

Nutraceuticals & their Classification: A Review

Purvi Gupta¹, Neelesh Kumar Maurya², *

Abstract

The combination of "nutrition" and "pharmaceutical" is called nutraceutical. Nutraceuticals, in general, are foods or dietary components that significantly contribute to changing and preserving normal physiological function, which keeps people healthy. Nutraceuticals can be classified into various categories on the basis of their composition and mechanism of action. Nutraceuticals are food items that contain dietary fibre (DF), probiotics, prebiotics, polyunsaturated fatty acids (PUFA), antioxidants, and other herbal natural foods. These nutraceuticals are used to treat a number of illnesses, including diabetes, cholesterol, osteoporosis, cancer, cardiovascular disease, and obesity. This study will examine the many categories of nutraceuticals and their possible medicinal applications.

Keywords: Nutraceutical, health, diseases, food, supplement

INTRODUCTION

Hippocrates (460–377 BC), often regarded as the founder of modern medicine, conceptualised the link between the usage of healthy meals and their medicinal advantages over 2500 years ago (J. Singh et al., 2012). The intriguing subject of nutraceuticals has always existed throughout history, and contemporary medicine has further verified this (Caponio et al., 2022). 'Nutrition' (a nutritious diet or food component) and 'Pharmaceuticals' (a pharmaceutical) were combined to form the word 'Nutraceuticals' [1]. The founder, Dr. Stephen De Felice of the Foundation for Innovation in Medicine (FIM), gave the word "nutraceutical" in 1989. He defines it as "food, or parts of a food, that provide medical or health benefits, including the prevention and treatment of disease" (Rahmanpoor, 2019). They provide health and medicinal benefits, including the potential to treat and prevent illnesses. They are organic bioactive chemicals with therapeutic, disease-prevention, and health-promoting activities that are present in foodstuffs, dietary supplements, and herbal preparations [2]. Nutraceuticals are chemicals that have advantageous physiological outcomes on the human body but are not often recognised as nutrition. The benefit of nutritional supplements over pharmaceuticals is that they do not have adverse effects (Asif Mohammad & Mohd Imran, 2019) Figure 1.

Considering that they are multiple-targeted substances used at low doses, nutraceuticals lack any regulatory definition. Nutraceuticals, as opposed to "functional foods," which are seen as food items fortified with vitamins, proteins, and carbs, are substances that have been grown, created, or extracted that, when given to people, can improve their health and well-being (Caponio et al., 2022). The main criterion used to group nutritional supplements into distinct groups is their chemical makeup or mode of action. As a result, nutraceuticals can contain molecules with specific therapeutic qualities, such as antioxidant, anti-inflammatory, antibacterial, and antineoplastic activity. These molecules include isoprenoid derivatives, phenolic compounds, fatty acids, lipid, amino acids, fibre, and carbohydrates (Gupta et al.,

***Author for Correspondence**
Neelesh Kumar Maurya
E-mail: neeleishkumar.maurya@gmail.com

¹M.Sc. Student, Department of Nutrition and Dietetics, Sharda School of Allied Health Sciences, Sharda University, Greater Noida, Uttar Pradesh, India.

²Assistant Professor, Department of Nutrition and Dietetics, Sharda School of Allied Health Sciences, Sharda University, Greater Noida, Uttar Pradesh, India.

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2010). The Mediterranean diet is abundant in nutraceuticals that have positive benefits on health. As a matter of fact, numerous studies have shown that greater obedience to the Mediterranean diet greatly lowers the risk of metabolic chronic illnesses, including cancer. Unknown is the precise mechanism through which the Mediterranean diet benefits the body (Chatzianagnostou et al., 2015). We can now discriminate between a number of outcomes, including effective cholesterol reduction, protection against inflammation, platelet aggregation, and oxidative stress. Inhibition of nutrition detection pathways through the limitation of certain amino acids and gut microbiota-mediated metabolites that impact metabolic health are additional consequences [3–5]. These include hormone modification, growth factors implicated in cancer development, and inhibition of nutrient detection pathways.

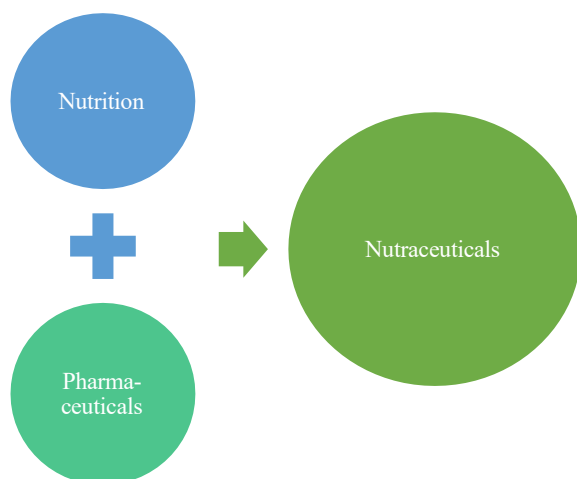


Figure 1. Concept of Nutraceutical.

