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Role of Nutraceuticals in Health Promotion

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Abstract: Nutraceuticals are food product that provides health as well as medical benefits; including the prevention and treatment of disease. Few nutraceuticals are being used as pharmaceutical and a number of other being used and purchased by the general public as self-medication. Such products may range from dietary supplements to genetically engineered foods, herbal products and processed foods. Clinical research on nutraceutical product is going on for integrating and assessing information. The main aim of this article is to explore and discuss that a number of nutraceuticals can actually treat or prevent underlying causes of disease. This article outlines nutraceuticals with their therapeutic applications, adverse effects and interaction.

Keywords: Nutraceuticals, functional food, dietary supplement, health promoters.

INTRODUCTION

The term "Nutraceutical" was first coined by Dr. Stephen L. Defelice as "a product isolated or purified from foods and sold in medicinal forms. They have physiological benefit"¹

Nutraceutical is a combination of 2 words

- 1. Nutrition and
- 2. Pharmaceutical.

Nutraceuticals are food product that provides health as well as medical benefits; including the prevention and 1. treatment of disease. Phytochemicals and antioxidants 2. are two specific types of nutraceuticals. Research has 3. proved that foods with phytochemicals may help to

provide protection from diseases such as cancer, diabetes, heart disease, and hypertension, e.g. carotenoids found in carrots. Antioxidants may be helpful in avoiding chronic diseases, by preventing oxidative damage in our body.² Over the last 20 years, numbers of Nutraceuticals are available for self-medication or for sale.³

There has been a boom in sale of Nutraceutical because of -

- Adverse effects of pharmaceuticals
- Increased tendency of patients for self-medication
- Aging population e.g. arthritis

Figure 1-Demand of Nutraceuticals





Fig 2.

CLASSIFICATION OF NUTRACEUTICALS-

Nutraceutical is a term used to describe product obtained from food sources that provides extra health benefits as well as basic nutritional value present in food. There are different types of products that comes under the class of nutraceuticals.⁵

DIETARY SUPPLEMENTS: A dietary supplement is a product that contains nutrients derived from food products .The "dietary ingredients" present in these products are: metabolites, vitamins, minerals, vitamins, herbs, and amino acids.

FUNCTIONAL FOODS: Functional foods are designed foods which provide enriched foods close to their natural state to consumer, rather than manufactured dietary supplements in liquid or capsule form. A process of making enriched food is called Nutrification. Functional foods provide required amount of vitamins, fat, carbohydrate, amino acid etc | to body.Established requirement that functional food should possess are-

(1) they should be in their naturally-occurring form,

(2) they should be an essential part of our daily diet,

(3) should regulate a biological process in hopes of preventing or controlling disease.⁶

RELATIONSHIP BETWEEN NUTRACEUTICALS, FOOD AND MEDICINE-

Figure 2 shows the relationship between nutra - ceuticals, food and medicine.

Pharmaceuticals are usually classified as medicines by law.

- 1. Herbal remedies may be classed as medicines because of their perceived risk with selfmedication e.g.-Digitalis
- 2. Functional food are closely related to nutraceuticals consumed as a part of normal diet, e.g. Carotenoid
- 3. Vitamins are classed as medicine but are freely available.⁴

EXAMPLES OF NUTRACEUTICALS CURRENTLY AVAILABLE IN MARKET-

- 1. FORTIFIED CEREALS-various cereals contain vitamins and minerals.
- 2. VITAMIN AND MINERAL SUPPLEMENTS-Vitamin A (Beta- Carotene),
- 3. ADDITIONAL SUPPLEMENTS-supplements other than vitamin and minerals which have beneficial effect on health for example-cod liver oil, primrose oil, glucosamine, garlic etc.
- 4. ENERGY DRINKS AND TABLETS-Tropicana, Minute Maid Pulp, Frooti
- 5. FOODS TO REDUCE CHOLESTEROL LEVELS-Abcor by Nutri-pharma, claimed to reduce cholesterol by 15-20% in 4 months.
- 6. PROTEIN POWDER -Protinex(Dumex),GRD(Zydus), B.Protein (British Biologicals)
- 7. PRO-BIOTICS-Bacteria containing foods that believed to improved health. For example-YAKULT; contains 6.5 million lactobacillus casei shirota, which is thought to improve gut health.^{4,5}
- 8. SPORTS PRODUCTS- Glucon-D (Heinz), Glucose D (Dabur)

SOURCE, MANUFACTURE AND ANALYSIS OF MAJOR NUTRACEUTICALS-

Most of nutraceuticals are natural products and obtained from plants and animals.

