enforcement of regulation regarding appropriate labels are measures which will improve the quality and acceptance of herbal preparations as therapeutic agents (Kuruvilla, 2002).

As mentioned earlier, there were eighty dietary supplement samples taken from different stores in Saudi Arabia and tested through five different media: BHI, VRGBA, MacConky, XLD, and BPAB agars for total count, coliform, *E. coli*, *Salmonella*, and *Staphylococcus aureus*, respectively. Out of these samples, nine samples were shown to have contamination. The population of *staphylococcus aureus* ranged from 1.69 to 8.43.

Similar studies have been conducted in other places in the world that share the same concerns. According to the International Journal of Food Microbiology, a similar study was undertaken, and out of 30 samples only eleven contained no viable bacteria. However, that study's field had a broader geographical scope, extending from the US to Austria, Italy, and the United Kingdom (Hamilton-Miller and Shah, 2002). Another study in South Africa isolated five products from the feces of patients diagnosed with the AIDS virus to test for *Salmonella typhi, s. typhimurium,* and *S. flexneri 3* along with other bacteria indigenous in South Africa. The results showed that all strains showed good inhibitory activity against the panel of indicator strains (Brink et al., 2005).

Also, in a study conducted for the pharmaceutical and microbial quality on 21 different brands of herbal medicinal products in Southwestern Nigeria, the microbial load of the products varied considerably. Over 47% of the samples showed contamination with *E. coli*; 33% with Salmonella; 71.4% with *Staphylococcus aureus;* and 57.1% were contaminated with fungi (Okunlola et al., 2007). Significant contamination with bacteria and fungi was reported during

the investigation of the microbial quality of herbal medicines collected from the shops in the Nelson Mandela Metropolis. The presence of *Salmonella, and, E. coli* in herbal powder and tablets have been also reported earlier (Ravindran & Duraisankar, 2012).

5.5 Conclusions

From this study we can conclude that there are some contaminations in supplements sold in Saudi Arab markets. Sometimes, the presence of microraginsm (*E. coli, Salmonella, S. aureus*) could be potentially harmful for human health. Improvements on the presence of such microbiological contamination by good manufacturing practice for handling, packing and storage is needed. This could be done by monitoring the manufacturing plants with trained quality assurance personnel.

5.6 Acknowledgements

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CHAPTER 6

Educating Athletes in Saudi Arabia toward Dietary Supplements

6.1 Introduction

There are many athletes who use different dietary supplements for a variety of reasons. Most athletes focus their efforts mainly on training in order to improve their athletic performance; many of them fail to pay adequate attention to their dietary intakes. It is important to understand energy and nutrient intakes that may enhance athletic performance (ADA, American Dietetic Association, 2009). Sometimes an individual's dietary behaviors may be detrimental to their athletic performance potential. Nutrition intake can make the difference in the performance and results (Buell et al., 2013; Williams, 2007). It is important for athletes to understand basic nutrition information and have basic knowledge of their energy and nutrient needs in order to optimize athletic performance (Dunn et al., 2007; Rash, Malinauskas, Duffrin, Barber-Heidal, & Overton, 2008). The majority of the current research concludes that athletes lack basic nutritional knowledge (Rosenbloom, Jonnalagadda, & Skinner, 2002; Zawila, Steib, & Hoogenboom et al., 2003). Most commonly, athletes appear to lack knowledge vitamins and minerals, and proper supplemental use (Rosenbloom et al., 2002). Some supplements have even been implicated as the cause of death and disability when used improperly (Dunn et al., 2001). Therefore, the amount of dietary supplements consumed should be within the recommended range for that particular product to ensure the expected results for which the athlete is striving (Tscholl, Alonso, Dollé, Junge, & Dvorak, 2010).

It has been seen that there is a correlation between greater knowledge of dietary supplements and reduced consumption. Professional soccer athletes have used supplements in higher amounts (Dunn et al., 2001). Such intensive sports require increased muscle mass and

strength. Information on the use of supplements is usually provided by the athletes' coaches and nutritional doctors (Jonnalagadda et al., 2001). To prevent athletes from the improper use of dietary supplements, those sports advisors who have a stake in the health of these professional athletes should inform supplement users about unproven results and provide warnings about the potential harm of such dietary supplements (Bishop, 2010; Hespel et al., 2006).

Saudi Arabia supervises 153 soccer clubs. These clubs consist of various grades and age groups, which range from twelve years of age to adult teams. The main objectives of the Saudi soccer leagues are to promote the spirit of competition and to create a strong base for sport in Saudi Arabia. The Saudi Professional League (SPL) is the primary soccer competition in Saudi Arabia. Despite being active in sports activities, there have been no previous survey studies conducted by the SPL to know whether the players are receiving accurate information regarding the use of dietary supplements (SAFF, 2013).

Since supplements are an integral part of players' lives, they must use these supplements properly in order to avoid negative health consequences. Therefore, the objective of this study was to understand the usage and beliefs about dietary supplements among professional athletes in Saudi Arabia and then to produce an educational program that would teach athletes about the proper use of these supplements. Sports centers are trying to curb this violent trend in access. Their objective is to see the desired results with a minimum of side effects. Many of the workers in the field of sports see the damage of stimulants and the addictions caused to abusers. They are working to provide a favorable environment for the growth of the athlete for the sports activity practitioner.

Recently, Saudi Arabia is spending a huge amount of money on physical education programs (Embassy, 2007). Approximately $8 million has been spent on physical education in

schools (Al-Liheibi, 2008). Educating students and athletes about the use of various supplements and drugs is very important as a mandatory curriculum in high schools and colleges. Accurate information, if provided to the athletes and students, would help them improve their overall health. In the past studies have been conducted on students' attitudes toward physical education and activities (Stelzer, Ernest, Fenster, & Langford, 2004). It is important for professional players to understand basic nutrition information and have basic knowledge of their energy and nutrient needs in order to optimize athletic performance. To this researcher's knowledge, there have been no studies that have been conducted on nutritional knowledge among professional soccer athletes in Saudi Arabia. The objective of this study was to determine the impact of educational workshop/training on the understanding of athletes in Saudi Arabia toward the benefits of dietary supplements. We expect this educational program will tend to change the behavior, use, and knowledge of dietary supplements and help modify practices among professional athletes.

6.2 Materials and Methods

The Institutional Review Board (IRB) of North Carolina Agricultural & Technical State University approved this study and questionnaire (Appendix Q). The survey method was discussed with professional athletes in the capital city of Saudi Arabia, Riyadh. The questionnaires were designed to understand perceptions of supplements among professional athletes in Saudi Arabia. The two sets of questionnaire were developed to understand the knowledge and use of supplements. For this (a) pre-survey and (b) post-survey results were compared and analyzed to determine the impact of this study on supplements use. In addition, a three-day workshop for the three teams was conducted to provide the required information and knowledge on the proper use of these supplements. A consent form was placed on top of the

survey for the sports and health department policy on using human subjects along with a description of subject's specifications and the nature of the survey.

6.2.1 Sampling method. Ninety professional soccer players were recruited as subjects from different sports teams in Riyadh, Saudi Arabia. All subjects were professional soccer players between the ages of 20 and 30 who were either Saudi or foreign nationals. Out of 90 players, 16 were international players from Argentina, Bahrain, Brazil, Ecuador, Egypt, Ghana, Morocco, Romania, Senegal, South Korea, and Uzbekistan. Each team was assigned to a coordinator who had the role of organizing recruitment efforts. The recruitment process included advertisement of the study via word of mouth, email, posters, and announcements at weekly training meetings. The date and location of the survey meeting was communicated in the recruitment information. All methods and materials used in this study were approved by the "The Saudi Professional League" of Saudi Arabia Riyadh Human (Appendix L; SAFF, 2013).

6.2.2 Translation of questionnaire. The questionnaire was constructed in English. However, the participants in this study most of the players did not have the ability to read the English version. Therefore, an Arabic version of the questionnaire was developed (Appendix O and Appendix P) by Dr. Osman H. Hassan, a research scientist at the University of North Carolina Agricultural & Technical State University reviewed the Arabic version of the questionnaire.

6.2.3 Survey questionnaire. A questionnaire was developed to collect data per the objective. The questionnaire consisted of 27 questions divided into different categories including understanding of dietary supplements, use of supplements, and reason for consumption, personal beliefs, and behavior. Overall, the survey questions pertained to the frequency of supplement purchases as well as factors that might be considered by professional athletes when purchasing

these supplements. Both sets of questionnaire (pre and post) were exactly the same (Appendix M and Appendix N).

6.2.4 Data collection (survey administration). The researcher traveled to Riyadh Saudi Arabia, to collect the data for this study. This study took approximately three months to administer the surveys and collect the data from the participants. During the month of February and March 2013, the survey was given to each sports team. The time and location for each survey was arranged and announced at least two weeks in advance. All professional players attended and participated in the survey that took place in the club classroom at 8:00 am on Saturday Saudi Arabian time. Approximately 15 minutes were needed to distribute surveys and provide information, while it took about 45-50 minutes to complete the survey questionnaires. After collecting these questionnaires, the researcher conducted a workshop that includes (a) lecture on sports nutrition, (b) a lecture on quality and safety of dietary supplements, and (c) open discussion session between athletes and expertise. At the end of the program, a set of post-survey questionnaires were again distributed to determine whether this educational session had made any changes in participating athletes' understanding of the use of supplements. Both sets of survey results were compared and analyzed.

6.2.5 Statistical analysis. The Statistical Analysis System (SAS Inc., Cary, NC, USA) was used to compute the data for this study. The dependent variable attitudes were measured by administering the questionnaire that consisted of 27 questions divided into five different categories including understanding of dietary supplements, use of supplements, reason for consumption, personal beliefs, and behavior. The independent variables were the professional athletes' responses. Results were analyzed by using chi-square tests with a significance level of 0.05.

6.3 Results

It was our endeavor to educate professional athletes on the use of dietary supplements. Different soccer teams in Saudi Arabia's capital, Riyadh, were selected to provide the adequate data for this study. We also chose these soccer teams based on their willingness to participate in this study. During the initial study (pre-test), total of 90 players were participated. In order to make our study statistically valid and representative, we needed at least 10% of the total team members. The teams consisted of male soccer players from Riyadh with ages ranging from 20 to 30 years of age. The survey contained 27 questions on different categories.

