



## Effect of Nutraceuticals as Therapeutic Moderators and its Impact in Economical Trade

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### Abstract

**Introduction:** Nutraceuticals are foods that offer nourishment or have therapeutic effects, such as the treatment and prevention of ailments. This review is an overview of the influence of the nutraceutical on the market, trade, medicinal system as well as lifestyle of almost every individual.

**Evidence Acquisition:** Diet and nourishment are the foundation of living wellbeing and development. With advancements in clinical nutrition and increasingly growing awareness of nutritional principles of eatables, nutraceuticals have emerged as an important part of the healthcare system. Combined with the word nutrition and pharmaceutical, nutraceuticals constitute an evolving food category described as food or their products which gives nutrition and health benefits, also prevent many diseases. Beriberi, pellagra, rickets, and scurvy are some of the diseases caused by the deficiency of nutraceuticals. Nutraceuticals are dietary supplements without harmful side effects; therefore, these have become a vital part of the nutritional as well as pharmaceutical class.

**Evidence Synthesis:** This unique class of nutraceuticals includes vitamins, minerals, prebiotics, probiotics, plant extracts phytochemical components, fibers, carbohydrates, proteins, amino acids, omega fatty acids, enzymes, essential lipids, and other essential oils as the key nutraceutical ingredients. These nutraceuticals have been researched to be armorous for the battle against some of the century's biggest health issues such as obesity, chronic disorders, stroke, osteoporosis, asthma, diabetes, cholesterol, etc.

**Conclusion:** The focus of this study is to enlist a few of such nutraceuticals of great importance along with their applications. This analysis essentially sheds a light on the current Indian nutraceutical industry as well.

**Keywords:** Nutraceuticals; Indian Market; Prebiotics; Probiotics; Omega Fats

### Abbreviations

FDA: Food and Drug Administration; FIM: Foundational for Innovation in Medicine; GIT: Gastrointestinal Tract; CVD: cardiovascular Diseases; COX: Cyclooxygenase; TNF: Tumor Necrosis Factor; KIHD: Kuope Ischemic Heart Disease Risk Factor Study; SDG: Secoisolariciresinol Diglucoside; LDL: Low-density lipoproteins; PG: Prostaglandin; FSSA: Safety and Standards Act; FSSI: Food Safety

and Standards Authority in India; GDP: Gross Domestic Product; USD: United States Dollar; ASSOCHAM: The Associated Chambers of Commerce and Industry of India; CAGR: Compound Annual Growth Rate

### Background

The living standards in terms of income, costs, and the way of life have improved with economic growth. Nutritional fixation was

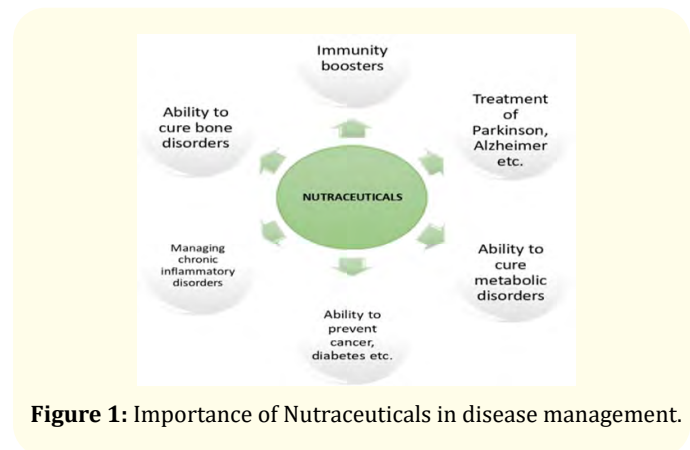
the very first goal of this shift in way of living. There's been a booming market for processed eatables which has led to several dietary diseases. When it is advised to "eat the vegetables because they are good for us" and it is still common to say, an apple a day keeps the doctor away. A lot of research has supported and delivered the scientific evidence for each of these widespread phrases to prove that such types of food make a real difference. In the early 1990s, scientists investigated hundreds of epidemiological researches linked to cancer and diet, and in 128 of 156 dietary experiments, fruit and vegetables had a major defense impact against a wide range of distinct cancers [1]. Over the past 20 years, roughly one-third of the approved drugs by the FDA are formed on nature-derived products or their derivatives, also the pharmaceutical industry has benefitted enormously from the significant medicinal value of these nature-derived products [2]. Dr. Stephen DeFelice, coined the expression "Nutraceuticals" in 1989 to identify a nutritional and pharmaceutical relationship, both of which are critical contributors to human well-being. Nutraceuticals are terms formed by the combination of Nutritive and Pharmaceuticals: a nutritious substance that gives medical benefits (such as a food enriched or dietary supplement) [3].

## Introduction

Food items that provide nutrition or have medicinal benefits, which include the treatment and prevention of illnesses, are also considered under the nutraceuticals. These products are productive and wellness-oriented for senile ages. In the management of many diseases, nutraceuticals can play a major role. No wonder, more and more people are routing their preference and selection towards nutraceuticals as part of their daily food habits [4]. Nutraceuticals such as *allium sativum* (garlic), *Glycine max* (soya bean), *Zingiber officinale* (ginger), and other nutrients, primary phytochemicals from food or plant extracts, through various studies have been proved to hold great potential in preventing and even treating various ailments [5]. Despite having many beneficial effects nutraceuticals offer challenges while incorporating them into food products. A few of these challenges include chemical instability, low water solubility, and susceptibility to changes in the gastrointestinal tract (GIT) and external environments such as heat, oxygen, and light. Natural products obtained have been used to treat and monitor illnesses and diseases not only in humans but also in veterinary care for certain animals as well [6].

