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Nutraceuticals is Used as Food or Medicines

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ABSTRACT: Nutraceutical is the hybrid of 'nutrition' and 'pharmaceutical'. Nutraceuticals, in broad, are food or part of food playing a significant role in modifying and maintaining normal physiological function that maintains healthy human beings. The principal reasons for the growth of the nutraceutical market worldwide are the current population and the health trends. The food products used as nutraceuticals can be categorized as dietary fiber, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants and other different types of herbal/ natural foods. These nutraceuticals help in combating some of the major health problems of the century such as obesity, cardiovascular diseases, cancer, osteoporosis, arthritis, diabetes, cholesterol etc. In whole, 'nutraceutical' has leads to the new era of medicine and health, in which the food industry has become a research-oriented sector.

KEYWORDS: Dietary fiber, Probiotics, Prebiotics, Polyphenols, Spices, Human diet.

I. INTRODUCTION

Nutraceutical is a term derived from "nutrition" and "pharmaceutics." The term is applied to products that are isolated from herbal products, dietary supplements (nutrients), specific diets, and processed foods such as cereals, soups, and beverages that other than nutrition are also used as medicine. In the US, the term "nutraceutical" products are regulated as drugs, food ingredients and dietary supplements. The term is not defined the same in different countries, but is usually defined as a product isolated from foods that is generally sold in medicinal forms not usually associated with food. A nutraceutical product may be defined as a substance, which has physiological benefit or provides protection against chronic diseases.[1] Nutraceuticals may be used to improve health, delay the aging process, prevent chronic diseases, increase life expectancy, or support the structure or function of the body.[2] Nutraceuticals, in contrast to pharmaceuticals, are substances, which usually have not patent protection. Both pharmaceutical and nutraceutical compounds might be used to cure or prevent diseases, but only pharmaceutical compounds have governmental sanction.[3]

II. NUTRACEUTICALS

The concept of "nutraceutical" arose first in the survey from U.K., Germany and factors to achieve a good health (Pandey et al. 2010). The term "nutraceutical" was coined from "nutrition" and "pharmaceutical" by Stephen De Felice, founder and chairman of the Foundation for Innovation in Medicine (FIM), Cranford, NJ in 1989. (Maddiet al.2007; brower 1998).
(a) the food industry,
(b) the herbal and dietary supplement market,
(c) pharmaceutical industry, and
(d) the newly merged pharmaceutical/agribusiness/nutrition conglomerates.

It may range from isolated nutrients, herbal products, dietary supplements and diets to genetically engineered "designer" foods and processed products such as cereals, soups and beverages. Nutraceuticals covers most of the therapeutics areas such as anti-arthritic, cold and cough, sleeping disorders, digestion and prevention of certain cancers, osteoporosis, blood pressure, cholesterol control, pain killers, depression and diabetes [4].

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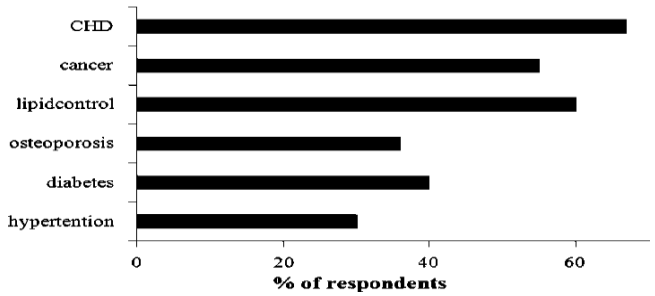

Fig:1 Therapeutic areas covered by nutraceutical products

Advantages of Nutraceuticals:

1. Reduced side effects.
2. Increases health benefits.
3. Provide dietary supplements naturally.
4.

Disadvantages of Nutraceuticals:

1. **Bioavailability**: Nutraceuticals are being eliminated from the body and do not provide any medicinal benefit with poor bioavailability.
2. **Impact of Placebo Effect**: Consumers may not use nutraceuticals accurately for healing illness interaction with prescription medicines or the effect they have on existing medical conditions. s, when the body is often able to recover on its own.

The food sources used as nutraceuticals are all natural and can be categorized as:

a. Dietary Fibre
b. Polyunsaturated fatty acids
c. Probiotics
d. Prebiotics
e. Antioxidants And vitamins
f. Spices
g. Polyphenols

A. DIETARY FIBRES

Dietary fibers is the food material, more precisely the plant material that is not hydrolyzed by enzymes secreted by the digestive tract, but digested by microflora in the gut. Dietary fibers mostly include non-starch polysaccharides (NSP) such as celluloses, hemicelluloses, gums and pectin, lignin, resistant dextrin and resistant starches. Foods rich in soluble fiber include fruits, oats, barley and beans. The level of dietary fiber in certain foods has been illustrated in Table 1.[5] Chemically dietary fiber means carbohydrate polymers with a degree of polymerization not lower than 3, which are neither digested nor absorbed in the small intestine.