Table 6.1 show the results related to the reason each athlete uses dietary supplements. In this study 90 athletes currently taking supplements were surveyed (mean age and standard deviation were 23.31 ± 2.73. Table 6.1 focuses on questions 1-5 which deals with the overall information and use of dietary supplements. In the question relating to the main reason for using dietary supplements, 25 (27.78%) athletes reported as to improve health and 30 (33.33%) performances similar to the post-test results of 29 (32.22%) 31 (34.44) Very few 2 (2.22%) players had an idea about the use of supplements to meet nutritional requirement. After the educational training, at least 10 (11.11%) players agreed that supplements also fulfilled their nutritional requirement. Only 25 (27.78%) players had an idea of functional supplements and our post-test results showed about 78 (86.67%) players were familiar with the word functional supplements. Initially at pretest survey 31 (34.44%), 23 (25.56%), and 30 (33.33%) players reported quality of dietary supplements as excellent, good and satisfactory. Our post survey results after education training showed slightly higher numbers of players reporting the quality of supplements as excellent 47 (52.22%) and good 28 (31.11%). However, only 5 (5.56%) players reported dietary supplements quality as satisfactory after educational program. We believe, our

educational program could have made players familiar with international brand like GNC, where the products are usually available in good standard quality compared to other places. The majority of the players reported that vitamin C as most frequently used supplements 28 (31.11%) followed by health bar 19(21.11%) and calcium 16 (17.78%) in the pre-test survey. After our educational program in our post survey results, the use of these supplements used by players increased to 30 (33.33%), 22 (24.44%), and 18 (20%) for Vitamin C, health bar, and calcium respectively. Sixty seven (74.44%) players have indicated they have not gotten any information on dietary supplements within the last 6 months period. However, after our workshop most of the players 58 (64.44%) mentioned their apprehension of dietary supplements which might have been due to their lack of knowledge of what exactly dietary supplements were. The results showed the slightly higher number of athletes indicated their frequent use of supplements (post-test) which could be due to the information they received in the program.

Table 6.1

Perception of Different Types of Athletes Represented in the Study Sample (n = 90)

Response	Pre *n* (%)	Post *n* (%)
1. If you are using dietary supplements, what is the main reason?		
Improve health	25 (27.78)	31 (34.44)
Prevent injury	15 (16.67)	6 (6.67)
Help recover from an injury or illness	10 (11.11)	12 (13.33)
Improve physical appearance	6 (6.67)	2 (2.22)
Improve athletic performance (speed, strength, power)	30 (33.33)	29 (32.22)
Meet nutritional requirements	2 (2.22)	10 (11.11)
2. Are you familiar with the word function supplements?		
Yes	25 (27.78)	78 (86.67)
No	65 (72.22)	12 (13.33)

Table 6.1 *(cont.)*

Response	Pre *n* (%)	Post *n* (%)
3. What do you think the general quality of dietary supplements available in the market in Saudi Arabia?		
Excellent	31 (34.44)	47 (52.22)
Good	23 (25.56)	28 (31.11)
Satisfactory	30 (33.33)	5 (5.56)
Do not know	6 (6.67)	10 (11.11)
4. Which of these dietary supplements have you used most frequently?		
Omega 3	13 (14.44)	18 (20)
Vitamin C	28 (31.11)	30 (33.33)
Health Bar	19 (21.11)	22 (24.44)
Calcium	16 (17.78)	18 (20)
None of the above	14 (15.56)	2 (2.22)
5. Have you looked for dietary supplements information from any sources in the past 6 months?		
Yes	23 (25.56)	58 (64.44)
No	67 (74.44)	32 (35.56)

Note: These results showed the response does differ significantly ($p < 0.0001$) indicating reasons of taking dietary supplements differ significantly between pre-test and post-test.

Table 6.2 covers questions 6–11 and deals the use of supplements based on daily intake. At pre-test, a total of 17 (18.89%), 24 (26.67%) and 14 (15.56%) players reported the use of omega-6, vitamin E, and creatine, respectively. Our post-test results also showed almost the same number of players reporting the use of omega 6, creatine and Vitamin E. However, in case of creatine, more number of players 23 (25.56%) reported that they are using creatine as protein source. In our pre-test results, 35 (38.89%) of players reported neither of these supplements use, but in our post-test 21 (23.33%) reported that they don't use any of these supplements. This

could be due to the knowledge on importance of supplements they received after our educational program.

Table 6.2

Perceptions of the Use of Supplements Based on Daily Intake (n = 90)

Response	Pre *n* (%)	Post *n* (%)
6. Which of these supplements do you use rarely?		
Omega 6 fatty acid	17 (18.89)	21 (23.33)
Creatine	14 (15.56)	23 (25.56)
Vitamin E	24 (26.67)	25 (27.78)
None of the above	35 (38.89)	21 (23.33)
7. Does an athlete's protein needs increase or decrease when working out?		
Increase	33 (36.67)	81 (90)
Decrease	26 (28.89)	4 (4.45)
Do not know	31 (34.44)	5 (5.55)
8. Protein should make up _____ of total daily calories.		
15–20%	15 (16.67)	62 (68.89)
25–35%	23 (25.56)	12 (13.33)
35–45%	28 (31.11)	5 (5.55)
45–55%	24 (26.67)	11 (12.22)
9. Does an athlete's Carbohydrate needs increase or decrease when workouts become longer and more vigorous?		
Increase	37 (41.11)	73 (81.11)
Decrease	21 (23.33)	14 (15.56)
Do not know	32 (35.56)	3 (3.33)

Table 6.2 *(cont.)*

Response	Pre *n* (%)	Post *n* (%)
10. Carbohydrates should make up _____ of total daily caloric intake.		
70–80%	28 (31.11)	3 (3.33)
30–40%	22 (24.44)	7 (7.78)
35–45%	23 (25.56)	8 (8.89)
50–65%	17 (18.89)	72 (80)
11. Does an athlete's lipids need increase or decrease when workouts become longer and more vigorous?		
Increase	13 (14.44)	83 (92.22)
Decrease	51 (56.67)	5 (5.55)
Do not know	26 (28.89)	2 (2.22)

Note. These results showed the response does differ significantly ($p < 0.0001$) indicating that the information about dietary supplements improved significantly in the post-test.

Most of the players 33 (36.67%) have no idea of protein need during physical exercise, but 81 (90%) of the layers reported that protein is important part in any physical activity after our education seminar. Initially, only 15 (16.67%) players were familiar with the daily intake level of protein. After educational program, 62 (68.89%) players reported the right amount of protein intake. Similarly, 73 (81.11%) players reported the increase need of carbohydrate during longer workout compared to the initial population 37 (41.11%). Initially only 17 (18.89%) players reported the right amount of daily intake of carbohydrate compared to the 72 (80%) players after post-test results. A total of 83 (92.22%) players reported increase need of lipid during vigorous exercise compared to the initial number of only 13 (14.44%) players.

Table 6.3 examines questions from 12-15 which deals with the marketing of different dietary supplements. It diagnoses where the athletes purchased the supplements they used. For example, 41 (45.56%) athletes reported as easy accessible of supplements, whereas 75 (83.33%)

reported that supplements can be easily available in local markets in their post-test survey. In the pre-test survey, maximum number of players 28 (31.11%) reported Vitamin C as readily available supplements whereas 10 (11.11%) players reported creatine as least available supplements. After post-test survey, 14 (15.56) and 33 (36.67) players reported creatine and vitamin C as readily available supplements respectively. The reason behind the slightly higher number of players reporting the availability of these supplements after post-test could be due to their understanding of creatine as protein and some other supplements as a source of vitamin C. Initially, 13 (14.44%) reported none of these supplement availability whereas after educational program only 1 (1.11%) reported the unavailability of supplements.

Table 6.3

Perception of the Marketing of Different Dietary Supplements (n = 90)

Response	Pre *n* (%)	Post *n* (%)
12. How accessible is it to locate dietary supplements in the market?		
Easy	41 (45.56)	75 (83.33)
Difficult	13 (14.44)	6 (6.67)
Not available	14 (15.56)	4 (4.44)
Do not know	22 (24.44)	5 (5.55)
13. On a scale of 1 to 5 (1 being the least), what supplements do you feel are the most readily available?		
Creatine	10 (11.11)	14 (15.56)
Multivitamins	19 (21.11)	20 (22.22)
Vitamin C	28 (31.11)	33 (36.67)
Calcium	20 (22.22)	22 (24.44)
None of the above	13 (14.44)	1 (1.11)

Table 6.3 *(cont.)*

Response	Pre *n* (%)	Post *n* (%)
14. Where do you usually buy your dietary supplements?		
Retail Store/pharmacy	5 (5.55)	2 (2.22)
Athletic Trainer or Physician	22 (24.44)	33 (36.67)
Nutritionist/dietician	33 (36.67)	42 (46.67)
Coach	17 (18.89)	11 (12.22)
GNC	10 (11.11)	2 (2.22)
Online Stores	2 (2.22)	0 (0.00)
Other	1 (1.11)	0 (0.00)
15. From whom do you get information about dietary supplements?		
Coach	15(16.67)	22(24.44)
Physician	28(31.11)	32(35.56)
Nutritionist/dietician	24(26.67)	31(34.44)
Family or friends	2(2.22)	1(1.11)
Academic Journals	8(8.89)	2(2.22)
Online	3(3.33)	1(1.11)
Magazine	7(7.78)	1(1.11)
Retail Store	2(2.22)	0.00
Other	1(1.11)	0.00

Note: These results showed the response does differ significantly (p-value <0.0001) indicating a significant difference between pre-test and post-test.

A total of 33 (36.67%) reported purchasing supplements from Nutritionist/dietician which was similar to our post-test results of 42 (46.67%) athletes reporting the same followed by athletic trainer or physician 33 (36.67%) and coach 11 (12.22%). Similarly, maximum number of athletes 24 (26.67%) and 28 (31.11%) reported Nutritionist/dietician and physician as the main source of information provider on dietary supplements. Less than 10% athletes reported their

sources of information as journals, magazines, and online resources. Our post-test survey also showed same range of athletes 31 (34.44), 32 (35.56%) reporting Nutritionist/dietician and physician as their source of information on dietary supplements. Interestingly, after our workshop no one or none reported online, magazines and retail stores as their source of information, which is indication of that, these places do not provide the good information on the proper use of supplements.

Table 6.4 (Questions 16–26) deal with the perception of dietary supplements regarding use, belief and safety. A total of 66 (73.33%) and 71 (78.89%) players agreed dietary supplements are healthy choice to improve their endurance in our pre-test results which was close to the population of 75 (83.33%) and 82 (91.11%) reporting the same in our post-test survey. This showed that majority of the players were familiar with the importance of supplements. Majority of the athletes agreed that these supplements are safe to use. However after our educational class on quality and safety of supplements, only 18 (20%) and 22 (24.22%) athletes were convinced that these supplements can be unsafe as well. A total of 56 (62.22%) and 72 (80%) athletes agreed on supplements as a good source of energy in pre and post-test survey respectively. Initially, 33 (36.67%) players agreed on supplement can provide longer training season but after the workshop majority 67 (74.44%) of the players reported these supplements are needed for such training. A total of 58 (64.44%) and 69 (76.67%) athletes agreed on supplements as a source of strength. In our pre-test results only 30 (33.33%) players reported that these supplements can work as analgesic, slightly more than double 63 (70%) agreed supplement can help reduce the pain during physical activities in our post survey results. After workshop, 64 (71.11%) players reported that these supplements can also enhance the concentration level which is higher compared to the initial population of only 41 (45.56%) agreeing on this. Reading the

safety of the supplements, some 18 (20%) players reported these might contain bacteria. Our post surveys results showed a total of 71 (78.89%) players reporting that supplement can contain harmful microorganisms. Initially only 27 (30%), 33 (36.67%) players agreed on that they can be sick using such contaminated supplements. However, knowing after the pathogenicity, 23 (25.56%), 60 (66.67%) players agreed that they can fall sick. After post survey, a total of 63 (70%) players agreed that government should be responsible to ensure the safety of these supplements as compared to only 37 (41.11%) players who agreed in our initial survey.

