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Nutraceuticals: A New Era In Modern Healthcare

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Abstract:

Nutraceuticals, a term coined by Dr. Stephen in 1989, refer to food products that offer health benefits beyond basic nutrition, including disease prevention and treatment. Following the Dietary Supplement Health and Education Act of 1994, the definition has expanded to include a variety of components such as vitamins, minerals, herbs, and amino acids. While nutraceuticals and functional foods have gained recognition, they are not uniformly regulated globally, making dietary supplements more prominent in many markets. This paper categorizes nutraceuticals into traditional and non-traditional types, discussing their applications in health promotion and disease management, particularly for conditions like diabetes, cardiovascular diseases, cancer, obesity, and neurodegenerative disorders. The Indian nutraceutical market is experiencing rapid growth due to increasing health awareness and lifestyle changes, leveraging the country's rich biodiversity and traditional medicine practices. The significance of nutraceuticals lies in their potential to mitigate malnutrition-related health issues and enhance overall wellness, positioning them as vital components of modern healthcare.

Nutraceuticals represent a crucial intersection of nutrition and medicine, utilizing natural food components to prevent and treat various diseases. The increasing awareness of the importance of nutrition in health maintenance has led to the rapid expansion of the nutraceutical market, particularly in India. Despite the promising benefits, challenges related to regulation and labeling persist, necessitating a structured approach to ensure safety and efficacy. Overall, nutraceuticals offer significant potential for enhancing quality of life and promoting healthier living.

Keywords: Nutraceuticals, Nutrition, Functional Foods, Dietary Supplements, Healthcare.

Introduction:

Natural material extracts have been extensively utilized by humans to produce medicines since ancient times, and they have been employed for a variety of purposes. The word "nutraceuticals," which unites nutrition and pharmaceuticals, first came into existence in 1989 by Dr. Stephen. The term "nutraceuticals" has been stated as encompassing vitamins, minerals, herbs and other botanicals, amino acids, and dietary components for human use as dietary supplements since the Health and Education Act of 1994 was passed [1]. AAFCO (1996) specifies a "nutrient" as a constituent of feed in a form and proportion that will support an animal's or human's life, and a "nutraceutical" as any nontoxic food ingredient with scientifically demonstrated health benefits, such as illness prevention and treatment [2]. The word nutraceutical is not widely acknowledged in worldwide regulatory systems, whereas dietary supplements are seen to be more prominent. There already exist around 470 Nutraceutical and Functional food products available that are scientifically shown to possess health benefits [3].

Nutraceuticals are food-derived products that claim to provide additional health benefits beyond the standard nutritional value of foods. Depending on the jurisdiction, goods can be claimed to prevent chronic

diseases, strengthen health, delay the aging process, extend life expectancy, or support the structure and functioning of the body [4]. Pharmaceuticals are healthcare products used primarily to cure diseases, whereas nutraceuticals are intended to prevent disease. Nutraceuticals are substances with biological activity found in foodstuffs that have comparable characteristics with both nutrition and pharmaceuticals. Nutraceuticals are natural bioactive or organic substances that, in addition to functioning as a nutritional supplement, enhance health, cure medical conditions, or prevent diseases. Nutraceuticals might include single nutrition, supplements with minerals and vitamins, diets, foods suggested for genetic modification, herbal products, and processed foods such as meals, soups, and drinks. Hippocrates emphasized, "Let food be your medicine and medicine Be your Food" [5-8]. Functional foods, nutraceuticals, dietary supplements, and medical foods each have comparatively distinct concepts. "Functional food" is specified as food that's being cooked or prepared making use of "scientific intelligence" with or without having any idea how or why it is being implemented. It consists of the body with the essential vitamins, lipids, carbs, along with additional materials that it requires to function properly. Nutraceuticals are somewhat food products that may help avoid and cure disorders or illnesses other than anemia [8,9].

Nutraceuticals are health-promoting substances that originate from a variety of companies. Including food, herbal products, and pharmaceutical production. The importance of these kinds of products has been associated to the treatment of several kinds of medical conditions, which might include cancer, problems with metabolism, cough and colds, depression as well, cardiovascular disease, delayed gastric emptying, and a number of other medical issues that require special attention [10,11]. Nutraceuticals are in growing demands due to their ability to provide high health value, prolong cell life, promote healthy living, lower the possibility of adverse reactions from current medicines. Nutraceuticals have significant biological benefits, including anti-diabetes, antioxidant support, anti-obesity, immune-mediated boosting, and combating heart disease. They also result in a better standard of life. One the pharmaceutical and food industries are collaborating to use bioactive food, pharmaceutical, and nutrition products, ranging from palatable dairy products to well-known designer bone, heart, and digestive medicinal products to calcium chews, from sports meals bar suppliers to soy burger companies. Bioactive foods are predicted to expand rapidly in the coming decades [12].

