



PURNABRAHMA

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NUTRACEUTICALS FOR HEALTH

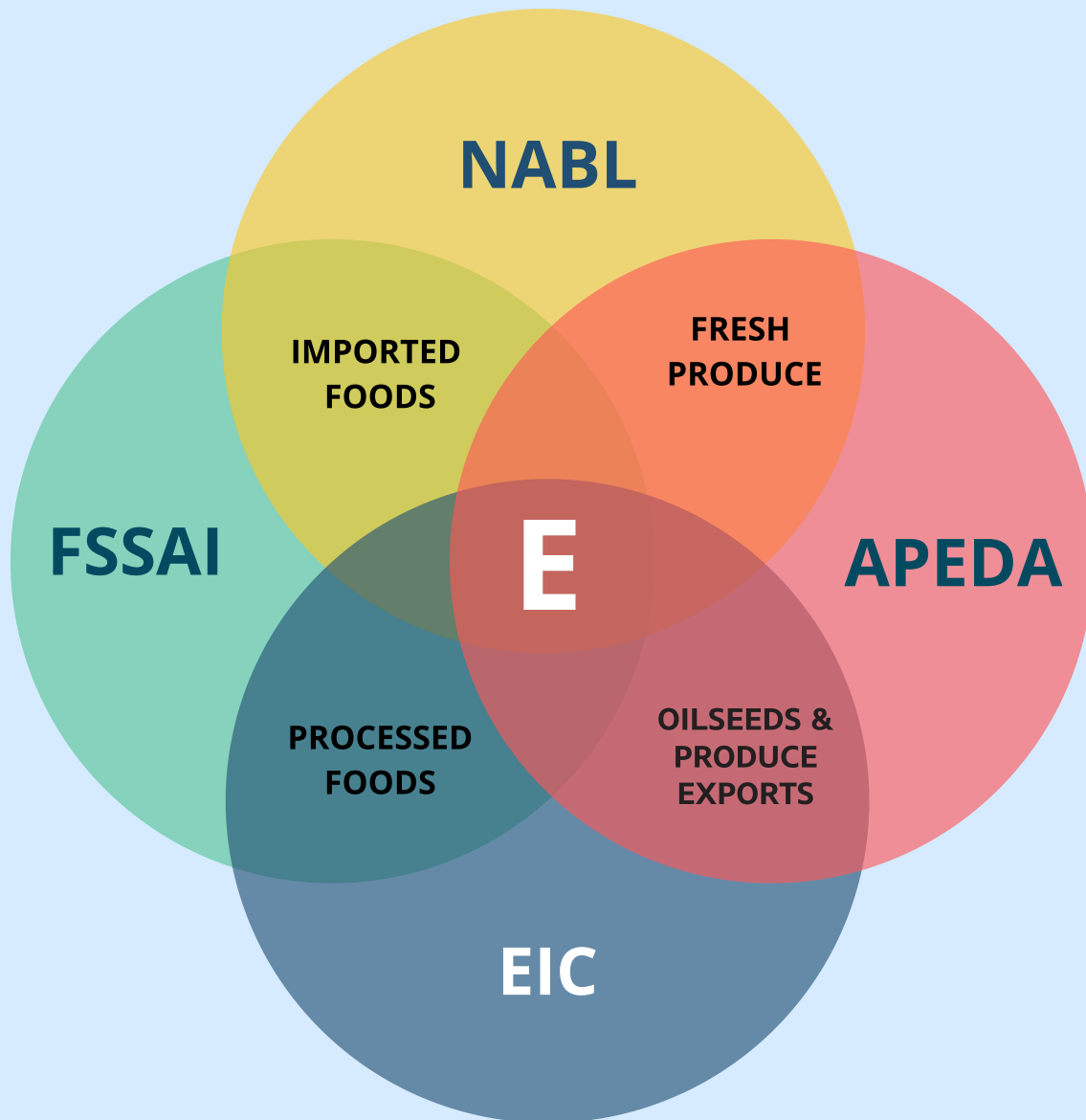




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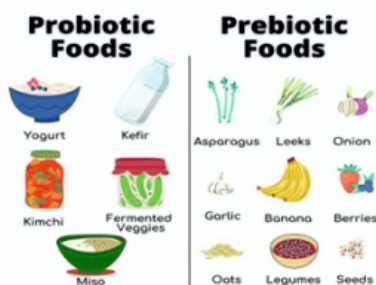
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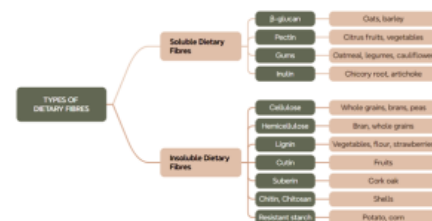
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CASMB MEMBER ACHIEVEMENTS



Mihir and Sanhir Foods Received winner award for Prollets in the category of 'Excellence in Packaging' (B2C) at the 2nd edition of the 'Fi India Awards' on 25th September 2024 at BIEC, Bengaluru.



Ms. Bhagyashri Mhatre has been selected in prestigious goldman sachs 10000 women program for women entrepreneurs that was held at IIM Bangalore



'Prollets' is awarded "StartUp of the year – Innovations in Millet Packaging" as part of 'Poshak Anaaj Awards – 2024' on 19th October in International Nutri-Cereal Convention 6.0' at HICC, Hyderabad.



CASMB ACTIVITIES



Dr. Prabodh Halde, Chairman of CASMB, met Hon. Mrs. Raksha Nikhil Khadse, Minister of State for Youth Affairs & Sports, Govt. Of India



CASMB Partnered with USA Dry Pea & Lentil Council for USA Pulses Innovation Day



Nirmal Swasthya National Nutrition program, Nirmala Niketan College CCGT Mumbai.



Pritee Chaudhary (IRS), Regional Director, Food Safety and Standards Authority of India - (West Region), Government of India & Dr. Krishna Methekar, Joint Director FSSAI visited our stall at Anufood India 2024



Pitching event at FundQuest at FI India, Bengaluru, 27 September 2024



Dr. Prabodh Halde, Dr. Umesh Kamble and Ms. Subha Nishtala felicitated Dr. Rajesh Narvekar, IAS for taking charge as the FDA Commissioner of Maharashtra

Dr. Prabodh Halde

Chairman
Chamber for Advancement of
Small and Medium
Businesses, CASMB



Wish you are very happy Diwali and New Year

It is an honour to give my message to this edition of *Purnabrahma* on Nutraceuticals. This industry combines the rich heritage of traditional health practices with modern scientific insights, creating immense opportunities, especially for India's SMB sector.

Ancient Roots of Nutraceuticals

Nutraceuticals are not a modern invention. Across ancient civilizations, foods, herbs, and natural substances were revered for their health-promoting properties. Early documentation reveals that:

Traditional Indian Ayurveda and Chinese Medicine emphasized using foods, herbs, and botanicals for health. Ayurveda used staples like turmeric, ginger, and ashwagandha for their anti-inflammatory, immune-boosting, and adaptogenic effects. Similarly, Traditional Chinese Medicine utilized ginseng and green tea for promoting vitality, longevity, and overall health.

Ancient Egyptian and Greek Medicine: Ancient Egyptians and Greeks valued plant-based remedies. Egyptians used garlic and honey for their antibacterial properties, while Hippocrates, the Greek physician known as the "father of medicine," promoted the principle that "food should be your medicine," incorporating herbs and foods into

treatment.

Roman and Middle Eastern Traditions: Romans and Middle Eastern scholars advanced the use of food in medicine, with ingredients like cumin, licorice, and fennel becoming staples in both medicinal and culinary applications.

The Evolution of Nutraceuticals in the Modern Era

The formal recognition of nutraceuticals as a field began in the 20th century, with key developments:

- Early 20th Century – Discovery of Vitamins: Identifying vitamins A, B, C, D, and E revolutionized health, highlighting how nutrients prevent diseases like scurvy and rickets.
- Mid-20th Century – Functional Foods: During the 1980s, Japan pioneered the concept of functional foods, incorporating health claims into food products, a foundational concept for nutraceuticals.
- 1989 – Coining of the Term Nutraceuticals: Dr. Stephen DeFelice coined "nutraceutical," formally establishing this category as products that provide health benefits beyond basic nutrition.
- 1990s to 2000s – Regulatory Developments: Regulatory frameworks emerged globally, with the US Dietary Supplement Health and Education Act (DSHEA) in 1994 setting guidelines for dietary supplements. The European Union also developed regulations for functional foods and health claims.
- 2000s – Global Rise of Nutraceuticals: Nutraceuticals grew rapidly worldwide, driven by consumer demand for natural

CHAIRMAN’S MESSAGE

health solutions, with Japan, the US, and the EU leading the trend, followed by emerging markets like China, India, and Latin America.

India's Advantage and Potential for SMBs

India's biodiversity and traditional knowledge offer a distinct advantage in nutraceuticals. With rich bioactive resources and Ayurvedic heritage, India has the potential to lead in producing authentic, high-quality nutraceuticals. FSSAI's Section 22 regulations ensure that Indian nutraceuticals are produced with safety, efficacy, and quality standards that enhance consumer trust and Brand India.

The FSSAI regulations categorize nutraceuticals into:

- 1. Health Supplements (HS)
- 2. Nutraceuticals (Nutra)
- 3. Food for Special Dietary Use (FSDU)
- 4. Food for Special Medical Purpose (FSMP)
- 5. Prebiotic and Probiotic Food (Pre-Pro)

And there are specific Schedules:

- 1. Schedule I: Essential nutrients (vitamins, minerals)

- 2. Schedule II: Plant-based botanicals
- 3. Schedule III: Active molecules and extracts
- 4. Schedule IV: Prebiotics and probiotics

Growing Market and Role of SMBs

With the Indian nutraceutical market valued at \$26 billion in 2023 and expected to reach \$40 billion soon, India's SMBs is crucial in this growth, creating jobs and supporting local economies. Nutraceuticals not only benefit consumers by offering preventive healthcare options but also uplift farmers, SMEs, and MSMEs, providing opportunities throughout the supply chain.

Conclusion

Nutraceuticals combine ancient wisdom with modern science, offering a transformative opportunity for India's SMB sector. Congratulations to Purnabrahma and CASMB for emphasizing this impactful category. By leveraging India's rich resources and heritage, we can drive growth, support preventive health, and strengthen India's position as a global leader in nutraceuticals.

Thank you, and best wishes for your continued success in this promising sector.

Dr. Prabodh Halde

Chairman, Chamber for Advancement of Small & Medium Businesses (CASMB)



**CHAMBER FOR ADVANCEMENT
OF SMALL & MEDIUM BUSINESSES**

Nilesh Lele

**President,
Chamber for Advancement
of Small and Medium
Business (CASMB)**



The Role of Nutraceuticals in Supporting Sustainable Development Goals (SDGs)

Dear Readers,

As we step into the last quarter of 2024, it's crucial to reflect on how industries across the world are aligning their objectives with broader global goals to create a sustainable future. One sector that stands at the intersection of health, sustainability, and economic growth is the nutraceutical industry. With the increasing focus on health and wellness, the role of nutraceuticals in supporting the United Nations' Sustainable Development Goals (SDGs) has never been more significant.

Two key SDGs that closely align with the nutraceutical industry are SDG 3: Good Health and Well-being and SDG 12: Responsible Consumption and Production. These goals aim to ensure healthy lives and promote well-being for all, while fostering sustainable production practices that minimize environmental impacts.

Promoting Good Health and Well-being (SDG 3):

Nutraceuticals play a transformative role in preventive healthcare. As consumers increasingly turn to functional foods and dietary supplements to address specific health needs-whether it be boosting immunity, managing stress, or enhancing cognitive function-the industry is stepping up to provide evidence-based solutions. By making nutrition more accessible and personalized, nutraceuticals contribute to the prevention and management of lifestyle-related diseases, thereby reducing the burden on healthcare systems globally. In

this way, they not only support individuals in leading healthier lives but also work towards achieving better health outcomes on a global scale.

Fostering Responsible Consumption and Production (SDG 12):

Beyond promoting health, the nutraceutical industry is also making strides in sustainable production and consumption practices. Consumers today demand transparency in sourcing, eco-friendly packaging, and minimal waste in the production process. From sourcing raw materials responsibly-using plant-based ingredients and avoiding over-exploitation of natural resources-to utilizing environmentally friendly manufacturing processes, the industry is moving towards greener practices. Companies are increasingly adopting circular economy models, where resources are reused, recycled, and repurposed to reduce environmental impact. By embracing sustainable consumption and production, nutraceuticals are not just contributing to individual well-being but also to the planet's health.

A Holistic Approach to Sustainability:

The alignment of the nutraceutical industry with the SDGs offers a holistic approach to health and sustainability. By fostering innovation in nutrition science and supporting ethical business practices, the sector is uniquely positioned to contribute to both individual and planetary health. However, continued progress will require deeper collaboration between policymakers, businesses, researchers, and consumers to ensure that the nutraceutical industry can fulfill its potential in achieving these global goals.

