

## NUTRACEUTICALS: USING COMMON FOODS TO IMPROVE HEALTH, PREVENTING ILLNESS, AND ADDRESS SAFETY ISSUES

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### ABSTRACT

Important dietary components known as nutraceuticals have both therapeutic and nutritional impacts. The active ingredients in these foods, including such carotenoids, collagen hydrolysate, and dietary fibers, are what provide them their health benefits. Nutraceuticals have been shown to have a good impact on immunological and cardiovascular health, as well as play a part in the prevention of infections and cancer. Depending on its nature and manner of action, nutraceuticals can be divided into many types. Various nutraceutical categories and their therapeutic potential effects, including anti-cancer, antioxidant, anti-inflammatory, and anti-lipid activity in disease, will be examined in this study. In addition, the many ways in which these accepted methods and structures, their application, and human safety would be covered, along with recent trends and nutraceuticals' potential for the development.

**Keywords:** Anti-Inflammatory, Antioxidant, Anti-Cancer, Anti-Inflammation, Anti-Lipid, and Safety and Toxicity of Nutraceuticals.

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### INTRODUCTION

In traditional Chinese, Romans, and Greek medicines in addition to the ancient Indian Ayurveda system, ordinary food plus botanical supplements have long been regarded as essential components of the holistic approach to achieving total wholeness and health. Hippocrates, a Greek physician, is credited with introducing the concept of food as medicines with his famous adage, "Let food be the medicine and medicine be the food." Many natural ingredients have been used throughout history of mankind for their curative and energizing properties, including cinnamon, saffron, honey, garlic, ginger, pomegranate, mint, and many others [1,2].

Nutraceuticals are active chemicals that are found in everyday foods or botanical sources. They can be consumed as functional ingredients or nutritional supplements to provide additional health benefits in addition to the adequate nutrient elements. Antioxidants, phytochemicals, fatty acids, amino acids, and probiotics are just a few of the bioactive compounds gathered in dietary sources that make up nutritional supplements [3]. Nutraceuticals are very well because its role in illness prevention and treatment, anti-aging qualities, and cancer prevention, either with the pre-existing benefits or possible implications. The substantial role that probiotics play in the prevention and treatment of gastroenterological illnesses encourages people to consume them. For instance, garlic has been recommended as an adjunctive treatment for excessive cholesterol and blood pressure [4].

Nutraceutical substances have drawn attention as a potential therapeutic and preventive strategy attributed to the prevalence of side effects caused by some pharmaceutical treatments and the growth of antimicrobial resistance, as well as the benefits of being more accessible and affordable. Numerous studies had conclusively demonstrated the positive benefits of nutritional components on immune system operations. These include strengthening immunomodulatory activity, improving the infectious signaling pathway, and helping to lessen the effects of autoimmune diseases and hypersensitivity. Nutraceuticals have also been demonstrated to have antioxidant, anti-inflammatory, anti-cancer, and lipid-lowering effects [5].

The immune system is a highly developed host defense system made up of several specialized cells and protein elements that work together as a unit to defend against illnesses. The innate and adaptive immune systems are the two subsystems that make up the immune system. These subsystems entail cellular and humoral reactions. The very first line of protection (skin and mucous) and the second line of defense (granulocytes, macrophages, and dendritic cells), as well as humoral elements like cytokines and complement, make up the innate immune system. These defense methods and elements are present at birth. The adaptive immune system in contrast hand, develops the memory cells by prior exposure to various antigens [6,7].

Vitamin C is one of the substances that are most frequently eaten when it comes to enhancing external immunity. Numerous studies have demonstrated that Vitamin C has positive impacts on the immune response by enhancing phagocytosis and chemotaxis defensive mechanisms, boosting adaptive and innate immune responses, and acting as an antioxidant [8].

The recognition of the science behind nutraceuticals has been expanding, along with interest in discovering innovative therapeutic choices using cutting-edge technologies and academic research methodologies. Although several nutraceuticals have been shown to have beneficial benefits on the immune system, additional high-quality, clinical research with strong supporting evidence is still required to better understand the long-term benefits and general safety. Because nutraceuticals still exist in a limbo where many people are unsure if they should be administered as medicine or if they fulfill a basic nutrient requirement, we have noted that it is essential to widely exploit the medicinal benefits and nutritional values of the those substances separately [9-11].