Example-lycopene extracted from plant, carnitine, creatine and carotenoids produced by fermentation for example-coenzyme Q10 and S-adenosyl glycoside

- 1. A number of nutraceuticals have GRAS status as defined by FDA, and increasingly manufacturers gain GRAS certification for product. A list of GRAS is published on the internet.
- 2. Nutraceuticals used same analytical procedure for identification and quantification as pharmaceuticals.³

Nutraceuticals	Source	Extraction/fermentation/ manufacturer	Analytical technique
Glucosamine. ^{8,3}	Bovine trachea, shellfish	Chitin acid hydrolysis, Fish shell enzymes hydrolysis	HPlc
Methylesulfonylmethane ⁹	Meat, milk	Peroxide oxidation of DMSO	gc
Coenzyme Q10 ^{10,3}	Common food	NaOH digest of hearts/livers after H2S treatment, fermentation	HPLC-Electro- chemical detector
Carnitine ^{11,3}	Heart, skeletal muscles	Chiral synthesis from butyrolactone	Chiral HPLC
Flax lignans ^{12,3}	Linum usitatissimum	Supercritical extraction co2	CCC
Resveratrol ^{13,3}	Red wine,polygonum,ca psidatum root	Mid polarity solvent extraction	CE,GC- MS,ELISA
Grape seed ^{14,3}	Vitis vinifera	Water/ethanol extraction	Supercritical extraction
Lycopene ^{15,3}	Foods including tomato, green algae	Tamato extraction, chemical symthesis	HPLC

 Table-1 Sources of Nutraceuticals

METABOLISM, BIOAVAILABILITY AND PHARMACOKINETICS OF NUTRACEUTICALS-METABOLISM DATA-

Metabolites play very important role in activity of particular Nutraceutical. List of nutraceuticals and their metabolites is given in table 2.

Dietary level have impact on physiological level .e.g. except for food containing Q10,Carnitine,soy there is little chance of dietary supplement increasing physiological level.

Some Nutraceutical do not show physiological level but consumption with other specific food e.g.-lycopene, tea or soy, increased physiological level.

Nutraceuticals	Physiological	Dietary Level	Metabolite	
	Level			
Glucosamine ^{8,16}	-	-	Glucosaminic acid	
Methylsulfonyl- methane ⁹	4mg/person	minimal	Methionine	
Methylsulfonyl- methane ⁹	4mg/person	minimal	Coenzyme Q9	
Coenzyme Q10 ¹⁰	0.5micro gm/ml	3-5mg/day	6-(5',8',6')carboxylated derivatives	
Coenzyme Q10	0.5micro gm/ml	3-5mg/day	6-hydroxymelatonin	
Carnitine ¹¹	9mg/L	3-97mg/100gm meat	acetylcarnitine	
Carnitine	9mg/L	3-97mg/100gm meat	Butyrobetaine	
Flax lignans ¹²	Diet dependent	Diet dependent	SDG-enterolactone	
Resveratrol ¹³	-	0.1-2.3 mg/L	Piceartanol	
Resveratrol	-	0.1-2.3 mg/L	Piceartanol plus another tetra hydroxystilbene	
Resveratrol	-	0.1-2.3 mg/L	dihydroresveratrol	
Grape seed ¹⁴	-	-	Catechin/proanthrocyanidin metabolites	
Lycopene	-	2-5 mg/day	5,6 dihydroxy 5,6 dihydrolycopine	
Lycopene	-	-	Lycopene epoxide	
Soy isoflavones	-	15-20mg/day	18-demethylated	

