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BENEFITS OF NUTRACEUTICALS ON HUMAN HEALTH: A COMPREHENSIVE REVIEW

Mahima Rao*, Shefali Agrahari
S.N. College of Pharmacy Lakhauwa Babupur Jaunpur
Corresponding Author

ABSTRACT
Nutraceuticals, which are bioactive substances obtained from food, are essential for managing chronic illnesses, preventing disease, and promoting health. This study addresses their definitions, classifications, mechanisms of action, and evidence-based advantages for neurological, gastrointestinal, immunological, metabolic, and cardiovascular health. The paper also discusses regulatory issues, safety concerns, and potential directions for nutraceutical research in the future. According to research, nutraceuticals can greatly enhance global health and supplement contemporary treatment when utilized properly.
KEYWORDS: *Nutraceuticals, Functional Foods, Human Health, Antioxidants, Phytochemicals, Probiotics, Disease Prevention.*

INTRODUCTION

Dr. Stephen DeFelice invented the term "nutritraceutical" in 1989, combining the words "pharmaceutical" and "nutrition," to describe substances derived from food that provide health or medical advantages beyond simple nourishment (DeFelice, 1995).
In recent decades, nutraceuticals have garnered attention as possible therapeutic and preventive interventions for long-term conditions such diabetes, cancer, heart disease, and neurological disorders (Dwivedi et al., 2023

1. Due to growing consumer desire for safer, natural, and plant-based alternatives to pharmaceutical drugs, the global market for nutraceuticals is growing. They still urgently require more clinical evidence and regulatory clarity, nevertheless, despite their potential

2. DEFINITION AND CLASSIFICATION OF NUTRACEUTICALS

2.1 Definition

Food ingredients that have physiological advantages or preventative actions against chronic illnesses are known as nutraceuticals (Puri et al., 2022). In contrast to medications, they are meant to preserve good health and stop the course of pathophysiology rather than to treat illnesses.

2.2 Classification

Nutraceuticals are commonly classified as:

- **Nutrients: omega-3** fatty acids, vitamins, minerals, and amino acids.
- **Herbal substances**: flavonoids, lycopene, resveratrol, and curcumin.
- **Functional foods**: foods that have been fortified to offer certain advantages.
- **Prebiotics and probiotics**: Good bacteria or fibers that promote intestinal health.
- **Alkaloids,** terpenes, carotenoids, and polyphenols are examples of phytochemicals.

3. MECHANISMS OF ACTION

Nutraceuticals act through multiple mechanisms:
1 Antioxidant activity: lowering oxidative stress and neutralizing free radicals (Waikar et al., 2021).
2 Anti-inflammatory effects: inhibiting the expression of cytokines and NF-κB (Sharma et al., 2023).
3 Lipid modulation: enhancing endothelial function and reducing triglycerides and LDL (Rai & Mishra, 2010).
4 Glucose metabolism). mproving glucose absorption and insulin sensitivity (Visha, 202I)
5 Microbiome modulation: regulating gut flora to promote metabolism and immunity (Singh et al., 2021)
6 Epigenetic effects : Modulating gene expression and cellular signaling (Venkatakrishnan et al., 2019).

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4. HEALTH BENEFITS OF NUTRACEUTICALS

4.1 Cardiovascular Health

. Plant sterols, polyphenols, and omega-3 fatty acids found in olive oil enhance lipid profiles and lessen oxidative damage (Cornwell, 2022). Reduced cardiovascular morbidity and death are linked to regular consumption.

4.2 Metabolic Disorder

Probiotics, resveratrol, and curcumin enhance insulin sensitivity, lower inflammation linked to obesity, and alter adipokines (Waikar et al., 2021). Fibers like β-glucans also reduce cholesterol and blood sugar.

4.3 Cancer Prevention

. In cancer cell lines, lycopene, curcumin, and flavonoids have anti-mutagenic and apoptotic properties (Puri et al., 2022). High consumption of fruits and vegetables is associated with a decreased risk of cancer, according to epidemiological research.

4.4 Immune Function and Infection Resistance

Probiotics, zinc, and vitamins C and D improve both innate and adaptive immunity. For immunological support, several drugs were studied during the COVID-19 pandemic (Singh et al., 2021).

4.5 Gastrointestinal Health

According to Lee et al. (2025), probiotics and prebiotics help maintain the integrity of the intestinal barrier, lower inflammation, and stop dysbiosis.

4.6 Cognitive and Bone Health

Bone mineral density, cognitive function, and age-related decline are all enhanced by polyphenols, omega-3 fatty acids, and isoflavones (Frontiers, 2022).

5. SAFETY AND REGULATORY CONSIDERATIONS

According to Muralidaran et al. (2023), the majority of nutraceuticals are safe when taken as prescribed, although there may be dangers due to contamination, incorrect formulation, or drug-nutrient interactions. While they are categorized as functional foods in Europe, they are dietary supplements in the United States (Lee et al., 2025). Countries have different regulatory systems. Consumer safety depends on labeling, standardization, and clinical validation.

6. FUTURE PERSPECTIVES

Emerging research focuses on:

. Personalized nutrigenomics: : adjusting nutraceuticals based on microbiota and genetic profiles.

. Nanotechnology: increasing the bioavailability of substances that are not well absorbed, such as lycopene and curcumin (Ul Alam et al., 2023).

. Integrative medicine: Combining nutraceuticals with pharmaceuticals for synergistic effects.

. Regulatory harmonization:. Creating uniform worldwide safety and effectiveness standards

7. CONCLUSION

Nutraceuticals are strong friends in the pursuit of human well-being. They are widely known for their ability to boost immunity, prolong life, and prevent chronic illnesses. But in order to reach their full potential, careful clinical validation, appropriate standardization, and knowledge of safe usage are necessary. It is preferable to think of nutraceuticals as supplements to a healthy diet and medical therapy, not as a replacement.

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