Because it will help turn these supposedly possible natural nutraceutical substances into workable, validated, regulated, and approved effective pharmaceutical treatments, advanced exploration of their safety, bioactivity, and bioavailability is vital.

This review's major goal is to highlight new findings on the immune-stimulating abilities of nutraceutical substances and their prospective therapeutic uses, including an overview of various nutraceutical kinds

and immune system action mechanisms. Career prospects, potential uses, and the safety of nutraceuticals will also be covered.

### DIFFERENT TYPES OF NUTRACEUTICALS

According to how they are used, nutraceuticals are divided into probiotics, prebiotics, conventional, non-traditional, fortified, recombinant, phytochemical, herbal, functional foods, and nutritional supplements [12].

### TRADITIONAL NUTRACEUTICALS AND PRODUCTS

#### Carotenoids

Carotenoids are pigment-producing natural substances that are found in large quantities in plants, fruits, vegetables, and algae. The human diet contains a variety of carotenoid derivatives, such as -carotene, -cryptoxanthin, lutein, lycopene, zeaxanthin, crocetin, fucoxanthin, and astaxanthin [13]. They are well known for having a variety of health benefits, such as antioxidant and anti-inflammatory characteristics. In addition, carotenoids have positive effects on human vision, cognition, the heart, the immune system, and cancer prevention. Two types of carotenoids, astaxanthin and -carotene, were shown to have anti-inflammatory properties in a study. Both have been found to be capable of reducing the expression levels of inflammatory mediators and suppressing the inflammation brought on by *Helicobacter pylori* [14,15].

#### Fatty acids

Animal fats, fish oil supplements, seeds, olive oil, and coconuts all include fatty acids as a component of their oils and fats. In addition to their function in energy storage, they have also been shown in numerous studies to have anti-inflammatory and immunomodulatory properties. In one research, individuals with rheumatoid arthritis (RA) who received omega-3 polyunsaturated fatty acids (PUFAs) at a dose of >2.7 g/day for at least 3 months noticed a decrease in the intensity of their symptoms [16,17].

#### Dietary fibers

Based on their solubility in hot water, ability to hold onto water, and viscosity, dietary fibers can be divided into more than just soluble and insoluble fibers. Viscous elements such as fructans and -glucans as well as non-viscous fibers like hemicellulose are found in soluble fibers. While soluble fibers tend to prolong gastric emptying time, insoluble fibers tend to expedite gastric emptying time, which helps to relieve constipation. Insoluble fibers tend to lose the characteristic of viscosity and are water insoluble [18]. Due to their ability to reduce the risk of ulcerative colitis and Crohn's disease, high fiber diets have been demonstrated to have a beneficial effect on inflammatory bowel illnesses [19,20].

#### Collagen hydrolysate

In mammals, collagen is a major protein that may be obtained from the connective tissues of cows, including their skin, bone, cartilage, and tendons. By extracting collagen, which is done by exposing it to hot water, gelatin, a partially hydrolyzed substance, is produced. Enzymatic hydrolysis is used to thoroughly hydrolyze gelatin to create collagen hydrolysates. The positive effects of collagen hydrolysates include antioxidant, anti-aging, anti-tumor, anti-inflammatory, and anti-obesity properties [21]. Collagen hydrolysates from the bones of domestic yaks (*Bos grunniens*) have been found in a study to have immune-stimulating properties and to have the ability to enhance mice's innate and adaptive immunity [22].

#### Probiotics

Probiotics are bacteria that are good for your health and are utilized in food, particularly milk products, which are crucial for promoting health since they have digestive and immunologic qualities. These live bacteria can also enhance the equilibrium of gut microbes. The most widely used probiotic that can thrive in the human intestine is *Lactobacillus*, which has several distinct species. *Streptococcus* and *Bifidobacterium* spp. are currently employed as probiotic strains as well [23,24].

#### Prebiotics

Short-chain carbohydrates make up prebiotic nutrients, which boost the probiotics' effectiveness. These prebiotics act as probiotics' literal fertilizers because they are unaffected by stomach acids and gastric pH. Prebiotics are non-digestible substances that support the development of beneficial microorganisms and modify the make-up and activity of the gut microbiota. Example of prebiotics used in functional ingredients to boost gastric health includes fructo-oligosaccharides and inulin [25].