Table-2 Metabolism data of Nutraceuticals

Nutraceutical	Dose	Bioavailability	Increased serum level
Glucosamine ¹⁶	7.5gm	26%,44% incorporation in	-
	_	to globulli	
Co-enzyme Q 10	30 mg	-	3.5% increase in serum level at 6 hours
Co-enzyme Q 10	30 mg	-	2.7-6 times normal level
Carnitine	2gm/12 hr	14-16 %	-
Carnitine	0.5-0.6 gm	14-18 %	43%
Resveratrol	50gm/Kg	38%	-

BIOAVILABILITY DATA- Bioavailability study of number of nutraceuticals is given in table3 **Table -3 Bioavailability data of Nutraceutical**

PHARMACOKINETIC DATA-

It is important to know about optimum dosage levels and frequency of administration of nutraceutical.the major pharmacokinetic parameter given in table **4**

Table-4 Pharmacokinetic data of Nutraceutical ¹²

Nutraceutical	No of dose	Dose	Cmax	t1/2	AUC
Glucosamine	8 beagles	1500 mg	12.7 µg/ml	1.52	17.8µg.hr/ml
Co-enzyme Q	9	180mg	1.03µg/ml	-	57.67µg.hr/ml
Caritine	15	2gmevery 12 hr	12.4 µg/ml	0.79	377Pg.hr/ml
Flax lignans	12	0.9 gm/kg	-	4.4	280µg.hr/ml

NUTRACEUTICAL AND HEALTH

1. JOINT DISEASE

Joint diseases affect people of all ages mainly the elderly. Main joint diseases are:-

- Osteoarthritis- Degenerative damage and loss of the articular cartilage of the joint due to loss of protein substance between the bones of joints.
- Rheumatoid Arthritis- Rheumatoid arthritis (RA) is a chronic, inflammatory disorder that may affect many an organs nd tissues but principally affect joints.In this condition inflamatory synovitis produced that causes distruction of articular cartilage.

Nutraceutical use-

A-Glucosamine and Chondroitin-

- **Glucosamine** is a precursor to a molecule called a glycosaminoglycan-this molecule is used in the formation and repair of cartilage.¹⁹
- Source-bovine or calf cartilage
- Glucosamine sulphate in several European countries used as first line of treatment for arthritis. There side effects and contraindications are less but diabetics need to be careful as glucosamine might have an effect on insulin resistance. Glucosamine sulphate stimulates the production of hyaluronic acid in joint fluid. Hyaluronic acid relieves pain and improves mobility by repairing damaged cartilage. In vitro experiment of Glucosamine has shown a dose

dependent increase in proteoglycan after administering it.²⁰

- It is marketed usually as hydrochloride or sulfate salt.Both compound have anti inflammatory effects.Combination of Glucosamine and chondrotin are available.¹⁹
- **Chondroitin** is the most abundant glycosaminoglycan in cartilage and is responsible for the resiliency of cartilage.^{19,21}

B-Methylsulfonyl Methane-

Methylsulfonyl Methane (MSM) is sold as nutritional and dietary supplement often used in combination with glucosamine and chondroitin for helping to treat or prevent.²²

MSM is the oxidized form of dimethyl sulfoxied; a natural organic form of sulfur. Both this compound used for pain and inflammation.MSM has advantage over DSMO as it is odourless and doses not cause skin irritation. MSM provide source of sulfur for the formation of the cartilage matrix or the antioxidant system.³

2. CARDIOVASCULAR DISEASE –

Cardiovascular disease, affect the heart and circulatory system. In cardiac heart disease, atherosclerotic plaques form on the inner surface of arteries, which narrow the lumen and reduced the blood flow.

There are many Nutraceutical which are beneficial in the prevention or symptom reduction of CHD. For example - soy protein, isoflavonoid and flax lignan.

A-Black and Green Tea-

Tea contains catechin derivative, amino acid theanine (shown reduced in blood pressure in hypertensive rats. Black and green tea both show equal activity in total plasma antioxidant status after single dose. But some study show green tea to be more effective than black. Tea polyphenols have anti-inflammatory, antithrombotic and antiplatelet properties and effective in lowering risk of developing CHD and MI.³

B- Soy-In 1999, FDA approved permission for manufacturing of soy foods. At least 25 gm administration of soy protein per day reduced risk to developing CHD.

