



Review Paper for Nutrients in food

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Abstract

The diet exerts a substantial influence on chronic illnesses and overall well-being. Addressing food-related behaviors will enable individuals to manage these conditions effectively. Enhancing health by making changes to one's diet through modification and fortification, introducing novel food options, and including essential nutrients. Enriched and utilitarian food products, supplements, and health-promoting substances Fortified meals and functional foods are designed to augment the nutritional requirements of individuals. Some meals, like morning cereals, are regularly enriched with vitamins and minerals, and there is a growing variety of foods that are enhanced with specific functions and claimed to provide health benefits. Nutraceuticals, also known as nutriceuticals, are naturally occurring bioactive chemicals that possess qualities that promote health or prevent diseases. The study investigated the correlation between nutrition and its influence on human well-being. It provided evidence that diet plays a significant role as an environmental component in the development of many chronic illnesses. Quantifying the precise magnitude of this impact is challenging, however, there has been a notable 35% decrease in the occurrence of Cancer among different age groups in the United States. The states have been proposed to be attainable using "feasible dietary methods". The potential to produce significant societal and economic benefits via the identification and utilization of health-promoting elements in foods is evident. Spectrum Population Capable The extent to which one can profit from this study will hinge upon how The data is utilized by scientists, the food business, and policy officials.

Introduction

The research focused on a crucial subject that is essential for the sustenance of life. Without it, life would not be possible, except for the topic of nutrients. Nutrients are chemical substances that are necessary for the survival and growth of an organism. They also play a vital role in the body's food processing. Organisms obtain nutrients from their surrounding environment. Through nutrients, we are able to acquire the energy required in significant amounts to sustain bodily functions and perform daily activities (Ross, 2002). The term 'nutraceutical' was coined in 1989 by DeFelice, combining the words 'nutrition' and 'pharmacy'. Originally, it was described as a food or a component of food that offers medical or health advantages, such as illness prevention and therapy (Singh, 2012).

A nutraceutical refers to a naturally occurring food that is abundant in nutrients, such as spirulina, garlic, soy, or a particular element found in food, such omega-3 oil derived from salmon. They are sometimes referred to as medicinal foods, nutritional supplements, and dietary supplements. The spectrum includes individual nutrients, nutritional supplements, genetically modified foods, specialized herbal products, and processed food items including cereals and soups. They have garnered significant attention because to their assumed safety and potential for nutritional and medicinal benefits. Individuals might enhance their well-being

through the use of supplements and the consumption of specially designed or fortified meals (Verma & Mishra, 2016).

Public education, renewable sourcing, cultivation and processing, environmental sustainability, and local accessibility are further factors contributing to the increasing popularity of nutraceuticals. 5 The United Kingdom, Germany, and France were the pioneers in recognizing that nutrition is a more significant determinant of good health than exercise or inherited factors. According to Canada, these products are classified as "a substance made from food but sold in the form of pills, powders (potions), and other medicinal forms that are not typically considered as food" (Silva, 2011). Nutraceuticals are dietary components derived from herbal or botanical sources that are utilized for the prevention or treatment of various acute and chronic ailments (Chauhan B, 2013).

There is a concurrent increase in public interest in food and/or active food components that enhance lipid profile and, consequently, promote better health. In addition to providing essential nutrients for overall health, several meals offer additional physiological advantages (Rosa et al., 2015). The proliferation of knowledge facilitated by education and an inquisitive media has led to the swift emergence of a self-care movement among consumers. Furthermore, our comprehension of the mechanism of action, health-enhancing benefits, and additional value of both food and non-food items is fast expanding. The combination of improved economic well-being and growing health consciousness is motivating consumers to actively participate in their health management. Individuals are becoming less inclined to passively rely on medical advice from the healthcare community only when faced with health issues (K Basu et al, 2007).

Reasons for choosing the topic of nutrients?

Consumers' awareness and concern regarding the connection between diet, food consumption, and health have grown. This heightened interest in nutrition and healthy eating has resulted in consumers showing more interest in better food options (Christine et al, 2011).

Many individuals find it challenging to obtain sufficient nourishment from their regular diet. Furthermore, we are in an exceedingly noxious habitat, replete with contamination and pesticides that disrupt our body's capacity to regulate itself. Several emerging diseases are currently prevalent within our population. A more prudent approach would be to enhance our system or terrain rather than relying on antibiotics that have become ineffective. Drug administration sometimes leads to negative effects due to their non-natural composition, but high-quality supplements that can be effectively absorbed and utilized by the body can really enhance our physical strength and vitality (Rajam et al., 2019).

The health benefits of functional foods and nutraceuticals primarily target the prevention and treatment of cardiovascular diseases, different types of cancer, diabetes, inflammations, and the enhancement of immune response. Additionally, they contribute to slowing down the aging process and extending a healthy lifespan (Fereidoon, 2009). (Rajasekaran et al., 2008) The study (Mannarino, et al, 2014) also noted that nutrients play a role in treating hypercholesterolemia. The literature has identified over 40 nutrients that potentially have a positive impact on lipid metabolism. Some of these nutrients have been proven to lower blood lipids and cardiovascular risk. Additionally, certain nutrients have been shown to have a beneficial effect on vascular damage.