As we move forward, let's recognize the critical role that nutraceuticals play not only in enhancing human health but also in creating a more sustainable world. The synergy between health and sustainability represents an exciting frontier for the industry, and together, we can push the boundaries of what's possible for both people and the planet.

Wishing you all health and inspiration.

Mr. Nilesh Lele

**President,
Chamber for the Advancement of Small and
Medium Business (CASMB)**



PURNABRAHMA

Dr. Ritika Joshi

**Editor
CASMB**



The Indian nutraceutical market size is expected to sky rocket from an estimated USD 26.87 billion in 2023 to about 13.5% hike in CAGR (Compound Annual Growth Rate) from 2024 to 2030. Rising consumer awareness about health, focus on health-promoting diets, changing lifestyles, increasing instances of lifestyle-related disorders and preventive health care are credited to be the major driving forces behind this market growth.

Now a days consumers have shifted their focus from synthetic nutraceuticals to those manufactured from natural ingredients or by the use of natural methods. Further, technological advancements and the adoption of AI technologies by consumers have enabled more personalized solutions based on dietary and health data of a consumer. Thus, AI is envisioned as a potential factor in fuelling the “nutraceutical needs” of the consumers.

Even industries are channelizing their resources to lure the consumers of all ages to the maximum possible extent. Chewables and gummies are some innovative nutraceuticals that have been introduced by the industries. These products are

delicious, convenient to consume, attractive and further eliminate the perception that they resemble medicinal pills.

Despite the surge in the use of nutraceuticals, substantial steps need to be undertaken to fully harness this potential industry in order to ensure sustained growth and to provide high quality products to the consumers. Ensuring product freshness, shelf-life management, optimizing storage conditions, complying with regulatory standards and quality, as well as educating consumers so as to use nutraceutical products cautiously are the key challenges that can be tackled together by industry, healthcare professionals, academia and policy makers.

The significance of nutraceuticals in maintaining a healthy lifestyle has certainly increased. However, nutrivigilance is the need of the hour, and healthcare professionals will have to play the role of a torch bearer. Since the innovation cycle with nutraceutical products is small, thus the research industries and academia can join hands to continue evaluating new formulations, innovative ingredients, and/or delivery mechanisms with strong scientific rationale.

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PURNABRAHMA

**Nidhi Godbole
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Innovation in Nutraceuticals:

The Next Big Thing for a Healthy Life

As the world continues to prioritize health and wellness, nutraceuticals have emerged as a pivotal force driving the future of nutrition and healthcare. These products, which bridge the gap between food and pharmaceuticals, are rapidly gaining recognition for their potential to prevent disease, enhance overall well-being, and support long-term health goals.

The nutraceutical industry, once a niche market, is now witnessing explosive growth, thanks to advancements in science and technology. Innovations in extraction processes, bioavailability, and ingredient sourcing are enabling the development of more potent, targeted, and effective products. From functional foods and dietary supplements to botanical extracts and probiotics, nutraceuticals are transforming the way we approach health management.

One of the most significant trends in this space is personalization. As consumers become more informed and proactive about their health, they are demanding products tailored to their specific needs. Companies are responding by leveraging data-driven insights, genetics, and artificial intelligence to

create personalized nutraceutical solutions. These innovations are not only improving efficacy but also making preventive healthcare more accessible to the consumer.

Sustainability is another driving force shaping the future of nutraceuticals. Consumers are increasingly looking for eco-friendly, ethically sourced products that align with their values. This shift is pushing manufacturers to innovate in sourcing, packaging, and production processes, ensuring that nutraceuticals contribute to both individual health and the well-being of the planet.

Moreover, regulatory advancements are playing a crucial role in fostering innovation. Governments and health authorities are recognizing the importance of nutraceuticals in preventive healthcare and are working to establish clearer guidelines and standards. This is creating a more transparent and trustworthy industry, encouraging further investment and research.

In the coming years, nutraceuticals are poised to become an integral part of mainstream healthcare. As innovation continues to drive this sector forward, we can expect a future where nutrition and medicine converge seamlessly, offering individuals more control over their health and longevity. The next wave of nutraceutical innovations promises not only to enhance our quality of life but also to redefine how we think about health in the 21st century.

The rise of nutraceuticals is not just a trend; it is a transformative movement towards a healthier, more sustainable future.

Nidhi Godbole Deshpande

**Sub-Editor CASMB
Senior Food Consultant
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PURNABRAHMA

Dr. Umesh Kamble

Secretary
Chamber for Advancement of
Small & Medium Businesses
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Navigating the Regulatory Landscape for Nutraceuticals: Challenges and Progress

As we step into the final quarter of 2024, the nutraceutical industry continues its remarkable growth, with an ever-increasing demand for products that enhance health and well-being. However, with this rapid expansion comes the pressing need for robust and clear regulatory frameworks to ensure product safety, efficacy, and consumer trust. Navigating the complex landscape of regulations, both in India and globally, remains one of the key challenges for the nutraceutical industry today.

In India, the Food Safety and Standards Authority of India (FSSAI) has been taking significant strides toward establishing comprehensive guidelines for nutraceuticals. The 2016 regulations for food and dietary supplements marked a major step forward, yet many areas still require clarity—particularly with respect to ingredient usage, labeling, and health claims. Manufacturers and businesses are often left struggling with a lack of uniformity in interpretations, creating roadblocks for innovation and market entry.

Globally, regulations vary significantly across regions. The United States follows the Dietary Supplement Health and Education Act (DSHEA), which places the onus of safety on manufacturers but allows more flexibility in health claims. Meanwhile, the European Union takes a stricter approach, with rigorous testing and approval processes for functional foods and supplements under EFSA. These differences make it challenging for companies to navigate cross-border compliance while maintaining the integrity of their products.

However, the regulatory landscape is evolving. There has been increasing dialogue between regulatory bodies, industry players, and scientific communities to create more harmonized standards. This is crucial to promoting both innovation and consumer safety.

Key Compliance Challenges:

1. **Ingredient Approval:** The process of gaining approval for new or innovative ingredients can be lengthy and cumbersome, delaying market introduction.
2. **Health Claims:** Making scientifically backed health claims that meet regulatory standards requires significant investment in clinical studies and data.
3. **Labeling & Transparency:** With consumers demanding more transparency, regulations around labeling must evolve to ensure that claims are clear, truthful, and not misleading.
4. **Global Compliance:** Manufacturers face the challenge of meeting diverse regulations across different countries, often having to reformulate or repackage products to comply.

Ensuring Consumer Safety:

For the nutraceutical industry to maintain consumer confidence, a few key actions are essential:

- **Commitment to Scientific Rigor:** Companies must invest in credible research and clinical trials to back their claims, ensuring products meet the highest standards of safety and efficacy.
- **Collaboration with Regulators:** Engaging with regulatory bodies at both national and global levels can help create clearer, more streamlined frameworks for compliance.
- **Transparency and Education:** Educating consumers about the products they are using, including clear labeling and information on sourcing, ingredients, and benefits, can bridge the trust gap.

As we continue to witness rapid innovation in the nutraceutical space, the industry's ability to adapt to the evolving regulatory frameworks will define its future success. By prioritizing safety, compliance, and transparency, we can ensure that nutraceuticals not only enhance health but do so with the utmost integrity and consumer trust.

Here's to a future where regulatory clarity fosters growth, safety, and well-being for all!

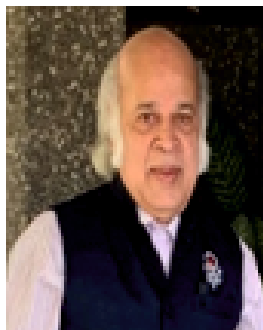
Warm Regards,

Dr. Umesh Kamble

Secretary
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Dr. Prakash Kondekar

**Fellow of Royal Society of Health (London),
Hon Director, Indian Institute of Naturopathy, Mumbai**



Nutraceuticals for Health

The relationship between food and medicine has long been of interest and was considered in many classical traditions, including those of [ancient Greece and China](#). Ancient Greek Physician Hippocrates, for example, introduced the idea “food be your medicine,” a concept that has retained its significance in the more than 2,000 years since.

In the latter part of the 20th century, so-called “health foods” entered the public conscience in many countries. Scientific interest in the overlap between food and medicine was also renewed during that time, notably in the early 1980s by American anthropologists Nina Etkin and Paul J. Ross with research that reinforced the dietary significance of plants used medicinally by indigenous people.

Nutraceuticals are products derived from food sources that provide both nutrition and medicinal benefits. Nutraceuticals are also known by the following terms: 1. Functional foods 2. Medical foods 3. Designer foods 4. Phytochemicals 5. Nutritional supplements. These products include dietary supplements, diets, herbal products, genetically engineered foods.

Starting from inflammation, oral health, skin health, infant and children health, weight management, sports nutrition, women's health, sexual and reproductive health, cardiovascular health, diabetes and blood sugar management, digestive health, bone and joint health, eye health etc., in all body systems nutraceuticals have roles to play.

Majority of low back sufferers do not respond to traditional therapies. The joint health market is expanding from a traditional aging population into younger age groups looking for relief from aches and pains from work or sports-related joint strain. Nutraceuticals are better suited to manage multi-factor-based health issues compared to purified chemicals which usually target a single site of action.

Nutrition deals with the provision of essential elements in food that are necessary to support human life and good health. Good nutrition is necessary for children to grow physically and mentally and for normal human biological development.

Nutrition interventions take a multi-faceted approach to improve the nutrition status of various populations. Policy and programming must target both individual behavioral changes and policy approaches to public health. While most nutrition interventions focus on delivery through the health-sector, non-health sector interventions targeting agriculture, water and sanitation and education are important as well.

Nutraceuticals have demonstrated activity on multiple inflammatory and pain pathways and thus provide promising leads to develop newer supportive care for mobility constraints. However, most have been studied for their effect on chronic pain conditions such as osteoarthritis. This overall situation created a need for an evidence-based fast-acting alternative of nutraceuticals for managing knee and lower back discomfort.

New range of nutraceuticals and new women's health formulations is both fascinating and welcome because historically women have been underserved with regard to dedicated formulations and evidence-based research.

Cultural taboos have also silenced marketing related to women's issues deemed private, such as menstruation and menopause. Shining light on women's health creates countless opportunities for growth in nutra-industry because there are many ingredients that can offer benefits. A new wave of positive momentum to promote gender parity, close research gaps and prioritize women's health is on the rise.

Nutraceutical market is currently a high-impact multi-billion-dollar industry and it is anticipated to grow rapidly over the next decade. Nutraceuticals comprise diverse food-derived product categories that have become widespread due to increased consumer awareness of potential health benefits and the need for improved wellness.

Nutraceuticals play major role in overall health of a human being. Hence more research in the nutraceutical formulations is the need of the hour. However, there is a need of administration and prescription of nutraceuticals and they should be strictly regulated in order to prevent their uncontrollable use and side effects. ❑

Turmeric milk - The Golden Drink of India

Dr. Sonika Pandey
(Ph.D. BHU, Varanasi)



Introduction

Turmeric milk is a traditional Indian beverage that is rich in antioxidants, which help protect cells from damage, fight off diseases and infections and contribute to one's overall health.

Turmeric (*Curcuma longa* L.) belongs to the family *Zingiberaceae* and one of the most important spices of India. It is an herbaceous plant and is called as the golden spice because of the beautiful yellow color. India is the major producer and exporter of turmeric. It is mainly used to give flavor, fragrance to curries as well as for coloring purposes. In pickles, it is one the most important ingredient for flavor and preservation.

Turmeric milk has great nutraceutical properties. It has many healing features according to the indigenous Ayurvedic system of medicine of India. It has the properties of pain-relieving, antibacterial, antiseptic, antispasmodic, digestive, carminative, diuretic, cardiovascular protectant, and anticancer. The medicinal property of turmeric is great for wound healing and anti-inflammatory.

Turmeric contains a bioactive compound known as curcumin a very strong antioxidant. Moreover, curcumin is very less absorbed into the bloodstream. To get the full benefit of curcumin, its bioavailability needs to be improved. So, it should be consumed with black pepper which contains piperine, which increases the absorption of curcumin. Also, curcumin is fat soluble so better to consume with meal rich in fat.



Recipe of Turmeric milk

Turmeric milk is one of the most common Indian household drink and a great home remedy for cough, congestion, colds, and skin problems. It is a creamy and comforting drink at bedtime. It is a warm tonic with spicy undertones that protects, nourishes and has a good taste. It can be made with plant based milk also.

Prep Time: 5 mins Cook Time: 10 mins
Total Time: 15 mins Servings: 1

Ingredients

- ¼ teaspoon powdered turmeric
- ¼ teaspoon powdered cardamom
- ⅛ teaspoon crushed black pepper
- 1 pinch grated ginger
- 1-2 cloves
- 1 cup milk
- ¾ teaspoon honey or jaggery
- ⅛ teaspoon vanilla extract

Method of Preparation

1. Whisk together turmeric, cardamom, black pepper, ginger, cloves, in a small bowl.
2. Heat milk in a small saucepan over medium heat until heated through, 3 to 4 minutes; stir honey and vanilla into milk until completely dissolved.
3. Now mix the turmeric combination into milk mixture; reduce heat to medium-low and simmer until flavors blend, 2 to 3 minutes. Pour mixture through a strainer and the milk is ready.

