



Herbal Nutraceutical Gummies: A Comprehensive Review

Priya Kurian*¹, Aadikesave S², Aiswarya R³, Aneesa Najimudeen⁴, Richu Manuel Sajeev⁵, Surya Gayathri V⁶

¹Faculty, Caritas College of Pharmacy, India.

^{2,3,4,5,6}Student, Caritas College of Pharmacy, India.

Received: 15 November 2025

Revised: 29 November 2025

Accepted: 16 December 2025

ABSTRACT

Nutraceutical is positioned at the intersection of food and pharmaceuticals. Nutraceuticals have become potential agents for preventing health problems and staying well. Gummies have a lot of attention because of their ease of consumption, palatability and increased patient compliance as compared to traditional dosage form. This review emphasizes the rising demand of nutraceutical gummies around the world driven by increasing health awareness, preventive health care trends and consumer preference. In addition to addressing regulatory concerns about safety, labelling and efficacy claims, it investigates formulation elements such as gelling agents, flavoring agents and stability issues. According to market data, the nutraceutical gummy sector is expanding rapidly due to advances in clean-label, sugar-free, vegan, and tailored nutrition formats. Literature studies show the versatility of gummies as carriers of bioactive such as vitamins, minerals, herbal extracts, probiotics, antioxidants, and adaptogens. The research found benefits for immunity, skin health, cognitive function, gastrointestinal wellness, and lifestyle-related illnesses. Optimizing bioavailability, ensuring component stability, and achieving sensory acceptance without losing health benefits are still challenging undertakings. Overall, nutraceutical gummies provide a lively and accessible platform for functional nutrition. Future prospects for long-term growth and acceptance in international markets include clinical validation, sustainable production, and advanced delivery modalities.

Keywords: Nutraceuticals, Gummies, Market, Bio-actives, Extracts.

INTRODUCTION

The new advancements in research are due to the growing interest of public in nutraceutical and functional foods. It has resulted in the rising consumer demand and increased public awareness of nutrition and health. Functional foods are gaining popularity worldwide due to global health and lifestyle trends. Diet, exercise, weight control and sustainable living are seen as essential in preventing or reducing many lifestyle-related diseases, even though heredity plays a significant role in the development.¹

Nutraceuticals are a combination of the terms "pharmaceutical" and "nutritional", and the term was introduced by DeFelice in 1989. It's been discussed further in his work on food industry R&D².

Nutraceuticals are considered foods or parts of food which provide health benefits, such as disease prevention and treatment. The different types include fortified foods, dietary supplements, vitamins, isolated nutrients, and "designer" foods. Many definitions may vary across organizations, and the International Food Information Council (IFIC) defines functional foods as "foods or dietary components providing health benefits beyond basic nutrition".³

Nutraceuticals are classified in several ways based on different backgrounds:

- By origin, plant-based, animal-based, or microbial sources.
- By chemical nature, as molecular or elemental compounds.
- By mechanism of action, as antioxidant, anti-bacterial, antihypertensive, anti-carcinogenic, or anti-inflammatory effects.⁴

Nutraceutical ingredients are typically considered as natural and healthy alternatives to allopathic medicines, and despite their health-promoting potential and their positioning as natural alternatives to conventional medicines, there remain many challenges.



Key issues include achieving effective dosage forms, masking flavours and odours, and ensuring ingredient stability in the final product.⁵

Nowadays, gummies or jellies are gaining popularity as nutraceuticals. These are clear or semi-transparent, oil-free semisolid oral preparations made from water-soluble bases such as tragacanth, gelatin, pectin, alginate, and boroglycerine. Gummies seem appealing to diverse patient groups, including children, geriatric, and those with dysphagia, due to their palatability and ease of use. They facilitate drug breakdown with saliva without the need for water and enhance absorption through the buccal mucosa, which reduces the first-pass metabolism effect. It provides an increased onset of action and improved bioavailability compared to conventional tablets.⁶

Challenges in production of nutraceutical gummies

Functional gummies are one of the fastest-growing trends among dietary supplements globally. However, the different production parameters pose several challenges that need to be addressed in order to meet consumer expectations and to ensure product quality. One of the primary concerns is achieving a satisfying taste while formulating gummies without compromising the taste, as this is a significant challenge for manufacturers.⁷

Texture is another critical factor that includes selection of appropriate gelling agent with suitable characteristics and properties in order to produce desired consistency. The choice of gelling agents, such as gelatin, pectin, or alginate, must balance texture, stability, and dietary considerations.⁸

To minimise the risk of cross-contamination and ensure product safety, highly hygienic production conditions are necessary. Innovations such as starch-free moulding systems and direct deposition into silicone or metal moulds provide hygienic alternatives to traditional starch mogul methods, elevating hygiene standards to pharmaceutical levels and increasing production efficiency.⁹

Also, the consumers increasing demand for clean labels with transparent ingredient specifications is a challenge for manufacturers to formulate high-quality products without sacrificing clarity or safety. Regulatory compliance and maintaining product consistency during scale-up from laboratory to commercial production is a complex process. Stability issues such as ingredient degradation due to heat, moisture, oxygen exposure, and sensitivity of vitamins pose a challenge, often requiring the need for advanced encapsulation and packaging technologies to preserve efficacy throughout the shelf life of the product.¹⁰

Finally, the market expansion has been influenced by sugar-free gummy trends, which pose formulation innovation to deliver health benefits while maintaining palatability and stability.¹¹

Nutraceutical gummies market and forecast outlook 2025 to 2035

The global nutraceutical market for gummies is estimated at USD 12.54 billion in 2025 and is projected to reach USD 37.22 billion by 2035 with a growing CAGR of 12.9%. Growth is driven by increasing preventive healthcare awareness, demand for convenient supplement formats, and product innovations, thereby emphasising clean-label and sustainability principles.¹²

