ROLE OF NUTRACEUTICALS ON HEALTH PROMOTION AND DISEASE PREVENTION: A REVIEW

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ABSTRACT

Nutraceuticals have received considerable zest for their expected safety, potential nutritive and therapeutic effects. These were used as alternative to modern medicines that promote quality of health, increases nutritive value of the diet and prolongs life expectancy. Major constituents of the nutraceuticals are herbals, various nutrients and dietary supplements are involved in preventing different diseases and minimizing pathophysiology of the disease too. It also acts as immune boosting, natural antioxidant, anticancer, anti-inflammatory, antidiabetic, cardioprotective, organoprotective agent in addition with different health promoting effects. Ultimately, they ensure better quality of life and the purpose of this review is to provide summary of current scientific impression in this regard which might be helpful to formulate further innovative research plan in new domain on nutraceuticals.

Keywords: Nutraceuticals; Disease prevention; Health promotion; Nutrients; Nutrition

1. INTRODUCTION

Exploration of novel dietary products with medicinal properties has created a renaissance in health and nutrition research. These are the emerging natural functional products that make the line between foods and drugs. It provides physiological health benefits as well as medicinal implications.\(^1\) Nutraceuticals are taken as a part of our daily diet to accomplish lucrative effect. Now the question arises whether nutraceuticals are foods or drugs? It may be considered as food, food supplement or drug like agent since it may apply for health promotion, disease prevention and adjunct supplement with the treatment. Nutraceuticals creates a new era of research to promote quality of life. It can reduce the risk of disease onset by retaining normal health condition and improving immunity.\(^2\) The treatment approaches of disease in the modern medicines are seeking complementary or alternative beneficial products, and nutraceuticals fulfilled this gap.\(^3\) In this review the role of some important nutraceuticals are emphasized based on their health promoting and diseases modifying indications. Herbal nutraceuticals has been efficient to cure oxidative stress, including allergy, Alzheimer’s disease, CVD, diabetes, cancer, inflammatory as well as obesity too.\(^4\)

The motto of nutritional therapy is based on the complimentary therapy with nutraceuticals as food is not only the source of energy and nutrients but also provides medicinal benefits. Nutraceuticals are detoxifying our body, restoring our healthy digestion and dietary habits also. They can be classified based on the source of foods, mechanism of action and their chemical properties.\(^5\) The food sources used as nutraceuticals are all natural and they are dietary fiber, probiotics, prebiotics, PUFA, antioxidant vitamins, polyphenols etc.
2. NUTRACEUTICALS ON HEALTH PROMOTION

Nutraceuticals with various bioactivities towards human body are being widely examined for their ability to provide health benefits \(^7\). Some of the most important bioactivities of such nutraceuticals have been discussed below (Table-1, Fig.1).

<table>
<thead>
<tr>
<th>Nutraceuticals</th>
<th>Health Promoting Activity</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onion, Garlic, Grapes, Rosemary, Broccoli, Spinach, Turmeric, Parsley</td>
<td>Antioxidant activity</td>
<td>8-9</td>
</tr>
<tr>
<td>Mitochondria Targeted Nutraceuticals</td>
<td>Mitochondrial bioenergetics</td>
<td>10</td>
</tr>
<tr>
<td>Flavonoids, Polyphenols, Probiotics</td>
<td>Gastro intestinal health</td>
<td>10-12</td>
</tr>
<tr>
<td>Nutraceuticals like Magnesium Citrate, Pine Bark of Pycnogenol, Pygeum, Potassium Citrate, IP6, Lutein, Lycopene, Xeaxanthin</td>
<td>Renal and excretory health</td>
<td>13-14</td>
</tr>
<tr>
<td>Ubiquinone Q10, Vitamin B6, Vitamin B12, Pycnogenol, Flax seed oil, Fish oil</td>
<td>Reproductive health</td>
<td>13-16</td>
</tr>
<tr>
<td>Blueberry, Green Tea, Catechins, Carnosine, Vit D3, PUFA, Essential Amino Acids</td>
<td>Stem cell growth</td>
<td>13-14</td>
</tr>
<tr>
<td>Nutraceuticals present in citrus fruits, Soyabean, Spermidine, Caffeic Acid and Rosmarinic Acid</td>
<td>Prolonging life Span</td>
<td>17, 12</td>
</tr>
</tbody>
</table>