Categories of Nutraceuticals:

Nutraceuticals are general biological medicines used to improve health, avoid cancer, and manage signs and symptoms. These can be divided into a number of categories [13].

Nutrient: The food element in the specific form and quantity required to sustain an animal's life. Lipids, proteins, sugars, mineral substances, and vitamins are the five main forms of feed nutrients.

Dietary Supplement: a substance that comprises more than one of the following dietary components: vitamin, minerals, herb or other botanical, essential amino acids (protein), together with the diet in the type of concentrates, components, extracts from plants, or byproducts.

Nutraceutical: A nutraceutical is any natural dietary component having scientifically demonstrated health benefits, such as medical conditions prevention and treatment.

Herbals: Herbals are concentrated or isolated substances from plants. Herbs are as ancient as humankind itself and give a vast array of remedies for both acute as well as chronic conditions. India has the most ancient written system for natural remedies called 'Ayurveda,' which provides numerous potent ways of assuring good health. Various Nutraceuticals are found in medicinal herbs with significant components.

Concept of Nutraceuticals:

In the pharmaceutical development process, clinical test outcomes from animal experiments and studies are required to prove the effects. In contrast, there was previously no technique of verifying foods for illness prevention. However, in recent years, the composition of food has been scientifically established to induce lifestyle-related disorders, making it a social issue [14].

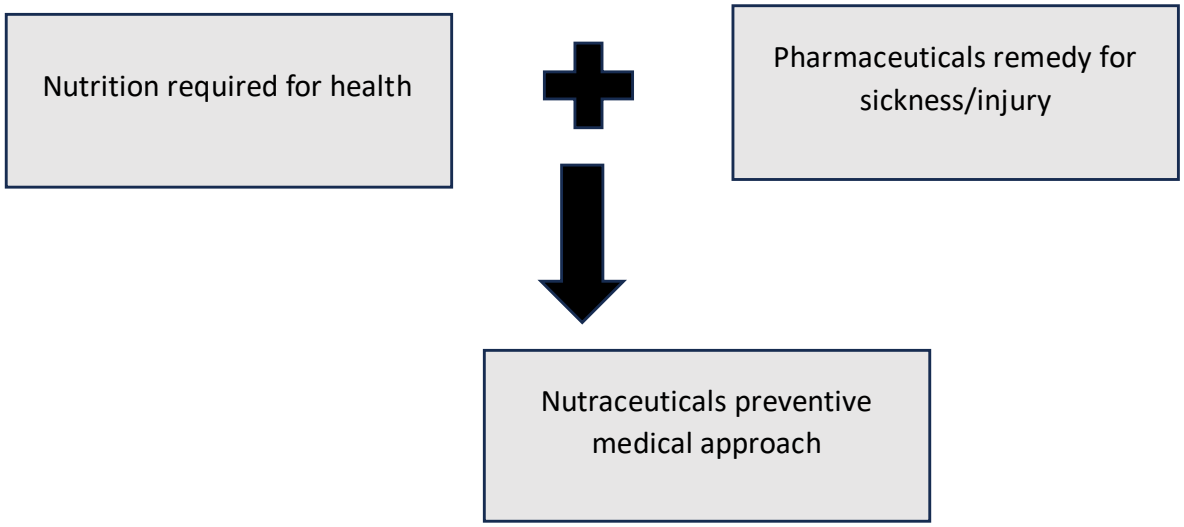

Figure 1. Concept of Nutraceuticals

Classification of Nutraceuticals:

On the basis of their uses, Nutraceuticals are classified into:
A) Traditional Nutraceuticals
B) Non – Traditional Nutraceuticals

A) Traditional Nutraceuticals
1)Nutrients
2)Herbals
3)Phytochemical
4)Probiotic organism
5)Nutritional enzymes

B) Non – Traditional Nutraceuticals
1)Fortified
2)Recombinant

A)Traditional Nutraceuticals: This group includes foods that do not undergo any manual alterations. The component parts are natural and have the ability to actively participate in health benefits [15]. The category includes lycopene, a tomato component [16].

Traditional Nutraceuticals include the following:

1)Nutrients: AAFCO (1996) defined nutrition as "a food component in an pattern and to an extent that can help an individual maintain a healthy lifestyle" [17]. The primary nutrients include carbs, lipids, proteins, vitamins, and minerals. Many foods contain vitamins, which can help treat ailments such as cataracts, heart disease, stroke, and osteoporosis. Similarly, minerals found in dairy items, animals, and plants can aid with anemia, osteoporosis, the production of strong wisdom teeth, muscle tissue, and the bones, and the improvement of the cardiac rhythm [18].

2)Herbals: The class includes herbs with therapeutic properties that have been linked to both the prevention and treatment of illnesses. Botanical goods can be made from fresh plants or any of their parts, such as dried leaves, fruit, stems, roots, seeds, or concentrated extracts [19].