The exponential growth as studied and represented through various research on nutraceuticals and functional foods over the previous two decades, shows increased public interest and belief in the benefits of nutraceuticals. It is quite evident that there can be a good number of research and publications even for each plant focusing upon several properties and medicinal values that the plant possesses. In this research, some can put light upon a particular natural matrix, including sesame and spices, and tea, whereas other publications can have a focus on different chemical compounds, such as peptides and proteins, or lipids. Additionally, few publications have demonstrated the nutraceutical's advantages for various diseases, such as degenerative joint diseases and atherosclerosis [7].

Nutraceutical items elucidated by Zeisel, are dietary supplements containing nutrition, condensed ingredients in a non-food matrix, of a, deemed biologically active drug, which can be used in dosages that are higher than those obtainable from regular food. The main distinction between functional foods and nutraceuticals is their formats, which can be explained as the nutraceuticals are ingested as tablets, capsules, etc. Functional foods are mostly taken in the form of the meal as normal foods. Therefore, when a phytoconstituent is used in food composition, it becomes a functional product. If a capsule contains the same plant chemicals, it is considered a nutraceutical [8]. Nutraceuticals include nutrients, foods and diets, genetically modified foods, herbal supplements, and packaged items such as rice, soups, and beverages, which can also be genetically modified. A nutraceutical is any dietary product not poisonous and is a scientifically validated alternative with possible health benefits in treating and preventing diseases [9]. Figure 1 depicts the importance of nutraceuticals for the well-being of human beings.



**Figure 1:** Importance of Nutraceuticals in disease management.

### Therapeutic significance of nutraceuticals

Fruit and vegetable intake have been found and proved to lower cardiovascular risks. Healthy People 2010’s national health priorities recommend an increase in fruit intake to ensure good health [10]. The defensive properties of fruit and vegetables have been primarily due to plant-based compounds such as phenolic acids, isoflavonoids, flavonoids, and carotenoids. There are thousands of phytochemicals present in food, but many have not yet been described. Various plant products are involved in defending against chronic diseases. Phytochemicals can, for example, inhibit the proliferation of cancer cells, control inflammatory and immune responses and prevent lipid oxidation [11]. In the present review, some of the nutraceuticals with their sources and beneficial properties will be explained in detail.

### Apple

As the antioxidant content in fruits and vegetables is higher, a healthy diet on such foods can help in reducing oxidative stress and can also help to avoid chronic disease and can also delay aging. The National Research Council has suggested that five and more portions of fruit and vegetables should be consumed every day to ensure good health. Many food items and drinks, including apples, cocoa, cranberries, onions, tea, and wine, were especially useful in the diet because of their increased level of phenolic compounds [1]. The most used fruit in the form of juice in Germany is apples (*Malus sp., Rosaceae*). A mean yearly intake per capita is around 18.4 kg in the raw form and 12.8 L in the form of fruit juice. A broad variety of biological behaviors, which may support boosting health by using apple as food or in any form for preventing/treating asthma, pulmonary dysfunction, cancer, cardiovascular diseases (CVDs), diabetes, and obesity has been reported in various research [12]. Apple has been reported to be one of the key sources of nutritional flavonoids which can play an influential role in lowering mortality. The Women’s Health-based Study explored the correlation between flavonoids and decreased risk of cardiovascular diseases and surveyed approximately 40,000 people with a 6.9-year follow-up. Lower risk of CVD has been linked and interpreted with the consumption of apples [13]. Many types of research directly linked reduced cancer risk, particularly lung cancer with an intake of flavonoids through apples as a source. A survey of over 77 000 people, involving 47 000 men, where the intake of fruits and vegetables was included in the health research and the follow-up study of health professionals. This correlation was however not seen in men

but was correlated with a reduction of 21 percent in lung cancer risk among the women [14]. The apple peels have a high phenolic content compared with other food-producing parts of the fruit. Although, peels of apples are considered as a waste product from the manufacture of applesauce and canned fruit due to which, the food chain eliminates a precious source of nutrition in the form of apple peels. Apple contains minerals, as well as nutrient elements such as dietary fibers as shown in figure 2. The average nutrient composition of apples also contains protein, natural vitamin C, and fiber content [15].

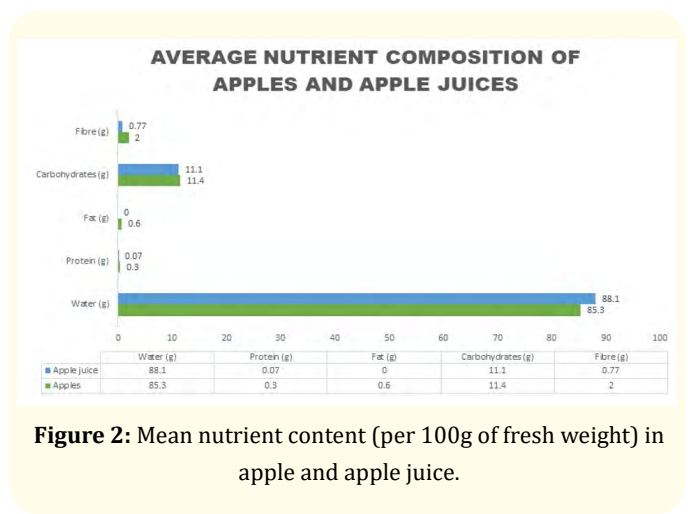


Figure 2: Mean nutrient content (per 100g of fresh weight) in apple and apple juice.