In order to comprehend nutraceuticals, it is necessary to provide clear definitions for certain words (Crandell & Duren, 2013). Food, as per the Food, Drug and Cosmetic Act (1968), refers to an item that offers flavor, scent, or nutritional benefits. The Food and Drug Administration (FDA) classifies food as 'generally regarded as safe' (GRAS). (Doyon and Labrecque, 2008,

page 1133) A dietary supplement is a product that contains one or more nutritional components, such as vitamins, minerals, herbs, botanicals, or amino acids (proteins), as defined by the Dietary Supplement Health and Education Act (DSHEA, 1994). Encompasses all potential elements of the diet, including concentrations, components, extracts, or metabolites derived from these substances.

A veterinary nutraceutical is a purified or extracted substance that is given orally to animals in order to provide essential agents for their normal body structure and function. The purpose of administering these substances is to improve the overall health and well-being of the animals. A drug, according to AAFCO (1996), is a material that is meant to be used for diagnosing, curing, alleviating, treating, or preventing diseases in humans or other animals. A non-food substance designed to alter the structure or function of the human or animal body (Bagchi, 2006).

Nutraceuticals, as defined by the dietary supplement industry, refer to nontoxic food components that have been scientifically demonstrated to provide health benefits, including the treatment and prevention of diseases. The citation is as follows: Palthur MP, 2009, page 14. Emerging terminology to appeal to consumers encompass cosmeceuticals and aquaceuticals, which strive to communicate medicinal efficacy and excellence in the domains of cosmetics and non-alcoholic beverages, correspondingly. Vitamins can be categorized as medications, however they may be easily accessible. The line between specific vitamins and nutraceuticals is indistinct, as exemplified by carotene, which serves as a precursor to vitamin A. Nutraceuticals, which are often produced from plants or foods, are often marketed in accordance with regulatory regulations. It is important to note that there is a clear distinction between medicines and non-medicines. The general view of the public may not differentiate significantly between these organizations, unless their legal status directly impacts their accessibility. The majority of individuals are influenced by marketing strategies, since nutraceuticals often present themselves with packaging and labeling that resembles pharmaceutical products. The usage of various words and definitions across different nations can lead to significant confusion (Lockwood, 2007).

Herbal: Nutritional treatment and phytotherapy have rapidly gained popularity as novel concepts and therapeutic approaches in recent years. The growing popularity of nutraceuticals, natural plant foods, nutritional treatment, and phytotherapy has led to strong recommendations for their use. These interventions are believed to enhance health and serve as preventive and therapeutic measures against illnesses. The growing plant biotechnology industry has focused on enhancing the nutritional content of fruits, vegetables, and other crops, as well as the bioactive compounds found in traditional herbal remedies (Zhao, 2007).

History And Rediscovery of Nutrients as Nutraceuticals

The concept that food has the potential to prevent diseases or alleviate ailments is a centuries-old proclamation made by our ancestors. The ancient texts and artworks of Egyptian, Roman, and Greek civilizations portrayed the medical and spiritual uses of plants. The concept originated 3000 years ago when Hippocrates established a correlation between the nutritional value of food and its potential medicinal benefits. The fundamental veracity conveyed in his assertion that "Let food be thy medicine and medicine be thy food" is extensively implemented in contemporary times. Therefore, based on these findings, it may be inferred that our natural environment provides a plethora of natural remedies. One notable discovery is the utilization of botanicals, which have been employed since ancient times for the purpose of cancer therapy.

Moreover, there are several chemotherapeutic agents originating from plants, including *Vinca* and *Taxus brevifolia* species, that are utilized for the treatment of cancer and associated ailments. In addition, Ginseng is a traditional medicinal herb that has been utilized in China for over 2000 years. The chemotherapeutic properties of ginseng were first recognized and utilized during the Liang dynasty of China, and these applications continue to be used in modern times. Based on historical records, the Egyptians recognized the therapeutic significance of coriander, fennel, juniper, cumin, garlic, turmeric, thyme, curry, and dried mint that were discovered in pyramids. In Egypt, the significance of medical substances was so significant that even cinnamon was regarded as more valuable than gold.

The Roman emperor Heliogabalus included cinnamon, clove, and pepper into meals and beverages, taking use of their known characteristics. These ingredients continue to be utilized in cuisines and soft drinks to this day. Furthermore, several additional botanical specimens and dietary supplements were detected, including honey and certain vitamins. Honey has consistently held significant value since ancient times. It was mentioned in Sumerian tablet writings as a remedy for health issues. According to the Bible, the wise King Solomon has said, "Consume honey, my offspring, as it possesses favorable qualities." Apitherapy has emerged as a distinct medical field that focuses on the therapeutic benefits of honey, based on its various beneficial characteristics. It has pledged to provide its function as a vasodilator, anti-allergic, and antihypertensive agent. Ancient people also recognized the need for vitamins, iodine, and other nutrients, in addition to honey.