#### Phytochemicals

Phytochemicals, such as lutein and lycopene, are advantageous, concentrated or purified compounds derived from plants that are involved in human biochemical and metabolic processes. To preserve the chemical balance of the brain, phytochemicals can help, which has a neuroprotective effect. In addition, a high intake of fruits and vegetables that include phytochemicals can lower your chance of developing cancer, heart disease, and neurological diseases [3,26].

#### NON-CONVENTIONAL APPROACH

As a non-conventional strategy, non-traditional nutraceuticals are manufactured foods or food items. To improve the nutritional value of food and improve human health, nutritious components are added using biotechnology or agricultural breeding techniques [27]. Non-traditional nutraceuticals can be divided into fortified and recombinant varieties depending on how they were processed. Instances of this category of nutraceuticals that contain provitamin A and can increase antioxidant activity include rice that has been enhanced with -carotene and cereals that have been fortified with vitamins and minerals [28].

#### Recombinant nutraceuticals

Foods made using genetic recombination and engineering are known as recombinant nutraceuticals. These kinds of foods or commodities are genetically manipulated to produce goods with recombinant substances and proteins that would make them healthier. These nutraceuticals include things such as iron rice, golden rice, maize, golden mustard, multivitamin corn, and gold kiwifruit [29]. A recombinant gene found in gold kiwifruit raises ascorbic acid, carotenoid, and lutein levels to improve immune function. It is also regarded as a source of fiber, potassium, and vitamins [30].

#### Fortified nutraceuticals

Fortified nutraceuticals are foods that have extra micronutrients or vitamins added to them to boost their value. Examples include milk with cholecalciferol vitamin and orange juice with calcium added. These meals give the body vital nutrients that can fight anemia and enhance overall health. For instance, adding calcium to a particular food, such as orange juice, can improve glycemic management [31].

### CLASSIFICATION ON MODE OF ACTION

#### Anti-cancer activity

According to research regarding the use of nutraceuticals as chemopreventative agents, they have the potential to both prevent and treat cancer. It has been demonstrated that nutritional supplements from many sources have anti-cancer properties. Many plants, including garlic, ginseng, curcumin, ginger, and green tea extract, have been found to inhibit oncogenesis. These pathways include the activation of autophagy and intrinsic apoptosis, as well as the suppression of DNA alkylation, tumor initiation, proliferation, and metastasis. In addition, it has been discovered that nutraceuticals reduce the activity of cancer signaling pathways that are thought to contribute to the development of cancer [32].

Cell cycle arrest, apoptosis, and inhibitory angiogenesis are the outcomes of activation of the Vitamin D receptor (VDR). Organs and tissues contain this nuclear receptor, which is intracellular. The growth arrest gene and the DNA damage-inducible gene are activated as a result of the active form of Vitamin D binding to VDR. This leads to the conclusion that while Vitamin D sufficiency benefits in illness

prevention, Vitamin D insufficiency would result in a variety of disorders. In addition, the possibility of vitamins including Vitamins A, C, and D as anti-cancer agents has been researched. On the other side, gemcitabine and the complementary treatment supplement *Clinacanthus nutans* have both been studied [33,34].

Numerous studies have been done on how prebiotics and probiotics affect colorectal cancer (CRC). It is thought that both prebiotics and probiotics are helpful in supporting human health, particularly in the gastrointestinal tract. High fiber consumption increases the number of short chain fatty acids (SCFAs), which produces bacteria and lowers the number of colon tumors, according to a study looking at the effect of prebiotics' anti-cancer potential. Similar to this, a study examining the prophylactic effects of *Lactobacillus rhamnosus* on the development of colorectal cancer (CRC) demonstrated that oral administration of this probiotic reduced the expression of inflammatory proteins such as NF- $\kappa$ B-p65, TNF, and iNOS, which is associated with inflammation related to tumor development.