### Berry

Blackberries (*Rubus spp.*), black currants (*Ribes nigrum*), blueberries (*Vacciniumcorymbosum*), raspberries (*Rubus idaeus*), red currants (*Ribes rubrum*), and strawberries (*Fragaria x ananassa*) are the most common berries that are commonly utilized as raw or in different eatables. There are also some crosses, such as loganberry (*Rubus loganbaccuus*), between raspberries and blackberries [16]. Berry fruits, typically part of the Finnish menu, are great sources of flavonol. Resultingly, dietary flavonoids have recently been highly attractive. The various *in-vivo* and *in vitro* studies have shown the presence of a range of potential biological characteristics in berries which can play a crucial role in preserving people’s health. The flavonoids are chelators in metals, strong antioxidants, and free radical scavengers; these prevent peroxidation of lipid and show numerous physiological functions such as anti-allergic, anti-arthritic, anticarcinogenic, anti-hypertensive, anti-inflammatory, and antimicrobial activity [17]. Flavonols found in other fruits, including berries, can inhibit cyclooxygenase (COX) and lipoxygenase

activities, both enzymes participate in the arachidonic acid release which triggers a general inflammatory response [18]. Numerous correlations between flavonoids (anthocyanins) in berries and CVD health have also been documented in research papers. There was a substantially lower risk of CVD-related deaths in the highest quartile of intake of berry (> 408 g/day) among 1,950 men relative to men with poor intake (< 133 g/day) during the mean follow-up to 12,8 years, as recorded in the Kuopio Ischemic Heart Disease Risk Factor Study (KIHD). These results were focused on a model that was calibrated for important CVD risk factors and showed an inverse association between fruit, berries, and vegetable intakes and serum haptoglobin, a marker of inflammation [19]. Several studies have researched on healthy people and people with CVD's risk factor for the beneficial advantages of wolfberries, strawberries, acai berries, raspberries, lingonberries, cranberries, bilberries, blackcurrants, blueberries, boysenberries, and chokeberries [20]. Berries are rich in both, micronutrients, and macronutrients. Sodium, potassium, phosphorus, manganese, magnesium, iron, copper, calcium, and aluminum are the main mineral elements present in berries. Mineral nutrients are responsible to play their role in the growth of the bones, teeth, and muscles. Therefore, these are medically acknowledged as necessary or potentially crucial components for human wellness. Such major and minor mineral elements are engaged in numerous essential physiological and biochemical processes, influencing the electrolyte balance, water levels, hormone functions, oxygen binding, metabolic catalysis, and an essential factor for the formation of membranes and bones [21]. The phenolic compounds shield plants from risk factors i.e., pathogens, physical injury, UV radiation, etc. Extracts of berry block contain the digestive enzymes of starch. Inhibition of  $\alpha$ -glucosidase in patients with non-insulin-dependent diabetes mellitus is already an established method to regulate post-meal glucose levels [22].

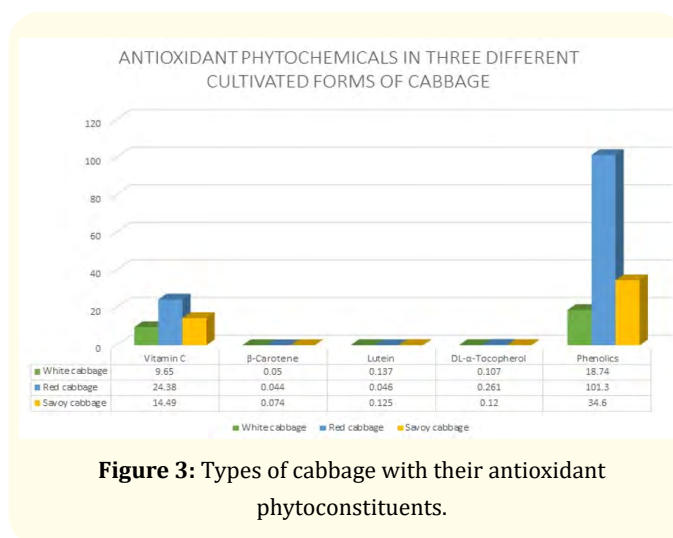
### Broccoli

Broccoli is a highly antioxidant-active vegetable. Antioxidants can scavenge free radicals and avoid oxidative stress on the human body, which is the primary reason for certain tumors and cardiac illnesses [23]. Broccoli has been ranked second among ten common vegetables with antioxidant activity. The per capita broccoli consumption of the USA was the twelfth of the twenty-three vegetables evaluated with the antioxidant activities [24]. Broccoli, due to its taste and chemical protection attributed to chemotaxonomic glucosinolates and degradation products, has been highly valued

by large sections of the population. Decreased risk of cancer, particularly lung and GI tract cancers are associated with increased consumption of cruciferous vegetables. The observational research studies support the view that increased intake of Brassica vegetables reduces prostate tumor risk. Broccoli has an exceptional phytotherapy function in skin diseases, where juices are used against warts [25].

### Cabbage

Cabbage (*Brassica oleracea L. var. capitata*) is among the worlds' topmost popular vegetables cultivated. It is part of the Cruciferae family which includes broccoli, Brussels, cauliflower, kale, and sprouts. This cool-seasoned, shallow-rooted crop is grown for its wide leafy head and is assumed to have emerged in Western Europe. In figure 3, the data for antioxidant phytochemicals are summarized, in the three different cultivated types of cabbage. Results suggest a large and important variability for antioxidant constituents between the three cultivated types ( $p \leq 0.05$ ) [26].



**Figure 3:** Types of cabbage with their antioxidant phytoconstituents.

White cabbage has a considerable place in the cultural values of certain countries and their regional cuisine. It is also commonly known to be used in the traditional medicine system. It was a 'medicine for the poor people and has been used to improve overall health and treat various inflammations, gastrointestinal conditions, or 'purification of the blood'. White cabbage is a cheap, but highly nutritious, a food source that provides nutrients and phytochemicals that promotes good health [27]. Besides phytochemicals and vitamins, it is also an essential source of dietary fibers. Up to

40 percent of white cabbage leaves have been reported to be lost after processing as waste, which is commonly used as animal feed or as fertilizers. Nevertheless, the waste contained high concentrations of dietary fiber and various phytochemical compounds [28].