2.1. Antioxidant activity

Several nutraceuticals reported till date having free radicals scavenging capacity. Studies shows that onion, garlic, grapes, rosemary, broccoli, spinach, turmeric, parsley possess considerable antioxidant activities \[^6\]. Nutraceuticals with antioxidant properties prevents several neurodegenerative diseases including Parkinson’s, Alzheimer’s diseases. They act on ROS, RNS and also prevent oxidized LDL formation \(^9\).

2.2. Mitochondrial bioenergetics

Mitochondria have been involved in the energy utilization during exercise and nutraceuticals implicated in the prevention and treatment of heavy exercise related to mitochondrial dysfunction. Mitochondria targeted nutraceuticals (MTNs) have antioxidant effects at the molecular level and boost mitochondrial bioenergetics. It has great impact on sports medicine \(^10\).

2.3. Gastro Intestinal health

About 40 million American suffers from a various digestive disorders like gastro-esophageal reflux disease, irritable bowel syndrome, celiac disease, food allergies, diverticulitis, ulcerative colitis, crohn's disease etc. \(^11\). The prebiotics which are polysaccharides in nature could be useful for both disease prevention and for healing process. Nutraceuticals have the ability to reduce antigenic and oxidative insults in the gastrointestinal tract of an individual. Flavonoids and polyphenols show antioxidant activity and have been found to be known as possible gastroprotective and cytoprotective agents. Glutamate, a neurotransmitter found in gut which improves neonatal gastrointestinal function, gastric emptying as well significant role in developing infant gastric mucosa \(^10, 11\). Herbal nutraceuticals like probiotics play an unique role for healthy digestive function. It may stimulate the growth of healthy gut microflora, slow down harmful bacterium and reinforce the body's natural gut defense mechanisms. It can reduce lactose intolerance and prevent GI tract disorders \(^12\).

2.4. Renal and excretory health

Specific nutraceuticals like magnesium citrate, pine bark of pycnogenol, pygeum, potassium citrate, IP6, lutein, lycopene, xeaxanthin plays a significant role at our excretory system that includes promotion of healthy urinary oxalate excretion, provides protective activity on kidneys, improve healthy urinary bladder health and sphincter tone, help to balance calcium accumulation, formation of calcium and oxalate crystals, maintains normal microbial flora in the bladder and urinary tract \(^13, 14\).

2.5. Reproductive health

Nutraceuticals have significant role on both male and female reproductive ability. Nutraceutical food supplements control male infertility, increases sperm count by 60\%, increases sperm motility by 3 fold, improves sperm quality and cures sperm dysfunction. It also prevents oxidative damage of sperms \(^13, 14\).

In case of female, it reduces the risk of preterm labor in human, influences steroid output at a cellular level. Ubiquinone Q10, Vitamin B6, B12, pycnogenol, flax seed oil, pycnogenol, fish oil reduces the damage of oocytes in fallopian tubes and encourages embryonic growth and development \(^15\).

Eating healthy diets with nutraceuticals reduces the sufferings from monthly trouble of women. Most menstrual disorders caused by nutritional deficiencies which lead to improper metabolism of sex hormones. Specific nutraceutical could influence hormones, the ovarian pathological conditions and increases reproductive \(^16\).