Nutraceutical gummies serve as a popular alternative to traditional supplement forms, thus combining functional ingredients like vitamins, minerals, botanicals, probiotics, and omega-3 fatty acids. The chewable, palatable nature of gummies supports better compliance, especially among children and elderly people. The growing interest in the preventive healthcare system and holistic wellness caused an increase in demand for supplements targeting immune health, cognitive function, digestive wellness, and beauty.¹²

Sustainability, clean label trends, and natural ingredient use have shaped product development, while packaging innovations have focused on freshness and environmental impact. Regulatory challenges remain for ingredient safety, labelling. And health claims across regions, including the US (FDA, DSHEA), EU (EFSA), Canada, India (FSSAI), Australia (TGA).¹²

Market drivers and growth factors

- Increasing consumer preference for chewable, tasty, and easy-to-consume supplements compared to capsules or powders.
- Rising demand for functional benefits supporting immunity, cognition, digestive health, sleep, and beauty.
- Expansion of clean-label, vegan, and sugar-free product formulations alongside sustainability-focused packaging innovations.



- Higher per capita spending on nutraceutical gummies, especially in developed countries, with growing affordability and adoption in developing regions.¹³

Regulatory landscape

- USA (FDA): it requires scientific substantiation for health claims and prohibits unapproved disease-treatment claims.
- Europe (EFSA): it provides consumer trust with stringent frameworks governing permitted claims and labelling.
- India (FSSAI), Australia (TGA), Canada (Health Canada): it enforces compliance for labelling, permissible ingredients, and claims.¹²

Regional Trends

- North America: it possesses the largest market, led by the US, with strong adoption of melatonin, collagen, ashwagandha, and ACV gummies.
- Europe: it has a moderate but stable growth with high demand for immune and multivitamin products under EFSA-regulated frameworks.
- Asia-Pacific: it is the fastest-growing region, leveraging traditional ingredients such as ginseng, turmeric, and green tea.^{12,13}

Opportunities and Challenges

- Opportunities: Personalised nutrition, AI-powered formulations, 3D-printed gummies, and enhanced delivery mechanisms.
- Challenges: Bioavailability of active ingredients, sugar content concerns, stability in packaging and regulatory ambiguities.¹²

Market Evolution and Future Outlook

- 2020-2024: Pandemic-driven immunity trends boosted demand but caused product saturation and credibility issues.
- 2025-2035: Market expected to mature with innovations like personalised gummy stacks, sustainable packaging, sugar alternatives, and ingredient transparency.¹²

REVIEW OF LITERATURES

- Karmase A, *et.al* assess the efficacy and safety of Nyumi radiant skin gummies in healthy adults with fine lines/wrinkles, hyperpigmentation, and dark circles of the eyes, focusing on gummies made with multivitamin and nutraceutical ingredients. The research involved 36 healthy males and females (in a 1:2 ratio) aged between 20 and 65 years, who took two gummies daily for 75 days, encompassing five visits. The tested product consists of a mix of Indian and Western components featuring a distinctive combination of HA, Curcumin, Multivitamin (Vitamins A, C, D2, E), Selenium, Zinc, and more, while the study was registered with the Clinical Trial Registry of India (CTRI). It was determined to be effective in diminishing fine lines/wrinkles, under-eye dark circles, and pigmentation, while also enhancing overall skin health, as demonstrated through dermatological, instrumental, and subjective evaluations using the Griffiths Scale, severity scoring, nine-point scale, six-point grading scale, Mexameter® MX 18, Corneometer® CM 825, Skin- Glossymeter GL 200, Cutometer dual MPA 580, and 3D analysis system on day 25, day 50, and day 75. This was achieved by lowering melanin concentration, boosting skin radiance/glow, enhancing texture and firmness, minimising skin roughness, and promoting even skin tone. Additionally, there are no noticeable or encountered discomfort, reactions, or any form of intolerance or negative skin reactions or incidents.¹⁴

- Aiello F, *et.al* studied on the development of antioxidant gummies utilised gelatin-rich extracts from citrus fruit peels. The extracts (5.75–9.65% yield) obtained from red and blonde oranges, along with lemons, using ultrasound-assisted hydroalcoholic methods, were utilised as active ingredient sources for the functional gummies. The extracts were then evaluated by colorimetric assays to assess their antioxidant activity, while the primary bioactive constituents (phenolic acids and flavonoids) were examined using LC–HRMS. A sustainable grafting technique was utilised to fix polyphenols to gelatin chains, resulting in macromolecular systems defined by thermal analysis and antioxidant characteristics. Scavenging property ($IC_{50} = 0.201\text{--}0.454\text{ mg mL}^{-1}$) enabled the utilisation of impressive antioxidant and rheological characteristics over a period of 14 days. The extracts, ROE, BOE, and LE,



were characterised through ultra-high-performance liquid chromatography–high-resolution mass spectrometry (UHPLC–HRMS) analysis, and their antioxidant activity was assessed using in vitro assays. Functionalized gelatin ROEP, BOEP, and LEP, along with commercial gelatin (CG), served as gelling agents in the creation of antioxidant gummies. The ultrasound-assisted extracts of orange and lemon peels obtained using water-ethanol mix were filtered, concentrated, frozen, and lyophilised.¹⁵