Red cabbage is famous for its compounds and therapeutic properties. Red cabbage's popularity is due to types of vitamins (K, E, C, A), and minerals (potassium, iron, manganese, magnesium, and calcium) it is enriched with antioxidants, phytochemicals, lower saturated fat, and cholesterol content. The crop also includes B vitamins, e.g., folate (B2), thiamine (B1), and riboflavin (B2). It protects from illnesses like Alzheimer's, malignancy, diabetes, premature aging, and ulcers. 'It helps in weight loss, enhances the immune system, improves skin and eye-sight, and detoxifies the body. Crop flavonoids have strong therapeutic potential in encountering pain and inflammation [29].

### Cocoa

Rich cocoa chocolates have been known for centuries not just because of their good taste, but also for their potential health benefits. In several countries, Cocoa (*Theobroma cacao* L.) is an important crop for the economy, including Ghana, Indonesia, Nigeria, and Malaysia [30]. Some impending effects of cocoa on health were improved heart functioning, relief from angina pectoris, relaxation of the nervous system, increased digestion, and enhanced renal and bowel functioning. However, cocoa was used to treat tuberculosis, kidney stones, fatigue, gout, fever, and anemia. First evidence shows a lowered risk of stroke and coronary heart disease and is inversely related to the effect of cocoa on CVDs in Kuna Indians, an indigenous public living on the coast of the island of Panama [31]. The usage of Cocoa has changed over the centuries to what we now know as chocolate. It is a solid or liquid processed bean, containing different percentages of cocoa butter, cocoa liquor, milk, and sugar. Its production has expanded worldwide to include equatorial regions of Asia and Africa [32]. Cocoa is rich in polyphenols, same as the ones in green tea, and as it has been observed that polyphenols have therapeutic effects against CVDs. Cocoa and chocolate are two distinct terms and cannot be interchanged. Cocoa is a non-fat compound of cocoa liquor used in the manufacturing of chocolate, used in cooking and for drinking, or as a cocoa powder (usually 12 percent fat). Chocolate is the combination of cocoa, cocoa butter, sugar into a solid food product [33]. Currently, shreds of evidence are supporting the belief that cocoa flavanols and procyanidins are

capable of functioning as antioxidants. Numerous intracellular signaling cascades have been shown to affect these nutrients and to impact the CV system by improving vascular function and decreasing the reactivity of platelets. Many in- vivo studies are supporting the hypothesis that the intake of foods high in flavanol, like some chocolates and cocoas, may be correlated with a lowered risk of vascular diseases [34]. Several studies reported later, a positive relationship between the consumption of chocolate or cocoa and numerous health markers. Which involves cardiovascular deaths, C-reactive protein serum, psychological health and diabetes risk, stroke, or myocardial infarction. Table 1 gives the information about the micronutrients content of the cocoa per 100g [35].

Micronutrients	Content (per 100g)
Calcium (mg)	150
Potassium (g)	4.2
Sodium (g)	0.02
Iron (mg)	25
Phosphorous (mg)	700
Magnesium (mg)	550
Copper (mg)	4
Zinc (mg)	7

**Table 1:** Cocoa powder: micro-nutritional information per 100g.

### Fenugreek

Fenugreek (*Trigonella foenum graecum*) belongs to the Leguminosae family, as an annual dicotyledonous plant. Fenugreek seeds have therapeutic properties. Few of which are as a galactagogue, antidiabetic agent, anticancer, hepatoprotective, and used for the treatment of anorexia. Furthermore, it also produces several other effects such as an antibacterial, gastric stimulant, and hypocholesterolemic. Such positive physiological impacts, including the hypocholesterolemic and antidiabetic activity of fenugreek, are largely due to the intrinsic constituent of dietary fibers with nutraceutical activities [36]. Magnificent effects and therapeutic qualities of fenugreek are due to its composition of phytochemical; 20-25 percent protein, 45-50 percent dietary fibers, 20-25 percent mucilaginous soluble fiber, 6-8 percent fixed fatty acids with volatile oils, and 2-5 percent steroidal saponins. In addition, some trace phytochemicals, such as alkaloids (trigonelline, choline, carpaine, etc.), free unnatural amino acids (4-hydroxy isoleucine), and individual furstanols and spirostanols, such as yamogenin, gitogenin, and

diosgenin were also known and classified as the main compound for their diverse health impacts [37]. Seeds of fenugreek are antimicrobial, carminative, aromatic, galactagogue, bitter, and can be eaten fried or raw. Fenugreek seeds, popularly used as condiments in India and other countries, as a major source of dietary fiber, and are therefore beneficial for managing diabetes. Epidemiologic data have demonstrated that the incidence of diabetes in high fiber intake populations is lower than in those with low fiber intake in the western population [38]. In folk medicines, fenugreek was used to treat cellulitis, burns, and tuberculosis. In the 19th century, patent medicine, fenugreek remained a primary component for dysmenorrheal and postmenopausal symptoms. This has been suggested to promote lactation. The fenugreek seeds were orally used as a replacement for insulin for blood glucose reduction and the sugar levels were reported to be lowered by the seed extracts [39]. Fenugreek has shown to be an essential therapeutic plant, with many therapeutic effects such as antibacterial, antidiabetic, antileukemic, antinociceptive, antipyretic, and hypercholesterolemic effects. In addition to its conventional use as a spice and forage crop, several researchers also have reported its anti-lithogenic properties [40]. Through the research, Robert, *et al.* demonstrated the utility of a water-soluble fiber fraction of fenugreek over placebo and likewise as a positive control (ranitidine), for various forms of heartburn symptom prevention evaluations. Therefore, this study offers the ability to avoid a certain degree of heartburn by taking fenugreek fiber as a natural alternative to over-the-counter antacids. In recent years, the production of "functional food" additives and natural health products in Canada has been a source of attraction [41].