Table 6.4

Perceptions of Belief, Safety, and Use among Professional Athletes toward Dietary Supplements (n = 90)

Response	Pre *n* (%)	Post *n* (%)
16. Dietary supplements are a healthy choice.		
Agree	71(78.89)	82(91.11)
Somewhat agree	13(14.44)	6(6.67)
Neither agree nor disagree	6(6.67)	2(2.22)
17. Dietary supplements improve my endurance.		
Agree	66(73.33)	75(83.33)
Somewhat agree	12(13.33)	11(12.22)
Neither agree nor disagree	11(12.22)	3(3.33)
Somewhat disagree	1(1.11)	1(1.11)
18. Dietary supplements are safe to use.		
Agree	41(45.56)	22(24.44)
Somewhat agree	43(47.78)	18(20)
Neither agree nor disagree	3(3.33)	43(47.79)
Somewhat disagree	2(2.22)	7(7.78)
Don not know	1(1.11)	0.00

Table 6.4 *(cont.)*

Response	Pre *n* (%)	Post *n* (%)
19. Dietary supplements are a good source of energy.		
Agree	56(62.22)	72(80)
Somewhat agree	22(24.44)	14(15.56)
Neither agree nor disagree	8(8.89)	3(3.33)
Somewhat disagree	4(4.44)	1(1.11)
20. Dietary supplements support longer training sessions.		
Agree	33 (36.67)	67 (74.44)
Somewhat agree	34 (37.78)	13 (14.44)
Neither agree nor disagree	17 (18.89)	8 (8.89)
Somewhat disagree	4 (4.44)	2 (2.22)
Disagree	2 (2.22)	0 (0.00)
21. Dietary supplements provide more strength compared to other nutritional diets.		
Agree	58 (64.44)	69 (76.67)
Somewhat agree	21 (23.33)	17 (18.89)
Neither agree nor disagree	8 (8.89)	3 (3.33)
Somewhat disagree	3 (3.33)	1 (1.11)
22. Dietary supplements can relieve pain.		
Agree	30 (33.33)	63 (70)
Somewhat agree	31 (34.44)	14 (15.56)
Neither agree nor disagree	27 (30)	12 (13.33)
Somewhat disagree	1 (1.11)	1 (1.11)
Disagree	1 (1.11)	0 (0.00)
23. Dietary supplements enhance concentration during the game.		
Agree	41 (45.56)	64 (71.11)
Somewhat agree	23 (25.56)	17 (18.89)

Table 6.4 *(cont.)*

Response	Pre *n* (%)	Post *n* (%)
23. Dietary supplements enhance concentration during the game (cont.)		
Neither agree nor disagree	25 (27.78)	8 (8.89)
Somewhat disagree	1 (1.11)	1 (1.11)
24. Dietary supplements can contain bacteria.		
Agree	18 (20)	71 (78.89)
Somewhat agree	12 (13.33)	13 (14.44)
Neither agree nor disagree	17 (18.89)	3 (3.33)
Somewhat disagree	33 (36.67)	2 (2.22)
Disagree	10 (11.11)	1 (1.11)
25. If dietary supplements contain bacteria, they can make you sick.		
Agree	27 (30)	60 (66.67)
Somewhat agree	33 (36.67)	23 (25.56)
Neither agree nor disagree	15 (16.67)	5 (5.55)
Somewhat disagree	12 (13.33)	1 (1.11)
Disagree	3 (3.33)	1 (1.11)
26. Dietary supplements are tested to ensure safety and quality by the government (SFDA).		
Agree	37 (41.11)	63 (70)
Somewhat agree	14 (15.56)	13 (14.44)
Neither agree nor disagree	23 (25.56)	12 (13.33)
Somewhat disagree	9 (10)	1 (1.11)
Disagree	7 (7.78)	1 (1.11)

Note. These results showed the response does differ significantly ($p < 0.0001$) indicating reasons and background information about taking dietary supplements differ significantly for each individual athlete.

Finally, Table 6.5 (Question 27) mainly deals with the quality of specific supplements based on their regular purchase and use. Initially, a total of 32 (35.56%), 62 (68.89%) players reported these supplements (minerals, vitamins, creatine, calcium, iron, folic acid) as excellent. Our post-test survey showed 50 (55.56%), 83 (92.22%) players reporting the quality of these supplements as an excellent. However, for the sports drinks only 59 (65.56%) players reported the quality as an excellent in our post-test which is lower compared to the 71 (78.89%) players reporting the same initially. This could be due to the knowledge of having sports supplement not being dietary supplements.

Table 6.5

Perception of the Quality of Specific Supplements Based on Their Regular Purchase and Use (n = 90)

	Pre n (%)				Post n (%)			
Dietary Supplements	Excellent	Good	Satisfactory	Do not know	Excellent	Good	Satisfactory	Do not know
Minerals	43 (47.78)	16 (17.78)	10 (11.11)	21 (23.33)	69 (76.67)	11 (12.22)	5 (5.55)	5 (5.55)
Multivitamin	52 (57.78)	21 (23.33)	11 (12.22)	6 (6.67)	81 (90)	6 (6.67)	2 (2.22)	1 (1.11)
Creatine	23 (25.56)	28 (31.11)	16 (17.78)	23 (25.56)	73 (81.11)	12 (13.33)	3 (3.33)	2 (2.22)
Calcium	52 (57.78)	21 (23.33)	10 (11.11)	7 (7.78)	67 (74.44)	13 (14.44)	5 (5.55)	5 (5.55)
Vitamin C	62 (68.89)	18 (20)	7 (7.78)	3 (3.33)	83 (92.22)	4 (4.44)	2 (2.22)	1 (1.11)
Iron	51 (56.67)	26 (28.89)	9 (10)	4 (4.44)	63 (70)	16 (17.78)	9 (10)	2 (2.22)
Folic Acid	32 (35.56)	27 (30)	28 (31.11)	3 (3.33)	50 (55.56)	14 (15.56)	6 (6.67)	20 (22.22)
Sports Drink	71 (78.89)	11 (12.22)	6 (6.67)	2 (2.22)	59 (65.56)	21 (23.33)	4 (4.44)	6 (6.67)

Note: These results showed the response does differ significantly ($p < 0.0001$) indicating that dietary supplements quality differ significantly between pre-test and post-test.

6.4 Discussion

The topics that were discussed in the workshops were chosen from of our previous results from participants. Based on these results, only needful topics were selected for our workshop. Most commonly, athletes appear to have a lack of knowledge about macronutrient needs, primary functions carried out by macronutrients, vitamins and minerals, and proper supplement

use (Brown, 2009). Professional soccer has been popular in Saudi Arabia. Improvement in players' performance is closely scrutinized. These players are always under pressure to perform well, win the match, and to be part of the national team. Therefore, athletes are always in need of dietary supplements to enhance their performance. Since doping is illegal, these players need legal nutritional guidelines during a sporting event. Recently, the Saudi Professional League has conducted random test works for doping, and the players that were identified for doping cases were suspended for two years (SAFF, 2013). Each year new supplements are appearing in growing Saudi Arabia markets and intake of supplements among athletes is also increasing. It is important to know the use of supplements by professional athletes. There is a little published information regarding the consumption of dietary supplements in Saudi Arabia. There is an inherent need to improve knowledge of dietary supplements use among consumers.

Some research studies in the past have shown a positive correlation between the nutrition knowledge of athletes and the quality of their dietary intakes (Dunn et al., 2007; Nichols, Jonnalagadda, Rosenbloom, & Trinkaus 2005). The study found a major gap between the athletes' nutrition knowledge and their actual dietary practices (Murphy & Jeanes, 2006). Another study found collegiate athletes to have issues translating their nutrition knowledge into their daily food choices (Dunn, Turner, & Denny, 2007). We believe educational workshop will be able to show the benefits and the potential risks of dietary supplements. This study also determined the different categories of supplements and why people have been found to take different supplements for different reasons.

In one of the previous study, the reason for using supplements was speed (26 %), strength (27 %), endurance (37 %) and health (10 %; Azizi, Mali, & Tabari, 2012) In another study, it was found that the main reasons reported by adult and elite athletes were to increase

energy, enhance performance, improved health, prevention of nutritional deficiencies, prevention of illness, increased muscle mass and improved recovery (Kristiansen et al., 2005; Froiland et al., 2004). These correlate with our study, which shows that the majority of the players took dietary supplements to improve performance (30%) and health (31%). In another study involving college athletes, it was revealed that (89%) of the players had used or were using supplements (Froiland et al., 2004). Additionally, Canadian athletes (94.3%) have been found to use one or more supplements at least once per month (Kristiansen et al., 2005). These indicate that all the players use supplements for various reasons. After the study was concluded, researchers found a significant increase of knowledge and attitude among the male soccer athletes. There were marked differences between the pre-test and post-test scores concerning the role nutrition played in their overall performance as athletes (Brown, 2009).

In our study, the most popular products used most frequently were Omega3 and vitamin C health bar and calcium supplements, which are similar to the study, conducted in Singapore college athletes (Tian et al., 2009). The use of vitamin C in our study is close to that shown in the study earlier reported by (Froiland et al., 2004; Kristiansen et al., 2005). Seventy-four percent of the athletes reported using vitamin C, and 72% reported using Omega3 products, health bar and calcium (Dickinson, Bonci, Boyon, & Franco, 2012). Similarly, the use of vitamins and multivitamins ranges from (26%–82%) among athletes. The use of multivitamins and vitamin C is higher than (50%) and (80%) respectively (Burns et al., 2004). The reasons these athletes use vitamins are primarily to stay healthy and to prevent illnesses during the game season (Azizi et al., 2012). We also found in our study that the use of other dietary supplements such as Omega-6, creatine, and Vitamin E were lower. The use of the most popular supplement, creatine, which is very low when compared to the western countries including the United States (Jacobson et al.,

2001). Jonnalagadda et al. (2001) reported 36-37% of athletes used creatine, which was higher compared to our pre-test study. In recent years, the use of supplements among athletes in a number of sports has been increasing to improve performance. However, different types of physical activities and exercises may increase or decrease the need of certain such supplements (Medicine & Association, 2000; Van Eenoo & Delbeke, 2003).

Nutritional supplements can also play an important role in helping athletes consume the correct amount of calories, carbohydrates, and proteins in their diet. However inappropriate use or contamination may cause health problems (Tian et al., 2009; Valliant, Pittman Emplaincourt, Kieckhaefer Wenzel, & Garner, 2012). In our study players were not familiar with the right intake level of protein, carbohydrates and lipids and the need during intense exercise. However, the post survey results showed an improvement of their knowledge. According to a study by Froiland et al. (2004), male athletes were more likely to obtain information about use of supplements from a store nutritionist, fellow athletes, friends, or from a coach. These results were similar to ours. Similarly, in a study by Kristiansen et al. (2005), health professionals and the Internet were the most common information sources, while friends and colleagues often recommended the use of supplements. We also found that some of the players were interested in buying or getting information on dietary supplements from online, magazines, and from retail stores. This might produce negative effects on health due to the misleading information reported on such sources. We also educated players about the importance of making sure you have the right sources of getting information on the use of dietary supplements.