CLASSIFICATION OF NUTRACEUTICALS

Traditional

The foods in this category are those that are not manually altered. The constituents are naturally occurring and may actively contribute to health benefits [6]. One example of this type of substance is lycopene, which is found in tomatoes (Ruchi, 2017) Figure 2.

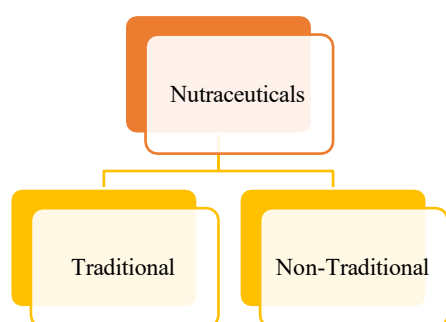


Figure 2. Flowchart showing classification of nutraceutical

Functional Foods

They are those that offer advantages beyond merely being high in nutrients for promoting health and preventing disease (Ruchi, 2017). These meals provide components that strengthen the anti-inflammatory and antioxidant defences against disorders like type 2 diabetes (Alkhatib et al., 2017). These meals are similar in quality to other traditional foods available in the market and are made available for everyday consumption for a specific [7–9]community (Alali et al., 2021). Rice, wheat, kidney beans, soybeans, lentils, chocolate, citrus fruits, almonds, and fermented milk are a few examples (Ruchi, 2017; Sikand et al., 2015).

Herbals

Herbs are non-woody plants that can be prepared in a variety of ways based on personal preferences. It is possible to dry herbs, however doing so reduces the potency of the plant's ingredients (Alali et al., 2021). Included in the class are plants with therapeutic properties that may be used in illness prevention and treatment (F. Singh et al., 2012). Willow bark (*Salix nigra*) contains salicin, the main active compound with anti-inflammatory, pain-relieving, fever-reducing, and anti-arthritis properties [10–14]. The flavonoids apigenin and psoralen found in parsley (*Petroselinum crispum*) have diuretic, carminative, and antipyretic properties (Borkar et al., 2015).

Phytochemicals

They are advantageous, concentrated, or purified compounds derived from plants that contain active ingredients for human biochemical and metabolic processes, such as lutein and lycopene (Ruchi, 2017). Phytochemicals have neuroprotective properties [15–17] because they can support the brain's chemical equilibrium (Kumar & Khanum, 2012). Consuming a lot of fruits and vegetables high in phytochemicals can also lower the risk of cancer, heart disease, and neurological diseases (Kumar & Khanum, 2012; Lobo et al., 2010).

Carotenoids

Carotenoids are naturally occurring substances that naturally give plants, fruits, vegetables, and algae their colour [18,19]. A diverse array of carotenoid derivatives, including lutein, lycopene, zeaxanthin, crocetin, fucoxanthin, astaxanthin, and beta-carotene, are consumed through the human diet (Y. Lee et al., 2019; Shardell et al., 2011). They are well known for having a variety of positive health effects, including as anti-inflammatory and antioxidant qualities (Eggersdorfer & Wyss, 2018). Furthermore, carotenoids have positive effects on human immunological, cardiac, cognitive, and visual functioning as well as cancer prevention (Alali et al., 2021).

Dietary Fiber (DF)

The European Food Safety Authority (EFSA) characterizes DF as a combination of non-digestible carbohydrates and lignin [20–23]. The EFSA enumerates various substances classified as DF, encompassing cellulose, pectins, fructo-oligosaccharides, hydrocolloids, non-starch polysaccharides, and resistant starch. (Hijová et al., 2019). According to several studies, fibres are non-starchy carbohydrates derived from plants that are poorly digested and offer a range of health advantages [24–27]. Fruits, vegetables, wheat bran, oats, and ispaghula husk are natural sources of these substances (Barber et al., 2020; McRorie & McKeown, 2017; Turner & Lupton, 2011). The classification of DF into soluble and insoluble groups is determined by its ability to dissolve in hot water, absorb water, and create a viscous solution. Viscous constituents like fructans and β -glucans as well as non-viscous constituents like hemicellulose make up soluble fibres. While soluble fiber extends the time food stays in the stomach, insoluble fiber hastens its passage, thereby helping to alleviate constipation [28–30]. Insoluble fibres also tend to lose their viscosity and become insoluble in water (Soliman, 2019). Due to their ability to reduce the risk of ulcerative colitis and Crohn's disease, high-fiber diets have been demonstrated to have a favourable effect on inflammatory bowel illnesses (Hou et al., 2011).

Fatty Acids (FAs)

These are the components found in animal fats, fish oil supplements, seeds, olive oil, and coconuts, serve as energy storage. Emerging research also highlights their anti-inflammatory and immune-regulating properties. One such research indicates that individuals with rheumatoid arthritis (RA) who consumed omega-3 FAs at a dosage of >2.7 g daily for at least three months experienced reduced RA symptom severity (Y.-H. Lee et al., 2012).

