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Review paper

Nutraceutical, Nutrition Supplements and Health Benefits: A Review

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ABSTRACT

Nutraceuticals are substances that can be found in various food products and offer numerous health benefits, including the ability to treat diseases. One advantage of nutraceuticals over medications is that they have fewer adverse effects and are made up of naturally occurring nutritional supplements. These nutraceuticals can be categorized into three main groups based on their natural source, chemical composition, and function, which include nutrients, herbal treatments, dietary supplements, and dietary fiber. Among these categories, dietary supplements and herbal products have shown the highest growth rates in the market, with annual increases of 19.5% and 116% respectively. To ensure their safety, the FDA has classified dietary supplements as foods and has estimated the global nutraceutical industry to be valued at USD 117 billion. In 2006, the Indian government passed the Food Safety and Standard Act to regulate the nutraceutical industry. By addressing both acute and chronic disorders caused by inadequate nutrition, herbal nutraceuticals serve as a powerful tool in promoting optimal health, longevity, and overall quality of life.

1. Introduction

The term "Nutraceutical" is derived from the root words "nutritional products" and "pharmaceuticals". It is used to refer to products that are distinct from herbal goods, dietary supplements, specific diets, and processed meals such as cereals, soups, and drinks. These products are utilized for medical purposes and also serve as a source of nutrition (Dr. S. Ruby et al. 2021). The demand for effective and safe antiviral medications has increased due to a significant rise in virus-induced infections and the corresponding mortality rate (Saumya Singh et al. 2021). Changes in food habits have been one of the primary casualties of this lifestyle change. It has also presented a significant challenge in the form of "lifestyle diseases". The consumption of junk food has significantly increased, leading to an upsurge in disorders related to nutritional deficiencies. The use of nutraceutical supplements can be highly effective in reducing these deficiencies. Nutraceuticals aim to enhance the body's supply of natural building blocks while providing functional benefits. These building components can be substituted to alleviate disease symptoms or enhance performance (Tank Dharti et al. 2010). Nutraceuticals can regulate DNA transcription in tumors and control DNA-damaging agents in cancer cells.

They possess a range of therapeutic benefits, such as anti-obesity, cardiovascular, anti-diabetic, immuno--logical enhancement, naturally occurring antioxidant activity, and anti-inflammatory effects (Ried, 2016; Affuso et al., 2010). Numerous medications originate from dietary sources. Recently, there has been significant attention given to the potential use of

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natural food ingredients as functional foodsfor treating hypertension, especially for individuals with borderline to mild high blood pressure who do not require prescription anti- hypertensive medications (Zhen-Yu Chen et al., 2009). Nutraceuticals are defined as bioactive compounds found in everyday foods orbotanical sources that can be consumed in the form of functional foods to provide additional health benefits in addition to essential nutritional ones (Baby Chauhan et al., 2013).

2. Health Benefits (DeFelice L. Stephen et al. 1995)

1. The potential to enhance the positive influence on health could be heightened.
2. These substances could serve as a naturally derived dietary supplement, thereby avoiding any undesirable side effects.
3. It is possible that they could contribute to improving human health, enhancing the diet, and optimizing the condition of the humanbody.
4. They have the potential to be easily accessible and affordably priced.

3. Definition

Stephen Defelice defines a Nutraceutical as any substance that falls under the category of food or is a component of food andoffers medical or health advantages, which may include disease prevention. (DeFelice L. Stephen et al. 1995, Brower V, 1998).

Hippocrates, a renowned Greek physician considered the pioneer of medicine, recommended that food should serve as your remedy. The guiding principle to follow is to prioritize prevention (Baby Chauhan et al. 2013).

4. How do Nutraceuticals differ from Functional food?

Nutraceuticals and functional foods have some distinctions. While functional food is prepared with scientific knowledge, nutraceuticals are specifically designed to prevent and treat diseases, in addition to providing essential nutrients for overall health (Kalra EK, 1998).