An further example that illustrates the significance of food and nutrition is that of the ancient crewmen. Historically, throughout the course of several centuries, several sailors on extended sea journeys perished from scurvy. Research conducted during exploration expeditions uncovered the lack of Vitamins B and C in their diet, which acted as antiscorbutic agents (R. Dev, 2011). The utilization of "nutraceuticals" (referring to nutrients and/or bioactive chemicals that have the potential to positively impact human health) has grown prevalent. These compounds can be included in food and drinks or consumed as dietary supplements in the form of liquid solutions, pills, or capsules (Pirro et al., 2016).

Concept of Nutraceuticals

The term "nutraceutical" encompasses isolated nutrients, dietary supplements, diets, processed products, and designed foods that provide a health benefit, such as disease prevention, maintenance of health and well-being, alleviation of illness symptoms, and prevention of challenges in developing delivery systems (Augustin & Csiro, 2012).

The notion of nutraceutical originated from a survey conducted in the U.K., Germany, and France. The poll found that consumers consider nutrition to be more important than exercise or inherited factors in obtaining excellent health. Nutraceutical refers to compounds that are not conventionally acknowledged as nutrition, yet provide beneficial physiological effects on the human body (Palthur et al., 2010). They do not readily fit into the legal classification of food and drug and frequently reside in a nebulous realm that lies between the two. Due to the potential for medication toxicity or unwanted effects, we have decided to explore safer alternatives such as nutraceuticals and functional foods for health management. This led to a global nutraceutical revolution. The emergence of nutraceuticals will usher in a transformative age in medicine and health, when the food business will adopt a research-focused approach akin to the pharmaceutical industry (Pandey, 2010).

Due to the fast advancement of knowledge in nutrition and related disciplines, there has been a significant shift in our understanding of food and its role in promoting good health. Among

these patterns, nutraceuticals have garnered considerable interest due to their substantial impact on enhancing health, bolstering immunity, and safeguarding against illnesses, hence leading to decreased healthcare expenses (Nimesh & Ashwlayan, 2018). Nutraceuticals are produced by extracting compounds from plant or animal diets. These compounds are then concentrated and formulated into pharmaceuticals to provide specific medicinal and nutritional advantages. Classification of substances can be determined by their availability, chemical features, and modes of action (Gupta et al., 2010). The anti-oxidative, anti-inflammatory, anti-cancer, and osteogenetic capabilities of several nutraceutical substances have been shown to prevent and treat different chronic illnesses. The positive impacts of nutraceuticals are ascribed to the diverse array of bioactive compounds they contain, as well as the many processes they engage (Sabharwal, 2022).

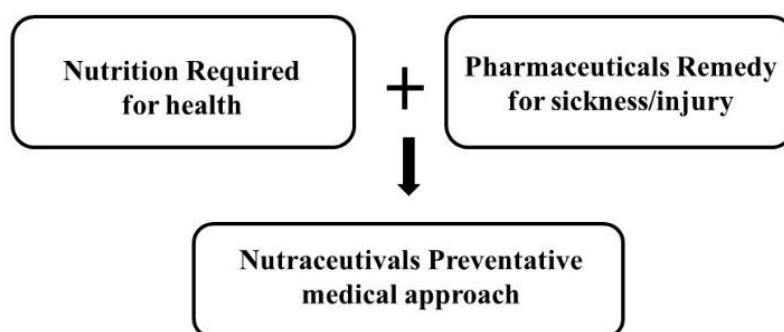


Figure 1. Concept of Nutraceuticals

Nutrient classification

Nutrients are bioactive substances that have been extracted or purified from dietary sources and have beneficial effects on health. In the context of nutrition, the term "nutrient" often denotes a substance, such as a meal, nutritional supplement, or bioactive chemical, that offers advantageous effects on health (Sirtori et al., 2007). A nutrient is a material that is classified as food or a component of food and has the ability to give medical or health advantages, such as the prevention and treatment of diseases. The word was introduced in 1989 by the Innovation Foundation in Medicine, located in New York. Nutrients encompass a variety of sources, including separated nutrients, dietary supplements, specialized food diets, and genetically engineered herbal items. Examples include of flavonoids extracted from soybeans, fish oil capsules, herbal extracts, glucosamine, chondroitin sulfate, tablets containing lutein-enriched vitamins, and antihypertensive pills using protein-derived peptides. The table provides a selection of several nutrients derived from diverse sources. While these components are not classified as essential nutrients, they are recognized as biologically active substances that may have health advantages, but their effectiveness has not been definitively demonstrated. Ongoing study in this area is probable. To develop a new generation of food products that can blur the distinction between food and medicine. Prevention and treatment are seen as important by public health agencies. Nutrients are an effective means of promoting health and combating various ailments (Venugobal, 2009).