3)Phytochemicals: These are chemical ingredients of plants that have distinct biological effects. These have been discovered to have active substances that influence metabolic and biochemical responses in living beings, resulting in health benefits [20].

4)Probiotic organism: The term "probiotics" means "for life". It comprises foods containing living bacterial cells that are good for your health. They destroy dangerous pathogens such as viruses, bacteria, or fungus that might cause diseases and act on specific areas in the digestive tract [21,22,23]. They maintain an antimicrobial impact by modifying microbiota, preventing bacteria from attaching to the gut lining, creating an antitoxic effect, and so on[24].

5)Nutritional enzymes: These digestive enzymes are generated from microbes, plants, and animal-based sources. Diabetes, overweight or obesity, and digestive issues can be managed by include enzyme supplements in the diet. They play a crucial role in our lives because without them, our bodies would not work properly [25].

C)Nontraditional Nutraceuticals: This class of nutraceuticals includes the enhancement of the nutritional value through the inclusion of nutrients, as well as nutrients from food to increase the quality of nutrition [15]. This class includes beta-carotene-enriched rice [16].

Non-Traditional Nutraceuticals include the following:

1)Fortified Nutraceuticals: The fortification of food substances is the practice of adding micronutrients (important trace substances and vitamins) to nutrition to enhance its potency and nutritional value. Its example is cholecalciferol-fortified milk, which is used to treat vitamin D deficiency [26,27].

2)Recombinant Nutraceuticals: Nanotechnology and genetic engineering are used to produce energy-rich foods like yoghurt and cheese, as well as to extract biologically active substances using enzymatic or fermenting technologies. Gold kiwifruit is genetically modified to contain high levels of the antioxidant ascorbic acid, carotenoids, and lutein and Zeaxanthin [26] [28].

Nutraceutical Growth:

Nutraceuticals and functional foods have grown to be multibillion dollar industries in the worldwide marketplace. Significant growth restrictions in this field are being experienced globally as a result of the need to accurately label and evaluate the health effects of functional and nutraceutical foods. Development of substitute nutraceuticals and functional meals with unique properties will be made possible by selecting for continuous production of different levels of production of active plant ingredients within particular ecological zones and more reliable health and food properties. The United States of America (USA) currently possesses the largest and most rapidly expanding functional food and Nutraceutical market in the world [29]. India is the beginnings of numerous types of plants, ingredients, and medicinal plants with sizable local markets. In India, nutritional foods and nutraceuticals that are sold under numerous trademarks and are accessible as Traditional Indian Ayurvedic Medicines. But in India, there are no stringent pharmaceutical laws governing the use of Ayurvedic and nutritional health items; instead, people can purchase them over-the-counter without a doctor's recommendation. However, India's major export destination is the USA and Japan [30].

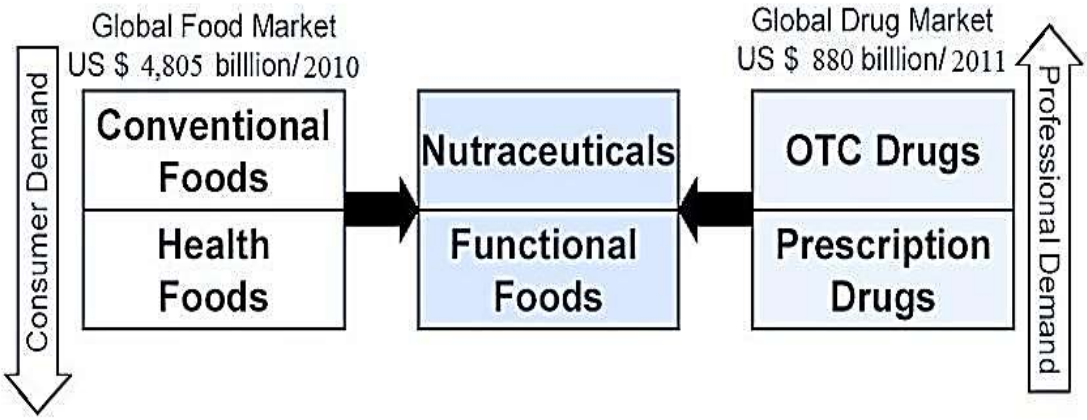

Figure 2. Growth of Nutraceuticals

Importance of Nutraceuticals:

In affluent and developing countries both, malnutrition is a major contributor to illness [31]. Despite the range of health issues brought by nutritional deficiency in calories and protein differs from over nutrition in empty calories, both of them can have disastrous effects on the lifespan and standard of life.