Many dietary or nutritional supplements have the reputation of being harmless because they consist mainly of naturally occurring compounds and tend to be advertised as safe and legal performance enhancing substances as opposed to the banned substances such as anabolic steroids

(S. R. Smith, 2012). Unfortunately, despite their seemingly ‘natural’ composition, not all supplements are tested by the Food and Drug Administration (FDA) therefore claims of safeness and reliability cannot be trusted (McDowall, 2007). In our pre-test study, the majority of the players reported that supplements are safe and can be taken without any harm. However, in our microbiological examination of these supplements, we determined that some of the most commonly used supplements contain harmful microorganisms (Aljaloud et al., 2009, 2013). Our post survey results showed that majority of the players are now aware that these supplements can be contaminated with bacteria as well. Brown (2009) have also reported a significant increase in participants’ nutrition knowledge after the completion of the nutrition education program (Brown, 2009). Similarly, Abood, Black, and Birnbaum (2004) reported significant increase of nutrition knowledge among participants who took part in the intervention program demonstrating a significant degree of positive dietary changes.

6.5 Conclusions

Approximately 50% athletes reported having knowledge on intake level of common supplements such as protein, carbohydrates, and lipids after the educational program. Similarly, perception, safety issues, and usages of dietary supplements among athletes were improved by 10-15% after the program. Therefore, from the things we have found, it is imperative that we educate not only athletes about dietary supplements, but for the sake of the health and well being of our community, this information needs to permeated throughout the community. Our post survey results showed education through workshop and lectures helps improve players’ knowledge, could modify practices and attitudes on dietary supplements. Therefore, athletes should be better informed and educated about the benefits associated with the consumption of supplements. Several previous studies have reported that nutrition education intervention

program significantly increase the nutritional knowledge among the participants and could be an effective way to improve the overall health and performance standard (Abood et al., 2004; Clifford, Anderson, Auld, & Champ, 2009). Several other activities can be incorporated such as weekly lectures, group activities, hand-on activities, and visual demonstrations to educate and create awareness of supplements positive and negative effects. In addition length of the educate training was short in our program; longer training and such sessions may lead to better understanding of these supplements and their use. Even though, players have nutritional knowledge but they may not practice while taking these dietary supplements. Future studies are needed to determine whether longer educational training could impact on understanding as well as intake of supplements among athletes.

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CHAPTER 7

Conclusion and Future Directions

The main findings of the study describes in this dissertation were:

1. Our study showed that the use of dietary supplements varies with each individual professional athlete for several reasons. According to the survey we gave, when asked about their use of supplements and their reasons for consumption, the majority of athletes expressed their desire to improve health and performance. Our survey results also showed the types of supplements used by athletes during the training season.
2. It is strongly evident that there is an increase for the concern in nutrition in today's society. This realization especially is seen in today's athletes who not only maintain a healthy diet, but also include a regiment of dietary supplements according to their individual needs. Results from the present study provide valuable information about the availability of dietary supplements in Riyadh, Saudi Arabia. Our results revealed that these supplements are mainly available in pharmacies, supermarket and GNC stores. Since protein sources of supplements play an important role in athletic performance, there is a need to expand protein markets as dietary supplements in the local markets.
3. After analysis of microbiological quality of different supplements, we found that some of the supplements are contaminated with microorganism. This suggests that improvements are needed in those supplements which tested positive for microbiological contamination.
4. Our educational training indicates there is some improvement in understanding of proper use of dietary supplements. It is important to conduct such workshop and provides information every year or during the training session.

In the future, more work is needed to evaluate the use and understanding of dietary supplements not only in Riyadh city but in other cities as well. These supplements should be readily available throughout the country so that players can have access to required nutritional supplements. In addition, it is important to evaluate the safety of new products launched in the market each year. Education should not only focus on soccer players but also athletes of other sports such as basketball, volleyball, and running.

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Appendix A

Consent for Participants Informed for Objective 1 (English)

Informed Consent for Participants

Sulaiman Aljaloud, Ph.D., student in Energy and Environment Study and primary investigator of this study and Dr. Salam A. Ibrahim, the primary investigator's advisor, are asking you to participate in a study "to evaluate the impact of nutritional knowledge and dietary intakes of professional athletes." We are asking you to volunteer to participate if you are between 20-30 years of age. The purpose of this research project is to determine whether athletes have had any benefits such as nutrition knowledge and/or dietary intake from a nutrition education class. The survey will determine if the materials presented are effective in increasing nutrition knowledge.

We will protect your confidentiality during the project. Any reports we prepare from the study will be for grouped data and no individual will be identified. But it is possible that the consent process and data collection will be observed by research oversight staff responsible for the rights and well-being of people who participate in research.

The participation in the study is voluntary. If you feel uncomfortable while reporting any information, you can choose not to answer any question, or to withdraw completely from the study at any time.

If you have any questions about your rights as a research study participant, you may contact the chair of the IRB through Compliance Office at (336) 334-7995 or rescomp@ncat.edu.

If you have any questions about the study, please contact:

Sulaiman Aljaloud
North Carolina A&T State University
Mailing Address: 3828 Wayfarer Drive. Greensboro, NC. 27410. USA
Email Address: a_soj@hotmail.com.
Tel. (011) (336)253-7049

Exempted
06-07-2012

Appendix B

Survey for Objective 1 (English)

Understanding the Behavior and Attitude of Professional Soccer Athletes in Saudi Arabia Towards Dietary Supplements

Read each question carefully. Mark your answer(s) with an 'X'.

1. Do you currently take dietary supplements? ☐ Yes ☐ No

2. What is the main reason of using dietary supplements?
   - Improve my health ☐
   - Prevent injury ☐
   - Help recover from an injury or illness ☐
   - Improve physical appearance ☐
   - Improve athletic performance (speed, strength,power) ☐
   - Lose weight ☐
   - Other _____

USE OF DIETARY SUPPLEMENTS

3. Have you used the following supplements in the last season? Cite only generic names—no brand names or functions.

Sports Supplements:

Sports drinks	☐ Yes	☐ No
Health bars	☐ Yes	☐ No
Vitamin B Complex	☐ Yes	☐ No
Vitamin C	☐ Yes	☐ No
Vitamin D	☐ Yes	☐ No
Vitamin E	☐ Yes	☐ No
Multivitamins	☐ Yes	☐ No

Minerals:

Iron	☐ Yes	☐ No
Calcium	☐ Yes	☐ No

Carbohydrates:

Carbohydrate electrolyte beverage	☐ Yes	☐ No
Fructose Syrup	☐ Yes	☐ No

Protein Supplements:

Amino Acids	☐ Yes	☐ No
Weight Gainer	☐ Yes	☐ No

Fish Oils:

Omega 3	☐ Yes	☐ No
Omega 6	☐ Yes	☐ No

Herbals:

Ginseng	☐ Yes	☐ No
Ginkgo Biloba	☐ Yes	☐ No

OTHER _____

Ergogenic Aids:

Red Bull	☐ Yes	☐ No
Slimming Products	☐ Yes	☐ No
Coenzymes	☐ Yes	☐ No
Caffeine (including Tea and Coffee)	☐ Yes	☐ No
Creatine	☐ Yes	☐ No
Ephedra	☐ Yes	☐ No

4. Where do you usually buy your dietary supplements? *Check one only.*

Retail Store/pharmacy ☐

Athletic Trainer or Physician ☐

Nutritionist /dietician ☐

Coach ☐

Family member or friend ☐

Online Stores ☐

Other _____

5. From whom do you get information about dietary supplements? Coach ☐

Physician ☐

Nutritionist/dietician ☐

Family or friends ☐

Academic Journals ☐

Online ☐

Magazine ☐

Retail ☐

Store Other _____

BELIEFS ABOUT SUPPLEMENTS

6. For each question, please check the choice that most accurately applies to you?

Benefits of dietary supplements	Agree	Somewhat agree	Agree nor disagree	Somewhat Disagree	Disagree	Do not know
7. Dietary supplements make me healthier.	☐	☐	☐	☐	☐	☐
8. Dietary supplements improve my endurance.	☐	☐	☐	☐	☐	☐
9. Dietary supplements are safe to use.	☐	☐	☐	☐	☐	☐
10. Dietary supplements provide me with more energy.	☐	☐	☐	☐	☐	☐
11. Dietary supplements increase the amount of training that I can undergo.	☐	☐	☐	☐	☐	☐
12. Dietary supplements increase my strength.	☐	☐	☐	☐	☐	☐
13. Dietary supplements increase my ability to cope with pain.	☐	☐	☐	☐	☐	☐
14. Dietary supplements improve my concentration.	☐	☐	☐	☐	☐	☐

DEMOGRAPHICS

15. What is your age? ☐ Years

16. What is your highest level of education?

- Less than high school ☐
- High school ☐
- Some college ☐
- Bachelor's degree ☐
- Graduate or Professional degree ☐

17. How long have you been a professional soccer player? _____

Thank you for completing this survey.

Appendix C

Consent for Participants Informed for Objective 1 (Arabic)

موافقة المشاركين في الدراسة

سليمان الجلعود ، طالب الدكتوراه ، في مجال دراسة الطاقة والبيئة (تغذية الرياضيين) والباحث الرئيسي لهذه الدراسة ، والمشرف الرئيسي للبحث الدكتور سلام ، ويطلب منك أن تشارك في دراسة " فهم السلوك والموقف من الرياضيين المحترفين في المملكة العربية السعودية نحو المكملات الغذائية " نطلب منك بالتطوع للمشاركة في الدراسة إذا كنت بين 20-30 سنة من العمر. والغرض من هذا المشروع البحثي تحديد ما إذا كان الرياضيون الخاضعون لهذا البرنامج يستفيدوا من حيث المعرفة والتغذية الصحيحة والمدخول الغذائي بالتعليم والتغذية. وسيتم مسح آخر لتحديد ما إذا كانت المواد والمعلومات المقدمة فعالة في زيادة المعرفة التغذوية.

سوف تكون المعلومات في غاية السرية من خلال المشروع.التقارير وجمع البيانات سوف تحدد ككل ولا تكون فردية. الشخص الوحيد الذي سوف يقوم بجمع البيانات من خلال عرض الاستبيانات هو الباحث.
المشاركة في هذه الدراسة هو طوعي. إذا كنت تشعر بعدم الارتياح يتم الإبلاغ للمشرف على إدارة البحث. ،كما يمكنك اختيار عدم الرد على أي سؤال ، أو الانسحاب تماما من الدراسة في أي وقت.

