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Review Article

**NUTRACEUTICALS FOR PREVENTION OF VARIOUS
DISEASE CONDITIONS****M Keerthana, Gera Jemimah, T Shravani Reddy, Yamuna Bonagiri, AVSSS Gupta,
Dr. JVC Sharma**

Joginpally B.R Pharmacy College, Yenkapally, Moinabad, Hyderabad, Telangana

Article Received: September 2019 **Accepted:** October 2019 **Published:** November 2019**Abstract:**

Nutraceuticals are foods providing all the essential nutrients required for maintaining the optimal health. They are used as alternatives to modern medicines to promote quality of health, increase nutritive value of the diet and to prolong life expectancy. They have received considerable zest for their expected safety and therapeutic effects. Generally, consumers prefer food supplements to improve their health, as drugs show various side effects and adverse reactions. The principle reason for the growth of the nutraceutical market worldwide is current health status and lifestyle disorders. Nutraceutical market is seeing tidal growth mainly in the United States, India and European countries. This article briefly discusses about their classification and uses in various diseases.

Key words: *Nutraceuticals, essential nutrients, health, therapeutic effects, food supplements.***Corresponding author:****Gera Jemimah,**

Joginpally B.R Pharmacy College, Yenkapally

Moinabad, Hyderabad, Telangana

Mobile: 9505346133

E-mail: gerajemimah7@gmail.com

QR code



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INTRODUCTION:

The term nutraceutical was coined by Stephen DeFelice, founder and chairman of the foundation for Innovation in Medicine, located in Cranford, New Jersey [1]. It combines the word nutrient (a nourishing food or food component) and pharmaceutical (a medical drug) [2]. The word ‘nutraceutical’ is defined as any substance that may be considered as a food or part of a food and provides medical and health benefits, including the prevention and treatment of disease. Pharmaceuticals may be considered as the drugs used mainly to treat diseases, while nutraceuticals are those that are intended to prevent diseases. Both pharmaceuticals and nutraceuticals can cure and prevent diseases but only pharmaceuticals have sanctions from the government. Nutraceuticals may range from isolated nutrients, dietary supplements and diets to genetically engineered designer foods, herbal products and processed foods such as cereals, soups and beverages. Hippocrates emphasized “Let food be your medicine and medicine be your food” [3-6].

There is a slight difference between the terms functional foods, nutraceuticals, dietary supplement and medical foods. When food is being cooked or prepared using “scientific intelligence” with or without the knowledge of how or why it is being used, then it is called “functional food”. It provides the body with the required amount of vitamins, fats, carbohydrates, etc. for the healthy survival. When functional food aid in prevention and treatment of disease or disorder other than anaemia, it is called a nutraceutical [6, 7].

A dietary supplement is a product that is intended to supplement the diet that bears or contains one or more ingredients like vitamins, minerals, herbs, amino acid or a concentrate, metabolite, constituent, extract, or combinations of these. Medical foods are a specific category of therapeutic agents that are intended for nutritional management of a specific disease [3].

Phytonutrients are plant nutrients with particular biological activities in supporting human health. Compared to nutraceuticals, functional foods and dietary supplements, phytonutrients are more natural bioactive compounds from plants. They have major role in many physiological functions like

1. Substrates for biochemical reactions
2. Cofactors of enzymatic reactions
3. Inhibitors of enzymatic reactions
4. Absorbents that bind to and eliminate undesirable constituents from the intestine

5. Enhancement of absorption and/or stability of essential nutrients
6. Selective growth factors for beneficial bacteria
7. Fermentation substrates for beneficial bacteria
8. Selective inhibitors of deleterious intestinal bacteria
9. Scavengers of reactive or toxic chemicals
10. Ligands that agonize or antagonize cell surface or intercellular receptors [8].

