



A REVIEW ON NUTRACEUTICALS & IT'S ROLE IN DISEASE PREVENTION

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ABSTRACT

Nutraceuticals have received considerable interest because of their presumed safety and potential nutritional and therapeutic effects". The concept of nutraceuticals was started from the survey in U.K., Germany and France which concluded that diet is rated more highly by consumers than exercise or hereditary factors for achieving good health. In recent years there is a growing interest in nutraceuticals which provide health benefits and are alternative to modern medicine. By using nutraceuticals, it may be possible to reduce or eliminate the need for conventional medications, reducing the chances of any adverse effect. Nutraceuticals often possess unique chemical actions that are unavailable in pharmaceuticals. The entire world is fighting diseases characteristic of the modern age such as obesity, osteoporosis, cancer, diabetes, allergies, and dental problems. With a global increase in the prevalence of obesity, both nutrition and exercise play key roles in its prevention and treatment. Nutrients, herbs and dietary supplements are major constituents of nutraceuticals which make them instrumental in maintaining health, act against various disease conditions and thus promote the quality of life. Using food products to promote health and cure disease is renowned. Currently most of the drug molecules available in the formulations were anciently used in their crude form.

KEYWORDS: Nutrient, Disease and treatments, Future food, Medicine.

INTRODUCTION

The term nutraceutical was defined by the nutritionist and pharmacist Stephen DeFelice, president of the Foundation of Innovation Medicine, in 1989. According to him, "a nutraceutical is defined as a food, or part of a food, that provides medical or health benefits, including prevention and/or treatment of a disease".^[1,2] Specifically, nutraceuticals are formed from active compounds obtained from plant foods (such as phytocomplexes) or from foods of animal origin, which are concentrated and provided in the appropriate pharmaceutical form, and also have a pharmacological effect and nutritional value.^[3] These can be used effectively to prevent and even cure some diseases when their safety is demonstrated, have a greater bioavailability, and have clinically proven health effects.^[4] In the case of Health Canada, it defines the term nutraceutical as "a product prepared from food, but sold in the form of pills, powder or other medicinal forms, which are generally not associated with food".^[5]

Before the appearance of nutraceutical concept, the consumption of fruits and vegetables was related in a preventive and protective way with a lower risk of suffering from chronic and degenerative diseases.^[6] These discoveries were and are correlated with the

diversity of plants and their richness in bioactive compounds, natural substances capable of modulating one or more metabolic processes, thus promoting health conditions.^[7,8] These substances, called phytochemicals, have allowed the discovery and the development of numerous medications especially for the treatment of diseases such as cancer, infectious diseases, cholesterolemia, and immunological disorders among others.^[9]

In the literature, other terms such as phytochemicals, herbs, spices, botanical medicines, dietary supplements, and secondary metabolites can be found, which can be mistaken for nutraceuticals.^[10] In the case of dietary supplements, these are known as "concentrated sources of nutrients or other substances with a physiological or nutritional effect to complement the diet".^[11] Nutraceuticals can be found in various forms (isolated compounds, dietary supplements, or whole foods). Therefore, all nutraceuticals are not dietary supplements, and all dietary supplements are not nutraceuticals.^[10] The difference between nutraceuticals and functional food is that the former are bioactive ingredients of natural origin and obtained from different food matrices, while the latter is considered any fresh or processed food that ensures a healthy effect and/or prevents diseases in

addition to having a nutritional function.^[12] Therefore, a food is functional when it has nutraceutical ingredients.

CLASSIFICATION OF NUTRACEUTICALS

1. Nutraceuticals Based on Food Availability

a. Traditional Nutraceuticals

These classes are generally sourced directly from nature, without any changes in the natural form. Various constituents such as lycopene in tomatoes, omega-3 fatty acids in salmon, or saponins in soy are available and consumed for different health benefits. Further, various types of traditional nutraceuticals are as follows:

- (I) Chemical constituents
 - (a) Nutrients
 - (b) Herbals
 - (c) Phytochemicals
- (II) Probiotic microorganisms
- (III) Nutraceutical enzymes

Chemical Constituents

- Nutrients

Primary metabolites such as amino acids, various vitamins, and fatty acids had well-defined functions in various metabolic pathways. Plant and animal products along with vitamin have many health benefits and are helpful in curing diseases related to heart, kidney, lungs, etc.

Natural products obtained from plants are beneficial in treating various disorders such as brittle bones and low hemoglobin count, and they provide strength to bones and muscles, help in neuron transmission, and maintain rhythm of heart muscles. Fatty acids, omega-3 PUFAs present in salmon, had influenced the overall inflammatory response and brain function and reduced cholesterol in the arteries.