Some health consequences of malnutrition:

Emerging economies Developed Economies	**Protein-calorie Under nutrition and obesity**
-Decrease in Muscle mass -Cardiac and renal mass cell mediated Immunity -Fertility -Numerous skin changes -Normocytic and normochromic Anemia -Fatigue -Cell-Mediated immunity Pneumonia -Oppurtunistic infections -Impaired wound healing	-Metabolic syndrome with Increase risk of Cardiovascular disease (CVD), Congestive Heart Failure (CHF), Peripheral Vascular Disease (PVD), End-Stage Renal Disease (ESRD) -Gall bladder disease -Cancer risk especially - Endometrial, breast, prostate and colon -Osteoarthritis -Infertility

As we have transitioned from pre-agricultural, hunting and gathering society to a more modern farming sector that depends on mechanical harvesting for our food supply, our nutritional needs have also altered.1, 2 The growing problem of nutritionally related illnesses has resulted from the shift from the Paleolithic diet—composed of vegetables, fruits, berries, nuts, fiber, seafood, fowl, and wild game—to our current diet. The Paleolithic dietary habits had low sodium, rich potassium, high dietary fiber, low fat, lean protein from animals, minimal refined carbohydrates, and minimal cholesterol intake. These conditions include hypertension, atherosclerosis, and target organ diseases (TOD), which include myocardial infarction (MI), cerebrovascular accidents (VA), coronary heart disease (CHD), congestive heart failure (CHF), and renal failure (RF)[32].

Nutraceutical in diseases:

1)Diabetes:

The most common aspect of diabetes mellitus is unusually elevated blood glucose levels, which can be caused by either insufficient or poor supply of insulin. Type-1 diabetes (5%), an autoimmune disease, and type-2 diabetes (95%), a condition linked to obesity, are the two most prevalent types of the disease. Pregnancy is the cause of gestational diabetes [33]. Omega -3 fatty acids are recommended for diabetes individuals in order to lower tolerance to glucose and increase insulin resistance. Long chains n-3 fatty acids, which include ethyl esters that may be advantageous in diabetes patients, can only be synthesized with insulin [34].

A high isoflavone consumption (20–100 mg/day) is linked to a reduced risk and death rate of heart problems, osteoporosis, type 2 diabetes, and some other malignancies [35]. Universal antioxidant lipoic acid may work better as a long-term dietary supplement intended to shield patients with diabetes against problems in advance. Pseudo-dietary fibers from psyllium aid in lowering blood sugar levels in diabetics, helping them lose weight, and lowering cholesterol in hyperlipidemia [36, 37].

2)Cardiovascular diseases:

The term "cardiovascular diseases" refers to a collection of conditions affecting the heart and blood arteries, that involve peripheral vascular disorders, cardiac failure, hypertension (high blood pressure), coronary heart disease (heart attack), and cerebrovascular disease (stroke). Low consumption of fruits and vegetables has been linked to a higher death rate from cardiovascular illnesses [38]. LDL-cholesterol levels in the blood tend to be lowered by nutraceuticals such as phytosterols, policosanol, monacolin, etc. This is accomplished via influencing the liver's synthesis of cholesterol, binding cholesterol in the intestines, and/or boosting the liver's absorption of LDLc receptors [39]. Nutraceuticals such as alpha-lipoic acid, magnesium, vitamin B6 (pyridoxine), vitamin C, N-acetyl cysteine, celery, omega-3-fatty acids, etc. have been shown to exhibit antihypertensive action through calcium channel blockage [40]. Plants include flavonoids called flavones and flavanones, which are important in the healing process and heart-related illnesses.

They also stop sticking and accumulation of platelets, which are caused by the ACE and cyclooxygenase pathway, and are both linked to hypertension. Flavonoids are thought to be cardio-protectors in slowing the formation of atherosclerosis due to their strong capacity to transmit electrons and scavenge reactive oxygen species, which reduces oxidative stress [41].

3)Cancer:

Dietary elements rich in bioactive nutrients have the potential to mitigate the risk of cancer [42]. Vitamins, particularly folate, are important for DNA methylation and avoiding the occurrence of cancer. An anti-inflammatory substance called ginseng helps to stop cancer's prolonged inflammation [43]. Citrus fruit flavonoids, which function as antioxidants, may provide cancer prevention [44]. Anticancer properties are exhibited by phenolics like turmeric, ferulic, caffeic, and a gallic acids. Both garlic and onions each possess thiosulfonates, which have anticarcinogenic qualities [45]. A traditional Chinese herb, Astragalus membranous (Fabaceae) has anticancer, antidiabetic, immune-stimulating, antioxidant, and hepatoprotective properties [46].

4)Obesity:

Angina pectoris, congestive heart failure, hypertension, osteoarthritis, hyperlipidemia, and other hazards are linked to obesity, a medical disease characterized by the development of extra body fat.