Table 1. Examples Of Nutraceuticals From Different Food Products

Muscle Foods	Fermented F	Plant Foods
Conjugated linoleic acid (CLA)	Sacharomyces boulardii	Ascorbic acid
	Bifidobacterium bifidum	Quercetin
Eicosapentaenoic acid (EPA)	B. longuin	Lutein

	Lactobacillus acidophilus	Gallic acid
Decosahexaenoic acid (DHA)	Streptococcus salivarius	
	Subspp. Thermophilus	Allicin
Choline		Lycopene
Lecithin		Capsaicin
Calcium		β -Ionone
Ubiquinone		α -Tocopherol
Selenium		β -Carotene
Zinc		Zeaxanthin
		Isoflavanones

As for the study (Shinde, 2012) the nutrients were divided as follows:

Nutraceutical Categories

Dietary Supplements including botanicals: (1) Vitamins, minerals, coenzyme Q, carnitine; (2) Ginseng, Ginkgo Biloba, Saint John's Wort, Saw Palmetto.

Functional Foods

A food product that is part of usual diet but has beneficial effects that go beyond the traditional nutritional effects. Examples: (1) Yogurts - Probiotics for intestinal health; (2) Foods/cereals/snacks enriched with soluble fibres, vitamins and minerals; (3) Omega-3 milk in prevention of heart disease; (4) Canola oil with lowered triglycerides for cholesterol reduction; (5) Oats, bran, psyllium and lignin's for heart disease and colon cancer; (6) Prebiotics - oligofructose for control of intestinal flora; (7) Stanols (Benecol) in reduction of cholesterol adsorption.

Medicinal Foods

Health bars with added medications, Transgenic cows and lacto-ferrin for immune enhancement, Transgenic plants for oral vaccination against infectious diseases. A study conducted by Sirtori (2009) has shown that making lifestyle changes, such as modifying one's food, can decrease the likelihood of developing early coronary heart disease (CHD) by 82%. On the other hand, only adopting dietary habits may lower the risk by 60%. The American Heart Association Nutrition Committee recently delineated food and lifestyle objectives for mitigating the risk of cardiovascular disease. The factors that contribute to a healthy lifestyle include: maintaining a balanced diet, maintaining a healthy body weight (with a body mass index between 18.5 and 24.9 kg/m²), achieving optimal levels of LDL-C, HDL-C, and TGs in the blood, maintaining normal blood pressure, and keeping plasma glucose levels below 100 mg/dl. Additionally, engaging in regular physical activity and avoiding tobacco use or exposure are also important. Explicit dietary guidelines consist of consuming a diet abundant in vegetables and fruits, opting for whole-grain and high-fiber foods, regularly consuming fish, particularly oily fish, at least twice a week, restricting the intake of saturated fat to less than 7% of energy, trans fats to less than 1%, and cholesterol to less than 300 mg per day. Additionally, it is recommended to minimize the consumption of beverages and foods that contain added sugars, select and prepare foods with minimal or no salt, and maintain a moderate intake of alcohol. Modifying the intake of carbohydrate, fat, cholesterol, protein, and dietary fiber can lead to a reduction of over 30% in blood total cholesterol and LDL-C levels. Preliminary research on the high-carbohydrate/high-fiber diet showed a significant decrease of over 30% in total cholesterol and over 40% in LDL-C levels after 4-6 weeks. After 1 year, the diet resulted in an 18% reduction in total cholesterol.

Phytochemicals

Phytochemicals, as stated by Singh (2012, 179), are a category of nutraceuticals. They are categorized based on their chemical name, which is determined by their phytochemical features. Carotenoids, which are a kind of isoprenoid, may be found in a variety of fruits, vegetables, and egg yolk. They have anticarcinogenic properties, enhance the activity of natural killer immune cells, and provide protection to the cornea from UV radiation. Legumes such as chickpeas and soybeans, as well as grains and palm oil, include non-carotenoids that have the ability to lower cholesterol levels and possess anti-carcinogenic properties. Flavonoid polyphenolics, powerful antioxidants and phytoestrogens, are present in berries, fruits, vegetables, and legumes. They have the ability to prevent breast cancer, prostate cancer, and regulate diabetes. Dark grapes, raisins, berries, peanuts, and turmeric roots contain non-flavonoid polyphenolics, which possess potent anti-inflammatory, antioxidant, and anti-clotting properties, and can help lower cholesterol levels. Phenolic acids, which are present in blueberries, tomatoes, and bell peppers, have antioxidant properties and decrease the mutagenicity of polycyclic aromatic hydrocarbons. The seeds of *Barbarea verna*, also known as broccoli, contain isothiocyanates (glucosinolates) and have antitumorogenic properties.