- Anaya BJ, *et.al* explored the phytochemical composition, antioxidant and anti-inflammatory effects and 3D-printing usage of *Origanum vulgare L.* ssp. *hirtum* extract. The extract included phenolic compounds, with rosmarinic acid as the main constituent (47.76%). They showed significant inhibition of lipoxygenase ($IC_{50} = 32.0 \mu\text{g/mL}$), indicating its potential anti-inflammatory activity. A high antioxidant activity has been exhibited during hydrogen peroxide scavenging ($SC_{50} = 99.2 \mu\text{g/mL}$) and hydroxyl radical scavenging ($IC_{50} = 64.12 \mu\text{g/mL}$). At high concentrations (50 $\mu\text{g/mL}$ and 100 $\mu\text{g/mL}$), reduced intracellular ROS generation in Caco-2 cells was observed, and it also inhibited NO production in LPS-activated J774A.1 macrophages. Integrating this extract into 3D-printed gummy offers a promising method to improve patient compliance and maintain the plant's antioxidant and anti-inflammatory effects, yet formulation and manufacturing challenges remain to guarantee the active compounds' stability over extended durations, efficacy, and safety.¹⁶
- Danesh A studied on Antimicrobial Lactic Products of raspberry and blackcurrant with gelatin and later added to lyophilised lactic acid bacteria powder. The formulation containing by-products of raspberry, milk permeate, and lyophilised *L. plantarum* combined with gelatin was acceptable. Here xylitol is used as a substitute for sugar. The gummies were assessed for quality factors such as antioxidant activity, colour coordinates, texture characteristics, and sensory attributes.¹⁷
- Rashmi P and Mona K aimed to choose vegan ingredients for developing and optimizing gummy formulation. Agar-agar (red algae) mixed with carrageenan to improve compressibility, which received favourable feedback regarding the texture profile from consumers, Spirulina emerging as the favourite, colour, choice. They featured Five unique formulations. Overall, the study confirmed gummies as an effective and enjoyable approach to introduce critical nutrients into daily life, combining nutrition with convenience. Continued research into formulation improvements and sensory tuning could boost their market appeal and functional efficacy.¹⁸
- Ganesh H, *et.al* assessed the clinical effectiveness and patient results of two novel delivery methods opaque gummies and oral dissolving strips (ODS)—created through liposomal encapsulation and nanodrop technology. The research lasted 12 months and included participants who has nutritional issues or particular health issues. They were separated into two groups: Group A (opaque gummies) and Group B (ODS). Biochemical indicators (e.g., Vitamin D, haemoglobin), patient-reported outcomes, and adherence, with enhancements in sleep quality, adherence rates, and patient satisfaction reported without any adverse events. The research did not have a control group.¹⁹
- Lohar PB, *et.al* utilized watermelon juice, beetroot juice, plant-derived pectin in place of gelatin, and stevia as components to create gummies high in fibre. The study involved analysing the ash and moisture levels, total dietary Fiber, using iodometric titration to measure vitamin C, conducting microbial analysis through the standard plate count method via pour plate technique, and examining the shelf life of samples at room temperature and in the refrigerator. Gummies are becoming increasingly popular in the market, and Melo beet gummies have the potential to be made with a variety of different ingredients. Sugar levels can be lowered via various methods of sugar reduction.²⁰
- Yadav K, *et.al* aimed in development of gummies with *Elettaria cardamomum*, *Zingiber officinale*, *Beta vulgaris L.* using different pharmaceutical excipients. The research had shown that the ethanolic extract of with *Elettaria cardamomum*, *Zingiber officinale*, *Beta vulgaris L* has anti- inflammatory properties in several situations. The studies mainly confirm the activity against the situations like analgesic effects, Relief from pain, antiseptic, expectorant, etc by the proven activity of the various herbal products used. These herbal enriched gummies process a beneficial approach to paediatric patients by effectively enhancing the children health. Additionally, these gummies show immunity boosting properties, Antiviral, Antifungal properties ultimately leading to mental and physical wellbeing.²¹
- Surana K, *et.al*, studied the development of gummies for antitussive, and in treatment of various antitussive activities in variety of coughs as agents specified in the study, these agents possess a wide range of activity against cough which are conventionally known. The studies prove the activity like antimicrobial, antibacterial, antitussive activity effectively for various age groups. The study also claims the excellent antimicrobial activity up on which can be administered by children in alternative solid dosage forms.²²
- Kazi-Chishti M, *et.al* focused on creating and refining gummies preparations as specified in the study, assessing its potential benefits of the patient after the consumption in the treatment of cancer in proving efficacy with in the paediatric patients. Primarily, the preparation utilized Ginger *Zingiber officinale* to address the clinical condition which arise during the treatment of cancer like



nausea and vomiting. The research primarily focuses on lessening chemotherapy-related nausea and vomiting in paediatric patients during therapy.²³