Some more food dishes with turmeric as an active ingredient

- Turmeric rich pickles

- Sautéed vegetables in turmeric
- Turmeric ginger candy
- Turmeric ginger tonic
- Turmeric chutney with coriander
- Tomato soup with turmeric
- Fresh turmeric curry
- Turmeric infused healthy laddoo
- Mango and turmeric coconut yoghurt
- Turmeric and coconut fish curry

Benefits of Turmeric Milk

Improves memory

Curcumin may be beneficial in treating Alzheimer's disease. Alzheimer's disease is the most common form of dementia and may contribute to up to 70% of dementia cases. Inflammation and oxidative damage occurs in Alzheimer's disease, and curcumin has a helpful effect on both.

Lowers cardiovascular diseases

Curcumin may lower your risk of heart disease. It lowers the cholesterol and improves the function of the endothelium or the lining of your blood vessels. Endothelium is the major component in heart diseases; it controls blood pressure, blood clotting, and various other factors.

Anti-inflammatory property

Curcumin is a natural anti-inflammatory compound. It reduces swelling. It lowers the enzymes that cause inflammation if taken for a long time.

Anti-cancer activity

Curcumin may affect cancer growth and development. Some studies have shown that it can:

- add to the death of cancerous cells
- reduce angiogenesis (growth of new blood vessels in tumors)
- reduce metastasis (spread of cancer)
- curcumin may prevent cancer from occurring in the original place, particularly cancers like colorectal cancer.

Antioxidant capacity

Turmeric acts as an antioxidant in the body. It prevents the oxidative damage that is believed to be the reason behind aging and many diseases. Curcumin reduces the free radicals that are highly reactive molecules with unpaired electrons. As a powerful antioxidant it can neutralize free radicals due to its chemical structure.

Boon for arthritis patients

Arthritis involves inflammation in the joints. Curcumin reduces the inflammation of joints and provides relief from pain.

Immunity Booster

Turmeric milk is considered to be a great immunity booster drink. It is often taken to cure cough, cold and fever.

Role against depression

Curcumin has been known to treat mood disorders. Its positive results on the brain shows an increase in the brain neurotransmitters serotonin and dopamine, reducing inflammation, and encouraging brain plasticity. Therefore, curcumin acts as a great antidepressant.

Skin health

Turmeric can help treat skin diseases and heal wounds faster. It is also used to make skin look fairer. □



NutriThink conf on 18 th July 2024, Dr Kondekar in Panel discussion on "Child and Maternal Health."



Dr Kondekar, in NutriThink conf in Hotel Sahara Star Mumbai on 18 th 19th July 2024.

The Power of Probiotics and Prebiotics: A Nutraceutical Revolution

Dr. Sonal R. Zanwar

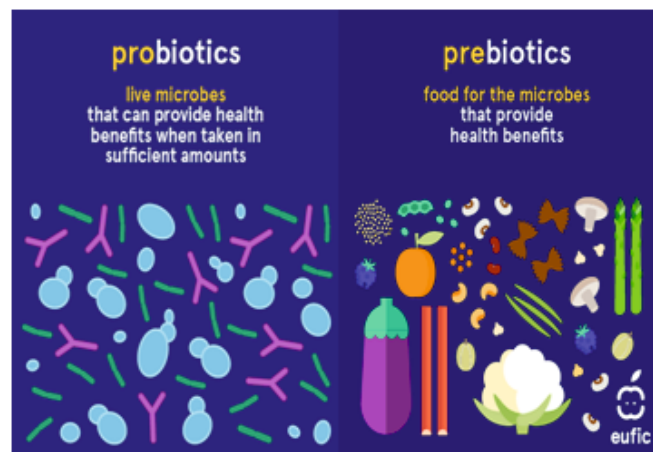
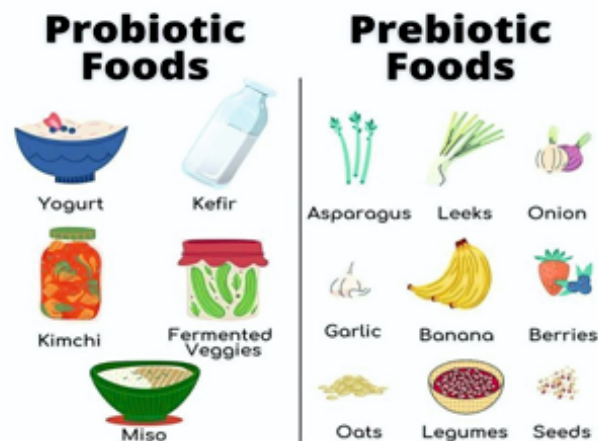
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In the ever-evolving world of health and wellness, probiotics and prebiotics have emerged as key players in the nutraceutical arena. With a growing body of research supporting their benefits, these two types of dietary supplements are making waves for their ability to enhance digestive health, boost immunity, and even improve mental well-being. But what exactly are probiotics and prebiotics, and how can incorporating them into our diet benefit us? Let's delve into this dynamic duo and explore their transformative potential.

Understanding probiotics

Probiotics are live microorganisms, often referred to as "good" or "beneficial" bacteria, that contribute to the balance of the gut microbiome. These friendly bacteria help maintain the health of the digestive system by promoting a balanced microbial environment. Common sources of probiotics include yogurt, kefir, sauerkraut, kimchi, and certain supplements.



Health benefits of probiotics:

- 1. Digestive health:** Probiotics are renowned for their role in supporting digestive health. They aid in the breakdown of food, absorption of nutrients, and can alleviate symptoms of irritable bowel syndrome (IBS), diarrhoea, and constipation.
- 2. Immune support:** A balanced gut microbiome is crucial for a strong immune system. Probiotics can enhance the body's defence mechanisms by stimulating the production of antibodies and supporting the activity of immune cells.
- 3. Mental well-being:** Emerging research suggests a link between gut health and mental health, often referred to as the "gut-brain axis." Probiotics may positively influence mood and cognitive function, potentially offering relief from conditions like anxiety and depression.

The role of prebiotics

While probiotics are the beneficial bacteria themselves,

prebiotics are non-digestible fibres that serve as food for these good bacteria. They help to stimulate the growth and activity of probiotics in the gut, ensuring a thriving microbial ecosystem. Common sources of prebiotics include foods like bananas, onions, garlic, asparagus, and leeks.

Health Benefits of prebiotics

1. **Gut health:** By nourishing beneficial bacteria, prebiotics help maintain a healthy balance of gut microbiota. This balance can improve digestive function and may aid in preventing gastrointestinal issues.
2. **Nutrient absorption:** Prebiotics enhance the absorption of minerals such as calcium and magnesium, which are essential for bone health and various physiological functions.
3. **Metabolic health:** Some studies suggest that prebiotics can influence weight management and glucose metabolism, potentially lowering the risk of obesity and type 2 diabetes.

Combining probiotics and prebiotics

The synergy between probiotics and prebiotics is where the real magic happens. This combination, often referred to as synbiotics, creates a powerful effect on gut health and overall well-being. When consumed together, prebiotics help probiotics flourish, amplifying their beneficial effects.

Incorporating probiotics and prebiotics into the diet

1. **Probiotic-rich foods:** Incorporate fermented foods like yogurt, kefir, miso, and kimchi into your meals. For those who prefer supplements, look for high-quality products

with proven strains of beneficial bacteria.

2. **Prebiotic foods:** Enhance your diet with prebiotic-rich foods such as bananas, onions, garlic, leeks, and whole grains. These foods not only support gut health but also contribute to a balanced and varied diet.
3. **Synbiotic combinations:** Consider combining probiotic and prebiotic foods in your meals. For example, top a bowl of yogurt with a banana or mix fermented vegetables into a salad.

The future of probiotics and prebiotics

As research continues to unfold, the scope of probiotics and prebiotics is expanding. New strains, delivery methods, and formulations are being developed to target specific health concerns and enhance efficacy. With ongoing studies revealing more about the complex relationship between gut microbiota and overall health, the future looks promising for these nutritional powerhouses.

Conclusion

Probiotics and prebiotics are more than just dietary trends—they represent a growing understanding of the integral role that gut health plays in our overall well-being. By incorporating these beneficial bacteria and their prebiotic fuels into our diet, we are not only supporting our digestive system but also contributing to a healthier and a more balanced life. As we continue to unlock the mysteries of the microbiome, one thing is clear: the journey toward optimal health is well-supported by these remarkable nutraceuticals.

Whether you're a health enthusiast or simply curious about improving your well-being, embracing the power of probiotics and prebiotics can be a transformative step in your wellness journey. 



DECLARATION



- The contents of this issue is referred and compiled from various sources and Purnabrahma doesn't claim it's authenticity.
- The contents given in the article are the views of the respective authors.

Nutraceuticals in Promoting Health and Preventing Health risks

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The old saying, "Let thy food be thy medicine and medicine thy food" is attributed to Hippocrates, the "Father of western medicine." Nutraceuticals include nutrients derived from natural goods, dietary supplements, herbal products, and processed foods including cereals, soups, and drinks. Nutraceuticals found in food are nutritional components that offer health advantages. Human health is defined by nutritional supplements.¹

Food components with potential health benefits beyond their basic nutritional value have been the focus of recent scientific investigation. "Nutraceuticals", which stems from the combination of the words *nutritional* and *pharmaceutical*, refers to foods or food

components that have health or medical advantages, including the prevention as well as treatment of disease. The potential of nutraceuticals to lower health risks and enhance health quality is becoming more widely acknowledged. Nutraceuticals have become a multi-billion-dollar sector in the global marketplace.²

(<https://www.lifecareneuro.com/top-10-nutraceutical-products-in-india/2024>)

Nutraceuticals can be anything from diet plans, herbal items, dietary supplements, and isolated nutrients to processed foods including cereals, soups, juices, and beverages, as well as genetically modified designer foods. A group of compounds flavonoids, alkaloids, carotenoids, pre- and probiotics, phytosterols, tannins, fatty acids, terpenoids, saponins, soluble and insoluble dietary fibres are major chemical categories that are now known to have potential health-promoting effects.

Nutraceuticals have been linked to several health advantages such as: calcium can protect from osteoporosis, the prevention of neural tube abnormalities in babies can be initiated by proper folate supplements, and colon cancer can be prevented by reducing dietary fat and increasing fibre. Consumers now have access to fresh food. Thanks to developments in food technology, food biochemistry, and the nutritional sciences, including nutritional genomics.

The combined effects of nutrients and bioactive substances are acknowledged as a possible sign of improved health. Bioactive materials are used and applied in many different fields, but most notably in the nutraceuticals industry.

Nutraceuticals have gathered attention lately due to their potential health advantages and role as complementary therapies to traditional medicine. Utilising nutraceuticals can help minimise the risk of side effects by reducing or eliminating the need for conventional drugs. Furthermore, nutraceuticals are important for enhancing immunity and contributing to the economic growth of a number of developing nations, such as India.³

The oceans are one of the main systems of our planetary biosphere. It accounts for almost half of the planet's biological production, but a much smaller proportion of human food. They have also become known as a rich and varied source of bioactive chemicals in recent years. There is growing

recognition of the function of marine organisms as an organic source of new compounds that can benefit the food sector and advance human health. With an emphasis on their potential applications as nutraceuticals and their associated health benefits a myriad of functional compounds are found in seafood, such as cellulose and chitosan, pigments made from algae, fish lipids and omega-3 fatty acids, essential amino acids, bioactive proteins and peptides, polysaccharides, phenolic compounds, and minerals.⁴

Contemporary health concerns like diabetes, cancer, obesity, osteoporosis, allergies, and dental disorders are being actively addressed by the European Union. Developed countries also have issues with an ageing population, an abundance of high-calorie meals, and nutritional imbalances. To cope with such difficulties that ongoing conditions pose for medical practitioners, especially when it comes to the long-term usage of medications that can have unbearable adverse effects, investigating natural substitutes as nutraceuticals may provide therapeutic and preventive advantages. The environment, social dynamics, and health are all greatly impacted by new dietary patterns and contemporary changes in food production and consumption. Exploring natural alternatives through nutraceuticals could offer both protective and therapeutic benefits. The date palm (*Phoenix dactylifera* L.) has been identified as a promising source of such nutraceuticals and functional food components.

Conclusion:

The potential of dietary supplements, functional foods, and nutraceuticals to address health issues, especially those pertaining to the probiotics, support physiological, immunological, and nutritional processes that are important to the health of the host. The methods by which these functional foods and nutraceuticals can improve host health are also highlighted.

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World Food day in MIT Loni Kalbhori Pune..16 th Oct 2024.



Nutrition week celebration September 2024, in Nirmala Niketan College Churchgate. Dr Kondekar as panel chair.