- Herbals

Nutraceuticals along with herbs had an excellent impact on prevention of various chronic diseases to make life better. Salicin present in the willow bark (*Salix nigra*) had been proved for anti-inflammatory, analgesic, antipyretic, astringent, and antiarthritic response clinically. Flavonoids such as psoralen present in parsley (*Petroselinum crispum*) is useful in diuretic, carminative, and antipyretic.

Peppermint (*Mentha piperita*) contains various terpenoids especially menthol, a bioactive constituent, and cures cold and flu. Tannin contents of lavender (*Lavandula angustifolia*) help releasing stress and blood pressure and are useful for lung disorders such as asthma.^[13]

- Phytochemicals

They are mainly classified on the basis of phytochemicals. Carotenoids (isoprenoids) are present in vegetables, enhancing immune system, mainly killer cells accounting for an anticancer response. Legumes (chickpeas and soybeans), grains, and palm oil contain

noncarotenoids, which remove cholesterol and are anticarcinogenic.

Flavonoids, a class of secondary metabolites, which are present in most of the plants, having more than 4000 varieties had been proven clinically for preventing various diseases such as cancer, diabetes, heart diseases, and kidney problem through its antioxidant properties and their bioactive components.^[14]

Phenolic acids are the largest class of secondary metabolites, mainly found in citrus fruits and red wine, and have the antioxidant activity of scavenging the free radicals produced as a result of various metabolic pathways such as protein, carbohydrate, and fat. They also have anticancer and antitumour activity.

One of the classical examples is curcumin (turmeric), used as phytochemicals in most of the kitchen.

Probiotic Microorganisms

Metchnikoff coined the term "probiotic." Its application is well boosted in modern medicine due to its ability of making the intestine more friendly for processes such as absorption and metabolism. Probiotics are very important to make life smoother by removing the toxic flora of the intestine and maintaining a friendly environment, for example, useful consumption of *Bacillus bulgaricus*.^[15] Currently various probiotic products are available in the market with adequate nutrients to counter various pathogens so that a number of ailments related to human body can be treated.

The antimicrobial property usually had an altering impact on the microflora, making the epithelial tissues more grounded and making a situation for the supplements for better retention, which is required by the body. Moreover, probiotics are very useful in lactose intolerance by the production of related enzymes (β -galactosidase) and hydrolyzing lactose into its sugar components.^[16]

Nutraceutical Enzymes

Enzymes are proteinous in structure, are produced by the cell, and act as a biocatalyst. It eases the metabolic rate and fastens the life process. The medical problem mainly related to the GIT whether GERD (gastroesophageal reflux disease) or constipation or diarrhoea or ulcerative colitis could be treated with enzyme supplements. The enzyme could be a better option for diabetic patients. Nowadays, enzyme therapies are used for several rare diseases such as Gaucher disease, Hunter syndrome, Fabry disease, and Pompe disease. Although enzymes are produced by their own cells, microbial sources are preferred more over plant and animal sources as they are more economical.

b. Nontraditional Nutraceuticals

They are foods enriched with supplements or biotechnologically designed crops to boost the nutrients;

for example, rice and broccoli are rich in β -carotene and vitamins, respectively. Food samples contain bioactive components which are engineered to produce products for human wellness. They are arranged as follows:

- Fortified Nutraceuticals

These types of nutraceuticals include breeding at the agriculture level or addition of compatible nutrients to the main ingredients such as minerals added to cereals, flour fortified with calcium, iron, and folic acid, and milk fortified with cholecalciferol commonly used for vitamin D deficiency.^[17]

- Recombinant Nutraceuticals

Biotechnology tools have been well applied through a fermentation process in various food materials such as cheese and bread to extract the enzyme useful for providing necessary nutrients at an optimum level.

2. Classification Based on Mechanism of Action

Nutraceuticals has been further classified in regard to specific therapeutic properties accounting for antimicrobial, anti-inflammatory, and antioxidant properties.

- Anti-Cancer Activity

The use of nutraceuticals as chemo-preventative agents has been studied, and promising results were obtained as per their ability to prevent and treat cancer. Nutraceuticals of different origins have been shown to exhibit anti-cancer activity.

- Anti-Inflammatory Activity

Nutraceuticals exert anti-inflammatory activities which help in the prevention and treatment of chronic inflammation-associated diseases. Another benefit of nutraceuticals as anti-inflammatory agents is that they can be used as a complementary alternative to anti-inflammatory therapeutic drugs, which leads to a reduction in drug dosage, and therefore reducing side effects. Chronic inflammation is the major cause of chronic diseases such as cardiovascular diseases, pulmonary diseases, diabetes, and cancer.