Nutraceuticals are Food or Drugs?

One distinction between a feed and a nutraceutical is that a nutraceutical is unlikely to possess a well-established nutritional benefit. Feeds must possess nutritional value and are responsible, through labeling, for providing information about these values. One more distinction between a feed (meal) and a nutraceutical is that feed is often acknowledged as safe. Nutraceuticals are pharmaceutical preparations, such as tablets, capsules, or powders, that include a concentrated version of a hypothesized bioactive phytochemical or zoolochemical agent derived from food. They are intended to enhance health in doses that surpass what can be acquired from regular diets. In the majority of nations, nutraceuticals are classified by the legislature as dietary supplements. Consequently, the level of regulation for nutraceuticals is not as rigorous as it is for medicines (B. Niyati, 2015).

Allergy and nutraceuticals

Allergy is an immunological condition characterized by an exaggerated response of the immune system. An allergic response often arises when an individual's immune system responds to chemicals that are typically innocuous. Allergic responses are characterized by the overstimulation of certain white blood cells known as mast cells and basophils, triggered by a particular type of antibody termed immunoglobulin E. This reaction elicits an inflammatory response that might vary in severity from discomforting to perilous. Quercetin shields low-density lipoprotein (LDL-C) against oxidative damage, particularly to blood arteries. LDL-C is a primary factor contributing to heart disease, while quercetin functions as an antioxidant and eliminates free radicals. Diabetic individuals face an increased susceptibility to blood vessel impairment due to oxidative stress. Hence, quercetin also provides advantages in these individuals (Nasri, 2014).

Malnutrition and insufficiencies in essential nutrients

The United Nations study delineated three crucial phrases pertaining to the gravity of nutritional shortages, as outlined by Schutter (2011).

The global community is presently experiencing significant consequences as a result of relying nearly solely on augmenting output during the past fifty years. Undernutrition continues to be a serious issue, mostly because Food farming systems do not sufficiently contribute to alleviate

rural poverty. One-seventh remains operational. Experiencing global hunger. Approximately 34 percent of children in poor nations have a weight of 186 units. Overall, one million children, who are below the appropriate age, represent the most prevalent manifestation of chronic malnutrition. Despite the fact that the Food Price Index of the Food and Agriculture Organization of the United Nations, when adjusted for inflation, indicates a decline in food expenses from the early 1960s to 2002, the most impoverished segments of society continue to endure poverty, with the exception of a sudden surge in 1973. This hinders their ability to acquire sustenance in a dignified manner, as the agricultural system was not designed to cater to the needs of the most vulnerable and marginalized groups.

Furthermore, there is a significant prevalence of micronutrient deficiencies, particularly among children and women. He is afflicted with a vitamin A deficiency that affects at least 100 million youngsters, causing stunted development, weakened immunity, and, in severe cases, blindness and increased death. Approximately 4 to 5 billion individuals experience a deficit. Approximately half of pregnant women and children under the age of five in developing nations are affected by anemia, resulting in an estimated two billion individuals being afflicted. Iron deficiency hinders the process of growth and development. Impaired cognitive and immunological function negatively impact academic performance in children and adults. Efficiency. Inadequate levels of iodine and zinc have detrimental impacts on health and decrease the child's chances of survival. Approximately 30 percent of families in underdeveloped nations do not utilize iodized salt. Infants born to moms with acute iodine shortage are at a higher risk of having learning disabilities or cognitive impairments. Moreover, certain vitamins' insufficiency might potentially impair both physical and cognitive growth as well as compromise the immune system.

Micronutrient deficiencies, also known as "hidden hunger," including undernutrition, are a violation of a child's right to adequate physical and mental development and the highest attainable level of physical and mental health, as recognized in Article 6, paragraph 2, and Article 24, paragraph 2(c) of the Convention on the Rights of the Child. Regional disparities in children's development can be attributed to environmental factors rather than heredity. The Child Growth Standards developed by the World Health Organization demonstrate that newborns and children from diverse geographical locations exhibit comparable growth patterns provided their health and nutritional requirements are adequately fulfilled. In theory, all children possess equal potential for development. Consequently, it is the responsibility of states to promote and uphold the practice of exclusive breastfeeding for six months, followed by continued breastfeeding in conjunction with appropriate complementary feeding until the child reaches two years of age. Additionally, states should establish food systems that can guarantee not only sufficient calorie intake for everyone, but also a diverse and balanced diet that encompasses all the necessary micronutrients.