Nutraceuticals create a new era of research to promote quality of life. They can reduce the risk of disease onset by retaining normal health condition and improving immunity [9]. As food is not only the source of energy and nutrients but also provides medicinal benefits and nutritional therapy is based on complimentary therapy with nutraceuticals [10].

Large numbers of people are dependent on natural and alternative medicines in India due to imbalance in the diet and nutritional deficiencies. Nutraceuticals are now available as capsules, tablets or powders in a prescribed dose. Vitamin D will see the fastest growth in demand due to its increasing clinical evidence in the treatment of swine flu, cancer, and other preventive medicine benefits [11]. Some popular nutraceuticals include green tea (anti-oxidant), glucosamine (for arthritis), lutein (for macular degeneration), ginseng (for cold), echinacea (anti-immune), folic acid, cod liver oil etc [12].

Advantages [13]:

1. Nutraceuticals play an important role in healthy eating and contributes in prevention and treatment of diseases
2. Enables consumers to derive daily dose of vitamins and minerals
3. They are less toxic when compared to conventional pharmaceuticals
4. Cost effective and are easily available

CLASSIFICATION OF NUTRACEUTICALS:

Based on the food sources, nutraceuticals are classified as follows [14-18]

1. Dietary fibres:

Dietary fibres are plant origin substances present in the food and are not digested in gastrointestinal tract but, add bulk to the intestinal contents. Intake of fibres in diet is associated with low risk of cardiovascular diseases, hypertension, diabetes, obesity, colon cancer and gastrointestinal disorders. Examples of dietary fibres include fruits, barley, oats, lignin, cellulose, pectin etc.

2. Probiotics:

Probiotics are live microbial food supplements which, when administered in adequate dose help in improving the intestinal microbial balance of the host. They decrease the risk of allergy, asthma, cancer, infection of ear and urinary tract. Examples of probiotics include Lactobacilli, Bifidobacterium etc.

3. Prebiotics:

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

4. Polyunsaturated fatty acids:

Polyunsaturated fatty acids can be omega-3-fatty acids like alpha linolenic acid, eicosapentaenoic acid and docosahexaenoic acid found in fatty fishes, flaxseeds, soybean etc. or omega-6-fatty acids like alpha linoleic acid and arachidonic acid found in corn, sunflower and soybean etc.

5. Antioxidant vitamins:

Antioxidants are endogenous or exogenous substances which inactivate the free radicals. Antioxidant vitamins are abundant in many fruits and vegetables, possess singlet oxygen quenching and lipid peroxidation preventing properties and also prevent number of diseases. Examples include vitamin C, vitamin E and carotenoids.

6. Polyphenols

Polyphenols are phytochemicals like flavonoids, anthocyanins and phenolic acids, which are produced by plant for protection against photosynthetic stress and reactive oxygen species. They possess anti-inflammatory and antioxidant properties and are found in foods like legumes, tea and soybean etc.

7. Spices

Spices are esoteric food adjuncts used to enhance sensory quality of foods. They have antioxidant, chemopreventive, anti-mutagenic, anti-inflammatory and immunomodulatory effects. Most of the components of spices are terpenes and other constituents of essential oils. Examples include ginger, turmeric, black pepper etc.

NUTRACEUTICALS IN DISEASES:

1. Diabetes

Diabetes mellitus is characterised by abnormally high levels of blood glucose, either due to insufficient insulin production, or due to its ineffectiveness. The most common forms of diabetes are type-1 diabetes (5%), an autoimmune disorder and type-2 diabetes (95%), which is associated with obesity. Gestational diabetes occurs in pregnancy [19].

In diabetic patients, Omega-3-fatty acids are suggested to reduce glucose tolerance and promote insulin sensitivity. Insulin is required for the synthesis of long chain n-3 fatty acids, which contain ethyl esters that may be potentially beneficial in diabetic patients [20]. A high isoflavone intake (20-100 mg/day) is associated with lower incidence and mortality rate of type 2 diabetes, heart diseases, osteoporosis and certain cancers [21]. Docosahexaenoic acid modulates insulin resistance, especially important in women with gestational diabetes mellitus which foster the recommendation for essential fatty acids during pregnancy [22].