- Fernandes AC, *et.al* studies show that finding out the effect of gummy candy containing KGM on high hunger and other data on appetite. konjac glucomannan is herbal medicine. 42 participants ages 18-45 completed the randomised trial on oxidative stress in over weight peoples. The KGM include benefits like reducing cholesterol, blood sugar, pressure, immunity. The studies show that reduction in body weight after 1g per day consumption this study shows the effectiveness in evaluation of gimmies with KGM showed significant results.²⁴
- Warule P, *et.al* assessed Herbal Multivitamin Gummies enhanced with natural substances including various ingredients used in study. The study demonstrates how herbal and natural ingredients can be successfully included into multivitamin candies to provide a useful, tasty, and health-promoting supplement that can be used on a daily basis. A balanced combination of all macronutrients is provided by carefully chosen ingredients. These gummies are good for both kids and adults because of their high nutritious content, tasty flavour, and manageable texture.²⁵
- Teixeira-Lemos E, *et.al* aimed to create natural gummies utilizing natural components, free from additives. Two conclusions on formulation one with honey added orange juice (ORH) and one with berries blend (BEM). Sensory evaluation showed that while the homemade gummy jellies were rated slightly lower than the market variety, the panellists still enjoyed them, especially the ORH, which obtained scores nearly matching those of the commercial product. In general, ORH and BEM gummy jellies could offer consumers a healthier option compared to the typical jelly candies found in stores. The analysis results of the study confirms that the gummies where acceptable for consumption according to EU legislation.²⁶
- Rawat S, *et.al* focuses on enhancing the concentration of functional components such as addition of black pepper, turmeric to curcumin and piperine in standardised gummies Consumer demand for healthier eating habits has driven the shift to natural products, resulting in substitution of products with addition of synthetic derivatives in the preparations. one fact is that they are available "anytime-everywhere" is similar to that of store-bought options. This comprehensive strategy will create opportunities for possible market growth. In further research, specific investigations concentrate examining new plant-derived gelling substances beyond those analysed in this study.²⁷
- Patel I and Patel B studied about herbal gummies as a novel, user-friendly delivery method for natural therapies, encouraging improved adherence and increasing the attractiveness of herbal remedies. Herbal gummies were created with mulberry (*Morus alba*) leaf extract, recognized for its abundant phytochemical properties and strong antioxidant, antihyperglycemic, and lipid-lowering effects. Orange flavouring was added to improve taste. The phytochemicals found in mulberry leaf extract, recognized for their antioxidant, antihyperglycemic, and lipid-reducing abilities, were successfully integrated into the gummies, maintaining their medicinal value. Consequently, the creation of herbal gummies made from mulberry leaves not only provides an innovative form of dosage but also fosters the use of plant-derived actives in both preventive and therapeutic health care. Future efforts targeting large-scale production, stability assessments, and clinical validation will be crucial for guaranteeing their market success and broader acceptance.²⁸
- Deshmukh SD and Bodhankar H produced gummy jellies using natural ingredients, without incorporating any excessive amounts of sugar or other additives. The goal was to develop gummy jelly candies that were nutritious by incorporating a crude extract of the leaves as specified in study. This study aimed to develop gummies fortified with crude extracts of leaves. The prepared gummies can offer an adequate level of nutrition to the body. Individuals dealing with blood pressure and diabetes issues may take these gummies. The components selected for the creation of gummies were carefully picked to ensure they offer adequate nutrition beneficial for a healthy lifestyle.²⁹
- Romano DEU, *et.al* stated that gummy supplements seek to evaluate their effectiveness, health advantages of users. Moreover, research frequently examines consumer satisfaction and compliance with herbal preparation in relation to other types of supplements. It relates to food science and is likely to be flavoured by numerous customers due to its flavour and the incorporation of these gummies into everyday habits. The study required careful preparation and innovative concepts to guarantee secure and appropriate experimental methods. The materials employed in this study were evaluated through sensory analysis. Texture profile analysis assessed the mechanical characteristics of functional gummies. In this context, plants have been employed since the dawn of human civilization as remedies and improvements for various health problems and are economical. To collect data, this research utilized a specifically designed survey, comprising two sections.³⁰
- Arefa Faiz Sheikh, *et.al* focused on developing and testing herbal hair candies, which offered a delightful and practical alternative to standard hair care treatment. In this study the key herbal materials are used in the formulation. Addition of several components into the formulation. Texture profile analysis indicated that variations in chewiness may influence consumer acceptability. They



should conduct a comprehensive nutritional evaluation confirmed that adequate levels of biotin, essential vitamins, and minerals required for hair growth and overall well-being were included. In addition, safety and compliance with regulatory requirements were ensured through heavy-metal testing. Microbiological evaluation and stability studies demonstrated that the formulations maintained acceptable microbial limits and stability over both short- and long-term storage. Overall, the results suggest that herbal hair gummies offer a natural, safe, and effective approach to supporting and improving hair health.³¹