According to Sulieman's (2018) study, there has been a notable surge in the attention given to micronutrient deficiencies in recent years. The increasing interest stems from the recognition of the adverse effects of malnutrition resulting from micronutrient deficiencies on human health. The World Health Report of 2000 highlighted iodine, iron, vitamin A, and zinc deficits as some of the most significant health risk factors globally. Micronutrient deficiency causes several non-specific physiological obstacles, leading to decreased immunity to infection, disruptions in metabolism, and delayed or impaired physical and psychological growth. The ramifications of micronutrient deficiency on public health are numerous, and they hold significant relevance in formulating strategies to prevent and manage diseases such as HIV/AIDS, malaria, TB, and diet-related chronic illnesses. Food fortification is a crucial health

intervention and is among the most efficient approaches to reduce nutritional deficits. The use of food fortification in some prominent nations had a crucial role in effectively eliminating goiter, rickets, beriberi, and pellagra. Food fortification planners frequently encounter a range of political, social, and technological challenges. To aid in the creation, execution, and assessment of food fortification programs, health experts and policy makers have established recommendations. Published information on the United States' extensive history of food fortification is scarce. To effectively prevent micronutrient malnutrition, it is crucial to maintain a well-balanced diet that includes sufficient consumption of all essential elements. Regrettably, achieving this goal is still far from being realized globally due to the need for widespread availability of sufficient nourishment and appropriate dietary practices.

Increasing Prospects for the Functional Food Industry:

The production of functional foods is gaining recognition as the leading global food sector due to shifting trends in population demographics, consumer wealth, higher education, longer life expectancy, and improved healthcare. These factors have led to the emergence of a fast-growing customer base that is cognizant of their diet and health. The tremendous global expansion of the nutraceutical and functional food sector has been primarily driven by the increasing awareness and concern for health.

According to a 1998 poll performed by the International Food Information Council (IFIC), over 95% of the respondents believed that some foods had the ability to lower health risks and that consuming certain meals can lead to a better quality of life. According to a separate poll conducted by the American Dietetic Association (ADA) in 2000, a significant majority of participants, namely 85%, expressed the belief that nutrition and food have importance in their lives. Additionally, the utilization of Alternative Medicines (AM) for personal purposes in the United States of America (USA) had a twofold increase (reaching 40%) over a span of seven years from 1990 to 1997. The utilization of nutraceuticals and functional foods has been documented to yield notable physiological effects, leading to a growing global adoption of these products. This trend may be attributed to both historical evidence and contemporary clinical findings that highlight the successful outcomes achieved via their consumption (K Basu et al, 2007).

The factors that affect food safety

Food fraud is a multifaceted problem that often elicits intense reactions from consumers and can pose risks to food safety (Fao, 2022). Food serves as the fundamental components of living organisms, but under some circumstances, it can potentially jeopardize human well-being and become detrimental to health. Numerous individuals worldwide suffer from illnesses as a result of the food they consume. Foodborne illnesses, often known as diseases connected with food intake, can be caused by harmful microbes. When bacteria, mold, viruses, parasites, and chemical poisons are present, foods can pose a risk to human health and may even be lethal. Hence, it is imperative that customers are furnished with a secure food provision. The potential threat posed by foods can be attributed to various factors, including inadequate agricultural practices, substandard hygiene throughout the food supply chain, insufficient preventive measures during food processing and preparation, improper use of chemical substances, contamination of raw materials, food, and water, and inadequate storage conditions (Makun, 2016).

Nutraceuticals And Diseases

Cardiovascular illnesses Globally, the prevalence of chronic illnesses such as cardiovascular diseases, malignancies, diabetes, and obesity is rising at a rapid pace. In 2001, chronic diseases

accounted for nearly 59% of the total recorded fatalities worldwide, amounting to 56.5 million deaths. Additionally, these disorders were responsible for 46% of the global burden of disease. Cardiovascular diseases (CVD) encompass a range of conditions affecting the heart and blood vessels, such as hypertension (high blood pressure), coronary heart disease (heart attack), cerebrovascular disease (stroke), heart failure, and peripheral vascular disease. In 1999, cardiovascular disease (CVD) accounted for one-third of all global fatalities. By 2010, it will become the primary cause of mortality in emerging nations. The majority of cardiovascular diseases (CVD) may be prevented and managed. Studies have indicated a correlation between a reduced consumption of fruits and vegetables and an increased risk of death in cardiovascular disease^{8,9}. Several research investigations have established that consuming a diet abundant in fruits and vegetables might provide protection against cardiovascular disease (CVD¹⁰). In addition to this, it is suggested to incorporate nutraceuticals such as antioxidants, dietary fibers, omega-3 polyunsaturated fatty acids (n-3 PUFAs), vitamins, and minerals into one's diet, along with regular physical activity, with the purpose of preventing and treating cardiovascular disease (CVD). Studies have shown that chemicals such as polyphenols found in grapes and wine have the ability to modify cellular metabolism and communication, which is associated with a decrease in artery disease. Adhering to a diet that provides the necessary nutrients, taking nutraceuticals, vitamins, antioxidants, and minerals, reducing weight, engaging in physical activity, quitting smoking, limiting alcohol and caffeine intake, and making other changes to one's lifestyle can help prevent, delay the development, lessen the severity, treat, and manage hypertension (Rajasekaran, 2008).