### Flax seeds

Flax (*Linum usitatissimum*) is an important economic oleaginous crop, especially for Canada, with approximately 40% of the world's flax-seed production and being the world's largest flaxseed exporting farm, accounting for about 75 % of global trade in flax [42]. Flax seeds have 35% oil of their weight, 15-18% is linoleic acid, and 55% of which is  $\alpha$ -linolenic acid ( $\omega$ -3 fatty acid). Flax seeds are high in  $\omega$ -3 fatty acids and are a rich source of lignans from the plant. The latest evidence of antioxidant activity was found in one of the lignans secoisolariciresinol diglucoside (SDG) of flaxseed. Lignan has been used to prevent various forms of tumor (breast tumor, colon cancer, prostate, and skin malignancy) and diabetes as well [43]. Two specific variants of flaxseeds are available: golden

or yellow and brown. Both have identical nutritional properties and the same number of  $\omega$ -3 fatty acids in the short-chain. The exception is yellow flax called solin, with unique oil characteristics and low omega-3 fatty acid. The fatty acid is called solin. As a food source offering several health benefits for decreasing malignancy and CVD, LDL-cholesterol decrease, and vasodilating functions, flaxseed is ingested as entire/milled/roasted seed in the form of oil, and as flour [44]. In food items like canned fish sauce, emulsion for meat, and ice cream, flax-seed-protein products containing various quantities of polysaccharide gums were evaluated as additives. In flax seeds, the protein content was recorded between 10.5 and 31 percent. Whereas the protein content of Khategaon cultivars grown in India is 21.9% [45]. Genetics and environmental variations can be responsible for variations in the content of protein. The high and low protein content of seeds can also be the result of the cool climate. Flaxseed has two main storage proteins, a primarily high molecular salt soluble fraction (11-12S; globulin; 18.6% Nitrogen) and a low molecular weight water-soluble basic component (1.6- 2S; Albumin; 17.7% Nitrogen). Flax-seed proteins can also be used in food products such as bakery and pastry, (bread, pizza, cookies, and muffins), snacks and breakfasts, sausage, gravy/soups, the emulsion of meat, whipped dessert, etc. [46]. With the use of two key components, namely eicosanoids, and cytokines, flax seed favorably impacts immunity. Flaxseed's lignan modulates the immune response and can contribute to the clinical management of autoimmune diseases. People should take a meal that contains a certain amount of essential fatty acids  $\omega$ -3 and  $\omega$ -6. The consumption of corn vegetable oils, sunflowers seed, safflowers seed, soybeans, and cottonseeds has increased considerably over the past 100 to 150 years, while the intake of omega-6 fatty acids has increased significantly. Figure 4 represents the nutritional composition of four different forms of flaxseed (per 100g) [47].

### Ginger

Ginger (*Zingiber officinale* Rosc.) is popular amongst the medicinal plants, both in the old and the new medical system. It is also used as a carminative and GI stimulant. It is an effective antimicrobial, antioxidative, antitumorigenic, and antiviral agent [48]. Over 400 chemical compounds in ginger, rhizomes extracts have been extracted and classified, and new extracts are still being discovered. Currently, only a handful have been tested for

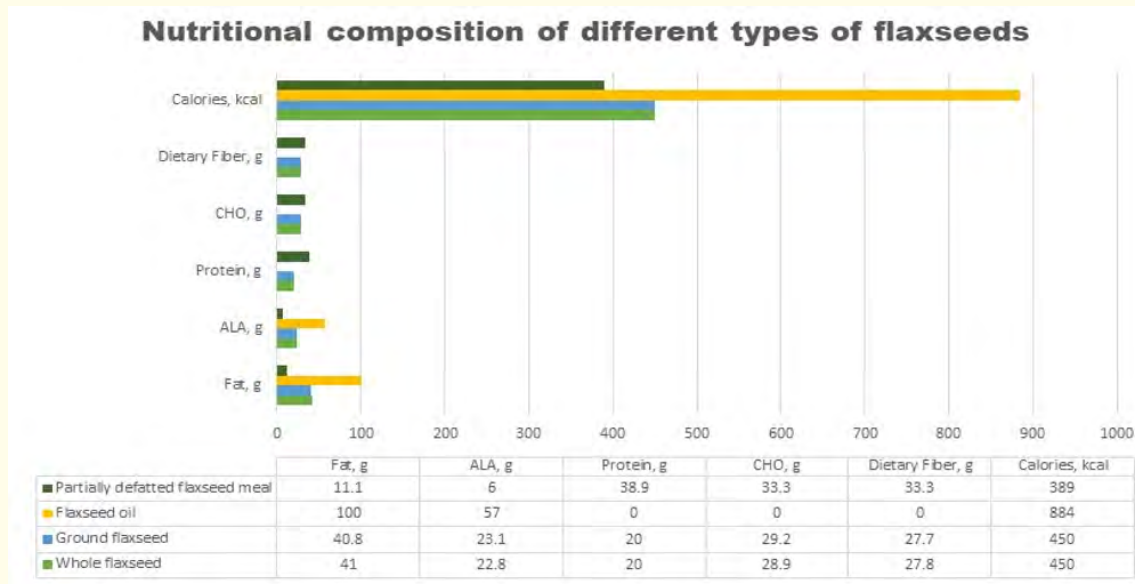


Figure 4: Nutritional composition of different types of flaxseeds.