- Rahul V. Pawar, *et.al* reported the development and evaluation of herbal weight gain gummies formulated using traditionally used, safe, and health-promoting natural ingredients (ashwagandha, shatavari, mulethi, musli and vidarikand) known to support weight gain, digestion, appetite enhancement, and overall strength. Final evaluation criteria are Organoleptic, moisture content, weight variation, pH determination, disintegration, Microbial Load Test. stability test should be done for the shelf life. The result of the study was Improved Appetite, Gradual Weight Gain, Increased Energy & Stamina, Muscle Recovery. The study concluded that it represents a beneficial and convenient option for supporting individual health and fitness goals while providing essential nutritional support.³²
- H SP, *et.al* aimed the development and evaluation of nutraceutical gummies formulated with *Matricaria chamomilla* (chamomile) and *Actinidia chinensis* (kiwi) extracts using natural excipients. The formulations were evaluated for physicochemical properties, antioxidant activity, and microbiological stability.³³
- Gawande S, *et.al* study focused on develop gummies with different formulations incorporating Cinnamon, Ginger, Fennel, Cumin. Evaluation parameters should be done are physical appearance, moisture content, Determination of pH. The findings suggest that these gummies may serve as a functional food product, offering an easy-to-consume and acceptable means of alleviating common digestive disorders. Further research should focus on addressing these challenges through advanced formulation technologies.³⁴
- Rane MV aimed to prepare and analyse nutraceutical gummies to improve hormonal balance, metabolic function, and general reproductive health in women with PCOS. Active constituents include Vitamin D, terpenoids, curcumin, cinnamon aldehyde, and inositol. In PCOS pharmacotherapy may cause side effect. According to the study herbal medicine may cause less side effect. These herbal treatments show potential in improving insulin resistance, modulating hormone levels (FSH and LH), and supporting ovarian function, including the reduction or dissolution of cysts, follicular development, and ovulation, possibly leading to pregnancy. Therefore, this study emphasises the possibility of herbal supplements as an effective alternative therapy option for PCOS.³⁵
- Ghadge A, *et.al* the study reports the development of edible gummies enriched with lutein and zeaxanthin for eye and brain health. The optimized formulation showed uniform thickness, consistent weight, and an appropriate pH range, supporting product stability and sensory acceptability. According to the study they play an essential role in filtering harmful blue light and protecting against oxidative stress. Assessment of sensory attributes, including appearance, taste, and texture, indicated good consumer acceptability. Overall, the study confirmed the successful development and optimization of lutein- and zeaxanthin-enriched edible gummies designed to support visual function and neural health.³⁶
- Khune, *et.al* aimed the formulation of herbal gummies intended to aid smoking cessation, using extracts of ashwagandha, ginger, cinnamon, liquorice, and Tulsi prepared through Soxhlet extraction with a hydroalcoholic solvent to ensure efficient recovery of active constituents. The gummies were evaluated for quality and sensory attributes, including appearance, texture, taste, and weight uniformity. The results demonstrated acceptable product consistency and quality, indicating that the developed herbal gummies possess favourable characteristics for supporting individuals attempting to quit smoking.³⁷
- Bartkienė E, *et.al* explored the bioconversion of *Spirulina* using fermentation with *Lactiplantibacillus plantarum* No. 122 and evaluated its use in nutraceutical chewing candies enriched with gamma-aminobutyric acid (GABA). The study analysed the effects of 24- and 48-hour fermentation on the physicochemical properties of *Spirulina* and examined the incorporation of L-glutamic acid-rich fermented *Spirulina* into sucrose-free gummy formulations. Fermentation time significantly influenced colour parameters, with fermented samples showing increased yellowness compared to non-fermented *Spirulina*. The highest levels of GABA and L-glutamic acid (4062 and 228.6 mg/kg, respectively) were detected after 24 and 48 hours of fermentation. Changes in lipid composition were also observed, as fermentation increased omega-3 and saturated fatty acids while reducing monounsaturated and omega-6 fatty acids. The addition of fermented *Spirulina* notably affected the gummies' colour, brightness, and texture, giving them a green appearance. Gummy candies formulated with xylitol, 3–5 g of fermented *Spirulina*, and 0.2 µL of *Citrus paradisi* essential oil achieved the highest overall acceptability scores, while formulations containing xylitol, agar, ascorbic acid, 3 g of fermented *Spirulina*, and 0.1 µL of *Mentha spicata* essential oil generated the strongest “happy” sensory response (0.052). These results suggest that fermented *Spirulina* has strong potential as a functional ingredient in the development of sucrose-free, health-promoting chewing confections.³⁸



- Bartkienė E, *et.al* formulated nutraceutical gummy candies using lacto- fermented lupine protein concentrates as a premium protein ingredient, combined with xylitol and *Citrus paradisi* L. essential oil. The study aimed to enhance fermented lupine protein concentrates—known for their high protein and genistein content—by adding xylitol as a low-glycaemic sweetener and grapefruit essential oil to provide antimicrobial effects and mask undesirable legume flavours. The lupine protein concentrate obtained from the Vilniai variety fermented with *Lactobacillus sakei* was selected for gummy production due to its superior nutritional characteristics, including the highest protein content (90.11%), protein digestibility (89.94%), and genistein levels, along with the lowest trypsin inhibitor activity. This approach optimized both nutritional value and bioactive compound availability, strengthening its functionality as a food ingredient. Gummy candies prepared with xylitol, ascorbic acid, grapefruit essential oil (up to 0.2%), and lupine protein concentrate (up to 13.0%) demonstrated desirable texture, high sensory acceptance, and satisfactory functional quality, highlighting their potential as effective nutraceutical products.³⁹
- Martin-Biggers J and de Campos ME focused on the efficacy and safety of a gummy supplement that includes botanical ingredients, zinc, and vitamin B. For the evaluation of gummies, 65 women between the ages of 18 and 60 were enrolled. Compared to the placebo group, the test product-using patients' hair density rose between baseline and six months. This study used subject perception for results that deviate from clinical assessments and did not evaluate hair for more than six months. synergistic action of the components in the new supplement formulation to enhance hair growth and subjective evaluation without having a negative impact.⁴⁰
- Mann P, *et.al* investigated a formulation containing *Valeriana officinalis* and *Withania somnifera* to explore the potential of nutraceuticals as a therapeutic approach for depression. The study assessed the solubility and bioavailability of *Withania somnifera* (Ashwagandha) using the Forced Swim Test model. The results demonstrated that the gummy formulation produced a strong antidepressant effect in this model. The researchers concluded that the gummy delivery system enhances the solubility and bioavailability of key herbal constituents, indicating its potential as a complementary or alternative option for depression management.⁴¹
- Vohra P, *et.al* studied about medicated gummies is used for the treatment of depression and anxiety. For managing depression, they were formulating a gummy by sing ingredients like Tulsi, Turmeric and chamomile. Various steps involved in the preparation of gummies are gelatin soaking, heating, mixing, filtering, moulding and drying. The conclusion is that the generate ground sticky natural ingredients for an antidepressant medication without preservatives. This article focusses on opening doors for antidepressant medication in a witching lozenge shape to increase patient compliance. Therefore, creating a compact, enticing sticky with colourful sauces may be a helpful solution for depression-specific issues.⁴²
- Tang M, *et.al* studied the antidepressant-like effects of five herbal essential oils: *Aloysia citriodora* essential oil (ACEOs), *Rosa rugosa* essential oil (RREOs), *Magnolia denudata* essential oil (MDEOs), *Jasminum sambac* essential oil (JSEOs), and *Abies balsamea* essential oil (ABEOs). Using a mouse model of reserpine-induced depression, the study explored both the behavioural effects and underlying mechanisms of these oils. Inhalation of the essential oils significantly reduced depression-related behaviours, including anxiety and immobility, in affected mice. Notably, JSEOs and ABEOs markedly improved reserpine-induced symptoms, such as weight loss and increased immobility, as assessed by the forced swim and tail suspension tests. The treatment also led to elevated glucocorticoid receptor (GR) and 5-HT1A receptor levels, reduced inflammatory responses, and mitigation of hippocampal and neuronal damage by ACEOs. Overall, the findings highlight the antidepressant potential of these herbal essential oils and suggest their possible use as nutraceutical interventions for depression.⁴³
- Abbasi-Maleki S, *et.al* aimed the antidepressant-like effects of *Origanum majorana* essential oil (OMEO) in mice, focusing on its modulation of monoaminergic systems using the forced swimming test. Traditionally, *Origanum majorana* has been used to address nervous system disorders, exhibiting sedative and anticonvulsant properties. The study aimed to evaluate its potential antidepressant effects in rats. Results showed that OMEO administration reduced immobility time while significantly increasing swimming and climbing behaviours. The essential oil demonstrated antidepressant-like activity by interacting with dopaminergic (D1 and D2), serotonergic (5-HT1A and 5-HT2A), and noradrenergic (α1 and α2 adrenoceptor) systems.⁴⁴
- Veerichetty V, *et.al* aimed to develop gummy bear supplements and investigated the antioxidant and antiproliferative capabilities of nuciferine in vitro. They concentrated on creating gummy bear supplements enhanced with nuciferine from *Nelumbo nucifera*. This study explores the many uses of nuciferine in the production of supplements for gummy bears that are enhanced with antioxidants. In addition to offering little calories, the hydrocolloids and additives in gummy candy act as an aesthetically pleasing encasing matrix to enhance the nutritional value.⁴⁵
- E Bartkienė, *et.al* focused on gummy candies with probiotics, essential oils, and bovine colostrum. In this study, they created antimicrobial nutraceuticals, such as gummy candies (GC) made from probiotic lactic acid bacteria (PLAB), essential oils (EOs), and bovine colostrum (BC). Heteropolysaccharide (agar) was utilized to prepare antibacterial GC.⁴⁶