إذا كان لديك أي أسئلة عن حقوقك كمشارك بدراسة البحث ، يمكنك الاتصال على رئيس مجلس ومراجعة الهيئة من خلال مكتب المطابقة والالتزام في (336) 334-7995 أو
rescomp@ncat.edu.

إذا كان لديك أي أسئلة حول هذه الدراسة ، يرجى الاتصال :

الباحث،

سليمان الجلعود
جامعة ولاية نورث كارولينا
العنوان: 3828. مدينة جرينسبورو في ولاية نورث كارولاينا. 27410. الولايات المتحدة الأمريكية
البريد الإلكتروني :

A_soj@hotmail.com
الهاتف: 011.336.253.7049

Exempted
06-07-2012

Appendix D

Survey for Objective 1 (Arabic)

فهم السلوك والموقف من الرياضيين المحترفين في كرة القدم بالمملكة العربية السعودية نحو المكملات الغذائية

أرجو قراءة الأسئلة بدقة. معظم الأسئلة يطلب منك "علامة على إجابة واحدة" هي علامة (×) في مربع الاختيارالذي يشير إلى إجابتك.

1. هل تتناول حاليا المكملات الغذائية؟ نعم ☐ لا ☐

2. السبب الرئيسي لاستخدام المكملات الغذائية؟
تحسين صحتي ☐
منع الإصابة ☐
تساعد على التعافي من الإصابة أو المرض ☐
تحسين المظهر الجسدي ☐
تحسين الأداء الرياضي (السرعة والقوة) ☐
زيادة واكتساب الوزن ☐
انقاص الوزن ☐
أخرى _____

استخدام المكملات الغذائية

3. **هل كنت تستخدم المكملات الغذائية التالية في الموسم الماضي؟** أذكر فقط أسم المكمل الغذائي بشكل عام، لا بذكر اسم تجاري أو وظيفة المكمل الغذائي.

المكملات الغذائية الرياضية		
مشروبات الرياضة	نعم ☐	لا ☐
وجبة خفيفة وملائمة للرياضي غنية بالعناصر الغذائية	نعم ☐	لا ☐
الفيتامينات		
فيتامين(ب)	نعم ☐	لا ☐
فيتامين (ج)	نعم ☐	لا ☐
فيتامين (د)	نعم ☐	لا ☐
فيتامين (هـ)	نعم ☐	لا ☐
مجموعة الفيتامينات	نعم ☐	لا ☐
المعادن		
الحديد	نعم ☐	لا ☐

الكالسيوم		نعم		لا
الكربوهيدرات				
مشروب الطاقة للرياضيين		نعم		لا
شراب الفركتوز مثل(شراب الذرة وقصب السكر..)		نعم		لا
مكملات البروتين				
الأحماض الأمينية		نعم		لا
زيادة واكتساب الوزن		نعم		لا
زيت الحوت (السمك)				
أوميغا 3		نعم		لا
أوميغا 6		نعم		لا
الأعشاب الطبيعية				
الجينسنغ		نعم		لا
جنكوولوبيا(الجنكة)		نعم		لا
مكملات غذائية / رياضية مساعدة يمكن من خلالها دعم الأداء وتحسين و تعزيز الأداء في الرياضة				
مشروب (ريد بل)		نعم		لا
منتجات التخسيس(نقص الوزن)		نعم		لا
الإنزيمات المساعدة		نعم		لا
الكافيين (بما في ذلك الشاي والقهوة)		نعم		لا
الكرياتين (مونوهيدرات الكرياتين)		نعم		لا
الإيفيدرا		نعم		لا

4. من أين تشتري عادة المكملات الغذائية الخاصة؟ حدد المراكز الثلاثة الأولى

البيع بالتجزئة / صيدلية	
مدرب رياضي أو طبيب	
خبير التغذية / اختصاصي التغذية	

مدرب ☐

أفراد العائلة أو الأصدقاء ☐

متاجر على الإنترنت ☐

أخرى _____

5. ما هي مصادر المعلومات الخاصة بك لاستخدام المكملات الغذائية؟

مدرب ☐

طبيب ☐

خبير التغذية / اختصاصي التغذية ☐

أفراد العائلة أو الأصدقاء ☐

مجلات أكاديمية علمية ☐

عبر الإنترنت ☐

المجلات العادية ☐

متجر التجزئة (سوبرماركت) ☐

أخرى _____

المعتقدات عن المكملات

6. في كل سؤال، يرجى الرجوع إلى الخيار الذي ينطبق على حالتك؟

قواند المكملات الغذائية	أوافق	اتفق إلى حد ما	لا أوافق ولا أختلف	اختلف إلى حد ما	لا أوافق	لا أعلم الإجابة
7. المكملات الغذائية تجعلني أكثر صحة.	☐	☐	☐	☐	☐	☐
8. المكملات الغذائية تحسن قدرة التحمل لدي.	☐	☐	☐	☐	☐	☐
9. المكملات الغذائية هي آمنة للاستخدام.	☐	☐	☐	☐	☐	☐
10. المكملات الغذائية توفر لي المزيد من الطاقة.	☐	☐	☐	☐	☐	☐
11. المكملات الغذائية تزيد من زمن طول التدريب الذي أخضع له.	☐	☐	☐	☐	☐	☐

12. المكملات الغذائية تزيد قوتي.	☐	☐	☐	☐	☐	☐
13. المكملات الغذائية تزيد من قدرتي على التعامل مع الألم.	☐	☐	☐	☐	☐	☐
14. المكملات الغذائية تحسن تركيزي.	☐	☐	☐	☐	☐	☐

15. ما هو عمرك؟ ☐ سنة

16. ما هو أعلى مستوى من التعليم الخاص

أقل من الثانوية العامة ☐

شهادة الثانوية ☐

دبلوم أو كلية ☐

درجة البكالوريوس ☐

دراسات عليا ☐

17. منذ متى وأنت لاعب كرة قدم محترف؟ _____

شكراً جزيلاً لإتمام هذه الاستبانة.

Appendix E

Written Approval from IRB for Objective 1

NC A&T DIVISION OF RESEARCH AND ECONOMIC DEVELOPMENT
1601 East Market Street
Greensboro, NC 27411
(336) 334-7314
Web site: http://www.ncat.edu/~divofres/compliance/irb/index.php
Federalwide Assurance (FWA) #00000013

To: Sulaiman Aljaloud

171 Carver Hall

From: Behavioral IRB

Date: 6/07/2012

RE: Notice of IRB Exemption
Exemption Category: 2.Survey, interview, public observation
Study #: 11-0202

Study Title: Understanding the Behavior and Attitude of Professional Athletes in Saudi Arabia toward Dietary Supplements

This submission has been reviewed by the above IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Study Description:

The purpose of this research is to improve the knowledge of dietary supplements use among consumers and professional athletes in Saudi Arabia.

Investigator's Responsibilities:

If your study protocol changes in such a way that exempt status would no longer apply, you should contact the above IRB before making the changes. The IRB will maintain records for this study for 3 years, at which time you will be contacted about the status of the study. **If you are conducting research in a public school, you must provide written approval of the superintendent's office prior to conducting your research.**

CC:
Salam Ibrahim, Family And Consumer Science

Appendix F

Letters to Whom it May Concern

NORTH CAROLINA
AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

ENERGY & ENVIRONMENTAL
SYSTEMS DEPARTMENT
1601 EAST MARKET STREET
401 GIBBS HALL
GREENSBORO, NC 27411

voice (336) 285-2355
fax (336) 256-2544
HTTP://NCATENERGY.ORG

May 5, 2012

To whom it may concern:

Mr. Sulaiman Aljaloud will be conducting a survey study between about June 22 to August 23, 2012 for his dissertation entitled "Understanding the Behavior and Attitude of Professional Athletes in Saudi Arabia toward Dietary Supplements." The study will be conducted in Riyadh city.

Mr. Sulaiman Aljaloud is currently working on his research and has made satisfactory progress. He is studying diligently and is hoping to complete his project by the end of 2013.

For this study, the following information is needed: Letter to Saudi Arabian Football Federation indicating survey will be conducted for at least 10% of players from Al Hilal, Al Nasr, and Al-Shabab teams. During the survey, 10 questionnaires divided into 5 categories (use of supplements, reason for consumption, family history, personal beliefs, and behavior) will be provided to each player.

Your aid in encouraging participation in this important study is appreciated.

Sincerely,

Keith A. Schimmel

Keith A. Schimmel, PhD, PE
Chair, Energy & Environmental Systems Department

Appendix G

Letters to President of SAFF (Arabic)

بسم الله الرحمن الرحيم

Kingdom of Saudi Arabia
Ministry of Higher Education
King Saud University
Code 034
College of Sport Sciences & Physical Activity
Vice Dean for Graduate Studies and Research

المملكة العربية السعودية
وزارة التعليم العالي
جامعة الملك سعود
رمزها ٠٣٤
كلية علوم الرياضة والنشاط البدني
وكيل الكلية للدراسات العليا والبحث العلمي

Date: ١٤٣٣/٦/٢٦ التاريخ:

No. ٣/٦٢٠٨٦٢ الرقم:

سعادة رئيس الاتحاد السعودي لكرة القدم **سلمه الله**

السلام عليكم ورحمة الله وبركاته **وبعد :**

نفيدكم بأن الأستاذ / سليمان بن عمر الجلعود، أحد منسوبي كلية علوم الرياضة والنشاط البدني والمبتعث لنيل درجة الدكتوراه من جامعة ولاية نورث كارولينا بالولايات المتحدة الأمريكية، بصدد زيارة مدينة الرياض لجمع البيانات الخاصة بموضوع رسالته" **فهم سلوك واتجاه الرياضيين المحترفين في المملكة العربية السعودية نحو المكملات الغذائية**" والتي سيتم جمعها بطريقة الاستبيان من لاعبي أندية (الهلال – الشباب – النصر) بنسبة لا تقل عن ١٠% من اللاعبين، وذلك خلال الفترة من ٦/٢٢ – ٢٠١٢/٨/٢٣م .

ونظراً لأهمية موضوع هذه الدراسة للرياضة السعودية عامة ولاعبي كرة القدم المحترفين خاصة، فإننا نأمل من سعادتكم التكرم بالموافقة وإجراء اللازم حيال تسهيل مهمته في جمع البيانات المطلوبة .

شاكرين لكم تعاونكم ومتمنين أن يكون هذا الموضوع باكورة التعاون العلمي البناء بين كلية علوم الرياضة والنشاط البدني والاتحاد السعودي لكرة القدم .

وتقبلوا خالص تحياتي وتقديري ،،،

وكيل الكلية للدراسات العليا

والبحث العلمي

د. أحمد بن محمد الفاضل

أخوكم /

P. O. Box 1949, Riyadh 11441 Tel 4698653 Fax.: 4698645
ص.ب ١٩٤٩ الرياض ١١٤٤١ هاتف: ٤٦٩٨٦٥٣ فاكس: ٤٦٩٨٦٤٥
www.ksu.edu.sa

Appendix H

Letters to President of SAFF (English)

Kingdom of Saudi Arabia
Ministry of Higher Education
King Saud University
Code 034
College of Sport Sciences and Physical Activity
Vice Dean for Graduate Studies and Research

Date: 16.06.1433H

No: 3.6.208162

President of Saudi Arabian Football Federation

Sulaiman Aljaloud, a part of the staff of King Saud University will be conducting a survey study for his dissertation titled "Understanding the behavior and attitude of professional athletes in Saudi Arabia toward dietary supplements" tentatively between June 22, 2012 to August 23, 2012. The study will be conducted in Riyadh city.