Nutraceuticals are dietary supplements derived from food sources, often in the form of capsules or tablets, claiming specific health benefits. They are regulated as supplements and may target specific health issues.

Functional foods, on the other hand, are regular foods enhanced with added nutrients or beneficial compounds, such as fortified cereals or probiotic yogurt. They are consumed as part of the regular diet and are typically regulated as conventional foods. While both aim to provide health benefits beyond basic nutrition, nutraceuticals are more concentrated, and functional foods integrate enhanced nutrients into everyday dietary choices.

5. Classification of Nutraceuticals (Silpi Chanda et al. 2019)

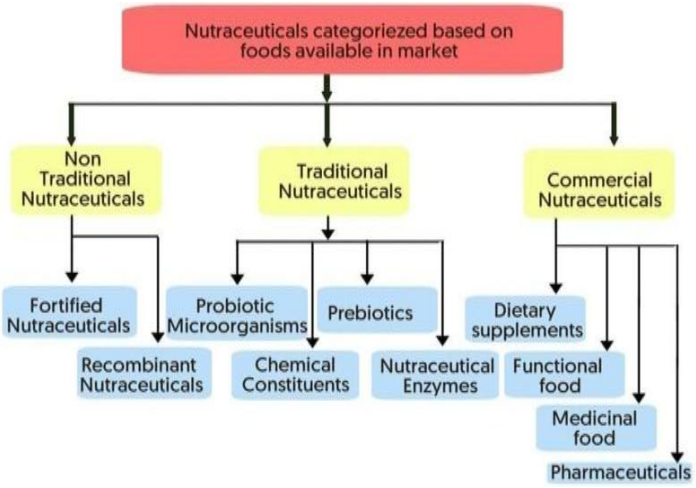
5.1 Nutraceuticals Based on Food Availability -

5.1.1 Traditional Nutraceuticals:

The courses are usually derived directly from nature, remaining unchanged from their natural state. Salmon's omega-3 fatty acids, tomatoes' lycopene, and soy's saponins are some examples of elements that can be consumed for numerous health benefits. Different traditional types of nutraceuticals consist of the following:

(i) Components:
  (a) Nutrients
  (b) Herbal extracts
  (c) Phytochemicals
(ii) Beneficial probiotic bacteria
(iii) Enzymes with nutraceutical properties

Flowchart depicting the classification of nutraceuticals based on foods available in market:



5.1.2 Nontraditional Nutraceuticals:

Fortified nutraceuticals are foods that have been enriched or crops that have been genetically modified to enhance nutrient levels; for example, rice and broccoli are rich in vitamins and beta-carotene, respectively. Bioactive components extracted from food samples are utilized in the production of products for human well- being. The sequence includes:

(i) Fortified Nutraceuticals
(ii) Recombinant Nutraceuticals

5.2 Classification Based on Mechanism of Action -

To accommodate distinct therapeutic abilities like antibacterial, anti-inflammatory, and antioxidant properties, nutritional supplementshave been categorized accordingly.

5.3 Classification Based on Chemical Nature -

The classification of these substances is determined by the origins of their primary and secondary metabolites, which include isoprenoidderivatives, phenolic compounds, fatty acids, carbohydrates, and amino acid-based materials.

Table 1 As per chemical classification (Faisal N et al. 2009)

Class	Example
Inorganic mineral supplements	Minerals
Vitamin supplements	Vitamins
Digestive enzymes	Enzymes
Probiotics	Lactobacillus acidophilus
Prebiotics	Digestive enzymes
Dietary fibers	Fibers
Cereals and grains	Fibers
Health drinks	Fruits juice
Antioxidants	Vitamin C
Phytochemicals	Carotenoids
Herb as functional foods	Soya proteins