2.6. Stem cell growth

Certain nutraceuticals produces significant effects on stem cell growth and proliferation and showed significant role in healing and tissue regeneration by stimulating and recruiting endogenous stem cell at the site of injury. Blueberries, green tea, catechins,
carnosine, vitamin D3, PUFA and essential amino acids strengthen our immune system.\textsuperscript{13, 14}

2.7. Prolonging life Span

Nutraceuticals present in citrus fruits and soybean has effects on epigenetic modifications, autophagy and necrosis.\textsuperscript{17, 18} Researches have shown that spermidine and its derivatives confer lifespan extension in humans by enhancing autophagy. Caffeic acid and Rosmarinic acid present in fruits, vegetables and herbs are also anti-carcinogenic, antioxidant, anti-rheumatic and anti-microbial. They can prolong the healthy life span extension.\textsuperscript{12}

3. NUTRACEUTICALS ON DISEASE PREVENTION

Nutraceuticals play an important role in preventing different disease onset and minimize complication of the disease. It provides protection against non-communicable diseases, delay ageing process, increases life expectancy and improves function of the body (Table-2, Fig.1).

<table>
<thead>
<tr>
<th>Nutraceuticals</th>
<th>Disease Prevention</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavonoids, Flavones, Quercetin in Onion, Cruciferous Vegetables, Black Berries, Cherries, Berries, Apples and Allicin.</td>
<td>Cardiovascular diseases</td>
<td>19-23</td>
</tr>
<tr>
<td>Ginseng, Beta Carotene, Sulfur Compounds in Garlic.</td>
<td>Cancer</td>
<td>24-27</td>
</tr>
<tr>
<td>Soy Isoflavones, Omega 3 Fatty Acid, Lipoy Acid, Catechins, Spices Like Fenugreek and Cinnamon, Bitter Melon, Pomegranate</td>
<td>Diabetes mellitus</td>
<td>28</td>
</tr>
<tr>
<td>Conjugated Linoleic Acid, Capsaicin, Psyllium, Herbal Nutraceuticals like Chitosan, Caffeine, Fenugreek, Vitamin C, Green Tea, Curcumin, Black Gram, Bottle Guard.</td>
<td>Obesity</td>
<td>29-32</td>
</tr>
<tr>
<td>Diacerin, Banana, Ginger, Green Tea, Pomegranate, Boswellia, Oxaceprol, Tipi, Willow Bark, Curcumin, Avocado, Soybean, Collagen Hydrolysate, Chondroitin Sulfate and Glucosamine</td>
<td>Osteoarthritis</td>
<td>33-38</td>
</tr>
<tr>
<td>Odonto Nutraceuticals, Green Tea, Grapes, Cocoa Seed Extracts rich in Polyphenols, Flavonoids and Proanthocyanidins</td>
<td>Oral diseases</td>
<td>39-43</td>
</tr>
<tr>
<td>Plant Polyphenols, Stilbenes, Soybean &amp; Other Phytoestrogens, Vitamin C, Vitamin D, Vitamin E, Coenzyme Q 10, Unsaturated Fatty Acid, Brahmi and Inosine.</td>
<td>Parkinson's disease</td>
<td>46-48</td>
</tr>
<tr>
<td>Lutein, DHA, Green Tea, Carotenoids, Flavonoids, Vitamin E, Coenzyme Q10, Zeaxanthi, Melatonin, Spirullina, Flavonoids, Ascorbic Acid, Tocopherol, Carotenoids, Caffeine, Pyruvate.</td>
<td>Eye disorders</td>
<td>49, 39</td>
</tr>
<tr>
<td>Adaptogens (Ashwagandha, Rhodiola, L-Theanine, Ginseng)</td>
<td>Stress Management</td>
<td>50</td>
</tr>
</tbody>
</table>

Figure 1: Role of nutraceuticals in health promotion and disease prevention
3.1. Cardiovascular diseases

Nutraceuticals like flavonoids, flavones, flavonones, quercetin in onion, cruciferous vegetables, black berries, cherries, berries, apples and other antioxidant vitamins and minerals may reduce the risk of death from CVDs. They inhibit cyclooxygenase pathway and angiotensin converting enzyme (ACE) which is responsible for high blood pressure. They also prevent platelet aggregation and stickiness. Flavonoid groups strengthen tiny capillaries which carry oxygen and essential nutrients to all cells. Polyphenols present in grapes alter cellular metabolism and signaling which reduces arterial diseases. A potent antioxidant ginger is an anti-inflammatory agent is recommended for the prevention of hypertension and palpitation. Allicin lowers blood pressure and cholesterol. Omega 3 series has lipid lowering property and prescribed for the treatment of arrhythmias. CVD could be managed by the supplementation of different lipid lowering nutraceuticals along with maintenance of proper life style. Poly-herbal products could affect synergistically to achieve a potential therapeutic target.

