

## Nutraceuticals and Their Impact on Human Health

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Herbal medicine is the need of the day. With the modernised, competitive lifestyle and ever increasing stressful conditions, all types of diseases are having a field day. Allopathic cure is available for most of the disorders but it comes at a price. First, the cost of medicine is increasing day by day as for all other commodities. Second, allopathic medicines are associated with a variety of side effects. Therefore, more and more people are inclining towards lifestyle modification and use of herbal products only. This helps in keeping various diseases at bay and boosting the overall health of the person.

Herbal or plant medicine constitutes an effective source of both traditional and modern medicines. It is more popular in rural population and around 80% of rural population in India depends on it for their primary health care [1]. Medicinal plants offer a rich, though inadequately explored, source of components which provide a variety of health benefits. These components, known as phytochemicals, can act as [2]:

1. Substrates for various biochemical reactions.
2. Cofactors/ inhibitors of different enzymatic reactions.
3. Absorbents/sequestrants that bind to and eliminate undesirable constituents in the intestine.
4. Ligands that behave as agonists or antagonists of cell surface or intracellular receptors.
5. Scavengers of highly reactive or toxic chemicals.
6. Compounds that enhance the absorption and/ or stability of essential nutrients.
7. Selective growth factors for beneficial gastrointestinal bacteria.
8. Fermentation substrates for useful oral, gastric or intestinal bacteria and selective inhibitors of harmful intestinal bacteria.

Foods containing these phytochemicals are known as 'nutraceuticals'. The term nutraceutical is derived from the words 'nutrition' and 'pharmaceutical'. Thus, nutraceutical is a food or a part of the food which exerts a curative or preventive effect on disease. These include various nutrients, dietary supplements, specially designed diets or herbal products. Nutraceuticals of both plant and animal origin hold great opportunities for food industries to bring out novel food catering to future needs [3,4].

The phytochemicals present in these foods have wide range of therapeutic effects against a number of diseases like diabetes, heart disease, common cold, arthritis, cancer, hypertension, dyslipidemia, inflammatory bowel disease, depression etc. Compounds like phenylpropanoids, isoprenoids, polyphenols, anthocyanidins, flavonoids, terpenoids, carotenoids, phytoestrogens and alkaloids etc are responsible for the beneficial effects of diet rich in fruits and vegetables. Melatonin (N-acetyl-5-methoxytryptamine) is also found in plant diets which produce kynuramine, a biogenic amine, by oxidative metabolism. Kynuramine improves mitochondrial metabolism, acts as cyclooxygenase-2 inhibitor and an important antioxidant [5].

The interface between the nutritional environment and cellular/genetic processes is termed as 'nutrigenomics'. It provides a molecular

enlightenment of phytochemicals benefitting human health by altering the expression or constitution of genes. This leads to alteration in initiation, development and progression of different diseases. Thus, nutrigenomics is very important in the role of nutraceuticals against ageing and different diseases by proving genetic information [6].

### Emerging trends in nutraceuticals

Nutraceuticals may be divided into herbal/ natural products, dietary supplements and functional foods. Out of these, most rapidly growing segment is herbal/ natural products followed by dietary supplements. The generation of scientific research linked foods of plant origin and health has resulted in understanding that plant bio-active compounds have antioxidant and other health promoting properties.

High dietary intake of fibres in the form of fruits, vegetables, whole grains is strongly linked to a reduced risk of chronic diseases like cancer and cardiovascular diseases. Cancer development is a chronic, stepwise complex process culminating into metastasis if not tackled in time. Epidemiological studies now provide convincing evidence that dietary factors may modify carcinogenesis. A number of phytochemicals as well as some plant origin foods with yet unidentified components possess anti-carcinogenic and anti-mutagenic properties. Thus, use of these bioactive compounds as chemopreventive substances, in future, can not be overlooked [7].

Similarly, isoflavonoids or soy products and flaxseed have the ability to decrease total and low density lipoprotein cholesterol (LDL-C) and increase high density lipoprotein cholesterol (HDL-C) resulting in reduced risk of cardiovascular diseases (CVDs). Phytoestrogens are also reported to be beneficial in prevention of CVDs. For CVD, important risk factors include obesity, hyperlipidemia, hypertension and diabetes which can be countered by phytochemicals. Phytochemicals help in reducing oxidative stress also which is implicated in process of atherosclerosis. Nutraceuticals help in boosting the antioxidant defense system of the body [8,9].