The crop buckwheat possesses unique biological properties that include decreasing cholesterol, preventing hypertension, and relieving diarrhea and obesity by functioning similarly to dietary fiber found in food. Green tea extracts and 5-hydroxytryptophan both lessen hunger and boost the consumption of energy, which may aid in loss of weight. Ephedrine, coffee, mahuang-guarana, chitosen, and other herbal boosters also aid in fat reduction. The nutritional supplement's combination of glucose chitosan, fennel, G sylvestre, and vitamin C dramatically decreased weight. Momordica Charantia (MC), capsaicin, and conjugated linoleic acid (CLA) possible anti-obesity qualities [47,48,49].

5)Alzheimer Disease:

Oxidative stress is linked to the etiology of multiple neurodegenerative illnesses, involving Alzheimer's disease. The main clinical symptom of Alzheimer's disease is progressive memory loss. Nutraceuticals that function as antioxidants and stop oxidative anxiety-related damage to brains include beta-carotene, lycopene, curcumin, and lutein [50].

6)Parkinson's Disease:

Parkinson's disease is a brain disorder marked by muscle weakness, tremors, and difficulty walking. 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 [51].

7)Allergy:

An excessive reaction of the human body to a foods or medication is known as an allergy. Quercetin is a polyphenolic compound, a flavonoid, and a naturally occurring antihistamine. It suppresses the synthesis of leukotrienes and several allergic enzymes, including lipid peroxidases. Additionally, it scavenges free radicals to produce antioxidant benefits [52].

8)Vision Improving:

Lutein, also called helenien, is used for curing vision abnormalities. It can be obtained from mangoes, corn, sweet potatoes, carrots, squash, tomato products, and green leafy vegetables like bok choy, collards, and kale. In traditional Chinese medicine, Zeaxanthin—which can be found in maize, egg yolks, and green foods like broccoli, green beans, green peas, brussel sprouts, cabbage, kale, collard greens, spinach, lettuce, kiwi, and honeydew—is mostly applied to treat visual abnormalities [53, 54].

9)Migraine:

Usually affecting one side of the head, migraine is characterized by recurring aching headaches that are often accompanied by vomiting and blurred vision. Nutraceuticals such as coenzyme Q10, feverfew, and petasites are used to treat migraines. Dopamine and chrysanthenyl acetate, which are found in dried ginger leaves, are involved in the treatment of migraines. Butterbur, or Petasites hybridus, has been shown to be a safe and efficient long-term migraine treatment [55].

10)Stress management:

Stress is an essential component of our mental health and a danger to our survival. Adaptogens are naturally occurring bioactive substances that aid in preventing cellular damage caused by stress. They produce a non-specific boost in an organism's resilience to harmful impacts and work to restore equilibrium and normal for psychological and physical health. Herbal supplements such as rhodiola, ginseng, ashwagandha, and L-theanine are potent adaptogens that stimulate the synthesis of HSP-70, a stress-suppressing protein, and stabilize physiological processes. They also enhance resistance to external stress, lessen moderate-to-severe anxiety, enhance sleep quality, lessen depression, and enhance secondary memory [56].

Applications of Nutraceuticals:

1) Nutraceuticals in cancer treatment:

Nowadays, adolescent cancer is the most frequent cause of death for adults. Cancer treatment typically entails the costly and unpleasant use of medications, surgery, and radiotherapy. In recent years, we have witnessed a decrease in the incidence of cancer due to changes in lifestyle. Up to thirty percent of malignancies are related to diet and nutrition. Scientific research on animals has demonstrated that a lack of forty essential nutrients can increase the risk of cancer. Scientific research on cancers in humans has shown a sizable group of organ-specific subtypes. The largest obstacle to investigating the therapeutic efficacy of nutraceuticals in the treatment of human cancers is the absence of an established therapeutic target. Nutraceuticals are used to modulate and regulate DNA affecting factors and gene transcription in malignancy or tumors. Nutraceuticals provide several biological benefits, including cardiac and immune system strengthening, anti-obesity, natural antioxidants, anti-diabetic, and antibacterial effects [57,58,59].

2) Nutraceuticals in Anti-inflammatory:

Nutraceuticals have anti-inflammatory properties that are commonly employed in the medical care of rheumatoid arthritis. Rheumatoid arthritis is a long-term inflammatory illness characterized by heightened oxidative stress and biomarkers associated with inflammation. Synthetic medications indicated for its treatments cause immediate reactions or other negative effects, thus new and safer techniques of medical care are being used. Many foods include anti-inflammatory compounds, such as phenolic compounds, phytosterols, tocopherols, and polyunsaturated fatty acids. Foods that include such components include tomato, carrot, green tea, fish oil, fenugreek, coriander, coconut, and so on. Nutraceuticals serve as a remedy for inflammation by blocking the stimulation of NK-kappa B, enzymes such as COX-2, and down regulating accumulation of CAMs and Phospholipase A2, among other mechanisms. Nutraceuticals can also eliminate reactive oxygen compounds and inhibit the production of pro-inflammatory cytokines like IL-1 and IL-6. Nonsteroidal anti-inflammatory medications and anti-inflammatory nutraceuticals share a same mode of action or molecular target.