3.2. Cancer

Nutraceutical rich bioactive dietary components have the ability to prevent cancer. Herbal nutraceuticals possess anti-mutagenic and anti-carcinogenic properties. Antioxidant activities of carotenoids, lycopene are effective for cancer. They are oxygen quencher and decreases oxidative stress. Nutraceutical controls DNA damaging factors in cells and prevents DNA transcription in tumors. Ginseng is an anti-inflammatory molecule that prevents chronic inflammation of cancer. Chemo preventive components in fruits and vegetables have potential anti-carcinogenic and anti-mutagenic activities. Beta carotene from yellow and orange fruits has anti-cancer activity. Cruciferous vegetables lowers the chances of colorectal and lung cancer. They block enzymes that promote tumor growth. Sulfur compounds in garlic boosts immune system, reduces atherosclerosis and platelet aggregation. Recent research further reported herbal nutraceuticals has the ability to alter metastatic spread of cancer.

3.3. Diabetes

Herbal dietary supplements containing nutraceuticals have proven to offer therapeutic benefit on type 2 diabetes. Soy isoflavones, omega 3 fatty acid lowers mortality and incidence of diabetes, promote insulin sensitivity, reduce glucose tolerance and bring blood sugar normal. Universal antioxidants like lipoic acid and catechins, the spices like fenugreek and cinnamon are used to treat diabetic neuropathy, nephropathy and retinopathy. Magnesium, chromium, calcium, vitamin D promotes insulin sensitivity, improve glycemic control etc. Caffeic acid reduces elevated plasma glucose in insulin resistant patients. Green tea and epicatechin 3 gallate reduces fasting and postprandial glucose and improves insulin resistance. Bitter melon, pomegranates are good for diabetes which regulates metabolism and transports glucose from the blood into cells.

3.4. Obesity

Obesity is a medical condition characterized by accumulation of excess body fat. Nutraceuticals like conjugated linoleic acid, capsaicin, psyllium have an excellent anti-obese properties. Herbal nutraceuticals like chitosan, caffeine, fenugreek, vitamin C, green tea, curcumin, black gram, bottle guard reduces body weight. They secrete leptin and other cytokines like IL-1, IL-6 and help to reduce LDL and total cholesterol and regulate food intake.

3.5. Osteoarthritis

Osteoarthritis is a disease with a multifactorial etiology affecting all joint tissues and involving both biochemical and mechanical factors that act in synergy to degrade cartilage. Joint discomfort reduces physical activities resulting energy imbalance and weight gain. Nutraceuticals like condroitin sulfate, glucosamine, diacerein, banana, ginger, green tea, pomegranate, boswellia, oxaceprol, tipi, willow bark, curcumin, avocado, soybean, collagen hydrolysate are used to alleviate the complications. They have pharmacological properties and important role in the regulation of gene expression along with their normal function as nutrient. Nutraceutical antioxidant agents have considerable evidence for treating inflammation, pain and joint destruction. Arthritic pain and narrowing of joint space could be prevented by the combined supplementation of chondroitin sulfate and glucosamine.

Application of olive oil also reduces pain, stiffness and swelling, physical function and knee status. Functional foods like oats, bran, Psyllium, lignin, prebiotics, omega 3 milk, canola oil are very efficacious.