Green tea's polyphenols, in particular, have been demonstrated to target cancers of the liver, lung, breast, prostate, and skin. Green tea is a rich source of catechins, which have anticancer properties including antioxidant, anti-inflammatory, anti-proliferative, and antiangiogenic effects. Epigallocatechin gallate (EGCG) has been shown in research on habitual green tea use in humans to lower the incidence of prostate cancer. In addition, green tea polyphenol E treatment of the prostate cancer cell line PC-3 caused intracellular oxidative stress, which in turn inhibited the pro-survival pathway Akt, causing cell death. Furthermore, EGCG administration showed an inhibition activity on lung cancer cells by triggering reactive oxygen species (ROS) that result in oxidative DNA damage, inhibiting the proliferation of malignant cells [35,36].

The treatment of poly E also slowed tumor growth, decreased metastasis, inhibited mammary ductal expansion, and affected angiogenesis by lowering levels of vascular endothelial growth factor (VEGF), according to a practical study investigating the impact of EGCG on mammary cancers. VEGF is a significant angiogenic agent that promotes tumour growth and metastasis. In addition, EGCG has demonstrated its potential to reduce the development of hepatocellular carcinoma by preventing HepG2 and PC12 from proliferating and by causing death in tumor cells.

One of curcumin's radiosensitizing properties is its capacity to inhibit signaling pathways, which increases the susceptibility of cancer cells to radiotherapy. Curcumin was administered, and the effects were seen in T cell lymphoma. The results show a decrease in VEGF proteins, which inhibits angiogenesis. The same study also discovered that curcumin inhibits Glut1, which causes decreased glucose absorption and induces apoptosis. Curcumin was found to target the PI3K signaling pathway to reduce cell viability and trigger apoptosis in breast cancer cells in an *in vitro* research. The expression of miR-99a is also observed to be upregulated by curcumin, which results in the deactivation of the JAK/STAT signaling pathway. The expression of miR-99a is also observed to be upregulated by curcumin, which results in the deactivation of the JAK/STAT signaling pathway. The earlier procedures had anti-tumor effects on retinoblastoma cells by inhibiting their growth, migration, invasion, and inducing apoptosis [37].

Resveratrol, a polyphenol functioning as a chemosensitizer by inhibiting NF- $\kappa$ B and STAT3 pathways, has been found to have cell signaling regulation effects. Furthermore, resveratrol is employed to lessen the cellular damage caused by chemotherapeutic treatments due to its capacity to the lower oxidative stress and upregulate the production of survival proteins. Resveratrol reduces the expression of miR-221 through regulating NF- $\kappa$ B expression, according to research on the anti-cancer effects of the substance in melanoma. Metastasis and cancer cell proliferation are reduced as a result of the ensuing inhibitory process [38,39].

### Anti-inflammatory activity

Nutraceuticals have anti-inflammatory effects that aid in the treatment and prevention of chronic disorders linked to chronic inflammation. Naturopathic remedies' usage as complementary alternatives to anti-inflammatory therapeutic medications enables a decrease in drug dosage, which minimizes side effects. This is another advantage of using nutraceuticals as anti-inflammatory agents.

When a strong anti-inflammatory like curcumin is administered, inflammatory cytokines like interleukin, TNF, and cyclooxygenase-2 (COX-2) can be suppressed. Periodontitis can be prevented and treated with the use of curcumin, which has anti-inflammatory properties. By lowering IL-8 and high-sensitivity c-reactive protein, curcumin can improve the condition of individuals with persistent pruritis brought on by the chemical sulfur mustard and decrease inflammation in those people (hs-CRP) [40,41].

PUFAs are one class of dietary supplements that have been demonstrated to reduce inflammatory diseases. Treatment with PUFA decreased NF- $\kappa$ B expression. Patients with Duchenne muscular dystrophy also showed a decrease in pro-inflammatory markers and a rise in the anti-inflammatory marker IL-10. Lycopene, an anti-inflammatory molecule present in tomatoes that can shield the heart and fend against cardiovascular conditions including atherosclerosis and myocarditis, is another illustration of a nutraceutical component. Lycopene was linked to a 17% lower risk of cardiovascular disease (CVD) in a meta-analysis to assess this relationship.

Probiotics with anti-inflammatory properties control inflammatory cytokines, the regulatory T cell response, and the NF- $\kappa$ B signaling pathway to reduce inflammation. For instance, a probiotic blend of *L. rhamnosus*, *Bifidobacterium lactis*, and *Bifidobacterium longum* showed anti-inflammatory efficacy by increasing IL-10 and decreasing pro-inflammatory cytokine production. Probiotics may also have anti-inflammatory and immunomodulatory properties, according to some research. In mice, pretreatment with -(1,3)-glucan reduced the expression of inflammatory cytokines and reactive oxygen species (ROS) and avoided the clinical symptoms of dextran sulfate sodium-induced inflammatory bowel disease [42].