Based on their water solubility, dietary fibers may be divided into two forms: -

1. Insoluble dietary fiber (IDF), which includes celluloses, some hemicelluloses and lignin which is fermented to a limited extend in the colon.[5]

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2. Soluble dietary fiber (SDF), which includes β-glucans, pectin, gums, mucilage and hemicelluloses that are fermented in the colon.

The IDF and SDF compounds are collectively known as non-starch polysaccharides (NSP)

Product	AOAC (g/100 g)[a]
Apples (with skin)	2.0
Bananas	1.9
Carrots (boiled)	3.1
Baked beans	4.2
Cabbage	2.0
White Bread	2.0
Brown Bread	4.5
Wholemeal Bread	7.4

[a] excludes fructans

[Source-AOAC values *CRC Handbook of Dietary Fibre in Human Nutrition,* 2nd edition (1993)]

Table: 1 Levels of dietary fibers in food

B. POLYUNSATURATED FATTY ACIDS (PUFA'S)

PUFAs are also called "essential fatty acids" as these are crucial to the body functional and are introduced externally through the diet. PUFAs as have two sub divisions:

Omega-3(n-3)-fatty acids and Omega -6 (n-6) fatty acids.

"The major omega-3-fatty acids are α-linolenic acid (ALA), eicosapentanoic acid (EPA), docosahexanoic acid (DHA) [8,9]. ALA is the precursor of EPA and DHA. EPA and DHA are found mainly in fatty fishes such as mackerel, salmon, herring, trout, blue fin tuna and in fish-oils. Principal sources of ALA are mainly flaxseed, soybeans, canola, some nuts (EX: walnuts) and red/black currant seeds (Institute of Medicine 2002).[6]

C. PREBIOTICS

The history of probiotics dates back as far as the first intake of fermented milks, over 2,000 years ago. The scientific interest in this area boosted from the work of Metchinkoff (1907) to transform the toxic flora of the large intestine into a host-friendly colony of Bacillus bulgaricus. A probiotic can be defined as live microbial feed supplement, which when administered in adequate amounts beneficially affects the host animal by improving its intestinal microbial balance (Food and Agricultural Org. 2001; Fuller 1992).

Probiotics generally include the following categories of bacteria: -

Lactobacilli such as L. acidophilus, L. casei, L. delbrueckii subsp. bulgaricus, L. brevis, L. cellobiosus.[7]

1. Gram-positive cocci such as Lactococcus lactis, Streptococcus salivarius subsp. thermophilus, Enterococcus faecium
2. Bifidobacteria such as B. bifidun, B. adolescentis, B. infantis, B. longum, B. thermophilum.

D. PREBIOTICS

Prebiotics are dietary ingredients that beneficially affect the host by selectively altering the composition or metabolism of the gut microbiota (Macfarlane et al.2006; Gibson and Roberfroid 1995). These are short-chain polysaccharides that have unique chemical structures that are not digested by humans; in particular fructose-based oligosaccharides that exist naturally in food or are added in the food [8].

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E. ANTIOXIDANT VITAMINS

Vitamins like vitamin C, vitamin E and carotenoids are collectively known as antioxidant vitamins. These vitamins act both singly as well as synergistically for the prevention of oxidative reactions leading to several degenerative diseases including cancer, cardiovascular diseases, cataracts etc. These vitamins are abundant in many fruits and vegetables and exert their protective action by free-radical scavenging mechanisms. Vitamin E which comprises of tocopherols together with tocotrienols transfer hydrogen atom and scavenge singlet oxygen and other reactive species thus protecting the peroxidation of PUFA within the biological membrane and LDL [10].

They have more recycling ability and are a better inhibitor of liver oxidation. Vitamin E and selenium has a synergistic role against lipid peroxidation. Vitamin C, better known as ascorbic acid donates hydrogen atom to lipid radicals, quenches singlet oxygen radical and removes molecular oxygen [10].

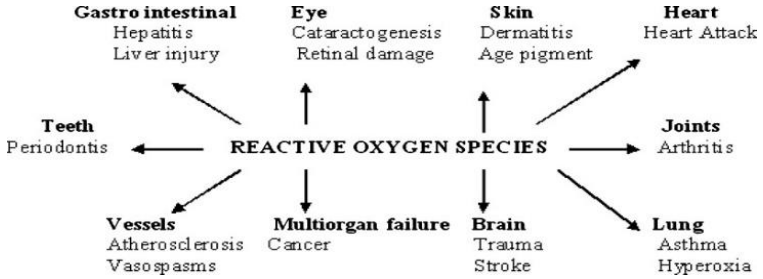

Fig:2 clinical conditions involving relative oxygen species

F. POLYPHENOLS

Polyphenols form a large group of phytochemicals, which are produced by plants as secondary metabolites to protect them from photosynthetic stress, reactive oxygen species. There are approximately 8,000 different classes of polyphenols, the most important being flavonols, flavones, flavan-3-ols, flavanones and anthocyanins.