Table 2 A brief review on plants used as nutraceuticals

Plant source	Active ingredients	Health benefits	Reference
Tomatoes	Lycopene	Anticancer activities (e.g. Lung and prostate) , reduce blood pressure.	[14]
Garlic	Alliin and Allicin	Anti-inflammatory, antibacteri al,antigout.	[8]
Ginger	Zingiberene	Stimulant, hyperglycemia, chronic bronchitis.	[8]
Liquorice	Glycyrrhizin	Anti-inflammatory, Expectora nt,Anti-Allergic.	[8]
Turmeric	Curcumin	Anti-inflammatory, antiarthrit is,anticancer.	[15,16]
Onion	Allicin and alliin	Hypoglycemic activity, Antibiotic, antiatherosclerosis.	[8]
Aloes	Aloins	Dilates capillaries, emollient, anti- inflammatory, wound healingproperties.	[15,17]
Senna	Sennosides	Purgative, constipation.	[8]
Asafoetida	Ferulic acid and umbellic acid	Stimulant, carminative, expectorant.	[8]
Marine algae	Fucoidans	Antioxidant, anticanc er,anticoagulant activity.	[18]
Salmon	Omega 3	Lower cardiovascular, diabetesdisease risk.	[19]
Soy	Saponin	Antioxidant, detoxification of enzymes, stimulate immune response, hormonal metabolism.	[20]
Artemisia	Artemisia annua	Fever, inflamation, headaches.	[21]
Guggal	Commiphora wightii	Cardio- protective,anti- inflammatory.	[21]
Ephedra	Ephedra sinica	Mild anti-asthmatic, obesity, bronchodilator.	[21]
Fennel	Foeniculum vulgare	Stimulant, digestive spasms.	[21]
Lemon grass	Cymbopogon citrates	Stomachache, expelling gas.	[21]
Capsaicin	Linolenic acid	Anti-inflammatory activity.	[22]
Carrots	Carotenoids	Nutraceuticals and disease.	[22]
Corn	Zeaxanthin	Contributes to the maintenance ofhealthy vision.	[22]
Tea	Catechin	Neutralizes free radicals, may reducethe risk of cancer.	[22]
Onion	Diallyl sulfide	Lowers LDL cholesterol, maintainhealthy immune system.	[22]
Cranberries	Proanthocyanidins	May improve urinary tract health.	[22]
Spirulina	Spirullin, rhamnose	Immuno-stimaulant activities.	[23]
Glycene soja	Soya beans, EpA	Lower blood cholesterol.	[23]
Brassica oleracea	Broccoli	Cancer protective compound.	[23]
Echinacea	Echinacoside	Stimulating immune.	[23]
Bael	Marmelosin	Digestive, appetizer, treatment ofdiarrhea.	[8]
Brahmi	Asiaticoside	Spasmolytic, anti-anxiety.	[24]
Ginkgo	Terpene lactone	Age related memory loss.	[8]
Actinidia chinensis[gold kiwi fruit]	Ascorbic acid, carotenoids	Immune system inhancement.	[25,26]
Brocolli	Sulforaphene, glucosinolate	Decrease risk of several cancers, antioxidant.	[27,28]
Capsicum	Capsaicin	Inhibit platelet aggregation,Diabetic nephropathy.	[26-28]
Gotu kola	Asiatic acid	Diabetic wound healing.	[29,30]

Cinnamon	Cinnamaldehyde	Antioxidant, diabetic nephropathy	[31,32]
Yam	Potassium, magnesium	Diabetic nephropathy.	[33]
Jambul	Anthocyanins, ellagic acid	Diabetic nephropathy, Ulcer healing.	[34,35]
Walnut	p-coumaric acid	Antioxidant effect.	[36]
Papaya	Saponins, glycoside	Diabetic wound	37]
Lingzhi mushroom	Peptidoglycan	Diabetic neuropathy.	[38]
Wolfberry	Stearic acid, palmatic acid	Antioxidant effect.	[39]