their pharmacological properties. Current evidence indicates that a sub-fraction of gingerol, shogaol, and paradols, which comprise the structurally connected components, constitutes a substantial proportion of ginger against inflammation [49]. Ginger infusions are well-known folk remedies for a broad variety of conditions in many countries, though mainly to cure colds, coughs, and flu. In Burma, the flu is reduced by the combination of palm juice of ginger, while the Colombian ginger is employed to cure colds and flu with hot panela. Rhizomes of ginger are mixed with brown sugar to cure a common cold, while powdered ginger with scrambled eggs is used as a household therapy in China to cure cough. In Congo, a concoction of ginger and mango juice (medicine to cure all) is considered a panacea. It is commonly used to prevent arthritis, headaches, sore throats, cramps, constipation, indigestion, diarrhea, asthma, dementia, fever, and infectious diseases. It may also be used for those who have gallstones. It contains potent antioxidants such as gingerol, zingerone, and vitamin C. Furthermore, it has the capacity of blood thinning and decreasing cholesterol levels to treat cardiovascular diseases [50]. Hepato-protective studies have shown that plants have active ingredients which can scavenge free radicals from living systems. There have been increasing numbers of studies that show promising cytotoxic results in several malignant cells including the retinoblastoma, prostate, ovarian, nasopharyngeal, lung, liver, colorectal, cervical, and breast from ginger extracts and their bioactive compounds [51]. Several pre-clinical

studies of allergies, diabetes, diarrhea, fever, inflammation, obesity, pain, rheumatoid arthritis, and several cancer types supported the phytochemical benefits of ginger. Additionally, the metabolites of ginger were recognized as strong antioxidants because they can inhibit the oxidation of different free radicals and the synthesis of nitric oxide [52].

### Turmeric

Traditional medicine is an ancient herbal medicine that has been used by Society to cure many diseases in various regions of the globe. India has an old and wide tradition of medicinal use of plants. Turmeric (*Curcuma longa L.*) is a therapeutic plant commonly used for various diseases in Unani, Siddha, and Ayurveda medicine. *C. longa L.* is a perennial plant with a small stem, broad oblong leaves, and bears ovate, pyriform, or oblong rhizomes, sometimes curled and brownish yellow, which has a botanical relation to ginger (family Zingiberaceae) [53]. In addition, turmeric has been prescribed in Indian natural medicines for many conditions. For the fourth straight year, Turmeric became the top-selling herbal supplement. Boost in popularity is due to the alleged anti-inflammatory, antimicrobial, antineoplastic, antioxidant, and wound healing properties of turmeric. Its medicinal properties were reported over the liver. Advantageous findings have also been seen in cholestasis control, hepatic cancer, hepatic fibrosis, and hepatotoxicity. It is also used in many urinary conditions, liver, and jaundice

diseases. In Indian natural medicine literature, turmeric has been identified as a cancer remedy [54]. Turmeric’s anti-inflammatory activity was studied using animal models and *in vitro* cultures through various research. Its medicinal applications include the diagnosis of diseases such as ulcers, skin diseases, parasites, and the strengthening of the immune system. It is also observed that curcumin inhibits the production of superoxide and prostaglandin E<sub>2</sub> (PGE<sub>2</sub>) and obstructs the expression of COX-2 and inducible nitric oxide synthase (iNOS) [55]. Turmeric has a long history of use in Southeast Asia as a popular home medicinal product and as a food spice. Turmeric includes yellow pigments (curcuminoids), starch, essential oils, and oleoresins. Curcumin attains a prominent place in Ayurveda medicine as a cleanser for the body and science is currently discovering an increased number of unhealthy conditions which can be controlled by active turmeric compounds [56].

**Indian nutraceuticals market**

Increased public awareness and reaction to the wellbeing of the consumerism of nutraceuticals have led to the shift towards nutraceuticals. People are more careful about their health and prefer to use nutraceuticals to avoid sickness [57]. The report projected the global nutraceutical market at 149.5 billion US Dollars in 2011 with approximately 93% of global nutraceutical demand in the US, Europe, and Japan as the main geographic markets. With these markets reaching maturity, nutraceutical manufacturers consider emerging countries such as India and China to be the main development areas, with very high per capita consumption. Table 2 shows a list of Indian nutraceutical product and their markets. Additional factors which could lead to nutraceutical growth in India are growing obesity and increasing cases of diabetes and CVDs, as well as the present low per capita spending on Indian goods [58].

So that scientific criterion for food substances is established and monitored, Food Safety and Standards Act (FSSA) 2006 for the Food Safety and Standards Authority in India (FSSAI) creation provided. The Health Ministry and the Family Welfare Ministry was the administrative ministry for the FSSAI introduction. As it was the responsibility of the FSSAI to supervise practices in the cultivation, storage, marketing, and sale of human consumption-oriented substances, this put all nutritional and food supplements under their control [59].

While rapidly growing, the nutraceutical industry is still in its initial phase considering the number of goods on the sale and nutraceutical contribution of the country’s GDP. The world’s nutraceuticals demand was \$379,061 billion in 2017, and \$734,601 billion is predicted to expand by 2026. The Nutraceutical Sector and Functional Food Markets currently stand at 2.8 billion USD (2015) and are projected to grow by 8.5 billion USD by 2022, according to ASSOCHAM (The Associated Chambers of Commerce and Industry of India). The Indian food supplement demand will also rise by Compound Annual Growth Rate (CAGR) 16 percent in the same period from the US \$1.8 billion to the US \$5.2 billion [60].

**Conclusion**

Nutraceuticals that have therapeutic or biochemical effects are evolving today as diet supplements/therapeutic foods. The emerging definition of nutraceutical goods provides the public with fascinating possibilities for future nutrient study and related health benefits. Nutraceuticals that offer health advantages and alternatives to mainstream medicine are shown an increasing interest in recent years. Nutrients, herbal products, and dietary supplements are essential components of nutraceuticals, which contribute to the preservation of health, avoid disease, and thus improve quality of life. These nutraceuticals add to the battle against some of the century’s biggest health issues such as obesity, chronic disorders, stroke, osteoporosis, asthma, diabetes, cholesterol, etc.

In the food and pharmaceutical markets, the nutraceutical industry is rising at a pace far exceedingly. Current demographic and wellness patterns are the key factors for the rise of the world’s nutraceutical industry. The demand for nutraceuticals is rising and due to the interest of industry and consumers, there will be further growth in the coming years. This interest could grow much faster in the coming years if it could be used for treatment or occasionally even in therapy for patients who do not apply for traditional pharmacological therapy.