For his study, a survey for at least 10% of the players from Al Hilal, Al Nasr, and Al-Shabab team will be conducted. During the survey, a questionnaire consisting of seventeen questions divided into 5 categories (use of supplements, reason for consumption, family history, personal beliefs, and behavior) will be provided for each player.

This is the first collaboration between King Saud University and Saudi Arabian Football Federation. I hope to work together in near future.

Your participation in this important study is appreciated.

Sincerely,

Dr. Ahmad Alfadhil

Vice Dean for Graduate Studies and Research
College of Sport Sciences and Physical Activity
King Saud University

Appendix I

Letters to Secretary General of Alshabab (Arabic)

KINGDOM OF SAUDI ARABIA
SAUDI ARABIAN FOOTBALL FEDERATION

المملكة العربية السعودية
الاتحاد العربي السعودي لكرة القدم

Ref. No. :
Date :
Enclosed :

الرقم : ٩/٥١٣٢
التاريخ : ٢١-٦-١٤٣٣هـ
المرفقات :

فاكس هام

سعادة أمين عام نادي الشباب **المحترم**

السلام عليكم ورحمة الله وبركاته

أهديكم أطيب التحية.. وأود إفادتكم بأن الأستاذ/ سليمان بن عمر الجلعود أحد منسوبي كلية علوم الرياضة والنشاط البدني بجامعة الملك سعود والمبتعث لنيل درجة الدكتوراه من جامعة ولاية نورث كارولينا بالولايات المتحدة الأمريكية، بصدد زيارة مدينة الرياض لجمع البيانات الخاصة بموضوع رسالته (فهم سلوك واتجاه الرياضيين المحترفين في المملكة العربية السعودية نحو المكملات الغذائية) والتي سيتم جمعها بطريقة الاستبيان من لاعبي الأندية، بنسبة لا تقل عن ١٠٪ من اللاعبين، وذلك خلال الفترة من تاريخ ٦/٢٢ إلى ٢٠١٢/٨/٢٣م.

ونظراً لأهمية موضوع هذه الدراسة للرياضة السعودية عامة ولاعبي كرة القدم المحترفين خاصة، فإنني آمل منكم اتخاذ اللازم حيال تسهيل مهمة المبتعث الأستاذ/ سليمان بن عمر الجلعود في جمع البيانات المطلوبة.

شاكراً اهتمامكم ومتمنياً لكم دوام التوفيق والسداد ،،،

ولكم خالص تحياتي ،،،

الأمين العام المكلف
د/
٦/٢١
عبدالله بن محمد السهلي

نادي الشباب
وارد
رقم: ٢٨٠
تاريخ: ٢١ / ٦ / ١٤٣٣هـ

مع التحية
مدير كرة القدم
للعمل اللازم حيال ذلك
شكراً
٦/٢٢

KINGDOM OF SAUDI ARABIA - Riyadh 11432 P. O. Box 5844
Tel. : 482 2240 Central - 482 1314 Direct - Fax : (01) 482 1215
المملكة العربية السعودية - الرياض ١١٤٣٢ - ص.ب : ٥٨٤٤
تلفون : ٤٨٢٢٢٤٠ سنترال - ٤٨٢١٣١٤ مباشر - فاكس : ٤٨٢١٢١٥ (٠١)
Website : www.thesaff.com.sa E-mail : info@football-saudi.com

Appendix J

Letters to Secretary General of Alnaser (Arabic)

KINGDOM OF SAUDI ARABIA
SAUDI ARABIAN FOOTBALL FEDERATION

المملكة العربية السعودية
الاتحاد العربي السعودي لكرة القدم

Ref. No. : ٩/٥١٢٤
Date : ١٤٣٢-٦-٢١هـ
Enclosed :

الرقم :
التاريخ :
المرفقات :

فاكس هام

سعادة أمين عام نادي النصر **المحترم**

السلام عليكم ورحمة الله وبركاته

أهديكم أطيب التحية.. وأود إفادتكم بأن الأستاذ/ سليمان بن عمر الجلعود أحد منسوبي كلية علوم الرياضة والنشاط البدني بجامعة الملك سُعود والمبتعث لنيل درجة الدكتوراه من جامعة ولاية نورث كارولينا بالولايات المتحدة الأمريكية، بصدد زيارة مدينة الرياض لجمع البيانات الخاصة بموضوع رسالته (فهم سلوك واتجاه الرياضيين المحترفين في المملكة العربية السعودية نحو المكملات الغذائية) والتي سيتم جمعها بطريقة الاستبيان من لاعبي الأندية، بنسبة لا تقل عن ١٠٪ من اللاعبين، وذلك خلال الفترة من تاريخ ٦/٢٢ إلى ٢٠١٢/٨/٢٣م.

ونظراً لأهمية موضوع هذه الدراسة للرياضة السعودية عامة ولاعبي كرة القدم المحترفين خاصة، فإنني آمل منكم اتخاذ اللازم حيال تسهيل مهمة المبتعث الأستاذ/ سليمان بن عمر الجلعود في جمع البيانات المطلوبة.

شاكراً اهتمامكم ومتمنياً لكم دوام التوفيق والسداد ،،،

ولكم خالص تحياتي ،،،

الأمين العام المكلف
٦/٢١
عبدالله بن محمد السهلي

الأمين العام ٢١

KINGDOM OF SAUDI ARABIA - Riyadh 11432 P. O. Box 5844
Tel. : 482 2240 Central - 482 1314 Direct - Fax : (01) 482 1215
Website : www.thesaff.com.sa E-mail : info@football - saudi.com

المملكة العربية السعودية - الرياض ١١٤٣٢ - ص.ب : ٥٨٤٤
تلفون : ٤٨٢٢٢٤٠ سنترال - ٤٨٢ ١٣١٤ مباشر - فاكس : ٤٨٢ ١٢١٥ (٠١)

Appendix K

Letters to Secretary General of Alhilal (Arabic)

KINGDOM OF SAUDI ARABIA
SAUDI ARABIAN FOOTBALL FEDERATION

المملكة العربية السعودية
الاتحاد العربي السعودي لكرة القدم

Ref. No. : ٩/٥١٧٢
Date : ٢١-٦-١٤٣٢
Enclosed : —

الرقم : ٩/٥١٧٢
التاريخ : ٢١-٦-١٤٣٢
المرفقات : —

فاكس هام

سعادة أمين عام نادي الهلال **المحترم**

السلام عليكم ورحمة الله وبركاته

أهديكم أطيب التحية.. وأود إفادتكم بأن الأستاذ/ سليمان بن عمر الجلعود أحد منسوبي كلية علوم الرياضة والنشاط البدني بجامعة الملك سُعود والمبتعث لنيل درجة الدكتوراه من جامعة ولاية نورث كارولينا بالولايات المتحدة الأمريكية، بصدد زيارة مدينة الرياض لجمع البيانات الخاصة بموضوع رسالته (فهم سلوك واتجاه الرياضيين المحترفين في المملكة العربية السعودية نحو المكملات الغذائية) والتي سيتم جمعها بطريقة الاستبيان من لاعبي الأندية، بنسبة لا تقل عن ١٠٪ من اللاعبين، وذلك خلال الفترة من تاريخ ٦/٢٢ إلى ٢٠١٢/٨/٢٣م.

ونظراً لأهمية موضوع هذه الدراسة للرياضة السعودية عامة ولاعبي كرة القدم المحترفين خاصة، فإنني آمل منكم اتخاذ اللازم حيال تسهيل مهمة المبتعث الأستاذ/ سليمان بن عمر الجلعود في جمع البيانات المطلوبة.

شاكراً اهتمامكم ومتمنياً لكم دوام التوفيق والسداد ،،،

ولكم خالص تحياتي ،،،

الأمين العام المكلف
٢١/٦
عبدالله بن محمد السهلي

الأمين العام ٢٠

Appendix L

Letters to Secretary General of Alshabab, Alnaser, and Alhilal (English)

Kingdom of Saudi Arabia
Saudi Arabian Football Federation

Date: 21.06.1433H No: 9/5133

Secretary General of AlShbab, AlNaser, and Alhlal.

Sulaiman Aljaloud, a part of the staff of King Saud University will be conducting a survey study for his dissertation titled "Understanding the behavior and attitude of professional athletes in Saudi Arabia toward dietary supplements" tentatively between June 22, 2012 to August 23, 2012. The study will be conducted in Riyadh city.

For his study, he has permission to conduct a survey for at least 10% of the players from Al Hilal, Al Nasr, and Al-Shabab team. During the survey, a questionnaire consisting of different questions will be provided.

This type of study is not only important for the professional players but also for improvement of sports in Saudi Arabia. Therefore, I strongly encourage all the players to participate in this program.

Sincerely,

Secretary General of of Saudi Arabian Football Federation

Abdullah bin Mohammed Al Sahli

Appendix M

Consent for Participants Informed for Objective 4 (English)

Informed Consent for Participants

Sulaiman Aljaloud, Ph.D., a student in Energy and Environment Study and primary investigator of this study, and Dr. Salam A. Ibrahim, the primary investigator's advisor, are asking you to participate in a research study "to evaluate the impact of nutritional knowledge and dietary intakes of professional athletes." We are asking you to volunteer to participate if you are between 20-30 years of age. The purpose of this research project is to determine whether athletes have had any benefits such as nutrition knowledge and/or dietary intake from a nutrition education class. The survey will determine if the materials presented are effective in increasing nutrition knowledge.

We will protect your confidentiality during the project. Any reports we prepare from the study will be for grouped data and no individual will be identified. But it is possible that the consent process and data collection will be observed by research oversight staff responsible for the rights and well-being of people who participate in research.

The participation in the study is voluntary. If you feel uncomfortable while reporting any information, you can choose not to answer any question, or to withdraw completely from the study at any time.

If you have any questions about your rights as a research study participant, you may contact the Office of Research Compliance and Ethics at North Carolina A&T State University at (336) 334-7995 or rescomp@ncat.edu.

If you have any questions about the study, please contact:

Sulaiman Aljaloud
North Carolina A&T State University
Mailing Address: 3828 Wayfarer Drive, Greensboro, NC 27410, USA
Email Address: a_soj@hotmail.com.
Tel. (011) (336)253-7049

DOCUMENTATION OF INFORMED CONSENT
You are voluntarily making a decision whether or not to participate in the research study. Your signature certifies that you have decided to participate having read and understood the information presented. You will be given a copy of this consent form to keep.

Appendix N

Survey for Objective 4 (English)

UNDERSTANDING THE BEHAVIOR AND ATTITUDES OF PROFESSIONAL SOCCER ATHLETES IN SAUDI ARABIA TOWARDS DIETARY SUPPLEMENTS

Read each question carefully.