3.6. Oral diseases

Odontonutraceuticals, a new term has been discovered. It represents pleiotropic phytotherapeutic agents in dentistry as they regulate different molecular and biochemical targets. These are bioactive phytochemicals that prevents oral diseases. It may play a significant role in the complex and multifactorial oral disorders. Odontonutraceuticals includes green tea, grapes, cocoa seed extracts that are rich in polyphenols, flavonoids and proanthocyanidins. Aloe vera gel heals mucosal wound and it can alleviate pain of patient with oral lichen planus disease. Probiotics are also helpful in the prevention of dental caries, gingivitis, periodontitis, halitosis, malodour etc.

3.7. Alzheimer's disease

Alzheimer's disease is also known as senile dementia. Antioxidants appear to slow down the advancement of the disease. Nutraceuticals like beta carotene, lycopene, curcumin, lutein and lavandula exploits their antioxidant effects to combat oxidative stress induced neuronal damage. These compounds are able to delay the development of dementia. Several studies indicate that supplementation of vitamins like folic acid and B12 reduces homocysteine levels which also avert disease progression.
3.8. Parkinson’s disease

In Parkinson’s disease the dopamine-releasing cells in the brain damaged due to neurodegeneration. It is the second most common age related disorder in the world 46. Plant Polyphenols, stilbenes, soybean and other phytoestrogens, vit-C, vit-D, vit-E, coenzyme Q 10 and unsaturated fatty acid revealed protective roles against progression of Parkinson’s disease 47. Herbal nutraceutical (Brahmi) is a natural brain tonic that helps in mental peace and relaxation, migraine, headache, insomnia, depression, anxiety, brain cell rejuvenation, blood circulation in the brain, improved memory function and hormone secretion 46. Researchers also used the dietary supplement inosine, a precursor to irate 48.

3.9. Eye disorders

Nutraceuticals rich diet appears beneficial for age related macular degeneration. Lutein, DHA, green tea, carotenoids, flavonoids, vitamin E, coenzyme Q10 posses antioxidant activity and are affective for presbyopia, cataracts. Zeaxanthin is used for the treatment of glaucoma, visual disorders 49. Melatonin, spirullina, coenzyme Q10 and soy isoflavones are also used for the control of macular degeneration. Flavonoids, ascorbic acid, tocopherol, carotenoids, caffeine, pyruvate are efficacious for retinitis pigmentosa 49. Rice bran, fruits and vegetables contain both lutein and zeaxanthin which improves eye sight and reduces the chance of cataracts formation. The essential fatty acid, omega 3, 6, and 9, folic acid in rice bran also promote eye health 49.

3.10. Stress Management

Stress is a vital part of our psychological make up and is a threat to our existence. The natural bioactive compounds called adaptogens helps to cope up against stress related cellular damages. They cause a non specific increase in the resistance of an organism to noxious influences. They exert to normalize and provide balancing action both for stress and mental health. Thus they gradually increase emotional performance that promote recovery from stressful situations. Herbal nutraceuticals like ashwagandha, rhodiola, L-theanine, ginseng are effective adaptogens that activates the production of stress suppressing heat-shock protein 70 (HSP-70). They also stabilizes physiologic processes, promotes homeostasis, increases resistance to environmental stress, reduces moderate to severe anxiety, improves sleep, reduces depression and improves secondary memory 50.

4. CONCLUSION

The scope of nutraceutical field is plenty both in terms of type and the varieties. Nutraceuticals industry in India is one of the rapid growing markets. Higher and upper middle class consumers are perceiving nutraceuticals as alternative to prescribed drugs and exclusively for their beneficial properties without any side effects. Consumers are showing sharp interest in nutraceuticals for boosting energy and improving their physical endurance and mental alertness. Nutraceutical industries are focussing to develop new product with innovative formulations and using proper advertisements for choosing the right products to the consumers. Nutraceuticals have significant promise in the promotion of human health and prevention of disease. They are widely accepted by all age groups due to their safety, higher quality, purity, efficacy, health promoting and disease curing activities. The newest trend is moved towards nutraceuticals led to new era of medicine and health. It is still in its stage of infancy in India. But in this hype era we must say “let food be your medicine” and “proper nutraceuticals daily can keep the medicine away”.

Conflict of Interest: The authors have no conflict of interest.

REFERENCES