C-Flaxseed and Fish Oil- is also very beneficial in cardiovascular heart disease. Flax seed contain lignans and fiber which involve in cardiac protection.

Table-5-	Nutraceutical	used in	various	diseases ³
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Disease	Nutraceuticals		
Eye health	Lutein and Zeaxanthin		
Mental health	Phosphatidylserine		
	Docosahexaenoic		
	Soy isoflavones		
Sleep	Melatonin		
enhancement			
Cancer	Tea,Lycopene,flaxseed,coenzyme		
prevention	Q10		
Bone health	Melatonin,L-carnitine		
Skin health	Tea, soy isoflavones,coenzyme		
	Q10,Glucosamine,melatonin		
Oral health	Pycnogenol,coenzyme Q10		

EFFECTIVENESS AND SAFETY-REGULATION-

Nutraceutical products also required same level of scrutiny and regulation as "dietary supplements".

Companies which involved in nutraceuticals production invest more on scientific research to substantiate their manufacturing standards, products by keeping the view in mind consumer benefits and products from "dietarv differentiate their supplements". international Now а day many companies move within the industry, professional organizations, academia, and health regulatory agencies to add specific legal and scientific criterion to the definition and standards for nutraceuticals.^{23, 24}

BIOAVAILABILITY-

Bioavailability is "absorption rate" of a supplement product. In development of effective nutraceutical products bioavilability play important role. The bioavailability of substance which is in natural state will be more as comparison manufactured product.

SAFETY AND EFFICACY-

Nutraceuticals hold great potential, as an alternative to substance obtained by plant. Yet, some time they also cause haemful effect as seen with ephedrine, a widely used botanical ingredient in weight-loss products..Now a days peoples are more conscious about there health and these products offer the promised health benefits.But danger is associated with some product due to lake of solid information about intraction and side effect..²⁵

LABELING AND HEALTH CLAIMS-

Proper labeling and health claims are very important for nutraceutical products because they alert consumers. Food and food substances can qualify for health claims only if they meet FDA requirements.

The following are the FDA-approved health claims showing a positive relationship between a certain compound and reduced risk of specific disease(s):

Potassium	High blood pressure and stroke	
Plant sterol and plant stanol esters	Coronary heart disease	
Soy protein	Coronary heart disease	
Calcium	Osteoporosis	
Fiber-containing grain products, fruits and vegetables	Cancer	
Folic acid	Neural tube birth defects	
Dietary soluble fiber, such as that found in whole oats and psyllium seed husk	Coronary heart disease	
Dietary sugar alcohol	Dental caries (cavities)	

Dietary fat	Cancer
Dietary saturated fat and cholesterol	Coronary heart disease
Sodium	High blood pressure

The remaining three FDA-approved health claims are based on diets low in "negative" nutrients in food, such as sodium. These health claims shows a relationship between certain compounds and an increased risk of disease(s):

Health claims are among the various types of claims allowed in food labeling. They show a relationship between a nutrient (and other substances in a food) and a disease or health-related condition.

CONCLUSION-

Nutraceutical is growing health care industry in India. Nutraceuticals is playing important role in developments of future therapeutics but it depends on control of purity, efficacy and safety. Nutraceutical

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products are used in prevention of disease not in cure of disease. Nutraceutical Products is collaborative research effort of pharma, food and chemistry.As healthcare industry is growing in India, growth of nutraceutical is also increase because people want treat their desease by improving their health with the help of Fast Moving Healthcare Goods. India is significant Player because it has extensive markets and facilities like rich bio-diversity, world-class R & D facilities, resources, qualified human, and varied raw materials aspects that provides edge our country. Now "nutraceutical a day may keep the doctor away" replace the old proverb "an apple a day will keep the doctor away" Consumers are turning massively to food well supplements to improve being where pharmaceuticals fail.

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