1. If you are using dietary supplements, what is the main reason? **(Check only one)**
   - ☐ Improve health
   - ☐ Prevent injury
   - ☐ Help recover from an injury or illness
   - ☐ Improve physical appearance
   - ☐ Improve athletic performance (speed, strength, power)
   - ☐ Meet nutritional requirements
   - ☐ Other: _____

2. Are you familiar with the word function supplements?
   - ☐ Yes
   - ☐ No

3. What do you think the general quality of dietary supplements available in the market in Saudi Arabia? **(Check only one)**
   - ☐ Excellent
   - ☐ Good
   - ☐ Satisfactory
   - ☐ Do not know

4. Which of these dietary supplements have you used most frequently?
   - ☐ Omega 3
   - ☐ Vitamin C
   - ☐ Health Bar
   - ☐ Calcium
   - ☐ None of the above

5. Have you looked for dietary supplements information from any sources in the past 6 months?

   ☐ Yes

   ☐ No

6. Which of these supplements do you use rarely?

   ☐ Omega 6 fatty acid

   ☐ Creatine

   ☐ Vitamin E

   ☐ None of the above

7. Does an athlete's protein needs increase or decrease when working out?

   ☐ Increase

   ☐ Decrease

   ☐ Do not know

8. Protein should make up _____ of total daily calories.

   ☐ 15–20%

   ☐ 25–35%

   ☐ 35–45%

   ☐ 45–55%

9. Does an athlete's Carbohydrate needs increase or decrease when workouts become longer and more vigorous?

   ☐ Increase

   ☐ Decrease

   ☐ Do not know

10. Carbohydrates should make up _____ of total daily caloric intake.

    ☐ 70–80%

    ☐ 30–40%

    ☐ 35–45%

    ☐ 50–65%

11. Does an athlete's lipids need increase or decrease when workouts become more longer and more vigorous? **(Check only one)**

- ☐ Increase
- ☐ Decrease
- ☐ Do not know

12. How accessible is it to locate dietary supplements in the market? **(Check only one)**

- ☐ Easy
- ☐ Difficult
- ☐ Not available
- ☐ Do not know

13. On a scale of 1 to 5 (1 being the least), what supplements do you feel are the most readily available?

- ☐ Creatine
- ☐ Multivitamins
- ☐ Vitamin C
- ☐ Calcium
- ☐ None of the above

14. Where do you usually buy your dietary supplements? **(Check only one)**

- ☐ Retail Store/pharmacy
- ☐ Athletic Trainer or Physician
- ☐ Nutritionist/dietician
- ☐ Coach
- ☐ GNC
- ☐ Online Stores
- ☐ Other: _____

15. From whom do you get information about dietary supplements? **(Check as many as apply)**

- ☐ Coach
- ☐ Physician
- ☐ Nutritionist/dietician
- ☐ Family or friends
- ☐ Academic Journals
- ☐ Online
- ☐ Magazine
- ☐ Retail Store
- ☐ Other: _____

BELIEFS ABOUT SUPPLEMENTS

For each question, please mark the choice that most accurately applies to you.

BENEFITS OF DIETARY SUPPLEMENTS	Agree	Somewhat Agree	Neither Agree Nor Disagree	Somewhat Disagree	Disagree	Do Not Know
16. Dietary supplements are a healthy choice.	O	O	O	O	O	O
17. Dietary supplements improve my endurance.	O	O	O	O	O	O
18. Dietary supplements are safe to use.	O	O	O	O	O	O
19. Dietary supplements are a good source of energy.	O	O	O	O	O	O
20. Dietary supplements support longer training sessions.	O	O	O	O	O	O
21. Dietary supplements provide more strength compared to other nutritional diets.	O	O	O	O	O	O
22. Dietary supplements can relieve pain.	O	O	O	O	O	O
23. Dietary supplements enhance concentration during the game.	O	O	O	O	O	O
24. Dietary supplements can contain bacteria.	O	O	O	O	O	O
25. If dietary supplements contain bacteria, they can make you sick.	O	O	O	O	O	O
26. Dietary supplements are tested to ensure safety and quality by the government (SFDA).	O	O	O	O	O	O

27. How do you rate the quality of following supplements?

For each supplement, please check the choice that most accurately applies to you

	Excellent	Good	Satisfactory	Do Not Know
Minerals	O	O	O	O
Multivitamins	O	O	O	O
Creatine	O	O	O	O
Calcium	O	O	O	O
Vitamin C	O	O	O	O
Iron	O	O	O	O
Folic Acid	O	O	O	O
Sports Drink	O	O	O	O

Thank you for completing this survey!

Appendix O

Consent for Participants Informed for Objective 4 (Arabic)

موافقة المشاركين في الدراسة

سليمان الجلعود ، طالب الدكتوراه ، في مجال دراسة الطاقة والبيئة (تغذية الرياضيين) والباحث الرئيسي لهذه الدراسة ، والمشرف الرئيسي للبحث الدكتور سلام ، ويطلب منك أن تشارك في دراسة " فهم السلوك والموقف من الرياضيين المحترفين في المملكة العربية السعودية نحو المكملات الغذائية " نطلب منك بالتطوع للمشاركة في الدراسة إذا كنت بين 20-30 سنة من العمر. والغرض من هذا المشروع البحثي هو تحديد ما إذا كان الرياضيون الخاضعون لهذا البرنامج يستفيدوا من حيث المعرفة والتغذية الصحيحة والمدخول الغذائي بالتعليم والتغذية. وسيتم مسح آخر لتحديد ما إذا كانت المواد والمعلومات المقدمة فعالة في زيادة المعرفة التغذوية.

سوف تكون المعلومات في غاية السرية من خلال المشروع.التقارير وجمع البيانات سوف تحدد ككل ولا تكون فردية. الشخص الوحيد الذي سوف يقوم بجمع البيانات من خلال عرض الاستبيانات هو الباحث.
المشاركة في هذه الدراسة هو طوعي. إذا كنت تشعر بعدم الارتياح يتم الإبلاغ للمشرف على إدارة البحث. ،كما يمكنك اختيار عدم الرد على أي سؤال ، أو الانسحاب تماما من الدراسة في أي وقت.

إذا كان لديك أي أسئلة عن حقوقك كمشارك بدراسة البحث ، يمكنك الاتصال على رئيس مجلس ومراجعة الهيئة من خلال مكتب المطابقة والالتزام في 3347995 (336) أو
rescomp@ncat.edu.

إذا كان لديك أي أسئلة حول هذه الدراسة ، يرجى الاتصال :

الباحث،

سليمان الجلعود
جامعة ولاية نورث كارولينا
العنوان: 3828. مدينة جرينسبورو في ولاية نورث كارولاينا. 27410. الولايات المتحدة الأمريكية
البريد الإلكتروني :

A_soj@hotmail.com
الهاتف: 011.336.253.7049

Appendix P

Survey for Objective 4 (Arabic)

فهم السلوك والموقف من الرياضيين المحترفين في كرة القدم بالمملكة العربية السعودية نحو المكملات الغذائية

أرجو قراءة الأسئلة بدقة. معظم الأسئلة يطلب منك وضع "علامة على إجابة واحدة" هي علامة (×) في مربع الاختيار الذي يشير إلى إجابتك.

1. إذا كنت تستخدم المكملات الغذائية - ماهو السبب الرئيسي لذلك

☐ تحسين صحتي
☐ منع الإصابة
☐ تساعد على التعافي من الإصابة أو المرض
☐ تحسين المظهر الجسدي
☐ تحسين الأداء الرياضي (السرعة والقوة)
☐ تلبية الاحتياجات الغذائية
☐ أخرى _____

2. هل أنت على دراية بوظيفة المكملات الغذائية؟

☐ نعم
☐ لا

3. .ما رأيك في جودة المكملات الغذائية المتوفرة في سوق المملكة العربية السعودية؟ اختر واحداً

☐ ممتاز
☐ جيد
☐ مرضي (مقبول)
☐ لا أعرف الإجابة

4. أي من هذه المكملات الغذائية ـــ استخدمتها في معظم الأحيان؟

☐ أوميغا 3
☐ فيتامين (ج)
☐ وجبة خفيفة وملائمة للرياضي غنية بالعناصر الغذائية
☐ الكالسيوم
☐ لا شيء مما سبق

5. هل بحثت على معلومات عن مصادر المكملات الغذائية خلال ال 6 أشهر الماضية ؟

☐ نعم

☐ لا

6. أي من هذه المكملات الغذائية نادراً ما تستخدمها ؟

☐ أوميغا 6

☐ كرياتين

☐ فيتامين (هـ)

☐ لا شيء مما سبق

7. هل الرياضي في حاجة للبروتين عند التدريب أو المنافسة (بزيادة أو بنقص)؟

☐ زيادة

☐ نقص

☐ لا أعرف الإجابة

8. يجب أن يشكل البروتين _____ من السعرات الحرارية اليومية ؟

☐ 15–20%

☐ 25–35%

☐ 35–45%

☐ 45–55%

9. هل الرياضي في حاجة للكربوهيدرات عند التدريب القوي والأكثر زمناً (بزيادة أو بنقص)؟

☐ زيادة

☐ نقص

☐ لا أعرف الإجابة

10. يجب أن تشكل الكربوهيدرات_____ من السعرات الحرارية اليومية ؟

☐ 70–80%

☐ 30–40%

☐ 35–45%

☐ 50–65%

11. هل الرياضي بحاجة لنسبة الدهون عندما تصبح التدريبات أكثر قوة وأطول زمناً؟ (بزيادة أو بنقص)؟

- ☐ زيادة
- ☐ نقص
- ☐ لا أعرف الإجابة

12. هل من السهل الوصول لتحديد موقع المكملات الغذائية في السوق؟

- ☐ سهل
- ☐ صعب
- ☐ غير متوفر
- ☐ لا أعرف الإجابة

13. اختار من 1 إلى 5 (1 هو الأقل)، المكملات الغذائية المتوفرة أكثر؟

- ☐ الكرياتين
- ☐ مجموعة الفيتامينات
- ☐ فيتامين (ج)
- ☐ الكالسيوم
- ☐ لا شيء مما سبق

14. من أين تشتري عادة المكملات الغذائية الخاصة؟ حدد المراكز الثلاثة الأولى

- ☐ البيع بالتجزئة / صيدلية
- ☐ مدرب رياضي أو طبيب
- ☐ خبير التغذية / اختصاصي التغذية
- ☐ مدرب
- ☐ GNC
- ☐ متاجر على الإنترنت
- ☐ أخرى _____

15. ما هي مصادر المعلومات الخاصة بك لاستخدام المكملات الغذائية؟

- ☐ مدرب
- ☐ طبيب
- ☐ خبير التغذية / اختصاصي التغذية
- ☐ أفراد العائلة أو الأصدقاء
- ☐ مجلات أكاديمية علمية
- ☐ عبر الإنترنت
- ☐ المجلات العادية
- ☐ متجر التجزئة (سوبرماركت)
- ☐ أخرى _____

