

Short Communication

FOOD SCIENCE AND NUTRITION

Microbiological quality and safety of dietary supplements sold in Saudi Arabia

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Abstract

The global market for dietary supplements has advanced in recent years capitalizing on the growing awareness of healthy living worldwide. Supplements provide enhanced nutritional levels for daily competitive performance. However, there is a need to explore the quality of dietary supplements as there are few studies related to this area. Therefore, the objective of this study was to determine the microbiological quality of dietary supplements in the local markets of Saudi Arabia. The total bacterial count, coliform, *Escherichia coli*, *Salmonella*, and *Staphylococcus aureus* were included in this analysis. The 80 most popular supplements were tested in this study. Our results showed that microbial contamination was present in only nine products. The microbial level ranged from 1.69–8.43 Log CFU/mL. The higher level of total count (8.43 Log CFU/mL) and *S. aureus* (8.39 Log CFU/mL) were found in supplement glutamine. Amino acids, dynamisan, glucosamine sulfate, glucosaiene, creatine monohydrate, whey protein, and folate acid also showed the presence of bacterial contamination. Our findings suggested that improvements are needed in these supplements which were tested for microbiological contamination. These findings highlight the fact that a review of product safety and quality is becoming increasingly important for consumer health. This will help to ensure safe products available for today's savvy, health-conscious consumer.

Key words: Dietary supplements, Microbiological, Supplement quality, Supplement safety, Bacterial contamination

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 as these products are safe and consumable (Ravindran and Duraisankar, 2012). It is also increasingly evident that consumers are becoming more aware of

functional foods and supplements as part of a balanced diet to ensure good health (Brink et al., 2005). 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. Supplements can be classified according to their function (muscle building, immune boosting, fuel providing), form (pills,

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powders, foods or drinks), availability (over-the-counter, mail order, Internet, multi-level marketing), and scientific merits of claims (well-supported, unsupported, undecided) (Burke et al., 2006). 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 and Kassirer, 1998; Borins, 1998). However, there are very limited published information regarding the quality and safety of these products in Saudi Arabian markets. Therefore, the objective of this study was to determine the microbiological quality and safety of dietary supplements from Saudi Arabia.

Materials and Methods

Our preliminary data (Aljaloud et al., 2010) showed the presence of microbial contamination in dietary supplements collected from Saudi Arabia markets. Based on this study we further determined to analyze the microbiological quality of different dietary supplements available in the market. Eighty of the most popular supplements were collected. Each supplement was picked in duplicate from each store. Samples were then shipped to Greensboro, North Carolina, for microbial quality and product safety analysis.

Microbiological and safety quality test

From each commercial sample, three capsules or tablets were placed in 10 mL sterilized BHI broth and mixed thoroughly. Samples were then 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 non-selective and 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 (Aljaloud et al., 2009).

Results

In this study, we examined the microbiological quality of dietary supplements available in the markets in Saudi Arabia. We collected 80 different common dietary supplements in the city of Riyadh as listed in Table 1. We tested for the presence of total bacterial count, total coliforms, *Staphylococcus aureus*, *Salmonella*, and

Escherichia coli. The population level of bacteria ranged from 1.69 – 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, glucosamine, creatine monohydrate, whey protein, and folate acid also showed the presence of bacterial contamination. In one product called 'pharmaton', we observed low total count (1.73 log) and *S. aureus* (1.69 log) respectively (Table 2).

Table 1. List of dietary supplements included in this study.