The highly branched phenylpropanoid pathway synthesizes majority of polyphenols. The most commonly occurring polyphenols in food include flavonoids and phenolic acids. Dietary polyphenols are of current interest because substantial evidence in vitro have suggested that they can affect numerous cellular processes like, gene expression, apoptosis, platelet aggregation, intercellular signaling, that can have anti-carcinogenic and anti-atherogenic implications as illustrated in Fig 3. [11].

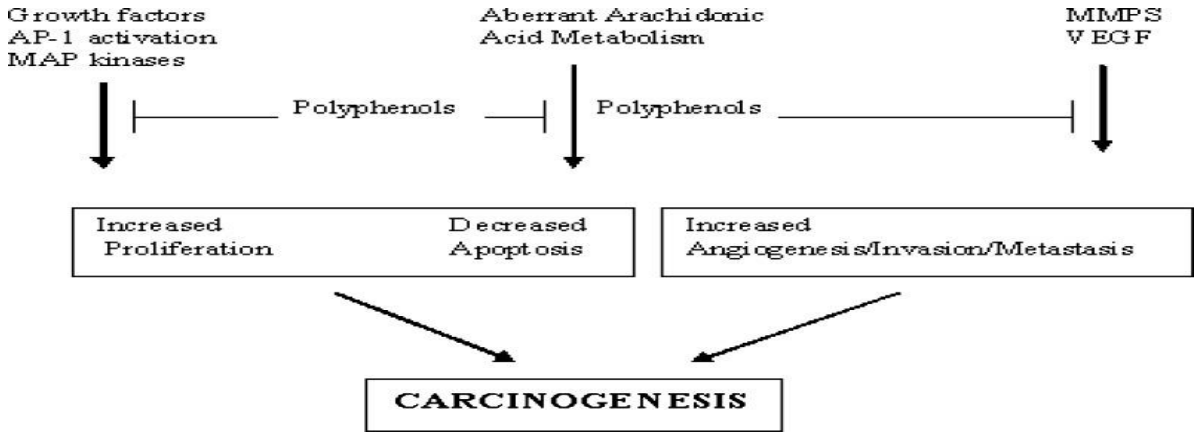

Fig:3 Proposed mechanistic scheme for prevention of cancer by dietary polyphenol.

"These apart, polyphenols also possess antioxidant, anti-inflammatory, anti-microbial, cardioprotective activities and play a role in the prevention of neurodegenerative diseases and diabetes mellitus. Polyphenols are mostly acknowledged for their antioxidant activities on the basis of their structural chemistry. Polyphenols have been shown to be more effective antioxidants in vitro than vitamin E and C on a molar basis [11].

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G. SPICES

Spices are esoteric food adjuncts that are used for thousands of years to enhance the sensory quality of foods. The quantity and the variety of the spices consumed in the tropical countries are particularly extensive. These impart characteristic flavor, aroma, or piquancy and colour to foods, stimulating our appetite as well as modify the texture of food. Recent research reveals that dietary spices in their minute quantities has an immense influence on the human health by their antioxidative, chemopreventive, antimutagenic, anti-inflammatory, immune modulatory effects on cells and a wide range of beneficial effects on human health by the action of gastrointestinal, cardiovascular, respiratory, metabolic, reproductive, neural and other system. Some of these functional aspects of the spices are mentioned in the Fig-4. [12,13,14]

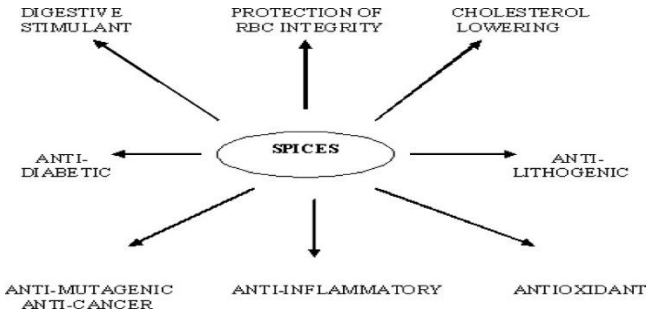

Fig: 4 Summary of potential health benefits of species

METHODS

The recently published papers about different aspects of nutraceuticals as alternative for pharmaceuticals were searched using scientific sites such as Medline, PubMed and Google Scholar. The used terms included nutraceutical and allergy, alzheimer, cardiovascular, cancer, diabetes, eye, immune, inflammatory or Parkinson.