Lipoic acid is a universal antioxidant, may be more effective as a long-term dietary supplement aimed at the prophylactic protection of diabetic patients from complications. Dietary fibres from psyllium help in weight reduction, glucose control in diabetic patients and to reduce lipid levels in hyperlipidaemia [23, 24].

Magnesium reduces diabetes risk and improves insulin sensitivity. Calcium and vitamin D also promotes insulin sensitivity and improves glycemic control in some diabetics. Caffeic acid reduces elevated plasma glucose levels in insulin resistant patients. Green tea and epicatechin-3-gallate reduces fasting and postprandial glucose levels and improve insulin resistance. Bitter melon, pomegranates are good for diabetes, as they regulate metabolism and transport glucose from the blood into cells [12].

2. Cardiovascular diseases:

Cardiovascular diseases is the name for the group of disorders of the heart and blood vessels, and include hypertension (high blood pressure), coronary heart diseases (heart attack), cerebrovascular disease (stroke), heart failure, peripheral vascular diseases, etc. It was reported that low intake of fruits and vegetables is associated with a high mortality in cardiovascular diseases [25]. Antioxidants, dietary fibres, omega-3 polyunsaturated fatty acids, vitamins and minerals along with physical exercise

are recommended for prevention and treatment of cardiovascular diseases [26].

Nutraceuticals like phytosterols, policosanol, monacolin etc, tend to reduce circulating levels of LDL-cholesterol. This is achieved by modulating cholesterol production in liver, binding cholesterol within intestines and/or increasing LDL-c receptor uptake in the liver [27]. Polyphenols present in grapes alter cellular metabolism and signalling, thereby reduces arterial diseases. They also reduce the possibility of oxidation by neutralising free radicals. Nutraceuticals that show antihypertensive activity by blocking calcium channels include alpha-lipoic acid, magnesium, vitamin B6 (pyridoxine), vitamin C, N-acetyl cysteine, celery, omega-3-fatty acids, etc. [28].

Flavonoids in plants available as flavones, flavanones play a major role in curing cardiovascular diseases. They inhibit cyclooxygenase pathway and angiotensin converting enzyme (ACE), which is responsible for high blood pressure and also prevent platelet aggregation and stickiness. Because of high ability to transfer electrons, scavenge reactive oxygen species i.e. decrease oxidative stress, flavonoids are considered as cardio-protectors in delaying the onset of atherosclerosis [29].

Phytosterols compete with dietary cholesterol by blocking the uptake and facilitating cholesterol excretion from the body. Buckwheat proteins more importantly lower cholesterol and high blood pressure, and are also beneficial in constipation and obesity. Dietary fibres from defatted rice bran have laxative and cholesterol lowering ability. Essential fatty acids are required for production and rebuilding of cells, to reduce blood pressure, lower cholesterol and triglycerides, reduce the risk of blood clots, helps in preventing many diseases including arthritis, arrhythmias, and other cardiovascular diseases. Octacosanol has gastroprotective and lipid lowering effects. Allicin lowers blood pressure and cholesterol [30].

3. Cancer:

Nutraceutical rich bioactive dietary components have the ability to prevent cancer [31]. Vitamins (folate) play a major role in DNA methylation and cancer prevention. Ginseng is an anti-inflammatory compound that prevents chronic inflammation of cancer [32]. Flavonoids found in citrus fruits appear to offer protection against cancer by acting as antioxidants [33]. Fruits and vegetables containing lycopene exert cancer-protective effect via decrease

in oxidative and other damage to DNA in humans. Tannins and saponins are found to have anticarcinogenic effect [34].