• Karthikeyan GB, *et.al* studies evaluated that the vitamin gummies enhance general health by offering an easy way to obtain vital vitamins and minerals. Muscle strength, are just a few of its many health advantages. This study assessed and created two healthy gummy candy recipes utilizing natural ingredients: one that used orange juice and the other that combined berries and puree. with honey. The calorie content of these formulations was reduced by substituting commercial sugars and chemicals for organic ingredients.⁴⁷

• Naware NS, *et.al* explored the benefits of green tea catechins as nutraceuticals. One promising application is the development of a gelatin gummy formulation, which can reduce the naturally bitter taste of green tea while retaining the health-promoting properties of catechins. The creation of a gelatin gummy formulation that will minimize the bitter taste of green tea is one potential use for catechins, which are advantageous phytoconstituents that enhance general health. Unlike green tea, the gelatin gummy formulation is portable, making it easier for the consumer to access. Fresh tea leaves contain theobromine (0.15–0.2%), theophylline (0.02–0.04%), and other methylxanthines, along with lignin (6.5%), organic acids (1.5%), chlorophyll (0.5%), theanine (4%), free amino acids (1–5.5%), and a variety of flavour compounds.⁴⁸

CONCLUSION

The collective findings from the studies suggests that nutraceutical gummies are an innovative and highly adaptable dosage form for delivering health promoting ingredients. Gummies seems to have superior consumer acceptance and compliance compared to conventional solid oral dosage forms owing to their chewable nature and ease of consumption. Thus, making them suitable for geriatric and paediatric patients.

The studies demonstrated diverse incorporation of the bioactive components like vitamins, minerals, herbal extracts, probiotics, proteins etc. as nutraceutical gummies providing benefits to skin, hair, immunity, digestion, metabolism etc.

The challenges to be addressed includes maintenance of stability of sensitive ingredients, texture, content uniformity and varying regulatory requirements. There were also emphasizes regarding the need for advanced formulation strategies, improved delivery technologies and clinical validations.

Overall, nutraceutical gummies serve as a promising platform within the field of functional foods and dietary supplements. However, a structured evaluation criterion, continued research and scientific substantiation will be essential to understand its complete potential.