Nutraceuticals can stop metastasis processes that generate inflammation by activating NK-kappa B, inducing and upregulating pro-inflammatory cytokines, and producing ROS [60,61].

3) Nutraceuticals as Anti-oxidants:

Antioxidants such as nutraceuticals function by interacting with free radicals or their products. It has been demonstrated by science that consuming a lot of foods and/or combinations with antioxidant properties reduces the number of human deaths. Among the food ingredients with antioxidant properties are onions, garlic, and turmeric, rosemary, and so forth. Antioxidant-containing nutraceuticals are helpful in the management of neurodegenerative conditions including Parkinson's and Alzheimer's. The main class of polyphenols that still exhibit antioxidant action include flavonoids, which include green tea apples, non-flavonoids like turmeric, grapes the phenolic acids or phenolic dieterpenes like rosemary, and organ sulfur compounds like garlic, cabbage, etc. By reducing free radicals, they strengthen the antioxidant defenses that are already present in cells. Additionally, the nutraceuticals prevent the oxidized LDL from being produced. Currently, the human system produces more antioxidants thanks to the use of biomolecules and nutraceuticals [62, 63].

4) Nutraceuticals as Anti-aging:

People are more aware of their skin and age-associated chronic conditions in today's culture. Therefore, scientific study has shown that using antioxidant-rich dietary supplements and taking appropriate skin-care cosmetics into consideration may be helpful in treating skin and age-related conditions. We must focus on using antioxidants because research indicates that the body's excessive production of free radicals is mostly to blame for causing harm to skin cells and even DNA. They also have an impact on the mechanisms that promote the synthesis of reactive species, such as RON and ROS. The treatment of many diseases depends on the appropriate selection of nutrients, which can be attained by eating a healthy diet and taking nutritional supplements high in vitamin E and folic acid, iron, vitamin B12, and other elements that are mostly found in a wide variety of food sources, such as egg yolks, almonds, and green leafy vegetables. In relation to obesity, curcumin, green tea, and black grams are the most commonly used nutraceuticals. Leptin and other cytokines, such as IL-1 and IL-6, which are vital in obesity and chronic inflammation, are secreted by them. Additionally, they aid in lowering total and LDL cholesterol. Some take action by capping daily food consumption overall [64].

5) Nutraceuticals as anti-diabetic:

Diabetes is an autoimmune disorder characterized by elevated blood glucose levels in the individual. It is brought on by either insufficient insulin synthesis, improper insulin cellular response, or both. Nutraceuticals like Emblica officinalis, fennel, green tea, etc. are used for both treating and avoiding diabetes. It also contains minerals like magnesium and chromium as well as antioxidant vitamins like C and E. In most cases, they work by influencing insulin resistance and preventing diabetes from developing. Certain agents function by elevating the content of hepatic glycogen while lowering the levels of glycogen phosphorylase and glyconeogenic enzymes [65,66,67].

Conclusion:

By utilizing the health advantages of natural food ingredients for both preventing and treating a wide range of disorders, nutraceuticals constitute an essential nexus between nutrition and medicine. Nutraceuticals, which are widely defined as non-toxic dietary ingredients with scientifically demonstrated health benefits, fall into two categories: traditional and non-traditional. The former include probiotics, herbal items, nutrients, and foods that have been fortified. Growing knowledge of the importance of nutrition in maintaining health, especially in relation to chronic diseases like diabetes, heart problems, cancer, weight gain, and neurological disorders, is the reason behind their increasing popularity.

The growing emphasis on health and wellness along with increasing disposable incomes are driving rapid growth in the nutraceutical market in India. But the sector has to deal with issues with labeling and regulations, which means a methodical approach is needed to guarantee effectiveness and safety. Nutraceuticals have a bright future in worldwide healthcare due to their capacity to improve the standard of life and encourage healthy living, making them an essential part of contemporary dietary regimens.

References:

[1] Kaur G, Mukundan S, Wani V, Kumar MS. Nutraceuticals in the management and prevention of metabolic syndrome. Austin J Pharmacol Ther 2015;3:1-6.

[2] Kathleen C, Stephen D. Nutraceuticals: What Are They and Do They Work? Kentucky Equine Research, Inc. Versailles, KY 7 (4); 2013:1-50.

[3] Brower V. Nutraceuticals: poised for a healthy slice of the healthcare Market. Nat Biotechnol. 1999; 16: 728-731.

[4] Singh J, Sinha S. Classification, regulatory acts and applications of Nutraceuticals for health: A review. Int J Pharm Biol Sci., 2012; 2(1):177-187.

[5] Rajasekaran A, Sivagnanam G, Xavier R. Nutraceuticals as therapeutic agents: A Review. Research J Pharm and Tech, 2008; 1(4):328-340.