Phenolics such as ferulic, caffeic, gallic acids and curcumin possess anticancer activity. Thiosulfonates present in garlic and onions possess anticarcinogenic properties [30]. *Astragalus membranaceus* (Fabaceae) is a traditional Chinese herb, used as anticancer, antidiabetic, immune enhancer, antioxidant and hepatoprotective agent [35].

4. Obesity:

Obesity is a medical condition characterised by accumulation of excess body fat and is associated with various risk factors such as angina pectoris, congestive heart failure, hypertension, osteoarthritis, hyperlipidaemia, etc. A tolerable and effective nutraceutical that can increase energy expenditure and/or decrease caloric intake is desirable for body weight reduction.

5-hydroxytryptophan decreases appetite whereas, green tea extract increases energy expenditure, thus promote weight loss. Fenugreek, chitosan, vitamin C, curcumin, black gram, bottle guard also reduces body weight [30].

5. Osteoarthritis:

Osteoarthritis is a disease with a multifactorial etiology affecting all joint tissues, involving both biochemical and mechanical factors that act in synergy to degrade cartilage [36]. Nutraceuticals like glucosamine, chondroitin sulfate, ginger, green tea, pomegranate, curcumin, avocado, collagen hydrolysate, etc. are used to decrease the complications associated with osteoarthritis [37]. Nutraceutical antioxidant agents have considerable evidence for treating inflammation, pain and joint destruction. Chondroitin sulfate and glucosamine supplementation prevents arthritic pain and narrowing of joint space. Application of olive oil reduces pain, stiffness and swelling [38].

6. Alzheimer's disease:

Oxidative stress is etiologically related to a number of neurodegenerative disorders including Alzheimer's disease, which is characterised by progressive dementia with memory loss as the major clinical manifestation. Nutraceuticals like beta-carotene, lycopene, curcumin, lutein etc, acts as antioxidants and prevent oxidative stress induced neuronal damage [39].

7. 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 difficulty in walking. Plant polyphenols, stilbenes, soybean and other phytoestrogens, vitamin C, vitamin D, vitamin E, coenzyme Q₁₀ and unsaturated fatty acids revealed protective roles against progression of Parkinson's disease [40]. Creatine appeared to modify Parkinson's disease features as measured by a decline in the clinical signs [30].

8. Allergy:

Allergy is a condition in which body has an exaggerated response to either a drug or food. Quercetin is a flavonoid, a polyphenolic substance and a natural antihistamine. It inhibits some inflammatory enzymes such as lipid peroxidases and decreases leukotriene formation. It also exerts antioxidant properties by scavenging free radicals [41].

9. Oral diseases:

Odontonutraceuticals represent pleiotropic phytotherapeutic agents in dentistry as they regulate different molecular and biochemical targets. They include green tea, grapes, cocoa seed extracts which are rich in polyphenols, flavonoids and proanthocyanidins, thus prevent oral diseases. Probiotics are helpful in preventing dental caries, periodontitis etc [42, 43].

10. Eye disorders:

Lutein also known as helenin, is one of the carotenoids found in fruits and vegetables, is used for the treatment of visual disorders. Zeaxanthin found in corn, egg yolks, green vegetables and fruits is used in the treatment of eye disorders [3]. Green tea, carotenoids, flavonoids, vitamin E, coenzyme Q₁₀ possesses antioxidant activity and are effective for presbyopia, cataracts. Omega 3, 6 and 9 fatty acids, folic acid in rice bran also promote eye health [9].

11. Migraine:

Migraine is a recurrent throbbing headache that typically affects one side of the head and is often accompanied by nausea and disturbed vision. Nutraceuticals used for the treatment of migraine are feverfew, petasites, coenzyme Q₁₀ etc. Dried leaves of feverfew contain melatonin and chrysanthenyl acetate, which play a role in treating migraine. *Petasites hybridus* commonly known as butterbur, found to be safe and effective for long-term use in management of migraine [43].