The anti-inflammatory properties of lycopene, ginger, cinnamon, and peppermint have also been demonstrated. Ginger and its constituents have anti-inflammatory properties that can lessen inflammation. In a study, ginger was given orally to newborn rats with necrotizing enterocolitis, and the levels of TNF-, IL-1, and IL-6 decreased, indicating a significant decrease in inflammation. Ginger was also found to reduce the acute inflammation in ulcerative colitis. In addition, peppermint extracts were able to reduce 90% of the expression of IL-6 at a dose of 50 g/mL and cinnamon extract were able to suppress and over 90% of the expression of IL-1 at that same concentration, both of which demonstrated strong anti-inflammatory effects [43].

### Anti-lipid activity

Vitamins, minerals, and antioxidants are examples of nutraceuticals that are thought to be helpful in managing hypercholesterolemia in a variety of illnesses, including hypertension, diabetes, and cardiovascular disease. The word "hypercholesterolemia" refers to the blood condition when there are too many low-density lipoproteins. This section will explore the impact of nutraceuticals on various illnesses linked to increased lipid levels because research has been done on how they can lower lipid profiles in hypercholesterolemic patients. Nutraceuticals have the ability to significantly reduce levels of total cholesterol (TC) and low-density lipoprotein (LDL) when used as hypolipidemic drugs. Based on how they work, lipid-lowering nutraceuticals can be divided into three classes. These strategies include reducing cholesterol production, reducing cholesterol absorption, and increasing LDL excretion [44,45].

Foods or supplements containing plant sterols have shown useful in decreasing lipid levels. Plant sterols have been shown to alter lipid

profiles by reducing the intestinal absorption of cholesterol. It has been discovered that consuming plant sterols had a positive impact on lipid profiles by reducing the levels of triglycerides and LDL in people at risk for or dealing with type-2 diabetes. An analysis of the effectiveness of yoghurt fortified with plant sterols has revealed a changed lipid profile with decreased levels of TC and LDL [46]. In addition, studies on the additive action of plant sterols with lipid-lowering treatments have shown that adding plant sterols to atorvastatin or ezetimibe led to further decreases in total and low density cholesterol.

Consuming dietary fiber is thought to be a successful strategy for modifying lipid profiles. Soluble and insoluble fibers are two categories of dietary fibers. Because the large intestine's microbiota ferments soluble fibers, they are more advantageous [47].

Berberine, a plant alkaloid recognized for its cholesterol-lowering properties, was proven to have cholesterol-lowering effects. Similar to how TC, LDL, and triglycerides are reduced by curcumin, which lowers them due to enhanced cholesterol excretion, curcumin is likewise thought of as a hypolipidemic agent. In conclusion, the ability of numerous nutraceuticals and functional foods to control lipid profiles has been demonstrated. Nutraceuticals can either decrease cholesterol synthesis, decrease cholesterol absorption, or increase cholesterol excretion depending on how they work [48].

#### Anti-oxidants

Free radicals build up in the body, causing oxidative stress, which can then trigger the onset of a number of chronic illnesses including cancer, cardiovascular and autoimmune disorders, ischemic disease, atherosclerosis, diabetes mellitus, and hypertension. Reactive oxygen species are typically produced and eliminated by the cell's redox (reduction and oxidation) balance (ROS). But a redox imbalance will cause ROS to build up and reduce antioxidants' capacity to counteract their effects, leading to oxidative stress [49].

Free radicals can be neutralized by exogenous antioxidants such as Vitamin C, vitamin E, and phenolic antioxidants. Vitamin C can scavenge free radicals like hydroxyl and superoxide anion radicals. A powerful antioxidant, Vitamin C shields DNA and cells from oxidative damage by scavenging free radicals. Cells can be protected against lipid peroxidation by Vitamins E and C [50,51].

Both quercetin and ginger extract are antioxidants, however ginger extract has a stronger inhibitory effect on hydroxyl radicals than quercetin. Blood oxidative stress was decreased and the antioxidant enzyme was increased by ginger extract.