6. List of Nutraceutical Manufacturers in India [40]

Manufacturer company	Manufactured nutraceutical product
Binova lifesciences	Amifull-forte capsules Breecy capsules Cardi-nrg tablet Carvi 500 capsules Carvi 1000 tablets Cherilife forte tablets Evlin-o soft gel Garcinia cambogia capsules Enorin-orl liquids Diagud-sr powder Glutagut powder Nevical forte softgel
Chaitanya agrobiotech group	Soya Protein Hydrolysate Casein Protein Hydrolysate Collagen Peptide (Fish/ Bovine) Promilk (Whey Protein Replacer) Soya Isolate Soya Concentrate Chelated Minerals Hydrolysed Vegetable Protein (Soya /Groundnut / Wheat Gluten Based) Yeast Extract Soya Sauce Powder Casein Hydrolysate
Lactonova nutripharm	Banana Leaf Extract Bilberry Extract Chondroitin Sulphate Cinnamon Extract Citrus Bioflavonoids Colostrum Powder CoQ10 Complex Glucosamine Sulfate Grape Seed Extract L-Methyl Folate Calcium Lactosorb Complex Methyl Sulfonyl Methane Mulberry Leaf Extract Oregano Leaf Extract Soy Isoflavones
Sydler	Nutrisyd Stress & Anxiety Care Formula Nutrisyd Healthy Joint Formula Sydlife – D Nutrisyd Protein for Proactive Family Nutrisyd Chocolate Drink for Kids Jetex-M Capsules Nurtisyd Whey Protein Powder Nutrisyd Nutritional Shake Mix Jetex-F Capsules Nutrisyd - A Premium Antioxidant Drink Nutrisyd Male Support Formula Fortimune Tablets Nutrisyd Female Support Formula
Zeon lifesciences limited	Carica Papaya Leaf Extract Tablets Ace Complex Mini Co Care Mokitel Syrup Multivitamins Capsules with Essential TraceElements Multivitamin with Trace Elements
	Delices Vitabuz Lamino Bix Bixtin etc.
Neiss wellness Ltd	Tracewell Cranwell Fracpro Protein kids Ten q plus Niswell women Mwh live green real grass • mwh live greenreal grass Jr.multivitamin & mineral Mwh nourishtra omega 3 Mwh nourishtra vitamin d Joint joy Ashwagandha
KD chem pharma	1:1 Ratio of Alpha- and Gamma-Tocopherols Ultraclear RENEW Berry 14 Grams of Fat with 3 Grams of MCT perServing Advanced Support for the NutritionalManagement of Compromised Gut Function in IBD Antispasmodic GI Support A balanced combination of proprietary peaand rice protein with added BCAAs Advanced Detoxification Support Bioactive Vitamin D in Micro tablet DeliveryForm Advanced Nutritional Support Designed forOptimal Health Borage Seed Oil Bioactive Pancreatic Enzymes for DigestiveSupport Bioactive Pure Whey Protein with NaturallyOccurring Immunoglobulins
Agati healthcare Pvt Ltd	Cow colostrum skimmed powder Cow colostrum powder whole powder Buffalo colostrum whole powder Coenzyme q10 bulk Coenzyme q10 liquid bulk Coq10 capsules Coenzyme q10 liquid Apro-adult powder Cololipid-lg Buffalo colostrum powder whole powder granules Cow colostrum skimmed powder granules
Premier nutraceuticals Pvt Ltd	Coral Calcium Coral Calcium D3 IAAC Tab. Super Antioxidant Iron & Cal Combination Therapy

	Two B12 BF
	Chelated Calcium with Collagen
	Coral Calcium K2
	Coral Calcium HD
	Protein with 7 flavors in one pack
	Dichrome tablets
	Utgard capsule