Nutraceuticals Connecting the Gap Between Food And Medicine

Hippocrates emphasized over 2000 years ago the need of using food as medicine and medicine as food. Nutraceuticals refer to food or dietary elements that provide health benefits. This expanding category of products blurs the distinction between food and drugs. They do not fit well into the established legal classifications of either food or medicine, and frequently exist in a vague and uncertain territory that lies between the two. In European Union (EU) legislation, the classification of a nutraceutical is primarily determined by its recognized impact on the body. Thus, if a material just aids in the preservation of healthy tissues and organs, it can be classified as a dietary ingredient. Nevertheless, if it can be demonstrated to impact one or more physiological processes in one or more organisms, it is probable that it will be regarded as a medical material. The European Medicines Act can classify a nutraceutical as a medication for two specific grounds (Agrawal et al., 2020): (1) It can be used to prevent, treat or cure a disease; (2) It can be administered in order to restore, correct or modify human physiological functions

Global Nutraceutical Markets

Roughly 66% of the American populace consumes at least one form of nutraceutical health product. The utilization of nutraceuticals, in an effort to achieve favorable therapeutic results while minimizing adverse effects, has shown to be highly lucrative. The predilection for the exploration and manufacture of nutraceuticals as opposed to medications is readily apparent in pharmaceutical and biotech firms. Pharmaceutical and biotech companies that allocate significant resources to the exploration of nutraceuticals include Monsanto (St. Louis, MO), American Home Products (Madison, NJ), Dupont (Wilmington, DE), Abbott Laboratories (Abbott Park, IL), Warner-Lambert (Morris Plains, NJ), Johnson and Johnson (New Brunswick, NJ), Novartis (Basel, Switzerland), Metabolex (Hayward, CA), Genzyme Transgenic, PPL Therapeutics, and Interneuron (Lexington, KY). The nutraceutical sector in the United States has an estimated value of around \$86 billion. In Europe and Japan, this proportion is marginally higher, accounting for almost 25% of their combined yearly food sales

of \$6 billion. Furthermore, 47% of the Japanese population regularly take nutraceuticals. Business reports regularly indicate that the industry is seeing steady growth, even in the absence of detailed financial data. An underlying factor contributing to the expansion of nutraceuticals in the United States is the increasing number of elderly individuals from the baby-boomer generation. With the ongoing growth in the average age of the population, there is a growing emphasis on health and wellbeing. According to projections, the population of Americans over the age of 50 might reach over 142 million by the midpoint of the 21st century, assuming a total population of roughly 400 million. While the introduction of generic nutraceuticals may lead to a decrease in their price, the industry is expected to maintain its stability due to the growing dependency on these products and their expanding availability. The worldwide nutraceuticals market was valued at \$117.3 billion in 2007, as stated in the technical market research study "Nutraceuticals: Global Markets and Processing Technologies" (FOD013C) by BCC Research. The projected value for 2013 is \$176.7 billion, with a compound annual growth rate (CAGR) of 7.4%.

The market is categorized into nutraceutical foods, drinks, and supplements. In 2007, the market sector of nutraceutical foods had the highest value of \$39.9 billion. The projected growth for 2013 is \$56.7 billion, with a compound annual growth rate (CAGR) of 6.9%.

In 2007, nutraceutical supplements accounted for the second biggest portion of the industry, producing a total of \$39.0 billion. The projected value of this market in 2013 is \$48.8 billion, with a Compound Annual Growth Rate (CAGR) of 3.8%.

By 2013, the nutraceutical beverages category is projected to dominate the market with the most market share, making it the fastest expanding segment. The value of this category was \$38.4 billion in 2007 and is projected to reach \$71.3 billion in 2013, representing a compound annual growth rate (CAGR) of 10.8%. The worldwide nutraceutical market refers to the total sales of functional food, beverages, and supplements that are enhanced with bioactive components such as fiber, probiotics, protein and peptides, omega, phytochemicals, vitamins, and minerals. At present, the worldwide nutraceutical industry is divided evenly among meals, beverages, and supplements, with each contributing around 33%.

Challenges

While nutraceuticals show potential in improving human health and preventing diseases, it is crucial for health experts and regulatory toxicologists to collaborate in order to develop effective laws that can maximize the therapeutic advantages for mankind. Ensuring the quality of nutraceutical manufacturing processes is of utmost importance, particularly in terms of the composition and quantity of active compounds in natural plants and their maintenance. To ascertain the safety and effectiveness of the product, comprehensive safety investigations are necessary, encompassing acute, sub-acute, sub-chronic, chronic, and long-term toxicity assessments, alongside animal studies and clinical trials involving human subjects. DNA microarray technology may be utilized to assess the safety and effectiveness of medications, chemicals, dietary supplements, and nutraceuticals. To summarize, agricultural, food, and biomedical biotechnology are consistently advancing and impacting our lives. There is a significant possibility for our food to eventually have medicinal properties as well (Agrawa et al, 2020).