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Pumpkin: Undervalued nutraceutical used in India

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Nutritional aspects of Pumpkin:

Pumpkin is considered as a valuable vegetable with medicinal and functional culinary properties. Leaves, flower, fruit both mature and immature and seeds have its own importance in medicine and now it's a part of nutraceutical. Pumpkin leaves (*Cucurbita* spp.) are widely consumed in Sub-Saharan Africa, Asia, Korea, the Pacific Islands, India, and Bangladesh, and are considered nutritious and functional vegetable. Pumpkin not only contains nutrients like carbohydrates, minerals, and dietary fibres but is an inexpensive source of vitamins, particularly carotenes. Apart from these pros pumpkin flesh has been reported to have hypoglycaemic, *invitro* antioxidant, cholinesterase and tyrosinase inhibition, and hypolipidemic effects. From the recent investigations peels are considered rich in nutrients and bioactive compounds (like pectin) having the potential to be used as an ingredient in food products. Fresh leaves and flowers have bioactive compounds with antimicrobial, antifungal, anti-mutagenic, antioxidant, hepato-protection, anti-hyperglycaemic, antidepressant, and anti-inflammation properties. Pumpkin seeds are consumed as snacks are a wonderful source of proteins, lipids, minerals, and phytonutrients that establish their medicinal and nutraceutical importance. Due to the presence of these bioactive nutrients, it is assumed to be used as a remedy for lowering blood cholesterol or depression. Besides these, anti-diabetic, antiulcer, wound healing, antioxidant, and hepatoprotective properties of the seed of pumpkin have also been investigated.



Introduction:

"Let food be thy medicine and medicine be thy food" was quoted by Hippocrates in 400 BC, which holds true in today's world as well. In early 1989, Dr. Stephen De Felice coined the term "Nutraceutical" which indeed is a combination of two words "nutrition" and "pharmaceutical". In simpler words it can be elaborated as food or a part of food which not only nourishes our body but also helps to improve our health and prevents us from various chronic ailments. These are also known as 'nutraceuticals', 'food supplements', 'dietary supplements' and 'functional foods' which are specially designed and formulated according to various clinical requirements based on evidences collected to ensure strong safety profile with few undesirable side effects and better bioavailability.

Various traditional Indian spices and herbs plays a key role in these nutraceuticals. As our traditional Indian diet believes in the theory of 'Food as Medicine' we include all spices and herbs in our traditional diets. But change in lifestyle has not only changed our environment but has also impacted on our health. We are turning more towards processed food instead of homely cooked fresh foods. Likewise various fruits and vegetables are also neglected which are now termed as functional foods and used as nutraceuticals. "Pumpkin" belonging to the Cucurbitaceae family of flowering plants and genus *Cucurbita* are among the largest vegetable crops native to Latin America and has been widely cultivated for over 10,000 years in North America and more than 500 years in Europe.

Some important bioactive compounds found in pumpkin peel, pulp and seeds are shown below in the Table1.

Table 1. Biological functions of compounds found in pumpkin peel, flesh and seeds.

Source	Bioactive compound	Biological function
Pumpkin peel	Pectin, polysaccharide	Antidiabetic
	Carotenoids, polyphenols, vitamin C	Antioxidant activities
	Carotenoids	Anti-fatigue activity
	Cucurmosin, polysaccharide, lignin	Anti-carcinogenic
	Tocopherol	Reduce inflammation
Pumpkin flesh/pulp	Phenols	Antidiabetic
	Fiber	Helps in weight loss
	Pulp Extract	Antidiabetic and antioxidant
	Polysaccharides	Antioxidant
	Carotenoids	Anti-aging effect
	β-carotene	Reduce inflammation, Fights against cancer
	Lutein and zeaxanthin	Prevent formation of cataracts in eyes
	Dextro-chiro-inositol	Act as insulin action mediator
	Fiber and zinc	Helps in treating gastrointestinal disorders

Pumpkin seeds	Zinc	Improve immune system
	Magnesium	Promote heart health
	Potassium	Prevent osteoporosis
	Phosphorous	Help muscle and nerves health
	Selenium	Prevent Cellular damage
	Phytosterols	Reduce blood cholesterol
	Cytosterols	Anticancer properties
	Phytoestrogen	Prevent breast cancer
	Tryptophan	Act as natural sleeping pills
	Omega-3 Fatty acid	Support heart health and lowers LDL levels
	Cucurbitacin	Helps in prostate health
	Cucurbitin	Eliminate intestinal worms

Utilization of pumpkin in our diet:

Traditional form of diet utilised pumpkin flesh, flowers, seeds and leaves in the fresh form. In India it is mostly as fresh vegetable with exception of its use in vegetable sauce where the pumpkin is being added as a thickening agent. We can include pumpkin in its fresh form in preparation of vegetables, sambar, halwa, fritters, soups, etc. Some other processed applications of pumpkin can be as follows which does not include any preservatives and can be made at home.

Pumpkin flour: Flour can be easily processed using fresh pulp. After cooking it can be solar dried or tray dried and can be stored in the airtight container at cool and dry conditions. This pumpkin flour or powder can be used as supplement. We can also incorporate this powder in roti flour, in gravies as thickening agent, desserts as gelatinization and thickening agent, in baked products like biscuits, crackers, cookies, bread,

pies, muffins, etc. for enhancing taste and nutritional value. Soups can be thickened using pumpkin flour. Even baby foods can be supplemented with pumpkin powder to improve its nutritional value.

Energy bars: For instant snacks we can easily use pumpkin seeds and flour along with some jaggery or honey, dry fruits, nuts and various seeds and make into traditionally named *chikki* and laddoo. This can be a best option for pre or post exercise snack, short break snacks for children and even elderly. Women in pre- and post-menopausal state can fulfil their required vitamins, minerals through this source.

Other market available products: Recently wide variety of pumpkin foods are available in the market under the name functional foods, supplementary foods, etc. These products include jam, jellies, marmalades, chips, yoghurts, juices, energy bars, porridges, cakes, biscuits, gummies, desserts, etc. Various animals are fed with pumpkin flour and seeds supplements and milk obtained from these are used to process cheese, panner, yoghurt and has shown various health benefits

in the studies, yet more detailed study needs to be done.

Conclusion:

Pumpkin is an edible plant, which can be included in our daily diet that can improve health by curing many diseases. No part of the pumpkin should be considered as waste as all three parts (peel, flesh and seeds) are fully loaded with compounds posing positive impact on human and animals health. Beneficial effects of pumpkin include anti-diabetic, anti-microbial, anti-carcinogenic, anti-ulcer, anti-viral, anti-oxidant and anti-inflammatory. Phytochemicals and bioactive compounds present in pumpkin peel, flesh and seeds include, phenols, flavonoids, carotenoids, terpenoids, peptides, polysaccharides, vitamins and minerals has also shown various biological functions in humans. Thus, including these all above mentioned products in our diet will ensure us with wonderful benefits and keep us nourished and protected from infections and disorders. Concluding with the most famous phrase "Eat Food as Medicine" so we don't have to "Eat Medicines as Food". ◻

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Nutraceuticals: A Common Quick Fix:



Consider protein supplements, for example. If you're a person who is constantly on the go, you have undoubtedly experienced times when preparing a breakfast seemed impossible. Protein smoothies or bars look like the perfect solution. The problem is that, although they might make you feel fuller and give you a fast energy boost, do they actually replace the vital nutrients that a traditional Indian lunch like *poha*, *upma*, or *idli*, would provide? Not really. Protein powders often are devoid of the fiber, vitamins, and minerals you'd get from whole foods.

A great example is the growing trend of meal replacement shakes, where people skip full meals for a scoop of powder mixed with water or milk.

While it may be practical, is it sustainable overtime? Indian food is nutrient- dense, so although shakes might be convenient, easy to use for fast paced lifestyle, meals shouldn't be permanently replaced with them.

The Nutraceuticals Craze and the Indian Workday:

A typical Indian workday, especially in metro cities even in TIRE 2 cities appears to be a never-ending battle against the clock.

Between traffic jams, endless meetings, and tight deadlines, eating healthy becomes an after thought. This is the point at which nutraceuticals-such as omega-3 supplements, energy drinks, and multi vitamins-are pushed as "quick fixes" to make up for the nutrients we don't get during the day.

The popularity of ashwagandha, turmeric pills, which are supposed to relieve fatigue and stress & boosts

immunity, is one recent example. Although these have been traditional herbs used for millennia, are now available as energy bars, powders, and pill forms. It's undoubtedly a fantastic adaptogen, but the way it's being promoted raises questions about whether we're attempting to treat the symptoms of a busy lifestyle rather than the root cause.

Post-Pandemic Immunity Campaigns:



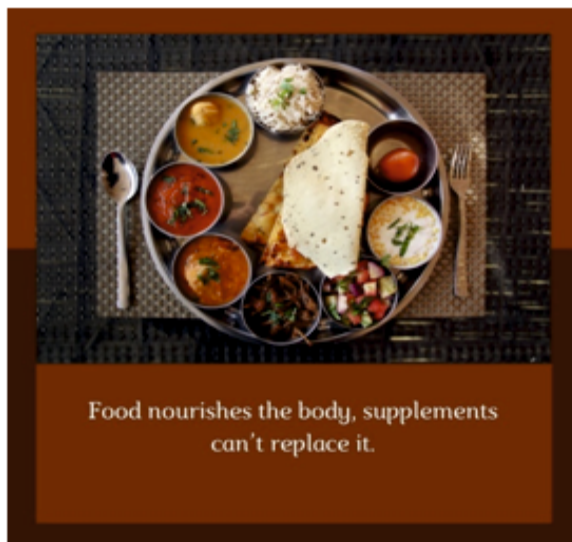
Immunity has become a household buzzword in the wake of the pandemic. Seizing the opportunity, nutraceutical companies launched immunity-boosting products-think turmeric shots and amla gummies. Although these are undoubtedly helpful, do we really need to take a pill for every situation?

For years, Indian households have relied on *haldi-doodh*, or turmeric milk, as a remedy for colds. You may now purchase *haldi* pills or pre-packaged turmeric lattes. Yes, it's practical, but isn't part of maintaining good health also about making time to prepare and consume a healthy diet? May be what we need is a little more balance- haldi from the kitchen spice jar when you have a moment.

A good example of products like Amla Juice and Tulsi Juice for daily immunity. These are great products, particularly if you can't get hold of fresh ingredients. Still, you can lose out on the flavor of a home-cooked Indian dish if you only use these quick remedies.

Good, Bad, or Addictive?

Here comes the real question: Are these nutraceuticals good for us? Or are they merely an additional comfort that we have come to rely on due to our inability to keep up with our hectic lives? Nutraceuticals are undoubtedly beneficial since they bridge nutritional gaps in our diets, particularly in situations where we



Food nourishes the body, supplements
can't replace it.

actually lack the time to cook wholesome meals. For example, people who don't get enough fatty fish or flaxseeds in their diet would benefit greatly from taking omega-3 supplements. Similarly, multivitamins can assist make sure we don't lose out on important micronutrients, especially when it comes to the nutrient-deficient meals that are typical in urban areas.

But this is crucial to understand, they cannot take the place of whole foods. It can be detrimental to rely too much on nutraceuticals if we start to use them in place of healthy meals. The nutrient synergy that whole foods offer is absent from them. Furthermore, taking supplements in excess can sometimes lead to side effects.

Take caffeine supplements for energy, which are often marketed under the guise of enhancing focus and reducing fatigue. They can be beneficial when used in moderation, but when used excessively, they can lead to dependency or even health issues like anxiety, high blood pressure, or digestive problems. Similarly, if protein powders are used in excess, it might cause renal discomfort or nutritional imbalances in other areas.

Where do we draw the line?

The key is to recognize that nutraceuticals are supplements—they should supplement, not replace, a balanced diet. It's acceptable to occasionally grab a protein drink instead of breakfast if you don't have time for breakfast. But if you're doing this every day, it's time to rethink your routine.

It is easy to obtain our nutrients from traditional meals in India because we have access to a wide range of rich, whole foods—think pulses, grains, veggies, fruits, and spices. Nutraceuticals can help us when life gets too busy, but the goal should always be to return to a more holistic, balanced approach to health.

Let's also not forget that India has a strong tradition which focuses on fresh, regional, seasonal food-based solutions for health. Although these traditions are greatly influenced by nutraceuticals, the original practice prioritizes long-term wellness, balance, and awareness over quick fixes.

Reasons to Consult Professionals:

It's important to keep in mind that there isn't a "one size fits all" approach while taking supplements or medications. Seeking advice from a dietitian or other medical professional can assist you in avoiding the dangers connected to improper or overuse. This is the reason why:

1. **Individual Needs Differs:** Not everyone has the same nutritional needs. While you may believe you require extra vitamins or omega-3s, a blood test may reveal otherwise. Supplementing at random might result in nutrient imbalances, such as taking too much iron or vitamin A.
2. **Possible Drug Interactions:** Some nutraceuticals may limit the effectiveness of medications you're already taking for conditions like anxiety, diabetes, or hypertension. Curcumin, for instance, may interact with blood thinners and several diabetes drugs, perhaps leading to problems.
3. **Over dosage Risks:** Excessive consumption of any supplement, including natural ones, might have negative consequences. For example, excessive dosages of vitamin D supplements can cause toxicity and result in symptoms such as nausea, renal difficulties, and elevated blood calcium levels.
4. **Quality and Safety:** To lower the possibility of contamination or false advertising, a nutritionist might suggest premium products that are subjected to independent testing. Many over-the-counter supplements might not adhere to safety regulations or have the precise dosages that are advertised.