### Categories of nutraceuticals [10]

1. Substances with established nutritional value i.e. nutrients e.g. vitamins, minerals, amino acids, fatty acids, polysaccharides etc.
2. Products of herbs or botanical products in the form of concentrates or extracts i.e. herbals e.g. aloe vera, wheat grass, ginger, garlic etc.

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3. Compounds derived from other sources serving specific functions such as sports nutrition, weight-loss supplements and meal replacements termed as dietary supplements.

### Based on food sources, nutraceuticals can be classified as

#### 1. Dietary fibres

These are the plant origin substances present in food which are not digested in gastrointestinal tract and add bulk to the intestinal contents. Examples include fruits, barley, oats, lignin, cellulose, pectin etc. Generous intake of these fibres in diet is associated with low risk of CVD, hypertension, diabetes, obesity, and colon cancer and gastrointestinal disorders [11].

#### 2. Probiotics

These are live microbial feed supplements which when administered in adequate dose help in improving the intestinal microbial balance of the host e.g lactobacilli, bifidobacteria etc. Their administration is reported to be associated with a decreased risk of allergy, asthma, cancer, infection of ear and urinary tract [12].

#### 3. Prebiotics

These are the dietary ingredients that benefit the host by selectively altering the composition or metabolism of gut microbiota. These are, generally, fructose based oligosaccharides existing naturally or supplemented in the food and are not digested by human beings. Examples of such foods are chicory roots, banana, tomato and alliums, beans etc. These are found to be beneficial in improving lactose tolerance, detoxification, and dyslipidemia, relief from constipation and in certain tumours [13].

#### 4. Polyunsaturated fatty acids

These may be omega 3 fatty acids e.g.  $\alpha$ -linolenic acid, eicosapentaenoic acid and docosahexaenoic acid found in fatty fishes, flaxseed, soybean etc. or omega 6 fatty acids e.g.  $\alpha$ -linoleic acid and arachidonic acid found in corn, safflower, sunflower and soybean etc. [11].

#### 5. Antioxidant vitamins

These include vitamin C, vitamin E and carotenoids. These vitamins are abundant in many fruits and vegetables and possess singlet oxygen quenching and lipid peroxidation preventing properties. Regular intake of these helps in prevention of a number of diseases [11].

#### 6. Polyphenols

These phytochemicals are produced by plant for protection against photosynthetic stress and reactive oxygen species e.g flavonoids, anthocyanins and phenolic acids. These possess anti-inflammatory and antioxidant properties and are found in foods like legumes, tea and soybean etc. [11].

#### 7. Spices

These are esoteric foods adjuncts used to enhance sensory quality of foods. Most of the components of spices are terpenes and other constituents of essential oils. Minute quantities of dietary spices have antioxidant, chemopreventive, antimutagenic, anti-inflammatory and immune modulatory effects [14].

### Areas of concern

The major concern for the use of nutraceuticals is the lack of quality control. Food laws which govern the quality and processing of

nutraceuticals lack the specificity required for botanical drugs. This may result in adulteration or contamination of nutraceuticals remaining unnoticed and posing threat to the health of consumers [15].

It is also important that a distinction is drawn between information obtained from in vitro studies with that of in vivo studies. The mechanism of action along with the efficacy of various phytochemicals in different clinical conditions needs to be established with help of in vivo studies [2]. Many widely used medicinal plants still lack the extensive physiological characterization. The detailed knowledge about metabolic pathways for biosynthesis of different phytochemicals with associated factors and role of genetic makeup and environmental modulations in these biosyntheses is also not yet available [16].

Furthermore, the cost of nutraceuticals is another concern. Commercially available preparations are bound to be purer and more effective forms but much more expensive as compared to the natural ones.

### Conclusion

Response of nutraceuticals varies from person to person. Individual's susceptibility to any particular disease depends on the genetic predisposition, environmental factors and lifestyle. But the role of nutraceuticals in prevention, restriction and cure of various diseases is beyond doubt. Their success will be governed by purity, safety and efficacy without compromising innovation in the field. Information available presently poses a challenge for nutritionists, physicians, food technologists, plant physiologists and public health personnel. The role of nutraceuticals in clinical practice is emerging but important pharmaceutical and clinical issues need to be answered. Long term clinical research is needed to scientifically validate their role in different diseases. Herbal medicine shows good results when treated as an adjuvant to allopathic medicine, but not as a substitute, in most of the diseases like diabetes, hypertension and cancer etc. With a little bit of careful handling, the future of both plant and animal origin nutraceuticals holds exciting opportunities in the medical field.

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