المعتقدات عن المكملات

في كل سؤال، يرجى الرجوع إلى الخيار الذي ينطبق على حالتك؟

	فوائد المكملات الغذائية	أوافق	أتفق إلى حد ما	لا أوافق ولا أختلف	أختلف إلى حد ما	لا أوافق	لا أعلم الإجابة
.16	المكملات الغذائية تجعلني أكثر صحة.	O	O	O	O	O	O
.17	المكملات الغذائية تحسن قدرة التحمل لدي.	O	O	O	O	O	O
.18	المكملات الغذائية هي آمنة للاستخدام.	O	O	O	O	O	O
.19	المكملات الغذائية توفر لي المزيد من الطاقة.	O	O	O	O	O	O
.20	المكملات الغذائية تزيد من زمن طول التدريب الذي أخضع له.	O	O	O	O	O	O
.21	المكملات الغذائية تزيد قوتي.	O	O	O	O	O	O
.22	المكملات الغذائية تزيد من قدرتي على التعامل مع الألم.	O	O	O	O	O	O
.23	المكملات الغذائية تحسن تركيزي.	O	O	O	O	O	O
.24	يمكن للمكملات الغذائية ان تحتوي على بكتيريا.	O	O	O	O	O	O
.25	إذا كانت المكملات الغذائية تحتوي على بكتيريا. هل تصيبك بالمرض؟	O	O	O	O	O	O
.26	هل المكملات الغذائية يجرى لها اختبار (جودة وسلامة) من قبل الحكومة أو هيئة الغذاء والدواء بالسعودية؟	O	O	O	O	O	O

27. كيف تقيم نوعية المكملات الغذائية ؟

	ممتاز	جيد	مقبول	لا أعرف
المعادن	O	O	O	O
الفيتامينات	O	O	O	O
الكرياتين	O	O	O	O
الكالسيوم	O	O	O	O
فيتامين ج	O	O	O	O
الحديد	O	O	O	O
حمض الفوليك(فيتامين ب9)	O	O	O	O
المشروبات الرياضية	O	O	O	O

شكراً جزيلاً لإتمام هذه الاستبانة.

Appendix Q

Written Approval from IRB for Objective 4

NC A&T DIVISION OF RESEARCH AND ECONOMIC DEVELOPMENT
1601 East Market Street
Greensboro, NC 27411
(336) 334-7314
Web site: http://www.ncat.edu/~divofres/compliance/irb/index.php
Federalwide Assurance (FWA) #00000013

To: Sulaiman Aljaloud
171 Carver Hall

From: Behavioral IRB

Date: 2/04/2013

RE: Notice of IRB Exemption
Exemption Category: Minor Modification to Previously Approved Research
Study #: 11-0202

Study Title: Understanding the Behavior and Attitude of Professional Athletes in Saudi Arabia toward Dietary Supplements

This submission has been reviewed by the above IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Study Description:

The purpose of this research is to improve the knowledge of dietary supplements use among consumers and professional athletes in Saudi Arabia.

Modification: Minor text changes to survey questions; no change in scope of research

Investigator's Responsibilities:

If your study protocol changes in such a way that exempt status would no longer apply, you should contact the above IRB before making the changes. The IRB will maintain records for this study for three years, at which time you will be contacted about the status of the study. **If you are conducting research in a location other than North Carolina A&T State University, such as an agency, organization, or school, you must provide written approval from an authorized representative (for example, the superintendent's office for research conducted in a public school) prior to conducting your research.**

CC: Salam Ibrahim, Family And Consumer Science

Appendix R

Letters to Whom it May Concern

NORTH CAROLINA
AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

ENERGY & ENVIRONMENTAL
SYSTEMS DEPARTMENT
[illegible]

February 11, 2013

To whom it may concern:

Mr. Sulaiman Aljaloud will be conducting a final survey study between February 27 and March 15, 2013 for his Ph.D. dissertation entitled "Understanding the behavior and attitude of professional athletes in Saudi Arabia toward dietary supplements." This study will be conducted in Riyadh City.

For this study, a letter was sent to the Saudi Arabian Football Federation indicating that the survey will be conducted for at least 10% of players from Al Hilal, Al Nasr, and AL-Shabab teams. During the survey, 27 questions divided into 4 categories will be provided. The two phases of surveying will be compared. For this, post survey results will be collected after conducting workshop/seminar to evaluate the impact of the educational program and to examine the attitudes of professional athletes in Saudi Arabia toward nutritional and dietary intake.

Your aid in encouraging participation in this important study is appreciated.

Sincerely,

Keith A. Schimmel, Ph.D., P.E.
Chair, Energy & Environmental Systems Department

Appendix S

Letters to President of SAFF (Arabic)

بسم الله الرحمن الرحيم

Kingdom of Saudi Arabia
Ministry of Higher Education
King Saud University
Code 034
College of Sport Sciences & Physical Activity
Vice Dean for Graduate Studies and Research

المملكة العربية السعودية
وزارة التعليم العالي
جامعة الملك سعود
رمزها ٠٣٤
كلية علوم الرياضة والنشاط البدني
وكيل الكلية للدراسات العليا والبحث العلمي

Date: ١٤٣٤/٤/٢٠ التاريخ:

No. ٢/٦/١٥٨٧٤٤ الرقم:

سعادة رئيس الاتحاد السعودي لكرة القدم **سلمه الله**

السلام عليكم ورحمة الله وبركاته **وبعد:**

نفيدكم بأن الأستاذ/ سليمان بن عمر الجلعود، أحد منسوبي كلية علوم الرياضة والنشاط البدني والمبتعث لنيل درجة الدكتوراه من جامعة ولاية نورث كارولينا بالولايات المتحدة الأمريكية في "فهم السلوك والموقف من اللاعبين المحترفين في كرة القدم بالمملكة العربية السعودية نحو المكملات الغذائية" بصدد زيارة مدينة الرياض مع عضو هيئة تدريس متخصص من جامعة ولاية نورث كارولينا بالولايات المتحدة الأمريكية لإجراء محاضرة تثقيفية للاعبين في أندية (الهلال،النصر،الشباب) باللغة الإنجليزية والعربية وتشمل المحاضرة **أربعة محاورعن** الإستخدام الصحيح للمكملات الغذائية وبيان الجوانب السلبية والإيجابية لها والإحتياجات الغذائية الأساسية ومدى خطورة المنشطات للاعبين وأخذ رأيهم في إستبانة عن المكملات الغذائية.

- كل نادي يحدد الموعد المناسب للزيارة لإجراء المحاضرة خلال أيام :**الأحد،الاثنين،الثلاثاء،الأربعاء** من ٢٠-٢٤ ربيع الثاني **١٤٣٤** الموافق **٢ — ٢٠١٣,٣,٦** في أي وقت يناسب النادي (صباحاً أو مساءً).
- نأمل توفير قاعة مجهزة لإلقاء المحاضرة (لعرض البوربوينت)
- التنسيق مع الباحث/ سليمان الجلعود عبرالايميل A_soj@hotmail.com أو الجوال **٠٥٥٥٥٥٤٧٤٥٢** لأخذ موعد مناسب لزيارة النادي.

نأمل من سعادتكم التكرم بالموافقة واجراء اللازم حيال تسهيل مهمته في جمع البيانات المطلوبة .

شاكرين لكم تعاونكم ومتمنين ان يكون هذا الموضوع باكورة التعاون العلمي البناء بين كلية علوم الرياضة والنشاط البدني والاتحاد السعودي لكرة القدم .

وكيل الكلية للدراسات العليا

والبحث العلمي

د. أحمد بن محمد الفاضل

P. O. Box 1949, Riyadh 11441 Tel 4698653 Fax.: 4698645
ص.ب ١٩٤٩ الرياض ١١٤٤١ هاتف ٤٦٩٨٦٥٣ فاكس: ٤٦٩٨٦٤٥
www.ksu.edu.sa

Appendix T

Letters to President of SAFF (English)

Kingdom of Saudi Arabia
Ministry of Higher Education
King Saud University
Code 034
College of Sport Sciences and Physical Activity
Vice Dean for Graduate Studies and Research

Date: 20.04.1434H

No: 3.6.158744

President of Saudi Arabian Football Federation

Sulaiman Aljaloud, a part of the staff of King Saud University will be conducting a final survey study between February 27- March 10, 2013 for his dissertation entitled "Understanding the behavior and attitude of professional athletes in Saudi Arabia toward dietary supplements".

For this study, a survey will be conducted for at least 10% of players from Al Hilal, Al Nasr, and AL-Shabab team. During the survey, 27 questionnaires divided into 5 categories will be provided. The two phase of survey will be compared. For this, post survey results will be collected after conducting workshop/seminar to evaluate the impact of the educational program and to examine the attitudes of professional athletes in Saudi Arabia toward nutritional and dietary intake.

This is the first collaboration between King Saud University and Saudi Arabian Football Federation. I hope to work together in near future.

Your participation in this important study is appreciated.

Sincerely,

Dr. Ahmad Alfadhil

Vice Dean for Graduate Studies and Research
College of Sport Sciences and Physical Activity
King Saud University

Appendix U

Educational Program

The researcher conducted an educational program that includes the following activities:

Workshop Objective:

The main purpose of this workshop is to change knowledge, believes, uses and practices toward dietary supplements.

Description:

This workshop is designed to introduce the concepts of dietary supplements. This workshop describes basic information and terminologies related to health supplements. The workshop also examines the science behind common supplements, it will help athletics earn basic knowledge to dietary supplement and choose some plan for good performance. Professional players, in addition to learning the lecture material presented here, also completed survey questionnaires.

Lecture on sports nutrition and Workshop outline:

- Introduction
- Relationship between, good nutrition, hydration and use of dietary supplements and ergogenic aids
- Definitions
    1. Dietary supplements
    2. Sport supplements
    3. Nutritional supplement
- Health benefits of dietary supplements
- Classifications of dietary supplements
- Common types of dietary supplements for Athletes (Supplements for endurance, strength and power, health, and weight reduction)
- Regulations and rules for the use of dietary supplements
- Functional foods
- Negative effects of dietary supplements were explained. Effect of doping and its consequences were also discussed.
- Stores offer supplements in the city of Riyadh, Saudi Arabia including: General Nutrition stores, pharmacies/drug stores, and supermarkets.
- Most commonly available dietary Supplements in the local markets discussed.
- The safety and quality of dietary supplements according International and Saudi FDA standards.

Questions and answers: All the concerned queries regarding the use of dietary supplements were explained by primary investigator to all the players, trainers, physicians, nutritionists, dieticians, trainers, and coaches. The latest research on use and safety of these supplements were also reported.

Hands-on demonstration: Different types of supplements and meal replacement including health bars were displayed. Information on the ingredients and labeling on supplements were provided. Players were informed to contact dieticians, nutritionists, trainer, coaches, and physicians from their respective teams to get the right intake level.

Importance of good nutrition, hydration, and most importantly the use of dietary supplements were discussed among the athletes to optimize their performance.