Regulatory Challenges

As commercial interest in the marketing of these foods and components grows, regulatory agencies face new challenges. Our current understanding of the benefits and risks related to health claims on such products is more qualitative than quantitative. Therefore, regulators are

cautiously exploring the issue from a variety of perspectives. For example (Health,2013,3): (1) How should nutraceuticals/functional foods be defined with precision for regulatory purposes? (2) Should such products remain as either foods or drugs under the Food and Drugs Act?; (3) What kinds of health claims, if any, should be allowed on food labels?; (4) What standards of evidence would be necessary and sufficient to prove a health benefit?

Future Developments for Nutraceuticals

Nutraceuticals are poised to have a significant impact on future therapeutic advancements and will continue to attract a wide audience due to its ease for modern lifestyles. Robert (2005) argues that there is a growing consciousness regarding physical fitness and well-being. The dissemination of information through media coverage is inciting the majority of the public to adopt better lives, engage in greater physical activity, and consume nutritious food. The growth of the Indian nutraceuticals industry is driving the expansion of the global nutraceuticals market. The burgeoning nutraceuticals industry is poised to dominate the market in the coming millennium. The user's text is empty. Prominent experts assert that enzymes constitute a captivating frontier in the nutraceutical sector. "Enzymes have not been fully utilized." They will become a highly sought-after region in the future. The user's text is empty. The utilization of microbial fermentation technology has significant promise.

The utilization of nutraceuticals in sports medicine is attractive. Action Sports Hub (ASH) is a leading institution dedicated to nurturing future champions in the field of sports. The user's text is empty. Lutein and lycopene, the two primary carotenoids, exhibit significant nutraceutical potential. Eileen Mourry, Business Manager for nutrition at Eostman Chemical in Kingsport, TN, says that tocotrienol has promise for nutraceuticals due to its health advantages. Research indicates that tocotrienols has potent antioxidant properties. Initial study suggests that it may also have potential anticancer effects. The user's text is empty. Gerry McKierman observes a rising interest in beta glucan. "We received numerous inquiries regarding our high-quality betaglucans produced through natural fermentation." It is crucial for the lowering of cholesterol in a soluble form and also specifically aims at combating colon cancer. (Ahmad, 2012) Historically, vitamins and other micronutrients were mostly advised to prevent the typical signs of nutritional shortage. Advancements in contemporary biology have provided us with further understanding regarding the molecular and cellular requirements of living organisms. For instance, the manifestation of clinical symptoms due to insufficiency might arise from a prolonged inadequate consumption of micronutrients. Prior to the onset of these symptoms, the insufficient transportation of micronutrients to their intended tissue leads to changes that might potentially initiate the progression of chronic illness (Hans et al., 2009).

Conclusion

Gaining a comprehensive comprehension of nutraceuticals inside a regulatory framework would diminish the perplexity in formulating nutraceutical policies. In order to establish a robust regulatory framework, it is necessary to transition nutraceuticals from a vague and ambiguous term with several and occasionally contradictory definitions to a well-defined and measurable notion. The regulatory status of nutraceuticals varies based on the regulatory framework of each nation.

The significance of functional foods, nutraceuticals, and other natural health products has been widely acknowledged in relation to promoting health, reducing the risk of diseases, and lowering healthcare expenses. Whole foods, such as whole grains, as well as the skins and by-products of processed meals, can contain concentrated components that have good benefits on health. Processing generally has a detrimental impact on the bioactive constituents of functional

foods and nutraceuticals. Thus, less processed items are more suitable for health-conscious consumers. While it may take many years for the new designer foods to be available in supermarkets, the ongoing initiative will result in the development of a new generation of foods. This will inevitably lead to a greater permeability between the realms of food and medicine. Henceforth, we shall witness the emergence of nutraceutical soups, nutraceutical processed meat, bread, and sausage. Furthermore, a considerable number of these food items might potentially be genetically engineered. For some, it is a terrifying sight, while for others, it is an extraordinary realization. The current body of information on nutraceuticals is a significant challenge for nutritionists, doctors, food technologists, and food chemists. Nutraceuticals are increasingly acknowledged for their potential benefits in treating conditions such as coronary heart disease, obesity, diabetes, cancer, osteoporosis, Parkinson's disease, and Alzheimer's disease. There is evidence to suggest that natural chemicals exert their effects through a diverse range of biological processes, such as activating antioxidant defenses and signal transduction pathways. Presently, dietary strategies are starting to mirror a basic shift in our comprehension of well-being. The expanding understanding of how diet affects genetic and molecular control is reshaping our perspective on the significance of nutrition, leading to the development of novel nutritional approaches. A well-balanced diet not only fulfills the body's metabolic needs, but also plays a role in enhancing human health. Therefore, it is necessary to identify and produce extracts of plants or individual chemicals that are considered to have positive effects on human health, in order to make them available in the food market as a complement to a well-balanced diet.

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