Prebiotics

Prebiotics are additives made of short-chain carbohydrates that increase the action of probiotics (Al-Sheraji et al., 2013). Prebiotics are essentially probiotics' fertilising agents since they are immune to

stomach acids and gastric pH (Ruchi, 2017). Prebiotics are indigestible substances that influence the makeup and function of the gut microbiota while encouraging the growth of beneficial microorganisms. Prebiotics such as fructo-oligosaccharides and inulin are utilised in functional meals to enhance stomach health (Al-Sheraji et al., 2013; Caetano et al., 2016).

Probiotic Microorganisms

Probiotics are good-for-you microorganisms found in food, particularly in dairy products. By aiding in digestion and strengthening immunity, they contribute significantly to overall well-being. These living microorganisms can also enhance the microbial balance in the gut (Kechagia et al., 2013). Among the several species of probiotics that may thrive in the human intestine is *Lactobacillus*. This is the most often utilised kind. These days, probiotic strains also include *Streptococcus* and *Bifidobacterium* spp. (Alali et al., 2021).

Nutraceuticals Enzymes

Enzymes are indispensable to life, serving as fundamental catalysts for bodily processes. Individuals grappling with hypoglycemia, blood sugar irregularities, obesity, or digestive disorders might be benefitted by incorporating enzyme supplements into their regimen. These supplements can be derived from plants, animals, and microorganisms. Examples include Bromelain, Catalase, Hemicellulase, Trypsin, Pepsin & so on (J. Singh et al., 2012).

Non-Traditional

This category of nutraceuticals includes dietary components for bettering the quality of nutrition and increasing nutritional content by nutrient addition. One product in this class is rice enhanced with beta carotene (Ruchi, 2017).

Fortified

The technique of adding micronutrients, such as vitamins and necessary trace elements, to food to improve its nutritional value and efficacy is known as fortification. One example it gives is cholecalciferol-fortified milk, which is used to treat vitamin D insufficiency (Casey et al., 2010; J. Singh et al., 2012).

Recombinant

Foods made using genetic recombination and biotechnology are known as recombinant nutraceuticals (J. Singh et al., 2012). These kinds of crops and foods are genetically engineered to produce goods with proteins and recombinant substances that improve their nutritional value (Drake et al., 2017). This category of nutraceuticals includes iron rice, golden rice, maize, golden mustard, multivitamin corn, and gold kiwifruit. A recombinant gene found in gold kiwifruit boosts levels of lutein, carotenoid, and ascorbic acid to improve immune function. It is also regarded as a source of fibre, potassium, and vitamins Table 1 (Alamgir, 2018; Skinner et al., 2011) [31,23, 33–36]].

Table 1. Sources and used of some nutraceuticals

Chemical Constituent	Sources	Uses	Reference
Lycopene	Guava, papaya, pink coloured grape fruit, water melon, Tomatoes,	They lower cholesterol, provide antioxidants, and stave against cancer.	(Mishra, 2016)
β-Carotene	Vegetables, fruits, oats, Carrots	antioxidants and UV light protection for the cornea	(Grune et al., 2010)
Omega 3	Salmon, Chia Seeds, Flax Seeds	Decrease cardiovascular, diabetes disease risk	(Deckelbaum & Torrejon, 2012)
Saponins	Soy bean, chickpea	Stimulate immune response, antioxidant, detoxification of enzymes hormonal	(Mishra, 2016)

		metabolism	
Curcumin	Turmeric	Anticarcinogenic, anti-inflammatory	(Pulido-Moran et al., 2016)
Probiotics	<i>Lactobacilli</i> , <i>bifidobacteria</i> present in yogurt	Helps in improving gastrointestinal health and systematic immunity	(Sanders et al., 2013)
Soluble fibre	Beans like Legumes, cereals like oats, barley, some fibrous fruits	They contain anticancer properties and aid in the preservation of a healthy digestive system.	(Soliman, 2019)
Insoluble fibre	Whole grain foods, Wheat, Nuts	They have anticancer (colon) action and aid in the preservation of a healthy digestive system.	(Hou et al., 2011)

CONCLUSION

Several ways in which nutraceuticals play a critical role in the prevention and treatment of various illnesses have been established by the studies. Demonstrated to ward off illness and improve well-being, nutraceuticals should be consumed according to suggested intake guidelines. The majority of individuals favour natural approaches to treating any illness, which may be accomplished by regularly consuming nutraceuticals. Nutraceutical intake is the finest way to maintain one's natural state and enhance one's quality of life. Furthermore, individuals who refuse to get pharmacological therapy may have an option with nutraceuticals. Cost-wise, it is also superior than alternative treatments. Nutraceuticals are crucial to the development of new treatments in the current self-medication environment. However, the success of nutraceuticals hinges on preserving their potency, safety, purity, and quality standards. As a result, this industry surely has the highest hidden worth; all that is needed to discover it is how to make life easier and healthier.

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