Sl. No.	Product Name
1	Creatine
2	Whey Protein
3	Glutamine
4	Multivitamins
5	Pyridoxin 40 (Vitamins B-6)
6	Amino acids
7	Vitamin B-12
8	Caffeine
9	Ginkgo Biloba
10	Thiamine
11	Riboflavin
12	Vitamin B-1 300mg
13	Folate acid 5mg
14	Ephedrine
15	Dynamisan (Vitamins, Minerals and Amino acids)
16	Glutamine L
17	Ribose
18	Antioxidants
19	Vitamin C
20	Ginkgo Biloba Kordel's
21	Vitamin D
22	Vitamin E
23	Iron tablets
24	Calcium tablets
25	Vitamin B-Complex
26	Glucosamine sulfate 750mg
27	Protein powder
28	Vita-C
29	Weight gainers
30	Fish oils
31	Omega 3
32	Omega 6
33	Methylcobal 500mg
34	Ginseng products
35	Ginkgo biloba
36	Neurorubine forte
37	Red Bull energy drink
38	slimming
39	Coenzyme Q10
40	Guarana 250mg (Herbal Supplement)
41	Viforcit 1000mg

42	Guarana	63	Arctic Cod Liver Oil237mg
43	WasserGlucoselcne	64	Folate acid 1mg
44	Creatine Monohydrate 700mg (dietary supplements)	65	Glucosaiene
45	Amino 1000mg (dietary supplements)	66	Chitosan Glucomannan
46	Evit(NaturalAntioxidants)	67	Solotron 50 Plus Dietary Supplement 90 caplets Multivitamin
47	Pyridoxin	68	Gnc Triflex Dietary Supplement 120 Ea
48	Navidoxin	69	Triple Strength Fish Oil Dietary Supplement 120 Softgels
49	pharmaton	70	Glucosamine 1000, Vegetarian Tablets 90
50	Tri_B (Vitamin B1,B6,B12,Folic Acid)	71	Vitamin E 400, Softgel Capsules 100
51	Centram(multivitamin Formula)	72	Natural Brand Lutein, 40mg, Softgel Capsules
52	Vitrite (multivitamin and Minerals)	73	Herbal Plus Grape Seed Extract, 100mg, Vegetarian Capsules
53	Gineosan	74	Gnc Melatonin 3 (Gnc)
54	Methycabal	75	Vitamin D
55	Vito-p (multivitamin and Minerals)	76	Green Tea Extract
56	Redoxon	77	Spirulina
57	Joint care (Oil)	78	glucosamine chondroitin joint health
58	Joint care (Powder)	79	Dynamic Health
59	Glucosamine sulfate 1000mg	80	Calcium Complete with Magnesium, Softgel
60	Dynamisan with Ginseng (Complete dietary supplements)		
61	Whey Protein isoates		
62	Flax Oil 250mg Cold-Pressed&Unrefined dietary supplements		

Table 2. Bacterial population (Log CFU/mL) present in different supplements.

Product	Bacterial population (Log CFU/mL)	
	Total count	<i>S. aureus</i>
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

Discussion

Quality assurance and standardization are two important key factors in the food products development. To determine 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).

Okunlola et al. (2007) studied the microbial quality of different medicinal products in Southwestern Nigeria which included 21 different brands of herbal medicine. This shows that among the tested products, microbial load varied considerably. Over forty-seven percent of the samples showed contamination with *E. coli*; 33% with *Salmonella*; 71.4% with *Staphylococcus aureus*; and 57.1% were contaminated with fungi. 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 and Duraisankar, 2012). In our study, out of eighty dietary supplement samples tested, nine products showed the presence of coliform, *E. coli*, *Salmonella* and *Staphylococcus aureus*. Hamilton-Miller et al. (1999, 2002) reported that out of 30 probiotic supplements tested, 18 contained species other than those on label indicating poor standard of supplements contrary to the claim. Authors have also reported the presence of potentially pathogenic species such as *E. faecium*. Similarly, Hamilton-Miller et al. (1999) and Barros et al. (2002) have found pediocci as contaminants in several probiotic supplements. The presence of such bacterial strains could increase the risk of bacterial outbreaks. Therefore, these results along with our findings emphasize for the need to improve the quality of dietary supplements sold in the markets.

Conclusions

From this study we can conclude that there are some contaminations in supplements sold in Saudi Arab markets. The presence of microorganisms (*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.

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