Conclusion:

So, are nutraceuticals good or bad for busy lifestyles? Like most things in life, the answer lies in balance. They're an excellent resource to have when managing several obligations, but they shouldn't be relied upon permanently. After all, our health isn't just about popping pills or mixing powders—it's about making conscious choices, even in small moments, to nourish our bodies.

"So, the next time you reach for that capsule, will you remember that your kitchen might just hold the best nutraceutical for long-term health?" ❑

Distinguishing Prebiotics from Dietary Fiber and Exploring Their Potential as Nutraceuticals

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Dietary Fibers:

Definition according to the CODEX: Dietary fibre refers to carbohydrate polymers with monomeric units (ten or more) that are not broken down by endogenous enzymes in the small intestine of humans and fall into the following categories:

1. Food that contains edible carbohydrates.
2. Carbohydrate polymers derived from food, either physically, chemically or enzymatically, have been proven to promote health based on scientific backing.
3. Synthetic carbohydrate polymers - [1].

Recommended daily allowance of dietary fibre		
	INDIA	FAO/WHO
MEN	30-50 g/d	>25 g/d
WOMEN	25-40 g/d	>20 g/d

Source: RDA FOR INDIANS ICMR – NIN – 2020 AND WHO

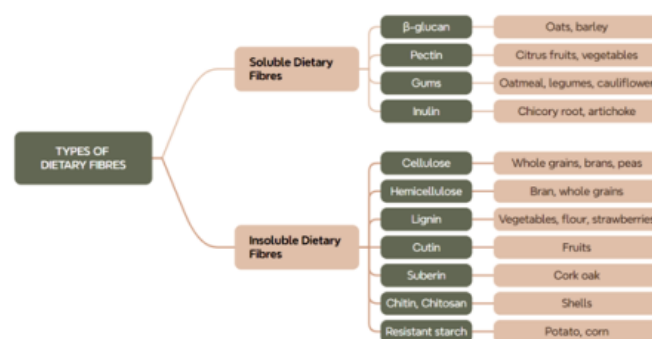


Fig 1: Classification and sources of dietary fibers. [2], [3]

Dietary fibres available in market:

- Soybean husk [4]
- Seaweed dietary fibre[5]
- Psyllium husk – water soluble fibre [6]
- Gum acacia – rich in soluble fibre [7]

Dietary fibre and gastrointestinal disorders: Dietary fibre has various health advantages, including the avoidance of constipation along with decreased gastrointestinal symptoms, a lower inflammatory condition, and less synthesis of uremic toxins derived in gut[8].

Dietary fibre and diabetes: Over 3 months, taking a daily 5g β-glucan (oat) supplement improved glycaemic control, lowered hunger, and modified microbiota of patients suffering from Type 2 Diabetes [9].

Dietary fibre and obesity: Consumption of barley β-D-glucan for 12 weeks reduced body weight, waist circumference (WC), visceral fat area (VFA), and BMI in people with visceral fat obesity [10].

Dietary fibre and cardiovascular diseases: A recent scientific investigation found that a lack of dietary fibres, namely resistant starch, can cause clinically significant hypertension in mice. Since intestinal dysbiosis and lower SCFA synthesis, blocks immunological pathways that have defensive benefits [11].

Dietary fibre and cancer: Fibre in fruits and vegetables protects against breast cancer by decreasing oestrogen release and blocking oestrogen enzymes [12].

Studies on purified dietary fibres:

Lentinula edodes (*L. edodes*) is a unique source of soluble dietary fiber (SDF) which can be extracted by the ultrasonic-assisted hot-water technique. The physicochemical characterization of U-SDF indicated a

better swelling capacity, water holding capacity, water solubility, and oil holding capacity than SDF extracted using the hot water technique without ultrasonication. Therapy with U-SDF improved glucose and peroxidation metabolism *in vivo* [13]. *Citrus unshiu* peels contain high amounts of dietary fibre. The ultrasound-assisted alkaline extraction method can be used to extract SDF with high antioxidant capacity. It offers significant growth potential in the industry of nutritional supplements [14].

Prebiotics:

International Scientific Association of Probiotics and Prebiotics define prebiotics as a substrate that is broken down or fermented by the microflora present in the gut leading to increasing health benefits. According to the above definition, non-carbohydrate elements are also considered to be prebiotics, though their uses are not limited to the gastrointestinal tract [15]. Prebiotics consists mostly of non-digestible oligosaccharides such as galactans, fructans, and inulin. They may include conjugated fatty acids and polyphenols. Potential prebiotics include pectins, whole grains, cellulose, mannose, maltose, arabinoxylan, resistant starches, lactulose, polydextrose, and β -glucans [16]. Certain prebiotics can retain water, increasing stool bulk and viscosity, making easy passage of faeces through the gastrointestinal system. SCFA production by prebiotic fermentation is proven to enhance intestinal health and intestinal movement. Furthermore, the fermentation of prebiotics in the colon may induce immunomodulatory reactions as well as the generation of neurotransmitters that increase colon contractility. Prebiotic fermentation by gut bacteria may cause the production of neurotransmitters that interact with the ENS and CNS. The bacterial neuromodulators act directly on nerve terminals in the digestive tract, prompting reactions from the gastric system that lead to quicker and easier defecation [17].

Although prebiotics present in foods can be categorized as dietary fibre, not all dietary fibre is prebiotic. The fibre that bacteria cannot ferment is not considered prebiotic.

Food Safety and Standards Authority of India (FSSAI), defines Nutraceuticals as, 'Foods which are specially processed or formulated to satisfy particular dietary requirements that exist because of a particular physical or physiological condition or specific diseases and disorders and are presented as such, wherein the composition of these foodstuffs must differ significantly from the composition of ordinary foods of comparable nature'.

Nutraceuticals may contain ingredients either of the following ingredients listed in:

- Vitamins and Minerals – Schedule I
- Amino acids – Schedule II
- Plants/Botanicals – Schedule IV
- Nutraceuticals – Schedule VI
- Probiotics – Schedule VII
- Prebiotic compounds – Schedule VIII

A total of 16 prebiotic compounds are approved according to the compendium of FSSAI.

- **Polydextrose:** Consumption of galactooligosaccharides (GOS) and polydextrose (PDX) has reported to decrease the adverse effects of stress exposure and the development of a health-promoting gut microbiome [18].
- **Soybean oligosaccharides:** A study incorporated 0.8% soybean oligosaccharides (SBOS) into the feed of growing-finishing pigs. It boosted the average daily weight gain of pigs. SBOS fermentation in the hindgut, changed the composition of short-chain fatty acids (SCFAs), and resulted in the decrease in fat deposition in growing-finishing pigs [19].
- **Isomalto-oligosaccharides:** Isomalto-oligosaccharides (IMOs) are oligosaccharide mixtures that mostly consist of α -1,6 glucosidic links between glucose units, with minor amounts of α -1,2, α -1,3, and α -1,4 connections. IMO has anti-obesity properties via increasing adipose tissue fat mobilization and lowering gastrointestinal inflammation [20].
- **Fructo-oligosaccharides:** Fructo-oligosaccharides are a combination of glucose and short fructose polymer chains connected by β (2,1) glycosidic linkages. [21].
- **Gluko-oligosaccharides:** Gluko-oligosaccharides (GlcOS) contain 2-10 glucose residues and one or more O-glycosidic linkages. have been shown to have prebiotic potential (not completely established prebiotics) [22].
- **Xylo-oligosaccharides:** XOs are non-digestible oligosaccharides with xylose monosaccharides (2-10 units) connected by β -1,4-xylosidic linkages. This form of connection enables XOs to survive stomach

enzyme assault, allowing them to travel through the upper gastrointestinal tract undigested until they reach the lower intestine and are processed by the probiotic bacteria –[23].

- **Inulin:** Because of its potential to decrease lipids and control glucose metabolism, inulin has been considered a treatment option in non-alcoholic fatty liver disease (NAFLD) [24].
- **Isomaltulose:** Isomaltulose is a sucrose isomer that has physical features with sucrose, including sweetness and solubility. Isomaltulose, a prebiotic, can alter the makeup and structure of the gut microbial community without causing diarrhoea[25].
- **Lactulose:** Lactulose, an orally given but non-absorbable disaccharide, increases intestine *Bifidobacteria* densities while decreasing the risk of systemic infections and death [26].
- **Lactoferrin:** Research suggests that lactoferrin improves gut health by increasing gut immunity, fortifying the intestinal barrier, and lowering the risk of colon cancer. Lactoferrin is partly digested and has been shown to influence microbiota as a prebiotic agent, potentially contributing to its favourable effects on gut health [27].
- **Sugar Alcohols (lactitol, sorbitol, maltitol, inositol, isomalt):** Sugar alcohols are commonly used as thickeners and sweeteners and are also referred to as bulk sweeteners. Its health benefits include providing calories and having a low glycemic index, which lowers blood glucose and insulin response [28].
- **Galacto-oligosaccharides:** Several studies in infants have demonstrated that GOS-containing milk formulas (with exclusively added GOS or added GOS in combination with other carbohydrates, particularly FOS) encourage the growth of good bacteria such as *bifidobacteria* and *lactobacilli*, leading to intestinal microbiota compositions similar to breast-fed infants [29].
- **Partially hydrolyzed guar gum (PHGG):** PHGG is water-soluble fibre derived from guar gum with promise as a prebiotic. It impacts the gut flora, which metabolizes it into SCFAs, and it has recently been found to protect people from influenza infection [30].
- **Pectin:** All pectins and associated oligomers

are highly fermentable, boosting the generation of health-enhancing SCFAs. Oligomeric pectins, as low-specificity fibres, can be used widely by a wider range of gut flora, enhancing conventional bifidogenic activity [31].

- **Resistant Dextrin (RD):** A study looked at the usage of RD extracted from potato, with prebiotic properties, as a viable ingredient to promote weight reduction by improving health of overweight children - [32].

This mini-review gives an overview of different types of prebiotics that can be incorporated as Nutraceutical ingredients.

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Dr Kondekar, with Director, MIT, Principal MIT, Pune, Shri Vikas Patil MD Mirtillo International and Ms Varsha Khatkhate, of Polychem Lab, Pune.



. Dr Kondekar, With Dr Sudhir Tamhane in US Pulses Innovation Day in Hotel Taj on 27 th July 2024.

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Marine Foods as a Hidden Source of Nutraceuticals

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Introduction

Nutraceuticals are food-based products that provide health benefits beyond basic nutrition, helping to prevent or treat diseases through bioactive compounds like vitamins, minerals, and antioxidants. They act as natural supplements to support overall well-being. Marine foods have long been a dietary staple in coastal communities, but they offer more than just basic nutrition. Beneath the surface, marine organisms like fish, seaweeds, and shellfish are hidden sources of potent nutraceuticals-bioactive compounds that promote health and prevent diseases. From omega-3 fatty acids to unique marine polysaccharides, these oceanic treasures hold immense potential in enhancing human health, supporting heart function, brain health, and even reducing inflammation. Marine foods are emerging as powerful tools in the world of nutraceuticals, offering new ways to combat chronic diseases and improve overall well-being. Their diverse range of bioactive components also plays a crucial role in combating oxidative stress and chronic inflammation, further establishing marine foods as key players in holistic health strategies. As research continues to

unveil the therapeutic benefits of these marine-derived compounds, they are poised to revolutionize dietary approaches to disease prevention and health promotion.

Nutraceuticals and diet

Nutraceuticals are defined as bioactive compounds present in foods that tend to have a pharmaceutical effect. According to the industry, they are regarded as 'pharmaceutical grade' nutrients that are consumed for health benefit. Most of the nutraceuticals are plant-based due to their richness in bioactive compounds, traditional medicinal use, natural health benefits, nutrient diversity, sustainability, and high bioavailability. Chia Seeds (Mexico); Maca Root (Peru); Miso (Japan); Kimchi (Korea); Turmeric (India); Goji Berries (China); Quinoa (Bolivia); Acai Berries (Brazil); Manuka Honey (New Zealand); and Sauerkraut (Germany) are some of the food supplements across the world, that are plant-based and present in their everyday diet. The traditional Indian diet is plant-based and contains numerous nutraceuticals such as turmeric (Curcumin), ginger, garlic, holy basil (Tulsi), fenugreek, amla (Indian gooseberry), and ginseng.

Communities such as the Inuit in Canada, the coastal populations of Japan (like Okinawa), and various Pacific Island nations (such as the Polynesians) predominantly follow marine-based diets, emphasizing seafood and marine resources. The marine based diet are rich in omega-3-fatty acids, Vitamin B12, collagen, iodine, etc., but they also lack in dietary fiber, phytonutrients, magnesium, and potassium. Pollution adversely affects plant-based nutraceuticals by contaminating soil and water, reducing phytochemical quality, and diminishing biodiversity. For marine-based nutraceuticals, pollutants accumulate in organisms, leading to contamination, while ocean pollution and climate change threaten marine biodiversity and nutrient availability.