Antioxidants are mostly found in food, vitamins, and dietary supplements. Fruits and vegetables, which contain high levels of vitamins and phytochemicals, are regarded as excellent sources of antioxidants. The betalain and phenolic chemicals found in beetroot boost the low-density lipoproteins' (LDLs') resilience to oxidation, shield the liver from damage, and lower blood pressure. Antioxidants found in dried fruits are beneficial to human health. They can lessen heart disease risk factors in addition to lowering blood sugar levels [52].

The two substances isoflavones and lignans, which are present in dates as an example of dried fruit, can function as antioxidants, play a role in diabetes, and have the ability to modulate pancreatic insulin release. Antioxidants, such as those found in nuts like pistachios, help minimize oxidative stress and lower the chance of developing chronic diseases [53]. Pistachios, along with other nuts such as walnuts and pecans, contain polyphenolic substances that function as antioxidants and may offer defense against diseases brought on by the buildup of free - radical.

#### NUTRACEUTICALS' SAFETY ON CONSUMERS

Only a small percentage of the nutraceuticals available on the market are detrimental to human health and are therefore not generally harmful

when consumed by humans. When administered in the right, regulated levels, studies have demonstrated that numerous frequently used nutraceuticals have many health advantages with relatively little harm. Anthocyanins, polyphenols, and catechins are examples of common nutraceuticals that are safe for human consumption when employed under controlled conditions. Only a small number of researches have shown how these compounds are bad for human health [54].

However, research on nutraceuticals has demonstrated that the advantages of use outweigh the risks, and they are universally accepted for use in humans when taken in the right amounts and dosages. Misuse and excessive usage of these products, however, could be harmful to people's health. The kind, duration, and quantity of use are the main determinants of these nutraceuticals' safety for customers. When certain nutraceuticals are used, especially by people who are taking medications, the interactions between the drugs and the nutraceutical ingredients can have extremely negative consequences on the body. As a result, for safe usage, they should only be used as directed by trained professionals, and only in the appropriate quantity, quality, and time [55,56].

Nutraceuticals' low cost, extensive safety profiles for both humans and animals, tolerance, and accessibility are some of their key qualities. Despite having a high level of safety, only a small number of them are said to have been harmed by heavy metals, hazardous pesticides, medications with abuse potential, possibly toxic plants, fertilizers, and mycotoxins. Regrettably, the safety profile of many nutraceuticals has not yet been fully investigated, and as a result, there are not enough safety available data for such agents. Toxicokinetics, start of action, necessary dose, and dosing frequency may all be understood by having a thorough understanding of the pharmacokinetic behavior of each drug. In addition, nutrient/food interactions are another critical component of safety assessments of nutraceuticals that evaluate the impact of interconnections on safety, efficacy, half-life, and future response to therapy.

Nutraceuticals are classified as dietary supplements in the majority of nations, including the United States, and may not be governed by the same rules and regulations governing allopathic pharmaceuticals' safety requirements. The "Dietary Supplements Health and Education Act," enacted by the US Congress in 1994, listed nutraceuticals as dietary supplements. Since they are not considered pharmaceuticals, their sale is allowed without any safety or effectiveness testing. However, to receive a license for use in the general population, such herbal agents must demonstrate scientific proof of their safety, effectiveness, and quality, in accordance with European Union standards. In contrast to pure synthetic compound-based products, it is more difficult to assess the toxicity and therapeutic effects of nutraceuticals since they typically contain a complex mixture of numerous components [57].

In addition, their chemical makeup differs depending on the region where the plants were collected, the varying impacts of fertilizers and pesticides, and the impact of stress. The limitations of nutraceuticals are all of the aforementioned factors, as well as the lack of very well techniques for extraction, identification, chemical composition, purity, potency, and safety of active pharmaceutical ingredients, which are to blame for batch-to-batch variation and the inability to replicate therapeutic effects. Nutraceuticals also contain a variety of substances that might cooperate or provoke an antagonistic reaction. Both of these actions could have positive therapeutic consequences as well as toxicity and perhaps a response that is sub therapeutic [58].