- Antioxidant Activity

The main sources of antioxidants are food, vitamins, and supplements. Foods such as fruits and vegetables are considered a great source of antioxidants due to their high levels of vitamins and phytochemicals. Beetroot contains betalain and phenolic compounds which cause an increase in the resistance of low-density lipoproteins (LDLs) to oxidation, protect the liver from damage, and decrease blood pressure. Dried fruits are a good source of antioxidants and have health benefits to humans. They can reduce glucose levels in the blood in addition to reducing risk factors associated with heart disease.

- Anti-Lipid Activity

The application of nutraceuticals as hypolipidemic agents has shown great potential in lowering total

cholesterol (TC) and low-density lipoprotein (LDL) concentrations. Lipid-lowering nutraceuticals can be classified into three groups based on their mechanism of action. Such mechanisms include the inhibition of cholesterol absorption, inhibition of cholesterol synthesis, and excretion of LDL. Plant sterol foods or supplements have displayed effectiveness in lowering lipid profiles.

3. Classification Based on Chemical Nature

These types are classified depending upon their primary and secondary metabolite sources such as isoprenoid derivatives, phenolic substances, fatty acids, carbohydrates, and amino acid-based substances.

NUTRACEUTICALS AND DISEASES^[18]

Nutraceuticals against Alzheimer's disease (AD)

Alzheimer's disease (AD), also called senile dementia of the Alzheimer type (SDAT), primary degenerative dementia of the Alzheimer's type (PDDAT), or simply Alzheimer's, is the majority ordinary form of dementia. The variety of nutraceuticals which are used to treat Alzheimer's disease is as follow:-

Antioxidants

Antioxidants are very indispensable in the treatment of almost all diseases because the majority chronic diseases carry with them a great pact of oxidative stress. Oxidative stress plays a chief job in neurodegenerative diseases such as Phosphatidylserine. Phosphatidylserine is a very exciting complex. Phosphatidylserine is the key phospholipids in the brain and it makes up the basic arrangement of the cell membrane. Membrane phosphatidylserine and phospholipids play a very important role in cell-to-cell announcement and transport of biochemical letters to the cell. Phosphatidylserine boost cellular metabolism and communication, and oral supplemental outcomes neuronal membranes, cell metabolism and specific neurotransmitters: acetylcholine, nor epinephrine, serotonin, and dopamine.

Cardiovascular Diseases

Universal, the burdens of chronic diseases like cardiovascular diseases, cancers, diabetes and obesity is quickly increasing. In 2001, chronic diseases contributed approximately 59% of the 56.5 million total reported deaths in the world and 46% of the global burden of disease. Cardiovascular diseases (CVD) is the name for the group of disorders of the heart and blood vessels and consist of hypertension (high blood pressure), coronary heart disease (heart attack), cerebrovascular disease (stroke), heart failure, peripheral vascular disease, etc. In 1999 CVD only contributed to a third of global deaths and by 2010 it would be the leading cause of death in developing countries. Majority of the CVD are preventable and controllable. It was reported that low intake of fruits and vegetables is related with a high mortality in cardiovascular disease.^[19] a lot of research studies have recognized a protective role for a diet rich in fruits and vegetables against CVD.

Parkinson's Disease

Parkinson's disease is a brain disorder that results from nerve damage in certain regions of the brain causing muscle rigidity, shaking, and difficult walking] typically happening in mid to late adult life. Canadian researchers indicated that vitamin E in food may be protective against Parkinson's disease]. Creatine appeared to modify Parkinson's disease features as measured by a decline in the clinical signs. Researchers have also studied glutathione to conclude its effect on nerve and its power as an antioxidant. The suitable long-term dosing, side-effects and the majority effective method of administration are not yet clear. Nutritional supplements have shown some capable results in preliminary studies, it is important to remember that there is not adequate scientific data to recommend them for Parkinson's disease at present. The patients should be cautioned that over-the counter medications do have side effects and interactions with other drugs and are also exclusive.^[20]

Obesity

Obesity is a composite condition, with serious social and psychological dimensions, affecting almost all ages and socioeconomic groups. The worldwide subsistence of obesity nearly doubled between 1980 and 2008. According to country estimates for 2008, over 50% of both men and women in the WHO European Region were overweight, and roughly 23% of women and 20% of men were obese. Given the worldwide increase in obesity and its health consequences, efficient strategies for its prevention and treatment are important. It has been recommended that weight reduction programs focus on achieving a modest weight loss of 7–10% of the initial weight. Obesity arises from an energy imbalance whereby energy intake exceeds energy expenses. Dealing with obesity — by either prevention or treatment — requires alteration of one or both mechanism of energy balance. Approaches to weight management (including a functional food approach) therefore can target multiple aspects of the energy balance systems: food intake, energy expenditure, and energy storage.