12. Stress management:

Stress is a vital part of our psychological makeup and is a threat to our existence. The natural bioactive compounds called adaptogens help to cope up against stress related cellular damages. They cause non-specific increase in resistance of an organism to noxious influences and exert to normalize and provide balancing action for both stress and mental health. Herbal nutraceuticals like ashwagandha, rhodiola, L-theanine, ginseng are effective adaptogens that activates the production of stress suppressing heat shock protein 70 (HSP-70) and stabilizes physiologic processes, promotes homeostasis, increases resistance to environmental stress, reduces moderate to severe anxiety, improves sleep, reduces depression and improves secondary memory [6].

13. Prolonging life span:

Nutraceuticals present in citrus fruits and soybean has effect on epigenetic modifications, autophagy and necrosis. Caffeic acid and rosmarinic acid present in fruits, vegetables and herbs are anticarcinogenic, antioxidant, anti-rheumatic and antimicrobial in nature, and can prolong healthy life span [44].

REGULATORY ASPECTS:

Even though nutraceuticals are safe and used for improvement of health status of an individual, the level of risk posed by them or functional foods varies widely and depends on many factors like, the ingredients of the products and the way they are used by the consumer. So, their use and production must be managed and regulated in keeping view the degree of risk they pose [45].

Dietary Supplement Health and Education Act (DSHEA) passed in the year 1994, governs the nutraceutical market. The passage of Food and Drug Administration Modernization Act (FDAMA) in the year 1997 made a number of options available to manufacturers of nutraceuticals. The FDA must establish good manufacturing practices for nutraceuticals to regulate the pharmaceutical industries to ensure the quality of the product.

ROLE OF R&D INNUTRACEUTICAL PREPARATIONS:

1. To test safety, purity and potency of products
2. To develop testing methods for ensuring and verifying the consistency of the dosage form
3. Develop new products either by combining existing ingredients used in nutritional supplements or identifying new ingredients that can be used in nutritional supplements [46].

ROLE OF PHARMACISTS IN SUPPLEMENTS:

Pharmacists play a critical role in the health and wellbeing of the customers they meet each day. More than just dispensers of pharmaceuticals, pharmacists work in partnership with doctors to ensure their customers receive the best and most appropriate treatments to cure their ills. Quite often, customers turn to pharmacists for their advice on not just prescription medication, but also dietary supplements, asking questions like which supplement is best for certain conditions and which brand is most reputable. Pharmacists should stay current with emerging nutrition science to support the health goals and interests of their customers. This leads to greater long-term health for everyone [47].

CONCLUSION:

It is very imperative that nutrients found in many foods, fruits and vegetables are responsible for the well documented health benefits. Nutraceuticals are widely accepted by all the age groups due to their safety, efficacy, high quality and purity. They play a crucial role in protection against the pathologies of numerous age related or chronic diseases. Future demand of nutraceuticals depends on consumer perception of the relationship between diet and disease. Nutraceutical industry in India is one of the rapid growing markets. Because of their numerous health benefits, they must be taken regularly to reduce risk factors like high cholesterol, high blood pressure and diabetes. With a little bit of careful handling, the future of both plant and animal origin nutraceuticals holds exciting opportunities in the medical field.

REFERENCES:

1. Lakshmana PS, SuriyaPTNK, Dinesh KC, Suresh KS, Ragavendran T. Nutraceuticals: A Review. *Elixir Pharmacy*, 2012; 46:8372-8377.
2. Ross S. Functional foods: the Food and Drug Administration perspective. *Am J Clin Nut*, 2000; 71:1735-1738.
3. Rajasekaran A, Sivagnanam G, Xavier R. Nutraceuticals as therapeutic agents: A Review. *Research J Pharm and Tech*, 2008; 1(4):328-340.
4. Brower V. Nutraceuticals: poised for a healthy slice of the healthcare market? *Nat Biotechnol*, 1998; 16(8):728-731.
5. Eskin M, Tamir S. 2019. *Dictionary of Nutraceuticals and Functional Foods*. Boca Raton, USA: CRC Press.
6. Kalra EK. Nutraceutical – definition and introduction. *AAPS Pharmsci*, 2003; 5:1208-1212.
7. Parasuram RR, Rawat BM Singh, Thangavel SK. Nutraceuticals: An area of tremendous scope. *International Journal of Research in Ayurveda & Pharmacy*, 2011; 2(2):410-415.
8. Padmavathi D. A general review on “Nutraceuticals”: Its golden health impact over human community. *International Journal of Food Sciences and Nutrition*, 2018; 3(2):214-217.
9. Sangita D, Kazi MA, Sandeep KD, Biplab G. Role of nutraceuticals on health promotion and disease prevention: A review. *Journal of Drug Delivery & Therapeutics*, 2018; 8(4):42-47.
10. Chauhan B, Kumar G, Kalam N, Ansari SH. Current concepts and prospects of herbal nutraceuticals: A Review. *Journal of Advanced Pharmaceutical Technology and Research*, 2013; 4(1):4-8.
11. Namdeo S, Bhaskar B, Sunil D, Pratik K. Nutraceuticals: A Review on current status. *Research J Pharm and Tech*, 2014; 7(1):110-113.
12. Stephen D. A report of National Nutraceutical Centre. *Nutraceuticals India 2012 webinar*, 2012; 1-22.
13. Salma Sayeed. 2015. Nutraceuticals – let food be your medicine. Available at: <https://www.slideshare.net/nimatanamikaze/nutraceuticals-45465067> [Accessed 24 October 2019].
14. Kiran D. Nutraceuticals and their impact on human health. *J Plant Biochem Physiol*, 2013;1(4):1-3.
15. Das L, Bhaumik E, Raychaudhari U, Chakraborty R. Role of nutraceuticals in human health. *J Food Sci Technol*, 2012; 49(2):173-183.
16. Lenoir-wijnkoop I, Sanders ME, Cabana MD, Caglar E, Corthier G, et al. Probiotic and prebiotic influence beyond the intestinal tract. *Nutrition Reviews*, 2007; 65(11):469-489.
17. Hord NG. Eukaryotic-microbiota crosstalk: potential mechanisms for health benefits of prebiotics and probiotics. *Annu Rev Nutr*, 2008; 28:215-231.
18. Kochhar KP. Dietary spices in health and diseases (II). *Indian J Physiol Pharmacol*, 2008; 52(4):327-354.
19. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes care*, 2011; 1:62-69.
20. Sirtori CR, Galli C. N-3 fatty acid and diabetes. *Biomedicine & Pharmacotherapy*, 2002; 56(8):397-406.
21. Brouns F. Soya isoflavones: a new and promising ingredient for the health foods sector. *Food Research International*, 2002; 35(2-3):187-193.
22. Thomas B, Ghebremeskel K, Lowy C, Crawford M, Offley-Shore B. Nutrient intake of women