[6] Brower V. Nutraceuticals: poised for a healthy slice of the healthcare market? Nat Biotechnol, 1998; 16(8):728-731.

[7] Eskin M, Tamir S. 2019. Dictionary of Nutraceuticals and Functional Foods. Boca Raton, USA: CRC Press.

[8] Kalra EK. Nutraceutical – definition and Introduction. AAPS Pharmsci, 2003; 5:12081212.

[9] 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.

[10] Saika D, Deka SC. Cereals: From staple food to Nutraceuticals. Int Food Res J 2011;18:21-30.

[11] Kaur G, Mukundan S, Wani V, Kumar MS. Nutraceuticals in the management and prevention of metabolic syndrome. Austin J Pharmacol Ther 2015;3:1-6.

[12] Naczk M, Amarowicz R, Zadernowski R, Pegg R, Shahidi F. Antioxidant activity of crude phenolics from Wild blueberry leaves. Polish J Food Nutr. 2003;12:166-170.

[13] Zeisel SH. Regulation of "Nutraceuticals". Science. 1999;285: 185-186.

[14]www.medicinalfoodnews.com/vol01/issue2/japan.Functional foods in Japan, Medical Food News, May 1997 No.6.

[15] Chintale AG, Kadam VS, Sakhare RS, Birajdar GO, Nalwad DN. Role of nutraceuticals in various diseases: A comprehensive review. Int J Res Pharm Chem 2013;3:290-9.

[16] Sapkale AP, Thorat MS, Vir PR, Singh MC. Nutraceutical-Global status and applications: A review. Int J Pharm Clin Sci 2012;1:1166-81.

[17] Shinde, N., Bangar, B., Deshmukh, S., & Kumbhar, P. (2014). Nutraceuticals: A Review on current status. Research journal of pharmacy and technology, 7(1), 110-113.

[18] Chauhan, B., Kumar, G., Kalam, N., & Ansari, S. H. (2013). Current concepts and prospects of herbal nutraceutical: a review. Journal of advanced Pharmaceutical technology & research, 4(1), 4.

[19] Singh F, Kumar SM, Mahadevan N. Nutraceutical: Uplift in health. Int J Recent Adv Pharm Res 2012;2:17-28

[20] Dillard CJ, German JB.Phytochemicals: Nutraceuticals and human health. J Sci Food Agric 2000;80:1744-56.

[21] Sapkale, A. P., Thorat, M. S., Vir, P. R., & Singh, M.C(2012).Nutraceuticals-global status and applications: A review. Int J Pharm Clin Sci, 1, 1166-81.

[22] Quigley, E. M. (2010). Prebiotics and probiotics; modifying and mining the microbiota. Pharmacological research, 61(3), 213-218.

[23] Gibson, G. R. (2004). Fibre and effects on probiotics (the Prebiotic concept). Clinical nutrition supplements, 1(2), 25-31.

[24] Singh, J., & Sinha, S. (2012).Classification, regulatory acts and applications of nutraceuticals for health. International Journal of Pharma and Bio Sciences, 2(1), 177-187.

[25] Nwosu, O. K., & Ubaoji, K. I.(2020).Nutraceuticals: History, Classification and Market Demand. In Functional Foods and Nutraceuticals (pp. 13-22). Springer, Cham.

[26] Singh J, Sinha S. Classification, regulatory acts and applications of nutraceuticals for health. Int J Pharm Biol Sci 2012;2:177-87.

[27] Casey CF, Slawson DC, Neal LR. Vitamin D Supplementation in infants, children, and adolescents. Am Fam Physician 2010;81 :745-8.

[28] Beck K, Conlon CA, Kruger R, Coad J. Stonehouse W. Gold kiwifruit consumed with an iron fortified breakfast Cereal meal improves iron status in women with low iron stores: A 16-week randomized controlled trial. Br J Nutr 2011;5: 101-9.

[29] World Nutraceuticals, 2006. Industry Study with Forecasts to 2010 & 2015. The Freedonia Group, Cleveland, OH USA.

[30] Patwardhan, BD Warude, P Pushpangadan and N Bhatt. Ayurveda and Traditional Chinese Medicine: a comparative overview. Evid Based.

[31] Weder AB. Your mother was right: eat your fruits and vegetables. Curr Hypertens Rep. 1999; 1:11-12.

[32] Eaton SB, Eaton SB III, Konner MJ. Paleolithic nutrition revisited: a Twelve-year retrospective on its nature and implications. Eur J Clin Nutr. 1997;51 :207-216.

[33] American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes care, 2011; 1:62-69.

[34] Sirtori CR, Galli C. N-3 fatty acid and diabetes. Biomedicine&Pharmacotherapy,2002; 56(8):397-406.

[35] Brouns F. Soya isoflavones: a new and promising ingredient for the health foods sector. Food Research International, 2002; 35(2-3):187-193.