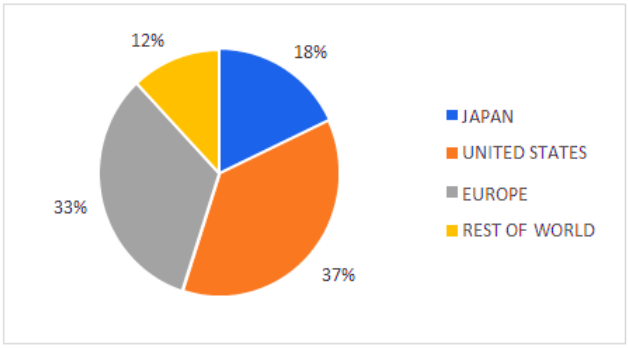
7. Global Demand of Nutraceutical

The nutraceutical industry is divided into three main segments: functional foods, dietary supplements, and natural products (Chauhan B. et al. 2013).

The global nutraceutical market is estimated to be USD 117 billion (INR 5148 billion) (Souyoul et al. 2018). In 2007, the sales of nutraceuticals are expected to reach $74.7 billion with an AAGR of 9.9%. This projection is based on a global economic recovery in 2003 and a decrease in price competition (Fig. 1).

A recent report indicates that the nutraceutical market in India is growing at a rate of 21 percent per year. Currently valued at INR 44 billion (€621 million), it is projected to exceed INR 95 billion in four years (Smith et al. 2010).

Although still in its early stages in India, the concept of "Nutraceuticals" has been experiencing rapid growth, with a CAGR of18% over the past three years, primarily driven by the functional food and beverages categories (Singh B. et al. 2017). The industry's fastest-growing segments have been dietary supplements (19.5% per year) and natural products (11.6% per year) (Mudhi Alali et al. 2021).



8. Future Perspectives of Nutraceuticals (Min-Tiz Liong et al.)

Businesses now possess a more comprehensive understanding of the impact of nutrition on individuals from a healthcare perspective. Consequently, they are currently exploring the potential connection between medical therapy and diet to offer holistic medical care. Presently, nutrition is considered a byproduct of maintaining a healthy lifestyle, while medical care is primarily associated with pharmaceuticals. However, further research is expected to be conducted shortly to explore the interaction and mutual support between the two. The nutraceuticals sector is projected to experience future growth in market revenues due to investments in new technologiesand the utilization of genetically modified technology for medical and health benefits in the food industry. The efficacy and safety of this new product will be validated through an expanding body of scientific research, which will in turn encourage additional investments in the technology and its application. Nutrition research is increasingly incorporating promising technologies such as nutrigenomics, imaging methods, and convergent technology.

The potential for developing meals tailored to specific demographic groups with known risk factors or illnesses, such as obesity, diabetes, allergies, and cardiovascular disease, is significant. Food technology innovation can further enhance the production of food items that support optimal health. Moreover, the increasing global awareness of functional foods and nutraceuticals is expected to drive additional revenue growth. The nutraceutical sector is projected to expand as developing countries increase their consumption of such products. Furthermore, it is expected that local manufacturers will introduce unique products targeting high- growth segments, such as probiotics and heart health. Consumer focus has shifted towards healthier lifestyles, preventive healthcare, and alternative treatments due to the aging population and rising healthcare costs. Nevertheless, concerns about naturalness, stringent global regulations, and safety issues related to foreign production may impede industry growth.

9. Conclusion

The potential for developing meals tailored to specific demographic groups with known risk factors or illnesses, such as obesity, diabetes, allergies, and cardiovascular disease, is significant. Food technology innovation can further enhance the production of food items that support optimal health. Moreover, the increasing global awareness of functional foods and nutraceuticals is expected to drive additional revenue growth. The nutraceutical sector is projected to expand as developing countries increase their consumption of such products. Furthermore, it is expected that local manufacturers will introduce unique products targeting high- growth segments, such as probiotics and heart health. Consumer focus has shifted towards healthier lifestyles, preventive healthcare, and alternative treatments due to the aging population and rising healthcare costs. Nevertheless, concerns about naturalness, stringent global regulations, and safety issues related to foreign production may impede industry growth.

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