- with and without gestational diabetes with a specific focus on fatty acids. *Nutrition*, 2006; 22(3):230-236.
23. Coleman MD, Eason RC, Bailey CJ. The therapeutic use of lipoic acid in diabetes: a current perspective. *Environ ToxicolPharmacol*, 2001; 10(4); 167-172.
24. Singh B. Psyllium as therapeutic and drug delivery agent. *Int J Pharm*, 2007; 334(1-2):1-14.
25. Rissanen TH, Voutilainen S, Virtanen JK, Vendo B, Vanharanta M, Mursu J, Salonen JT. Low intake of fruits, berries and vegetables is associated with excess mortality in men: the Kuopio Ischaemic Heart Disease Risk Factor (KIHD) study. *J Nutr*, 2003; 133(1):199-204.
26. Mandala F, Guida R, Guida GF. Nutraceuticals: what they are and how they work. *European Society of Cardiology practice*, 2010; 9(11).
27. German JB, Walzem RL. The health benefits of wine. *Annu Rev Nutr*, 2000; 20:561-593.
28. Houston MC. Nutraceuticals, vitamins, antioxidants, and minerals in the prevention and treatment of Hypertension. *Prog Cardiovasc Dis*, 2005; 47(6):396-449.
29. Hu FB, Willett WC. Optimal diets for prevention of coronary heart disease. *JAMA*, 2002; 288(20):2569-2578.
30. Hamid N, Baradaran A, Shirzad H, Rafieian-Kopaei M. New concepts in nutraceuticals as alternative for pharmaceuticals. *Int J Prev Med*, 2014; 5(12):1487-1499.
31. Avrelija C, Walter C. Antimicrobial agents deriving from indigenous plants. *Recent Pat Food Nutr Agric*, 2010; 2(1):83-92.
32. Sabita NS, Trygve OT. The role of nutraceuticals in chemoprevention and chemotherapy and their clinical outcomes. *Journal of Oncology*, 2012; 64:1-23.
33. Frydoonfar HR, McGrath DR, Spigelman AD. The variable effect on proliferation of a colon cancer cell line by the citrus fruit flavonoid Naringenin. *Colorectal Dis*, 2003; 5(2):149-152.
34. Stahl W, Sies H. Bioactivity and Protective Effects of Natural Carotenoids. *Biochim Biophys Acta*, 2005; 1740(2):101-107.
35. Silpi Chanda, Tiwari RK, Arun K, Singh K. Nutraceuticals Inspiring the Current Therapy for Lifestyle Diseases. *Advances in Pharmacological sciences*, 2019; Article ID 6908716.
36. Wildman REC. 2006. Handbook of Nutraceuticals and Functional foods. New York: CRC press.
37. Sacco SM, Horcajada MN, Offord E. Phytonutrients for bone health during ageing. *British Journal of Clinical Pharmacology*, 2013; 75(3):697-707.
38. Agarwal S. 2017. Leading pharmaceutical consultant, Nutraceuticals and osteoarthritis. Available at: <https://www.drсанjayagarwal.com> [Accessed 25 October 2019]
39. Klatte ET, Scharre DW, Nagaraja HN, Davis RA, Beversdrof DQ. Combination therapy of donepezil and vitamin E in Alzheimer disease. *Alzheimer Disease and Associated Disorder*, 2003; 17(2):113-116.
40. Chao J, Leung Y, Wang M, Chang RCC. Nutraceuticals and their preventive or potential therapeutic value in Parkinson's disease. *Nutrition Reviews*, 2012; 70(7):373-386.
41. Formica JV, Regelson W. Review of the Biology of Quercetin and related bioflavonoids. *Food and chemical Toxicology*, 1995;33(12):1061-1080.
42. Gaur S, Agnihotri R. Green tea: a novel functional food for the oral health of older adults. *Geriatrics and Gerontology International*, 2014; 14(2):238-250.
43. Somya G, Parvez N, Sharma PK. Nutraceuticals as functional foods. *Journal of Nutritional Therapeutics*, 2015; 4(2):64-72.
44. Pietsch K, Saul N, Chakrabarti S, Sturzenbaum SR, Menzel R, Steinberg CE. Hormetins, antioxidants and prooxidants: defining Quercetin-, caffeic acid- and rosmarinic acid-mediated life extension in *C.elegans*. *Biogerontology*, 2011; 12(4):329-347.
45. Available at: <https://www.canada.ca/en/health-canada/services/food-nutrition/food-labelling/health-claims/nutraceuticals-functional-foods-health-claims-foods-policy-paper.html> [Accessed 25 October 2019]
46. Quazi M, Khurshid IM, Nazim S, Asir Q, Shoeb Q. Nutraceuticals: Important and advances in medicine and health. *International Research Journal of Pharmacy*, 2012; 3(4).
47. Available at: <https://www.nutraceuticalsworld.com> [Accessed 25 October 2019]