Nutraceuticals are often more concentrated in fermented foods compared to non-fermented ones, as the fermentation process enhances the bioavailability of nutrients, increases the production of beneficial compounds like probiotics, and can create additional bioactive substances that contribute to health benefits. Fermentation can reduce the toxicity caused by pollution by breaking down harmful substances and detoxifying pollutants through microbial activity, which can transform toxins into less harmful compounds or completely eliminate them. Additionally, fermentation can enhance the nutritional profile of foods, making

them safer and healthier for consumption. Marine Foods based nutraceuticals Proteins derived from fish and marine foods are high in quality and aid in fast digestion compared to those derived from meat and poultry. Marine sources provide essential nutrients that are sometimes lacking in terrestrial food sources, making them valuable for dietary supplementation. Marine nutraceuticals are rich in bioactive compounds, such as omega-3 fatty acids, which are linked to various health benefits, including cardiovascular health and cognitive function. They are often viewed as safe and natural alternatives to synthetic supplements, appealing to health-conscious consumers. Both plant-based and marine-based nutraceuticals offer unique health benefits. Plant-based sources are rich in antioxidants and fiber, while marine-based sources provide essential fatty acids and unique bioactive compounds, making each beneficial in different ways (Table 1). Mollusks, echinoderms, crustaceans, and sponges have diverse chemical substances and	bioactive compounds; they are known for their antiviral and antibacterial properties and also contribute in developing new therapeutics. Fish peptides can help treat diseases like hypertension and cancer. Microalgae is used in infant formulas and food additives. Fish Protein Hydrolysate (FPH) is used as condiments in sauces. Marine collagen can be used in protein shakes, yogurt, capsules, and beverages. Seaweed is considered a "superfood", novel, and vegan friendly food. Chitin and cellulose inhibit microbial growth and extend shelf life, hence enhancing food safety. They are also used to create protective films for packaging, control moisture, can be incorporated in functional foods for health benefits, and aid in cholesterol reduction and weight management. 2% of microcrystalline chitin can be incorporated into wheat breads, which helps to increase the volume of loaf, whereas the higher concentrations can decrease the yield. Phloroglucinol, derived from seaweeds, has potential for development as a novel anticoagulant in the pharmaceutical industry.
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Table 1. Nutraceuticals from the different marine sources and its health benefits

S.No.	Details of the Nutraceuticals	Marine Micro and Macro – organism	Health Benefits
1	Dopamine	Inks of octopus, Cuttlefish, Squid	1. It is a neurotransmitter responsible for learning mood regulation, etc. 2. It is used to treat bipolar disorder, Parkinsons.
2	Omega-3-fatty acids	Shellfishes, Shrimps, Lobsters, Mussels, Oysters, Scallops, Clams, Finfishes, Salmon, Herring, Sardines, Anchovy, Tuna, Seamammals–harborseal, Greyshark, Beluga whale, Microalgae, Algae, Seaweed - Nori	1. Omega -3- fatty acids also present in fish oils. 2. It is beneficial in maintaining and improving cardiovascular health.
3	Bioactive peptides	Scallops, Crab, Fish muscles, Seaweeds	1. Bioactive peptides have immune functions, antioxidant properties and provide various other health benefits. 2. These bioactive peptides help in inhibiting angiotensin -2 and converts ACE enzyme which results in regulating blood pressure and reducing cardiovascular diseases.
4	Astaxanthin	Shrimps, Salmon	1. Carotenoids which are known as the precursor of vitamin A, immunity enhancers antioxidants. 2. This pigment has good antioxidant properties and enhance brain health and functions

5	Proteins	Tuna, Anchovy, Nori, Narwhal	1. They are required muscle maintenance and recovery.
6	Calcium	Discarded bones of fishes, Muscles of Sardines Wakame - Seaweed	1. It is an important nutrient for bone growth and health.
7	Fucoidans	Brown algae (<i>Fucus vesiculosus</i> , <i>Sargassum</i> sp)	1.Anti-coagulant activity, 2.Anti-viral effects (HIV, herpes), 3.Prevention of cardiovascular diseases, 4.Potential use in nutraceuticals and functional foods
8	Carrageenan	Red algae (<i>Chondrus crispus</i> , <i>Kappaphycus alvarezii</i>)	1.Widely used as food additives (emulsifiers, stabilizers, thickeners). 2.Anti-viral properties. 3.Potential anti -HIV and antimicrobial activities
9	Laminarans	Brown algae (<i>Laminariasp</i> , <i>Saccharina</i> sp)	1.Immunomodulatory properties. 2.Potential antioxidant effects. 3.Contributes to reducing inflammation and oxidative stress
10	Ulvan	Green algae	1.Potential applications in pharmaceuticals, nutritionals, agriculture, and cosmetics. 2.Antiviral, antioxidant, and immune stimulating activities.
11	Fucoxanthin	Brown seaweeds (<i>Undaria pinnatifida</i> , <i>Laminaria japonica</i>)	1.Antioxidant properties, prevention of cardiovascular diseases, cancer prevention, inhibition of intracellular ROS formation and protection against DNA damage.
12	Astaxanthin	Algae (<i>Haematococcus pluvialis</i>)	1.Powerful antioxidant, anti-inflammatory effects, beneficial for skin health, eye health, and cardiovascular health.
13	Sulfated Polysaccharides (SPs)	Brown algae, Red algae, Green algae	1.Anticoagulant, antiviral, and antioxidant properties. 2. Potential therapeutic role in immune modulation and anti-inflammatory processes.
14	Lectins	Algae	1.Carbohydrate-binding proteins, potential as antibiotics against marine vibrios. 2. Involvement in cell-cell recognition, stability under extreme conditions.
15	Fucosterol	Brown algae (<i>Sargassum</i> sp, <i>Fucus</i> sp)	1.Cholesterol-lowering properties. 2. Membrane reinforcement. 3. Potential cardiovascular health benefits.
16	Mycosporine-like Amino Acids (MAAs)	Various seaweeds (<i>Porphyra</i> sp., <i>Gracilaria</i> sp., <i>Ulva</i> sp)	1.UV protection for aquatic organisms, antioxidant properties. 2. Protection against cellular damage from ROS (reactive oxygen species).
17	Protein and Peptides	Red seaweeds, (<i>Palmaria palmata</i> , <i>Porphyra</i> sp) Brown and Green algae	1.Source of bioactive peptides with antioxidant, antihypertensive, and anticoagulant properties. 2.potential for food proteins and nutraceutical development.
18	DHA (Docosahexaenoic Acid)	<i>Aurantiochytrium limacinum</i>	1. It plays a crucial role in brain and eye development, cognitive function, and overall heart health.

Health benefits of nutraceuticals

Most of the nutraceuticals can be incorporated into foods due to their antioxidant properties and antiviral properties. Some of the nutraceuticals have special properties like antiviral, anti-cancer, anti-HIV-AIDS effect, anti-coagulant etc., so that they act as therapeutic aids. Cyanobacteria and microalgae are rich in antioxidants, phlorotannins from brown vegetables *E.cava*, fucoxanthin from brown seaweeds (*Undaria pinnatifida*, *Laminaria japonica*) reduce free radical CCl_4 . Dioxinohydroeckol from *E.cava*. can reduce the chances of human breast cancer by reducing the growth of human breast cancer cells (MCF-7). Other nutraceuticals like phlorotannins such as fucodiphloroethol G, dieckol, eckol, and phlorofucofuroeckol from *E. cava* also show potential cytotoxic effects on human cancer cell lines such as cervical cancer (HeLa), fibrosarcoma (HT1080), lung cancer (A549), and colon cancer (HT-29) cells.

Sexually transmitted diseases are lethal and always difficult to cure, marine derived nutraceuticals have anti-HIV AIDS properties; phlorotannins show inhibitory effects on HIV-reverse transcriptase and HIV-protease. Fucoidans from brown seaweeds demonstrate antiviral activity against HIV, herpes simplex virus (HSV-1 and HSV-2), and cytomegalovirus. Sulfated polysaccharides (SPs) like carrageenans and sulfated rhamnogalactans inhibit the entry of enveloped viruses such as herpes and HIV into cells. Saringosterol, a derivative of fucosterol from *Lessonia nigrescens* and *Sargassum ringgoldianum*, has been shown to inhibit the growth of *Mycobacterium tuberculosis*, the bacteria causing tuberculosis. Anti-coagulating agents are chemical substances that prolong the blood clotting time in order to prevent or reduce blood coagulation. Sulfate polysaccharides extracted from sea vegetables have higher anti-coagulating properties than heparin. Ink of Squid exhibits anti-cancer, anti-retroviral properties.

Diverse health benefits from marine discards

Fish heads, fish skin, fish bones, fish guts (viscera), fish scales, bycatch, fins, and fish roe (eggs) are some of the by-products produced after processing. These discards can also be generated during the canning of fish. They are converted into edible FPH. This FPH is produced by the breakdown of discarded products by enzymes such as proteases like chymotrypsin, collagenases, and cathepsin D. FPH is composed of fish proteins consisting of smaller amino acids, it is a cardio-

protective nutrient, helps in the immune defense system, and has antioxidant properties. It also reduces tumor necrosis factor. In a study, obese Zucker rats were fed with FPH, and its consumption showed anti-obesity properties by increasing the ratio of HDL to the total fat. The most important thing that must be taken into consideration is the storage conditions of FPH. It can be only stored at 5 °C with low moisture content in order to preserve its nutritional and functional properties. Marine collagen is also produced from these discards, it improves joint health, skin health, and wound healing.

Challenges

It is difficult to establish quality control and marketing regulation, especially for seaweeds. The cost of the nutraceutical product is one of the difficult challenges. Transforming seafood processing waste into valuable products is a significant challenge for food research and development. Gaining consumer acceptance for new marine nutraceutical products is crucial for their success in the market. Advanced extraction and processing technologies are required to obtain bioactive compounds from marine sources efficiently. The concentration and types of bioactive compounds can vary widely depending on the species, environmental conditions, and seasonal factors, making standardization difficult. Marine nutraceuticals often face regulatory challenges in terms of safety, efficacy, and labeling, which can hinder their market acceptance and commercialization.

Future Scope

The future of marine-based nutraceuticals is promising, focusing on innovative extraction techniques and sustainable practices to enhance production efficiency. Personalized nutrition will allow tailored health solutions, while robust clinical research will establish credibility and safety. The development of functional foods incorporating marine bioactives will cater to health-conscious consumers.

Conclusion

Marine foods are not only rich in essential nutrients but also packed with bioactive compounds that provide significant health benefits. Future research has to uncover the full potential of these hidden nutraceuticals, which offer a promising future for preventive healthcare and nutrition. Whether through direct consumption of seafood or the extraction of specific marine compounds for supplements, the ocean holds the key to innovative solutions for improving human health and wellness. By tapping into these marine resources, we can embrace a more sustainable and health-conscious future.

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Fermented food as the source of nutraceuticals

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products, dietary supplements, isolated nutrients, and genetically modified foods. Most nutraceuticals contain important nutrients, including vitamins and minerals, lipids, protein, carbs, and other essentials. Most of them have been associated with particular health benefits for the conditions enumerated below; there is arthritis, cold and cough, sleep problems, osteoporosis, blood pressure, cholesterol control, pain relief, depression, and diabetes. Some nutraceuticals are also applied in the prevention/ treatment of cancer-like diseases. Most food items act as nutraceuticals, and fermented foods are also a good source of nutraceuticals. This study correlates and discusses fermented foods and their nutraceuticals and various potentials of those nutraceuticals. (Maurya et al., 2022)

Fermented Foods

Fermented foods include those "produced through controlled microbial growth, and the conversion of food components through enzymatic action". Fermentation has been used to preserve numerous foods. These include meat and fish, dairy products, vegetables, soybeans, other legumes, cereals, and fruits. The fermenting process involves a variety of components, including microorganisms, nutritious ingredients, and the atmosphere, which results in thousands of different types of fermented foods. Fermentation is traditionally used to preserve food, and the process produces antimicrobial metabolites such as organic acids, ethanol, and bacteriocins, which lower the chance of infection by harmful microbes. Fermentation may also be employed to improve the organoleptic properties of foods, such as flavour and texture. Some foods, such as olives, would be unpalatable without the bitterness. (Dimidi et al., 2019)

Prebiotics

Prebiotics are nutraceuticals that promote probiotics. These nutrients serve as a food resource for friendly probiotic microorganisms. Prebiotics can improve the immune system, either directly or indirectly, by increasing the number of beneficial microorganisms or probiotics in the gut, particularly *lactic acid bacteria* and *Bifidobacterium*. Several studies have found that prebiotics can aid with IBD. Obesity is increasingly linked to alterations in the structure and function of the gut microbiota. The work conducted has led to the introduction of prebiotics as a potential treatment or preventative for obesity. Oral administration of inulin, a prebiotic, reduces the severity of dextran sodium sulfate (DSS) colitis. (Yoo et al., 2024)