REFERENCES

1. Fernandes S.D., Narayana R.C., Narayanan A.V. The Emergence of India as a Blossoming Market for Nutraceutical Supplements: An Overview. *Trends Food Sci. Technol.* 2019; 86:579–585.
2. DeFelice SL. The nutraceutical revolution: its impact on food industry R&D. *Trends Food Sci Technol.* 1995; 6:59–61.
3. Wildman RE. Nutraceuticals and Functional Foods. In *Handbook of nutraceuticals and functional foods* 2019 Nov 19 (pp. 3-22). CRC Press.
4. Santini A., Novellino E. Nutraceuticals—Shedding Light on the Grey Area between Pharmaceuticals and Food. *Expert Rev. Clin. Pharmacol.* 2018; 11:545–547.
5. Keservani R.K., Kesharwani R.K., Sharma A.K., Gautam S.P., Verma S.K. Developing New Functional Food and Nutraceutical Products. Academic Press; New York, NY, USA: 2017. Nutraceutical formulations and challenges; pp. 161–177. [Google Scholar]
6. Preparation and evaluation of nutraceutical gummies using *Justicia adhatoda* (Vasaka) Mohammed Ashiq M J, Areeja Ummar, Amrutha O C, Asiya D, Shijina K S, Nishamol K S. *International Journal of Pharmaceutical Research and Applications* Volume 9, Issue 3 May-June 2024, pp: 1673-1680 www.ijprjournal.com ISSN: 2456-4494
7. Forbes, The Rise Of Functional Candy, Oct 28, 2021, <https://www.forbes.com/sites/annahaines/2021/10/28/sweet-functional-treats-for-a-healthy-halloween/?sh=2441303b7c3c>
8. Functional gummies: the (still) rising star of the nutraceutical space and the production challenges brands can face on the ascent; Pierre-Albert Thomas; Global Director Rousselot Functional Ingredients; Rousselot SAS, France
9. Absolute Reports, Global And United States Functional Gummies Market Report & Forecast 2022-2028 <https://www.absolutereports.com/global-and-united-states-functional-gummies-market-20990925>
10. Nutrition Business Journal, 2022 Delivery Format Report, <https://store.newhope.com/products/delivery-format-report-2022>
11. Sugar-free gummy market outlook (2023 to 2033): <https://www.futuremarketinsights.com/reports/sugarfree-gummy-market>
12. Future Market Insights. Nutraceutical Gummies Market [Internet]. 2024 [cited 2025 Sep 24]. Available from: <https://www.futuremarketinsights.com/reports/nutraceutical-gummies-market>
13. Grand View Research. India Gummy Market Size, Share & Trends Report [Internet]. 2024 [cited 2025 Sep 24]. Available from: <https://www.grandviewresearch.com/industry-analysis/india-gummy-market-report>



14. Karmase A, Agarwal A, Patel B, Joshi P, Sethi S, Shrivastava A. An open-label, single-arm clinical study to evaluate efficacy and safety of Nyumi radiant skin gummies in healthy adult subjects with fine lines/wrinkles, hyperpigmentary spots, and under eyes dark circles. *Cosmoderma*. 2024 Jan 3;4.

15. Aiello F, Caputo P, Oliviero Rossi C, Restuccia D, Spizzirri UG. Formulation of antioxidant gummies based on gelatin enriched with citrus fruit peels extract. *Foods*. 2024 Jan 19;13(2):320.

16. Anaya BJ, Raudone L, Ureña-Vacas I, Sanz-Perez A, Marksa M, Vilkickyte G, García-Rodríguez JJ, Serrano DR, González-Burgos E. *Origanum vulgare* ssp. *hirtum*: From Plant to 3D-Printed Gummies with Antioxidant and Anti-Inflammatory Properties. *Gels*. 2025 Mar 26;11(4):246.

17. Danesh A. The Development of Nutraceuticals in Gummies Form, Based on Antimicrobial Lactic Acid Bacteria, Multifunctional Gels, and Berries/fruits by-Products (Master's thesis, Lithuanian University of Health Sciences (Lithuania)).

18. Rashmi P, Mona K. Formulation of vegan nutritional gummy supplements and their textural-organoleptic analysis. *Journal of Applied & Natural Science*. 2023 Dec 1;15(4).

19. Ganesh H, Yarlagadda S, Tumepalli T, Yalamanchili S, Gavirneni S. Clinical Efficacy and Patient Outcomes with Novel Vegan Nutraceuticals: A Study on Gummies and Oral Dissolving Strips. *Journal of Contemporary Clinical Practice*. 2024 Dec 24; 10:364-70.

20. Lohar PB, Shrivastav PM, Kulavoor SS. Development of fiber rich gummies. *IJARIIT*. 2020;6(4):52-5.

21. Yadav K, Gawai NM, Shihhare B, Vijapur LS, Tiwari G. Development and evaluation of herbal-enriched nutraceutical gummies for paediatrics health. *Pharmacognosy Research*. 2024;16(4).

22. Surana K, Vaishali Sonawane, Chaitali Yeola, Jayesh Musale, Mahajan S, Deepak Sonawane, et al. Formulation, Development and Evaluation of Herbal Paediatrics Edible Jelly for Cough. *Ars Pharmaceutica (Internet)*. 2024 Dec 20;66(1):89–100

23. Kazi-Chishti M, Kulsum UJ, Dehghan MH, Chishti MN, Bilal K. Development of ginger oleoresin-enriched marshmallow candy as a nutraceutical for managing paediatrics chemotherapy-induced nausea and vomiting. *Journal of Holistic Integrative Pharmacy*. 2025 Mar 1;6(1):1-0.

24. Fernandes AC, Muxfeldt L, Motta NG, Skonieski C, Fagundes KR, Sandri G, de Chaves DB, Suthovski G, Gallina AL, Araujo SM, Benvegnú DM. Gummies candy enriched with Konjac glucomannan reduces hunger intensity and waist circumference of overweight individuals. *International journal of biological macromolecules*. 2023 Jan 31; 226: 72-6.

25. Warule P, Diksha K, Prathamesh B, Samarth B, Samarth D. Formulation and Evaluation of Herbal Multivitamin Gummies. *International Journal of Pharmaceutical Sciences*. 2025;3(6):4119–27.

26. Teixeira-Lemos E, Almeida AR, Vouga B, Morais C, Correia I, Pereira P, Guiné RP. Development and characterization of healthy gummy jellies containing natural fruits. *Open Agriculture*. 2021 Jul 16;6(1):466-78.

27. Rawat S, Rai S, Sangeeta S, Kumar A, Ramachandran P, Sharma SK, Dubey SK, Prakash A, Joshi R. Application of Plant-Based Hydrocolloids on the Textural Profile of Vegan Gummies Supplemented with Turmeric and Black Pepper. *International Journal of Food Science*. 2024;2024(1):7127635.

28. Patel I, Patel B. Formulation & evaluation of gummies from mulberry leaf extract * 762 *World Journal of Pharmaceutical Research*. 2025 14:763.