A. ALLERGY AND NUTRACEUTICAL

Allergy is a hypersensitivity disorder of the immune system. An allergic reaction usually occurs when a person's immune system reacts to normally harmless substances. Allergic reactions are distinctive because of excessive activation of certain white blood cells called mast cells and basophils by a type of antibody called immunoglobulin E. This reaction results in an inflammatory response which can range from uncomfortable to dangerous [15].

B. ALZHEIMERS DISEASE AND NUTR ACEUTICALS

Alzheimer's disease (AD) is the most common form of dementia. There is no cure for the disease and eventually leads to death. Most often, AD is diagnosed in people over 65 years of age, [15] although the less-prevalent early-onset Alzheimer's can occur much earlier. There were 26.6 million sufferers worldwide in 2006 and is predicted to affect 1 in 85 people globally by 2050. Women are more affected in comparison to men, at a ratio of almost 2:1. Several lines of evidence suggest that oxidative stress might be related to a number of neurodegenerative disorders including AD [16].

C. CARDIOVASCULAR DISEASE AND NUTRACEUTICALS

Worldwide, the prevalence of CVD and the researches in this area is increasing. CVD is a term which is used for disorders of the heart and blood vessels and includes coronary heart disease (heart attack), peripheral vascular diseases, cerebrovascular disease (stroke), hypertension, heart failure, and so on. It is believed that low intake of vegetables and fruits is associated with a high mortality in CVD. Majority of the CVD are preventable. Many studies have reported a protective role for a diet rich in vegetables and fruits against CVD [17].

D. CANCER AND NUTRACEUTICALS

Cancer has emerged as a major public health problem in developing countries. According to the World Cancer Report the cancer rates are increasing and it would be 15 million new cases in the year 2020 that is, a rise in 50%. A healthy lifestyle and diet can help in prevention of cancer. Carotenoids are a group of phytochemicals responsible for different colors of the foods. They have antioxidant activities and effective on cancer prevention. [17]

E. DIABETES AND NUTRACEUTICALS

The most common form of diabetes is type 2 diabetes with 95% prevalence and is associated with obesity. Although various drugs for prevention and treatment of diabetes have been introduced, however, globally the total number of people

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with diabetes with various causes is increasing [18]. Diabetes, not only imposes considerable economic burdens on individual patients and their families but also places substantial economic burdens on society [18].

F. EYE DISORDER AND NUTRACEUTICALS

Healthy lifestyle with a diet containing foods rich in antioxidants, such as n−3 fatty acids, lutein and zeaxanthin appears beneficial for age-related macular degeneration (AMD). High content of polyphenolic flavonoids in nutraceuticals have been shown to possess antioxidant activity. Herbs or herbal extracts, such as green tea, Allium spp., Vitamins C and E, polyphenols, carotenoids (mainly lycopene and β-carotene), and coenzyme Q10 possess antioxidant properties and effective in AMD [18]. Astaxanthin is an important naturally occurring carotenoid in the marine world such as sea bream, salmon, trout, and shrimps.

G. INFLAMMATION AND NUTRACEUTICALS

Inflammation is characterized by swelling, pain, redness and heat, and is the response of body tissues to irritation or injury. Nutraceuticals that their influence on osteoarthritis has been tested are ginger, soybean, unsaponifiable, glucosamine, chondroitin, S-adenosylmethionine. Although they are safe and well tolerated, however, the results are hampered by heterogeneity of the studies and inconsistent results. Vitamins C and D are micronutrients for which evidence of benefit exists. Cat's claw is a potent anti inflamatory agent [20].

H. OBESITY AND NUTRACEUTICALS

Obesity is, nowadays, a global public health problem with about 315 million people involved. Obesity is a risk factor for many disorders such as hypertension, congestive heart failure, angina pectoris, hyperlipidemia, respiratory disorders, osteoarthritis, cancer, renal vein thrombosis and reduced fertility [21]. One of the primary causes of obesity is the increased availability of high-fat, energy-dense foods. There is a very high prevalence of obesity globally and hence nutrition and exercise play a key role in its prevention and treatment. Nutraceutical interventions are currently being investigated on a large-scale basis as potential treatments for obesity and weight management [21].

III. CONCLUSIONS

Nutraceuticals might be defined as substances that have physiological benefits or provide protection against chronic diseases. Nutraceuticals may be used to improve health, delay the aging process, prevent chronic diseases, increase life expectancy, or support the structure or function of the body. Nowadays, nutraceuticals have received considerable interest due to potential nutritional, safety and therapeutic effects. Recent studies have shown promising results for these compounds in various complications. In the present review much effort has been devoted to provide their diseases modifying indications related to oxidative stress including allergy, Alzheimer, cardiovascular, cancer, diabetes, eye, immune, inflammatory and Parkinson's diseases as well as obesity.

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