[36] Coleman MD, Eason RC, Bailey CJ. The therapeutic use of lipoic acid in diabetes: a current perspective. Environ ToxicolPharmacol, 2001; 10(4); 167-172.

[37] Singh B. Psyllium as therapeutic and drug delivery agent. Int J Pharm, 2007; 334(12):114.

[38] 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.

[39] German JB, Walzem RL. The health benefits of wine. Annu Rev Nutr, 2000; 20:561-593.

[40] Houston MC. Nutraceuticals, vitamins, antioxidants, and minerals in the prevention and treatment of Hypertension. Prog Cardiovasc Dis,2005; 47(6):396-449.

[41] Hu FB, Willett WC. Optimal diets for prevention of coronary heart disease. JAMA, 2002; 288(20):2569-2578.

[42] Avrelija C, Walter C. Antimicrobial agents deriving from indigenous plants. Recent Pat Food Nutr Agric, 2010; 2(1):83-92.

[43] Sabita NS, Trygve OT. The role of nutraceuticals in chemoprevention and chemotherapy and their clinical outcomes. Journal of Oncology, 2012; 64:1-23.

[44] 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.

[45] 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.

[46] Silpi Chanda, Tiwari RK, Arun K, Singh K. Nutraceuticals Inspiring the Current Therapy for Lifestyle Diseases. Advances in Pharmacological sciences, 2019; Article ID 6908716.

[47] Rajasekaran A, Sivagnanam G, Xavier R: Nutraceuticals as therapeutic agents. Res J. Pharm. and Tech. 2008; 328-340.

[48] Chaturvedi N, Sharma P, Shukla K, Singh R, Yadav S: Cereals Nutraceuticals, Health Ennoblement and Diseases Obviation: A Comprehensive Review. J Applied Pharma Sci. 2011; 6-12.

[49] Bhowmik D, Gopinath H, Pragati Kumar B, Duraivel S, Sampath Kumar K P:
Nutraceutical –A Bright Scope and Opportunity of Indian Healthcare Market. The Pharma Innovation 2013; 29-41.

[50] 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.

[51] 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.

[52] Formica JV, Regelson W. Review of the Biology of Quercetin and related bioflavonoids. Food and chemical Toxicology, 1995;33(12):1061-1080.

[53] Sumeet Gupta, Devesh Chauhan, Kritika Mehla, Preeti Sood, Anroop Nair: An Overview Of Nutraceuticals: Current Scenario. J Basic and Clin Pharm. 2010; 55-62.

[54] Umesh B. Telrandhe, Rakesh Kurmi, Vaibhav Uplanchiwar, Mohd. H. Mansoori, Vivek Jain, Raj Kumar Jain, Sunil Kumar Jain: Nutraceuticals- A Phenomenal Resource in Modern Medicine. Int J Univ Pharma and Life Sci. 2012; 175-195.

[55] Somya G, Parvez N, Sharma PK. Nutraceuticals as functional foods. Journal of Nutritional Therapeutics, 2015; 4(2):64-72.

[56] Kalra EK. Nutraceutical – definition and introduction. AAPS Pharmsci, 2003; 5:12081212.

[57] Watson RR. Functional Foods & Nutraceuticals in Cancer Prevention. (1stedn), Iowa State Press, 2003.

[58] Ahmad A. Molecular Targets of Naturopathy in Cancer Research: Bridge to Modern Medicine. Nutrients. 2015; 7:321-334.

[59] Kuppusamy P. Nutraceuticals as potential therapeutic agents for colon cancer: a review. Acta Pharmaceutical Sinica B. 2014; 4:173-181.

[60] Alokbi SY. Nutraceuticals of anti-inflammatory activity as complementary therapy for rheumatoid arthritis. Pub/med.gov. 2014; 30:734-749.

[61] Huang MT. Inflammatory Process and molecular targets for anti-inflammatory Nutraceuticals. Comprehensive Reviews in Food Science and Food Safety. 2006; 3:127139.

[62] Kaur S. Free radicals and antioxidants (Nutraceuticals): Boom to human health. International Journal of Natural Product Science. 2012; 1:175.

[63] Kelsey NA. Nutraceutical Antioxidants as novel Neuroprotective agents. Molecules. 2010; 15:7792-7814.

[64] Dariji VB. The role of nutraceuticals in anti-aging medicine. Acta Clin Croat. 2010; 49:537-544.

[65] Kaur G. Nutraceuticals in the Management and Prevention of Metabolic Syndrome. Austin J Pharmacol Ther. 2015; 3:1-6.

[66] Conroy KP. Pathogenic obesity and nutraceuticals. Proc Nutr Soc. 2011;70:426-436.

[67] Davi G. Nutraceuticals in diabetes and metabolic syndrome. Cardiovasc Ther. 2010; 28:216-226.