Product	Category	Indian Manufacturer
Calcitriol D-3	Calcium supplement	CadillaHealthcare
Celestial Healthtone	Immune booster	Celestial Biolabs
Chyawanprash	Immune booster	Dabur
Garcinia cambogia	Weight management	Bionova Lifesciences
Lactosorb complex	Lipid management	LactonovaNutri-pharm
Soya isolate	Protein powder	Chaitanya Agrobiotech Group

**Table 2:** List of Indian marketed nutraceutical products and their manufacturers.



The health benefits of the nutraceuticals have been shown and their use (within their appropriate Prescribed Dietary Intakes) can keep diseases in check and allow people to maintain good health. Although nutraceuticals have an extensive promise to help human health and the prevention of diseases. Nutritionists and regulatory toxicologists should work together strategically to prepare the proper regulation to provide human beings the ultimate value in their health and their care. Therefore, the governing authority must be introduced to standardize the nutraceutical industry. As nutraceuticals provide medicinal and nutritional benefits, the manufacturing and distribution of nutraceutical products require a strict regulatory framework. In 2006 the Indian government adopted the Nutraceutical Industry FSSA.

There is a role for nutraceuticals in clinical practice, but more study is required to solve critical pharmaceutical and clinical problems. Their success or loss would be affected by exponential progress, advances in research, lack of requirements, marketing oriented, quality management, and controlling.

### Authors Contribution

All authors have equally participated in the preparation, drafting, and reviewing of the manuscript. All authors read and approved the final version of the manuscript.

### Disclosure of Conflicts of Interest

The authors declare no conflict of interest.

### Acknowledgments

None.

### Bibliography

- Boyer J and Liu RH. "Apple phytochemicals and their health benefits". *Nutrition Journal* 3 (2004): 5.
- Andrew R and Izzo AA. "Highlights into the pharmacology of nutraceuticals". *British Journal of Pharmacology* 177 (2020): 1209-1211.
- Chauhan B., et al. "Current concepts and prospects of herbal nutraceutical: A review". *Journal of Advanced Pharmaceutical Technology and Research* 4 (2013): 4-8.
- Pandey M., et al. "Nutraceuticals: new era of medicine and health". *Asian Journal of Pharmaceutical and Clinical Research* 3 (2010).
- Gossiau A and Chen KY. "Nutraceuticals, Apoptosis, and Disease Prevention". *Nutrition Journal* 20 (2004): 95-102.
- Durán N and Marcato PD. "Nanobiotechnology perspectives. Role of nanotechnology in the food industry: a review". *International Journal of Food Science and Technology* 48 (2013): 1127-1134.
- Bernal J., et al. "Advanced analysis of nutraceuticals". *Journal of Pharmaceutical and Biomedical* (2010).
- Zeisel SH. "Regulation of Nutraceuticals". *Science* 285 (1999): 1853-1855.
- Dillard CJ and German JB. "Phytochemicals: nutraceuticals and human health". *Journal of the Science of Food and Agriculture* 80 (2000): 1744-1756.
- Kaur G., et al. "A review of acute or chronic renal failure, common kidney diseases, and herbal plants used for management". *International Journal of Botany Studies* 6 (2021): 50-56.
- Singh S., et al. "Vegetables as a potential source of nutraceuticals and phytochemicals: a review". *International Journal of Medicine and Pharmaceutical Sciences* 5 (2015): 1-14.
- Gerhauser C. "Cancer Chemopreventive Potential of Apples, Apple Juice, and Apple Components". *Planta Medica* 74 (2008): 1608-1624.
- Sesso H., et al. "Flavonoid intake and risk of cardiovascular disease in women". *The American Journal of Clinical Nutrition* 77 (2003): 1400-1408.
- Feskanich D., et al. "Prospective study of fruit and vegetable consumption and risk of lung cancer among men and women". *Journal of the National Cancer Institute* 92 (2000): 1812-1823.
- Tiwary S and Hussain MS. "Functional foods for prevention and treatment of cancer". *Asian Journal of Pharmaceutical and Clinical Research* 14 (2021): 4-10.
- Beattie J., et al. "Potential Health Benefits of Berries". *Current Nutrition and Food Science* 1 (2001): 71-86.
- Puupponen-PimiaÈ R., et al. "Antimicrobial properties of phenolic compounds from berries". *Journal of Applied Microbiology* 90 (2001): 494-507.
- Rissanen TH., et al. "Low intake of fruits, berries and vegetables is associated with excess mortality in men: the Kuopio Ischaemic Heart Disease Risk Factor (KIHD) Study". *Journal of Nutrition* 133 (2003): 199-204.