Nutraceuticals have been emerged as an substitute to current medicines and have proven health benefits.^[21]

Nutraceuticals for Diabetes

Diabetes is a chronic metabolic disorder, where the body is unable to utilize carbohydrate due to absolute or relative lack of insulin, a hormone naturally produced by the β cell of the islets of Langerhans in pancreas. Isoflavones are phytoestrogens have a structural/functional similarity to human estrogen and have been consumed by humans worldwide. Cinnamon tea and green tea can help people suffering with diabetes.^[22] Dietary fibers from psyllium have been used for glucose control in diabetic patients and to reduce lipid levels in hyperlipidemia. Omega-3 fatty acids supplementation in type 2 diabetes has a favorable impact in lowering triglycerides and VLDL cholesterol,

and reducing blood pressure and inflammatory markers.^[23]

Nutraceuticals in Hypertension

Hypertension as “a common condition in which the force of the blood against artery walls is high enough that it may eventually cause health problems, such as heart disease.” Many natural compounds in food, as well as certain nutraceutical supplements, vitamins, antioxidants, or minerals, can mimic drugs, functioning in a similar fashion to a specific class of antihypertensive medications. Melatonin, Hesperidin, pomegranate juice and grape seed extract have shown to be helpful in reducing BP.^[24] Flavonoids are the natural substances found to reduce stroke and enable smooth cardiac functions. Lycopene present in the carotenoid family, it helps reduce BP and oxidative stress. Use of garlic helps reduce BP and is also useful in treating patients already on drugs. Clinical studies show that seaweed lower BP within 4 weeks of administration. Sesame reduces BP, arterial stiffness, and improves oxidative defense. Beverages: Tea, coffee, and cocoa – These help reduce BP and improve endothelial function.^[25]

Nutraceuticals with Anti-inflammatory activities

Inflammation is a process by which the body's white blood cells and substances they produce protect us from infection with foreign organisms, such as bacteria and viruses. It is the response of body tissues to injury or irritation, characterized by pain and swelling and redness and heat. Rheumatoid arthritis (RA) is a chronic inflammatory disease characterized by elevated oxidative stress and inflammatory biomarkers.^[26] Various studies were conducted by many researchers on fish oil, primrose oil, curcumin, fenugreek, liquorice, coriander, tomato, carrot, sweet potato, broccoli, green tea, rosemary, hazelnut, walnut, wheat germ, Beet roots, cucumber fruits, spinach leaves and date for anti-inflammatory properties.^[27] During these studies, changes in inflammatory biomarkers (erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), seromucoids, fibrinogen, tumor necrosis factor- α (TNF- α), prostaglandin E2), oxidative stress (malondialdehyde), antioxidant status (total antioxidant capacity, vitamin C, vitamin E, retinol, β -carotene), the level of copper (Cu) and zinc (Zn) and colonic microflora in response to the administration of nutraceuticals have been assessed. Studies concluded that the majority of nutraceuticals studied possess beneficial effect toward chronic inflammatory diseases, which might be due to the presence of one or more of the above-mentioned phytochemicals.^[28]

CONCLUSION

The nutraceutical industry is growing at a rate far exceeding expansion in the food and pharmaceutical industries. Public health Authorities consider prevention and treatment with nutraceuticals- as a commanding gadget in maintaining health and to perform against nutritionally induced acute and chronic diseases, thereby

promoting optimal health, longevity and quality of life. Future demand of nutraceutical depends on consumer perception of the relationship between diet and disease. Although nutraceuticals have significant promise in the promotion of human health and disease prevention, health professional, nutritionists and regulatory toxicologist should strategically work together to plan appropriate regulation to provide the ultimate health and therapeutic benefit to mankind.

It is very imperative that the nutrients found in many foods, fruits and vegetables are responsible for the well documented health benefits. Evidences indicate that the mechanistic actions of natural compounds involve a wide array of biological processes, including activation of antioxidant defenses, signal transduction pathways, cell survival-associated gene expression, cell proliferation and differentiation and preservation of mitochondrial integrity. It appears that these properties play a crucial role in the protection against the pathologies of numerous age-related or chronic diseases.

In order to have scientific knowledge about the nutraceuticals, publics should be educated, and recommended daily doses of these nutraceuticals should be known by each consumer. Nutraceutical Products is collaborative research effort of pharma, food and chemistry. As healthcare industry is growing in India, growth of nutraceuticals is also increasing because people want to treat their disease by improving their health with the help of Fast Moving Healthcare Goods. 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 supplements to improve well being where pharmaceuticals fail.

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