#### FUTURE PERSPECTIVES

People are now turning to nutraceuticals as an alternate form of therapy due to the severe side effects and ineffectiveness of current medications. The use of nutraceuticals for medical purposes has been supported on the grounds that they treat diseases brought on by nutrient deficiencies. The use of nutraceutical supplements has been shown to enhance health and stave off disease. Nutraceuticals with antioxidant activity are anticipated to have positive effects on the entire body rather than just

to treat the symptoms of a disease condition, and the therapy through nutraceutical supplements does not involve diagnosis by a skilled practitioner. The use of nutraceuticals by consumers allows them to easily manage their health without consulting their doctors.

Despite their advantages, long-term self-medication with nutraceuticals may have financial consequences for the consumer and could be more costly than other pharmaceuticals. This is a result of media and advertising glorifying the advantages of nutraceuticals. Nutraceuticals are well known to health professionals such as general practitioners, nurses, pharmacists, and nutritionists, who inform their patients or clients about how these products should be used. Nutraceuticals should not be used for self-medication of major illnesses, but their long-term usage in the prevention of chronic illnesses is safe and advantageous. Carnitine and flaxseed oil, which are mostly used to treat cardiovascular disease, and antioxidants, which are primarily used to prevent cancer, are examples of nutraceuticals for serious disorders.

The expense and profitability of producing nutraceuticals are well known to the manufacturers. To help the nutraceutical business grow, manufacturers often introduce new goods to the market. To prevent and treat chronic diseases, the use of nutraceuticals has indeed been promoted. Green tea and soy products, for instance, are used to prevent cancer.

Federal money for nutraceutical study has also surged, as has support for clinical trials. The regulatory authorities have control over the supply of nutraceuticals and the creation of analytical monographs of nutraceuticals for regular quality assurance. The consumer can choose the highest-quality products using analytical profiles of those products that are released by consumer organizations. The data that are now available about the use of nutraceuticals against a number of fatal diseases are still insufficient to support the marketability of nutraceuticals. Government support is therefore necessary to advance or enhance the research in these fields. The concept of nutrigenetics, which describes how individuals react differently to the same nutraceutical, has also advanced our understanding of the genetic variations across individuals. Genotyping is used by pharma firms to forecast the effectiveness, safety, and toxicity of medications during clinical trials, and the availability of genomic information hastens the progression of illness therapy. In pharmacogenomics, the patient's response to medication is researched, whereas "nutrigenomics" has been established to study the impact of nutraceuticals and dietary components on the health of a specific individual. Nutrigenomics uses genetic data from a specific person to forecast the need for dietary supplements to promote wellness or fend against sickness.

## CONCLUSION

Nutraceuticals are a cutting-edge and exciting research area for the development of novel health products with enormous potential for positive health effects, including safety, efficacy, and affordability. Scientists have come to the conclusion that dietary supplements and good nutrition can both prevent and treat chronic diseases on a global scale. Numerous nutraceutical types have been extracted from foods, and they are manufactured in large quantities using biotechnology and genetic engineering techniques that have positive pharmaco-economic effects. In addition to their nutritional qualities, these items offer great health advantages by preventing a number of disorders. Numerous illnesses, such as cancer, rheumatoid arthritis, diabetes, and other chronic diseases, have been successfully treated with nutraceuticals.

Comparing nutraceuticals to the both complementary therapies and traditional pharmaceuticals, there are generally fewer side effects, unfavorable effects, and medication interactions. The lack of side effects, adverse effects, and drug interactions does not really mean that nutraceuticals lack these features, but risk-benefit analyses for the use of nutraceuticals have yet to be completed in the same way as for other traditional drugs.

The pharmaceutical and food sectors, as well as academia, are very interested in this research area. Several pharmaceutical companies, notably Ranbaxy and Abbott, have taken the initiative to provide a variety of nutraceutical products for customers of various ages. Researchers have discovered that these products play a significant preventive role; hence, more in-depth academic and pharmaceutical sector research is required regarding their safety and efficacy. In addition, the application of cutting-edge and high-throughput technologies can aid in our understanding of the underlying mechanisms of action and expand the boundaries of this fascinating field of study for the benefit of humanity in terms of both economic and health results.

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## AUTHORS CONTRIBUTIONS

All the authors contributed equally in conceptualizing the theme as well as finalizing the draft.

## CONFLICTS OF INTEREST

The authors confirm that the content of the article has no conflict of interest.

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