29. Deshmukh sd, bodhankar h. Production and Qualitative Analysis of Gummies from Tulsi (Holly Basil) and Jivanti (Leptadenia reticulata) Powder. *International Journal of Applied Home Science*. 2023;10(3 & 4):45–48

30. Romano DEU, Putot FLE, Pael SLM, Cordova JNA, Bucog PSB, Destajo KLM. *Euphorbia hirta* (Asthma Plant) Gummies as Alternative Supplements: An Experimental Research. *Cognizance Journal of Multidisciplinary Studies*. 2024 May;4(5):67–74.

31. Arefa Faiz Sheikh, Aman Aziz Sheikh, Uruba Azka Taj, Payal K Thak, Pavan P Shende. Formulation and Evaluation of Herbal Gummies. *International Journal of Advanced Research in Science, Communication and Technology*. 2025 Apr 6;281–90.

32. Mr Rahul V. Pawar, Mr Nikhil R. Rathod, Ms Kajal P. Kale. Formulation and Evaluation of Herbal Weight Gain Gummies. *International Journal of Advanced Research in Science, Communication and Technology*. 2025 May 11;235–43.

33. H SP, A M, S L, Shree S. Formulation and Evaluation of Matricaria chamomilla and Actinidia chinensis Nutraceutical Gummies. *Cross Current International Journal of Medical and Biosciences*. 2025 May 5;7(03):37–41.

34. Gawande S, Ghadge A, Palshikar G. A comprehensive review on medicinal gummies for gastrointestinal relief. *International Journal of Pharmacognosy and Pharmaceutical Research*. 2025 Jan 1;7(1):94–8.

35. Rane MV. Design and Characterization of a Mushroom-Enriched Chewable Supplement for PCOS Management. *International Journal for Research in Applied Science and Engineering Technology*. 2025 Jun 14;13(6):1641–8.

36. Ghadge A, Gawande S, Palshikar G. Development of edible gummies for enhancement of vision and nerves. *Journal of Medicinal Plants Studies*. 2025 Mar 1;13(2):210–5.

37. Khune, Amit & Rathod, Harishkumar & Deshmukh, Swati. (2024). Development of herbal medicated gummies for nicotine cessation support. *GSC Biological and Pharmaceutical Sciences*. 28. 084-089. 10.30574/gscbps.2024.28.2.0213

38. Bartkienė E, Tolpežnikaitė E, Klupsaitė D, Starkutė V, Bartkevičs V, Skrastina A, Pavlenko R, Mockus E, Lele V, Batkevičiūtė G, Budrikytė A. Bio-converted Spirulina for nutraceutical chewing candy formulations rich in L-glutamic and gamma-aminobutyric acids. *Microorganisms*. 2023 Feb 9;11(2):441

39. Bartkienė E, Sakiene V, Bartkevičs V, Wiacek C, Rusko J, Lele V, Ruzauskas M, Juodeikiene G, Klupsaitė D, Bernatoniene J, Jakstas V. Nutraceuticals in gummy candies form prepared from lactose-fermented lupine protein concentrates, as high-quality



protein source, incorporated with Citrus paradise L. essential oil and xylitol. International Journal of Food Science and Technology. 2018 Aug;53(8):2015-25

40. Martin-Biggers J, de Campos ME. A Randomized, Placebo-controlled Clinical Study Evaluating a Dietary Supplement for Hair Growth. The Journal of Clinical and Aesthetic Dermatology. 2024 Nov;17(11):34..

41. Mann P, Sharma U, Singh G, Jangra G. Antidepressant Efficacy of Nutraceutical Gummies: Formulation of Withania Somnifera and Valeriana officinalis Evaluated in Force Swim Test Model. Recent Advances in Food, Nutrition & Agriculture. 2025 Jun 11;16.

42. Vohra P, Patil S, Khan W. Herbal medicated gummies: A flange approach in management of depression and anxiety. 2023 Mar 15;10(1):17-9.

43. Tang, M. et al. (2024) 'Comparative analysis of antidepressant-like effects of five herbal essential oils on mice with reserpine-induced depression', Journal of Essential Oil Bearing Plants, 27(2), pp. 383-396.

44. Abbasi-Maleki S, Kadkhoda Z, Taghizad-Farid R. The antidepressant-like effects of *Origanum majorana* essential oil on mice through monoaminergic modulation using the forced swimming test. J Trad Complement Med. 2019 Jan 14;10(4):327-335.

45. Veerichetty V, Saravanabavan I, Pradeep A, Abiraamasundari R. Development of gummy bear supplements and in vitro exploration of antioxidant and antiproliferative potential of Nuciferine. Journal of Ayurveda and Integrative Medicine. 2024 Jan 1;15(1)

46. E Bartkienė, M Ruzauskas, Lele V, P Zavistanaviciute, J Bernatoniene, V Jakstas, et al. Development of antimicrobial properties nutraceuticals: gummy candies with addition of bovine colostrum, essential oils and probiotics. World Academy of Science, Engineering and Technology International Journal of Agricultural and Biosystems Engineering: ICAE 2018: 20th International Conference on Agricultural Engineering: April 16-17, 2018, Lisbon, Portugal: conference proceedings [Internet]. 2018 [cited 2025 Dec 18];20(4).

47. Karthikeyan GB, Vanishree M, Joseph ma. a study on the growth of vitamin gummies and their future trend in the market3.

48. Naware NS, Ambatkar S, et al. A review focusing on the benefits of green tea catechins as nutraceuticals. Sciences of Phytochemistry. 2023 Jul 1;2(2):138-46.

How to cite this article:

Priya Kurian et al. Ijppr.Human, 2025; Vol. 31 (12): 614-623.

Conflict of Interest Statement: All authors have nothing else to disclose.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.