Introduction

Greek physician Hippocrates, known as the father of medicine, said that "Let food be your medicine" is the philosophy behind nutraceuticals (Maurya et al., 2022). The term "Nutraceutical" was coined in the year 1989 by Dr. Stephen De Felice, who was the founder and chairman of the "Foundation of Innovation Medicine." The terms "Nutrition" and "Pharmaceutics" make portmanteau Nutraceuticals (Chaudhari, 2017a). Nutraceuticals are natural active compounds that can be defined as food/part of food that offers medicinal or health benefits. Nutraceuticals are scientifically proven non-toxic food components that have been used for the improvement of health, including the prevention and treatment of disease (Shinde et al., 2014). The 'specially designed preparations' created to meet specific dietary needs besides providing preventive health care are known as nutraceuticals. Nutraceuticals are products from the food source that provide benefits other than the basic nutritional value of foods. Nutraceuticals include processed foods, herbal

Probiotics Probiotics are live bacteria that, when consumed in large doses, provide additional health advantages. They have received a lot of attention recently, especially as a nutraceutical. It improves gut health, regulates the immune system, and protects against illnesses. Probiotics, like bacteria and yeast, are live microorganisms that have shown favorable effects on human health and promise as adjuvant therapy for many intestinal disorders. Probiotics play a significant role in human gut microbiota-associated diseases. Probiotics may change the gut microbiota, potentially controlling many bowel disorders and promoting overall well-being. Whereas probiotics were initially found as nutraceuticals aimed at maintaining gastrointestinal health. They now reduce the risk of cardiovascular disease, enhance lipid profiles, and reduce inflammation. Important risk factors for cardiovascular disease, in addition to cholesterol, such as blood pressure, may be decreased by different probiotic strains in a way that minimizes oxidative stress. Besides these benefits, probiotics have been shown to be prospective contributors to the treatment of metabolic illnesses such as obesity and type 2 diabetes(Iatcu et al., 2022). Probiotics, in particular, serve as an adjuvant to anti-depressants, which helps with mental problems. It prevents, manages, and treats mental and emotional diseases, most notably major depressive disorder and metabolic depression(Jach et al., 2023).Probiotics' potential significance in Alzheimer's disease prevention has recently sparked widespread interest(Anania et al., 2022). Many clinical investigations have shown that the gut microbiota can affect systemic inflammatory and immunological responses, impacting the development of sensitization and allergies. Probiotics are being utilized to treat Alzheimer's disease. Nutraceuticals in Fermented Foods Fermentation represents the enzymatic processing of raw material through the action of functioning microorganisms. The process will enhance the nutrition's bioavailability, appreciation of flavor and odor, act as a biopreservative agent, remove toxic compounds, and elicit various nutraceutical compounds(Chaudhari, 2017b). Nutraceuticals found in fermented foods like bioactive peptides, vitamins, probiotics, phenolic compounds, organic acids, exopolysaccharides, antioxidants, amino acids, polyunsaturated fatty acids, prebiotics, tryptophane, phytochemicals, fermented alkaloids, isoflavones, glucosinolates, and indoles, lactic acid bacteria	metabolites, melanoidins, short-chain fatty acids, gamma-aminobutyric acid, and minerals bioavailability(Das et al., 2012)(Figure 1) (Table 1). Health Benefits of Nutraceuticals from Fermented Foods ▪ Bioactive peptides: They have antioxidant, antimicrobial, anti-inflammatory properties as well as antihypertensive activity(Chourasia et al., 2023) ▪ Vitamins: Vitamins have very crucial roles to play in metabolic and cardiovascular health. (Carvalho & Conte-Junior, 2024) ▪ Organic acids: They help to maintain healthy gut and suppress pathogenic bacteria. Intestinal pH is kept at its desirable value.(Carvalho & Conte-Junior, 2024) ▪ Exopolysaccharides: They have a prebiotic character, which feeds the good gut bacteria and smooth out the digestion process.(Zhang et al., 2023) ▪ Antioxidants: These compounds protect against free radicals, which are unstable atoms that can damage the body.(Lobo et al., 2010) ▪ Amino acids: Treat nervous system inhibitor and also used in lowering blood pressure. ▪ Polyunsaturated fatty acids: Maintain healthy heart and anti-inflammatory functions. ▪ Tryptophan: It is a mood-enhancing compound.(Ko et al., 2023) ▪ Phytochemicals: These acts as antioxidants, anticancer, and anti-inflammatory agents with immense utility in prevention and treatment.(Park, 2023) ▪ Fermented alkaloids: They enhance wakefulness and act as an antioxidant, thus potentially having positive effects on mental health.(Heinrich et al., 2021) ▪ Isoflavones: Isoflavones shows estrogenic activities and help women beyond menopause reduce the incidence of osteoporosis and cardiovascular diseases.(Yu et al., 2016) ▪ Glucosinolates and Indoles: These compounds are indeed related to the prevention of cancer and many more to the inhibition of the proliferation of cancer cells in the digestive tract.
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- **LAB Metabolites:**These possess antimicrobial activity.
- **Melanoidins:** Melanoidins show antioxidant, anti-inflammatory and antimicrobial activities. Melanoidins improve gut health.
- **Short-chain fatty acids:** These act in the maintenance of intestinal integrity, repression of inflammation, glucose, and lipid metabolism.
- **Gamma-aminobutyric acid:** This acts like an endogenous neurotransmitter in the brain and aids in lowering stress.

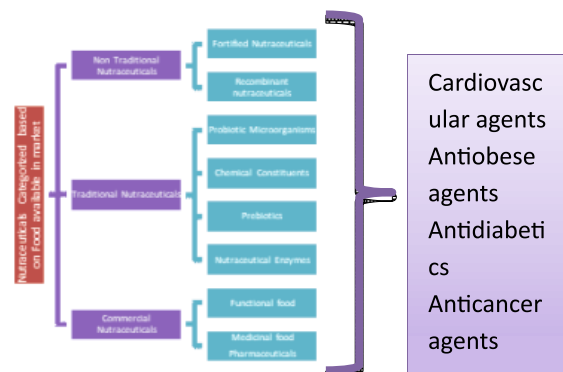


Figure1. Types of Nutraceuticals (Chaudhari,2017b)

Table 1: Range of nutraceuticals present in the fermented foods

S.No	Products and country of origin	Category	Strater Culture(s) of the fermentation	Nutraceuticals present in the food products	Reference
1	1. Yoghurt [MiddleEast] 2. Kefir [Caucasus Region] 3. Cheese [England] 4. Kumis [Central Asia] 5. Lassi [India] 6. Dahi [India] 7. Skyr [Iceland] 8. Labeneh [Middle East] 9. Viili [Finland] 10. Filmjolk [Sweden]	Dairy based products	1. <i>Lactobacillus bulgaricus</i> 2. <i>Streptococcus thermophiles</i> 3. <i>Lactobacillus kefir</i> 4. <i>Saccharomyces</i> 5. <i>Lactococcus species</i> 6. <i>Lactococcus lactis</i> 7. <i>Penicillium species</i> 8. <i>Lactobacillus delbrueckii</i> 9. <i>Saccharomyces species</i> 10. <i>Lactobacillus acidophilus</i> 11. <i>Streptococcus lactis</i> 12. <i>Lactobacillus plantarum</i> 13. <i>Geotrichum candidum</i> 14. <i>Leuconostoc mesenteroides</i>	1. Probiotics 2. Peptides 3. Bioactive protein 4. Bioactive peptides 5. Polysaccharides 6. CLA 7. Calcium 8. B-vitamins 9. Digestive enzymes 10. High protein content 11. vitamin B12	(Chen, 2021) (García-Burgos et al., 2020) (Some & Mandal, 2020) (Tamang et al., 2016)
2	1. Kimichi [korea] 2. Sauerkraut [Germany] 3. Miso [Japan] 4. PickledTurnips [Middle East] 5. Tempeh [Indonesia] 6. Giardiniera [Italy] 7. Tsukemono [Japan] 8. Curtido [El Salvador] 9. Kvass [Russia] 10. Gundruk [Nepal]	Vegetable based products	1. <i>Lactobacillus plantarum</i> 2. <i>Lactobacillus brevis</i> 3. <i>Leuconostoc mesenteroides</i> 4. <i>Aspergillus oryzae</i> 5. <i>Lactobacillus spp.</i> 6. <i>Saccharomyces spp.</i> 7. <i>Leuconostoc spp.</i> 8. <i>Pediococcus spp.</i> 9. <i>Rhizopus oligosporus</i> 10. <i>Saccharomyces cerevisiae</i>	1. Vitamin C 2. Beta-carotene 3. Phenolic acids 4. Isothiocyanates 5. Glucosinolates 6. Lactic acid 7. Isoflavones 8. Saponins 9. Antioxidants 10. Phenolic compounds 11. Phytosterols 12. Protein hydrolysates 13. Fiber 14. Vitamin K 15. Polyphenols 16. Betalains 17. Nitrate	(Chen, 2021) (Viridiana et al., 2018) (Some & Mandal, 2020) (Tamang et al., 2016)

3	1. Kombucha [China] 2. Tepeh [Indonesia] 3. Apple Cider [UK, France] 4. Tapai [Southeast Asia] 5. Fermented papaya [Brazil] 6. Fermented baobab [Africa] 7. Pulque [Mexico] 8. Amazake [Japan] 9. Blackcurrant [Finland] 10. Noni juice [Polynesia]	Fruits based products	1. <i>Saccharomyces cerevisiae</i> 2. <i>Acetobacter sp.</i> 3. <i>Rhizopus oligosporus</i> 4. <i>Lactobacillus plantarum</i> 5. <i>Rhizopus oryzae</i> 6. <i>Pediococcus acidilactici</i> 7. <i>Zymomonas mobilis</i> 8. <i>Aspergillus oryzae</i> 9. <i>Leuconostoc mesenteroide</i> 10. <i>Aspergillus niger</i>	1. Polyphenols 2. glucuronic acid 3. vitamins B 4. antioxidants 5. Isoflavones 6. dietary fibers 7. vitamin and minerals 8. Pectin 9. phenolic acids 10. flavonoids 11. Probiotics 12. organic acids 13. Carotenoids 14. papain 15. vitamin C 16. Saponins 17. Amino acids 18. Enzymes 19. Anthocyanins 20. Polysaccharides 21. Iridoids	(Chen, 2021) (Some & Mandal, 2020) (Tamang et al., 2016)
4	1. Salmi [Italy] 2. Kimichi jeotgal [korea] 3. Suan Yu [China] 4. Nem Chua [Vietnam] 5. Pepperoni [USA] 6. Sujuk [Turkey] 7. Chorizo [Spain] 8. Nham [Thailand] 9. Saucisson Sec [France] 10. Merguez [North Africa]	Meat and fish based products	1. <i>Lactobacillus sakei</i> 2. <i>Pediococcus pentosaceus</i> 3. <i>Staphylococcus carnosus</i> 4. <i>Lactobacillus plantarum</i> 5. <i>Leuconostoc mesenteroides</i> 6. <i>Lactobacillus brevis</i> 7. <i>Lactobacillus fermentum</i> 8. <i>Staphylococcus spp.</i> 9. <i>Pediococcus acidilactici</i> 10. <i>Micrococcus varians</i> 11. <i>Pediococcus spp.</i> 12. <i>Staphylococcus xylosus</i> 13. <i>Staphylococcus carnosus</i>	1. Bioactive peptides 2. antimicrobial peptides 3. Omega-3 fatty acids 4. lactic acid bacteria 5. Antioxidants 6. Peptides with antioxidant properties 7. Antimicrobial peptides 8. Polyphenols 9. Probiotic strains 10. Antioxidants 11. peptides with anti - hypertensive properties 12. Polyunsaturated fatty acids (PUFAs)	(Lücke, 2003) (Chen, 2021) (Some & Mandal, 2020) (Tamang et al., 2016)
5	1. Injera [Ethiopia] 2. Pozol [Mexico] 3. Kenkey [Ghana] 4. Ogi [Nigeria] 5. Idli [India] 6. Tarhana [turkey]	Cereals and Millet based products	1. <i>Saccharomyces cerevisiae</i> 2. <i>Lactobacillus spp.</i> 3. <i>Lactobacillus plantarum</i> 4. <i>Lactobacillus acidophilus</i> 5. <i>Saccharomyces spp.</i>	1. Prebiotics 2. vitamins (B-group) 3. phenolics 4. Antioxidants 5. Fiber 6. lactic acid	(Chen, 2021) (Blandino et al., 2003) (Some & Mandal, 2020) (Tamang et al.,

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Nutraceuticals and HORECA

Executive Chef Sumit



One of the fastest and most successfully growing sector of hospitality industry in India is HORECA. A short for Hotel, Restaurant and Catering which serves the diverse needs of Indian consumers from keeping their cultural and traditional values to an extraordinary exposure to international cuisines, standards and services. Use of Nutraceuticals, in HORECA, is a need of the hour.

An Internationally renowned Executive Chef, Mr Sumit Ghadiyali, who had his early education in Mumbai and had his Post Graduate Diploma in Culinary Arts & Kitchen Management from Ealing Hammersmith & West London College(UK) in 2009, wrote for Purnabrahma, upon Dr. Kondekar's request.