19. Basu A., *et al.* "Berries: emerging impact on cardiovascular health". *Nutrition Review* 68 (2010): 168-177.
20. Nile SH and Park SW. "Edible berries: Bioactive components and their effect on human health". *Nutrition Journal* 30 (2014): 134-144.
21. Paredes-López O., *et al.* "Berries: Improving Human Health and Healthy Aging, and Promoting Quality Life - A Review". *Plant Foods for Human Nutrition* 65 (2010): 299-308.
22. Verlangieri AJ., *et al.* "Fruit and vegetable consumption and cardiovascular mortality". *Medical Hypotheses* 16 (1985): 7-15.
23. Sun T., *et al.* "Evaluation of the antioxidant activity of asparagus, broccoli and their juices". *Food Chemistry* 105 (2007): 101-106.
24. Moreno DA., *et al.* "Chemical and biological characterisation of nutraceutical compounds of broccoli". *Journal of Pharmaceutical and Biomedical Analysis* 41 (2006): 1508-1522.
25. Singh J., *et al.* "Antioxidant phytochemicals in cabbage (*Brassica oleracea* L. var. capitata)". *Scientia Horticulturae* 108 (2006): 233-237.
26. Samec D., *et al.* "White cabbage (*Brassica oleracea* var. capitata f. alba): botanical, phytochemical and pharmacological overview". *Phytochemistry Review* (2016).
27. Nilnakara S., *et al.* "Production of antioxidant dietary fiber powder from cabbage outer leaves". *Food and Bioproducts Processing* 87 (2009): 301-307.
28. Sarkar D and Rakshit A. "Red cabbage as potential functional food in the present perspective". *International Journal of Biore-source Science* 4 (2017): 7-8.
29. Othman A., *et al.* "Antioxidant capacity and phenolic content of cocoa beans". *Food Chemistry* 100 (2007): 1523-1530.
30. Corti R., *et al.* "Cocoa and Cardiovascular Health". *Circulation* 119 (2009): 1433-1441.
31. Steinberg FM., *et al.* "Cocoa and chocolate flavonoids: Implications for cardiovascular health". *Journal of the American Dietetic Association* 103 (2003).
32. Cooper KA., *et al.* "Cocoa and health: a decade of research". *British Journal of Nutrition* 99 (2008): 1-11.
33. Keen CL., *et al.* "Cocoa antioxidants and cardiovascular health". *The American Journal of Clinical Nutrition* 81 (2005): 298S-303S.
34. Ramiro-Puig E and Castell M. "Cocoa: antioxidant and immunomodulator". *British Journal of Nutrition* 101 (2009): 931-940.
35. Wani SA and Kumar P. "Fenugreek: A review on its nutraceutical properties and utilization in various food products". *Journal of the Saudi Society of Agricultural Sciences* (2016).
36. Khorshidian N., *et al.* "Fenugreek: potential applications as a functional food and nutraceutical". *Nutrition and Food Sciences Research* 3 (2016): 5-16.
37. Srinivasan K. "Fenugreek (*Trigonella foenum-graecum*): A Review of Health Beneficial Physiological Effects". *Food Reviews International* 22 (2006): 203-224.
38. Madar Z and Stark AH. "New legume sources as therapeutic agents". *British Journal of Nutrition* 88 (2002): S287-S292.
39. Acharya SN., *et al.* "Antioxidant and antileukemic properties of selected fenugreek (*Trigonella foenum-graecum* L.) genotypes grown in western Canada". *Canadian Journal of Plant Science* 91 (2011): 99-105.
40. DiSilvestro RA., *et al.* "Anti-Heartburn Effects of a Fenugreek Fiber Product". *Phytotherapy Research* 25 (2011): 88-91.
41. Acharya SN., *et al.* "Fenugreek: an "old world" crop for the "new world". *Biodiversity* 7 (2006): 27-30.
42. Oomah BD. "Flaxseed as a functional food source". *Journal of the Science of Food and Agriculture* 81 (2001): 889-894.
43. Toure A., *et al.* "Flaxseed Lignans: Source, Biosynthesis, Metabolism, Antioxidant Activity, Bio-Active Components, and Health Benefits". *Comprehensive Reviews in Food Science and Food Safety* 9 (2010).
44. Goyal A., *et al.* "Flax and flaxseed oil: an ancient medicine and modern functional food". *Journal of Food Science and Technology* (2013).
45. Ganorkar PM and Jain RK. "Flaxseed - a nutritional punch". *International Food Research Journal* 20 (2013): 519-525.
46. Rabetafika HN., *et al.* "Flaxseed proteins: food uses and health benefits". *International Journal of Food Science and Technology* 46 (2011): 221-228.

47. Hussain MS., *et al.* "Nutritional composition and functions of flaxseed (*Linum usitatissimum* linn.)". *Food Therapy and Health Care* 3.4 (2021): 88-97.
48. Singh M., *et al.* "Augmentation of nutraceuticals, productivity and quality of ginger (*Zingiber officinale* Rosc.) through triacontanol application". *Plant Biosystem* 146 (2012): 106-113.
49. Grzanna R., *et al.* "Ginger-An Herbal Medicinal Product with Broad Anti-Inflammatory Actions". *Journal of Medicinal Food* 8 (2005): 125-132.
50. Singh JP., *et al.* "Development of Nutraceutical Ready-to-Serve Blends of Ginger and Honey". *Journal of Postharvest Technology* 2 (2014): 188-194.
51. Mahomoodally MF., *et al.* "Ginger and its active compounds in cancer therapy: From folk uses to nanotherapeutic applications". *Seminar in Cancer Biology* (2019).
52. Mazza G and Francis FJ. "Anthocyanins in grapes and grape products". *Critical Reviews in Food Science and Nutrition* 35 (1995): 341-371.
53. Maulidi RR., *et al.* "The effectiveness test of turmeric extract toward *Bacillus cereus* bacteria with the comparison of Ciprofloxacin". *Biospecies* 13 (2020): 15-22.
54. Lee BS., *et al.* "Autoimmune Hepatitis Associated with Turmeric Consumption". *ACG Case Report Journal* 7 (2020).
55. Lantz RC., *et al.* "The effect of turmeric extracts on inflammatory mediator production". *Phytomedicine* 12 (2005): 445-452.
56. Mishra S and Palanivelu K. "The effect of curcumin (turmeric) on Alzheimer's disease: An overview". *Annals of Indian Academy of Neurology* 11 (2008): 13-19.
57. Pise A., *et al.* "Strategic Analysis of Indian Nutraceutical Regulatory Scenario Through Market Research". *International Journal of Current Research and Review* 4 (2012): 223-231.
58. Bhowmik D., *et al.* "Nutraceutical -A Bright Scope and Opportunity of Indian Healthcare Market". *The Pharma Journal* 1 (2013): 29-41.
59. Fernandes SD., *et al.* "The emergence of India as a blossoming market for nutraceutical supplements: An overview". *Trends in Food Science and Technology* 86 (2019): 579-585.
60. Sachdeva V., *et al.* "Current Prospects of Nutraceuticals: A Review". *Current Pharmaceutical Biotechnology* 21 (2020): 884-896.

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