It is important to note that HORECA industry in India is the quick adaptability of consumer demands to explore new things, merging themselves with the most recent and upcoming trends in food and service industry, by focusing on Go-Green initiatives, Nutra-healthy and organic foods, their dining experiences which connect them to their traditional values by modernizing them.

The Indian HORECA industry is poised to grow at a rate of 7% every year. It contributes 10% to India's GDP and employs millions of people. According to The Federation of Hotel and Restaurant Associations of India (FHRAI), the registered data on the number of HORECA industry units are 53,000 hotels, 70 lakh restaurants and 2.3 crore unorganized outlets. The average Indian household's budget for food expenditure is projected to increase from 29% in 2024 to 35.4% by 2026. This growth in disposable income is increasing the demand for frequent dining out, online

food ordering, catering services, and accommodation, resulting in rapid growth of the Indian HORECA market.

Sectors Contributing to the growth are Hotels, Restaurants, Café's, Street Food Vendors and Catering Services.

- **Hotels:** These include luxury hotels, budget hotels, and serviced apartments. India's hotel industry is experiencing rapid growth, with the establishment of foreign hotel chains significantly enhancing service standards and establishing new benchmarks for excellence. The number of hotels in India has tripled in the past ten years, reflecting the growing demand for quality accommodation and catering to the diverse needs in terms of food and beverages. One of the major contributors of growth in hotel industry is Tourism Industry. Both foreign tourist arrivals as well as domestic tourism in India has consistent sustenance for the country's hotel industry. From guest houses in the Himalayas, palace hotels in Rajasthan, innovative, niche hotels in one of the megacities, beach resorts in Goa, to the houseboats in Kerala: India offers a large variety of hotels for all kinds of travelers from backpackers to wellness tourists or business travelers.
- **Restaurants:** These are the backbone of the HORECA industry. The Indian restaurant industry has undergone a significant transformation in recent years, with 2024 marking a new era of growth and innovation. With advancement in digital transformation and contactless dining, adopting sustainable practices, diversification of culinary offerings, rise in ghost kitchens and majorly focusing on health and wellness, reimagining traditional recipes including Nutraceuticals and redefining healthy dining options. Also, Indian cuisine plays a substantial role in bolstering the Indian economy. The food service sector is a major source of employment in India, yielding billions of dollars of revenue each year.
- **Café's:** With India rapidly transforming into a major coffee consuming nation, coffee shops, roasters and producers are primed for extraordinary growth. The growing popularity of specialty coffee and tea, and demand for premium and artisanal products have contributed to the largest share of the segment in the region. Increasing demand for a relaxed atmosphere and social interaction among young consumers, coupled with a focus on quality and unique experiences, is driving the demand for cafes.

- **Street Food Vendors:** India's street food vendors are considered as the essence of the country's food Industry. They are a great source of employment for many in the country, and around 1.2 million households are dependent on this informal sector as their primary source of income. About 10 million vendors in India make up a thriving street vendor market estimated to be at around INR 8000 crores daily.
- **Catering Services:** The catering service market in India was estimated to be about 70 billion U.S dollars in 2023. It is estimated to increase to 125 billion U.S dollars in 2029. Catering services are an important part of many events, including meetings, conventions, celebrations and corporate gatherings. The catering market is growing due to changing lifestyles and the increasing preference for outsourcing services. Convenience and flexibility are key trends in the market, with many providers offering streamlined event management services and online ordering systems.

Regional Growth Market

- **Tier 1 Cities:** Delhi, Mumbai, Bengaluru and Hyderabad continue to drive growth through high disposable income, large urban population, presence of international brands and strong hospitality infrastructure.
- **Tier 2 and 3 Cities:** Pune, Ahmedabad, Chandigarh and others are emerging as growth hubs with growing urbanization, emergence of new shopping and entertainment hubs and government initiatives for improved connectivity and infrastructure.
- **Eastern India:** Kolkata, Bhubaneswar and Guwahati are witnessing increased demand due to increased literacy rates, use of social media market and trends reaching to local areas.

Future Outlook:

The HORECA industry will continue to evolve, driven by:

1. Changing consumer behaviors and preferences
2. Advancements in technology and digitalization
3. Growing demand for sustainability and eco-friendliness
4. Increasing focus on wellness and health with use of Nutraceutical-Products.
5. Emerging trends in cuisine and dining experiences

By embracing these, HORECA businesses can thrive, innovate and provide exceptional experiences for customers, ultimately driving success and growth in the industry.

Conclusion

The HORECA industry indeed relies on human connection, cultural exchange, and shared experiences and Nutra-products now, making it a unique and dynamic sector. This industry is an ever-evolving space, constantly adapting to meet the changing needs of consumers. By leveraging this, businesses can thrive in the years to come. Staying updated with HORECA trends, prioritising sustainability, using technology effectively, and providing outstanding experiences are crucial for success for the HORECA industry and in turn Nutraceutical industry in India.

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3. International Hospitality Council (IHC) ❑



Dr Kondekar, With Padma Vibhushan Dr Mashelkar in Baner Pune, on Ganesh Chaturthi day (7th Sept 2024)

An Interview

A Businessman in Making

After completing his internships in Mother Dairy and Amul, Mr Vikas Ramchandra Patil created his own start up Mirtillo International as a founder Director. CASMB Advisor Dr. Prakash Kondekar, personally visited Akluj with Mr Vikas and is more than delighted to introduce such a wonderful start up to the members and readers of Purnabrahma. Mirtillo caters to the sales & marketing of food ingredients, new product development and research and development.



Dr. PK: Vikas first let me congratulate you for your achievements.

Mr. VP: Thank you, Sir. I am also happy that you were kind enough to visit our processing unit in Akluj.

Dr. PK: Tell us about your family and school education.

Mr. VP: I belong to very humble family from a Radhanagari Village in Kolhapur district and completed my school education till 12th at Kolhapur. Thereafter, I did my B. Tech. in Dairy technology from College of Dairy Technology, Warud, Pusad.

Dr. PK: What made you choose dairy technology?

Mr. VP: My passion for dairy technology sparked early in my career when I realized the immense potential this field holds in improving the quality and accessibility of

nutritious food. I chose dairy technology because it offers a unique intersection of science, health and innovation which allows me to contribute to the food industry in a meaningful way. So, I started my journey in Dairy industry in the year 2000 from College of Dairy Technology.

Thereafter, I worked for various Multinational Companies in this field. Finally my journey began with a deep interest in understanding the tones of Dairy Processing and New Product Development which eventually led me to establish Mirtillo Food Ingredients, 10 years ago. At Mirtillo International we focus on third-party manufacturing and innovative product solutions. Additionally, as the Chairman of the Plant-Based Foods Council, I am committed to expanding the possibilities of both dairy and plant-based products, ensuring sustainable and healthy options for consumers.

Dr. PK: Where did you pursue initial training or internship?

Mr. VP: My Initial Training was with Mother Dairy and Amul.

Dr. PK: We would love to hear about your entrepreneurship journey...

Mr. VP: I became an entrepreneur driven by a strong desire to innovate and make a meaningful impact in the food industry. My journey as an entrepreneur began when I recognized the growing demand for high-quality, nutritious food products that cater to both traditional and evolving dietary preferences. With my background in dairy technology and a thorough understanding of food ingredients, I founded Mirtillo International, an Organisation which deals with Food Ingredients, Dairy Processing, Third Party manufacturing and New Product Development. The company specializes in third-party manufacturing and new product development, which allows us to leverage our expertise and deliver tailored solutions to clients.

Becoming an entrepreneur was a natural progression of my passion for innovation, food science and my vision to provide sustainable, quality products that meet the needs of modern consumers. Over the time, my entrepreneurial journey expanded further when I took on the role of Chairman of the Plant-Based Foods Council, where I advocate for plant-based alternatives, ensuring a broader range of healthy options in the marketplace."

Dr. PK: How difficult was your journey from

entrepreneur to a successful businessman?

Mr. VP: My journey from an entrepreneur to a successful businessman has been a challenging, yet rewarding experience. When I founded Mirtillo Food Ingredients, my vision was to create innovative solutions in third-party manufacturing and new product development. However, like any entrepreneurial path, it was not without many difficult situations. Establishing a brand, building a strong client base and navigating the complexities of the food industry required unwavering commitment and resilience.

One of the most difficult aspects was balancing innovation with market demands. Bringing new ideas to the table while ensuring they met industry standards and consumer expectations was a constant learning process. There were times when products didn't perform as expected or we faced operational setbacks but those moments taught us invaluable lessons through persistence and adaptability.

Growing the business, also meant managing financial risks and ensuring consistent quality which required developing a skilled team and building solid relationships with suppliers and partners. I had to be hands-on, deeply involved in every aspect of the business, from product development to customer satisfaction.

Though the COVID-19 pandemic added an additional layer of complexity, the greatest challenges for scaling up the business was staying ahead of industry trends, and diversifying our product lines. It was through strategic planning, continuous innovation, and a deep understanding of the market that we were able to overcome these hurdles.

Now, as the Chairman of the Plant-Based Foods Council, I see these challenges as milestones that shaped my growth as a businessman. They refined my ability to lead, innovate and respond to an ever-evolving industry. Today, I take pride in the fact that Mirtillo Food Ingredients is at the forefront of both dairy and plant-based solutions, meeting the demands of modern consumers while staying true to the values that we set out with.

Dr.PK: Let us know about your various achievements.

Mr. VP: They are like....

1. Exhibition FI India, Mumbai 2017
2. Exhibition FI India, Pragati Maidan, Delhi 2017

3. VKL – Highest Contribution in sales of Flavors, Delhi 2018 -19
4. Dupont Ice Cream India Expo Exhibition IICE, Gandhinagar, Gujarat 2019
5. Exhibition FI India Bombay Exhibition Centre, Mumbai 2019
6. Exhibitor, Ice Cream India Delhi 2019
7. World Mithai Namkeen Convention & Expo Exhibitor, Jaipur, Rajasthan, 2021
8. World Mithai Namkeen Convention & Expo Exhibitor, Chandigarh, 2022
9. Ice Cream Exhibition, Hyderabad, Andhra Pradesh, 2022
10. Speaker, Icecream Exhibition, 2023
11. Speaker, ASSOCHAM, New Delhi 2023
12. Exhibition, Food Khadya Exhibition, Gandhinagar, Gujarat, 2023
13. Chairman, Plant Based Foods Industry Association 2024
14. Speaker – US Soybean Export Council, Dubai 2024
15. Speaker – Workshop of Manufacturing & Demonstration of Soy food Products, Bhopal 2024
16. Speaker – Anuga Foodtech India, Mumbai NESCO 2024
17. Speaker – Vegan India Conference, Mumbai, Hotel Holiday Inn 2024
18. Speaker -FI India, Bangalore 2024
19. Magazine Recognition – Purnabrahma Magazine
20. Exhibition, World Food India, 2024

Dr. PK: Your future plans?

Mr. VP: My future plans are centred around further expanding Mirtillo Food Ingredients and continuing to innovate within the food industry. One of my key focuses is to enhance our capabilities in third-party manufacturing by integrating more sustainable and cutting-edge technologies. As consumer preferences continue to shift towards healthier, more eco-friendly options, I see significant potential in the plant-based sector. As the Chairman of the Plant-Based Foods Council, I am committed to driving research and

development in this area, ensuring that we offer not just alternatives but products that deliver superior taste and nutrition.

In the coming years, I also plan to scale our operations globally by forming strategic partnerships and entering new markets. I want Mirtillo to be known not only for its excellence in dairy technology but also as a leader in plant-based food innovations. Expanding our product portfolio to include more functional foods that cater to health-conscious consumers is another priority. Additionally, I aim to invest in building a strong team that aligns with our vision of sustainable growth.

Mentoring the next generation of food innovators and entrepreneurs is something I am passionate about. My goal is to create a business ecosystem that fosters collaboration and continues to set new benchmarks in quality and sustainability.

Ultimately, my vision is to make Mirtillo a name synonymous with innovation, quality and sustainability while contributing to the global movement toward healthier food systems with the help of my Team Mirtillo and my family including my parents, my wife and my two sons.



Factory Entrance & inside Mr Vikas & Dr Kondekar.



Mr Vikas & family



In MIT Loni Kalbhor, Pune, with Director, Principal & Faculty, on World Food Day Celebration 16th Oct 2024...



Mirtillo Product range



YUMMY MILLETS for HAPPY TUMMY[#]



Lower in
Calories*



Rich in
Fibre



Breakfast Cereal. Creative Visualization. *40% lower in comparison to commonly cereal based breakfast / snack recipes ie Dosa, Sooji upma, poha, potato paratha & vegetable sandwich. Recipes & serving as mentioned by NIN, ICMR. *Dietary fiber helps maintain normal digestive function, EFSA, 2010



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SECTORS IN THE FOOD SUPPLY CHAIN

RETAIL AND WHOLESALE

Category F & FI



TRANSPORT AND STORAGE

Category G & GI



FARMING

Category AI & All



FOOD MANUFACTURING

Category CI, CII, CIII, CIV, DII, K



FOOD PACKAGING MANUFACTURING

Category I



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Category DI & DII



CATERING

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