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Formulation and Evaluation of Nutraceuticals Powder

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ABSTRACT
The present study reports the formulation and evaluation of a nutraceutical powder composed of Guava, Moringa, Tulsi (Basil), Orange Peel, Ashwagandha, Cinnamon, and Sucrose, aimed at promoting overall health and preventing chronic diseases. These ingredients are rich in bioactive compounds including vitamins (A, B-complex, C, D, E), essential minerals (Ca, Fe, Zn, Mg, K, Cu), antioxidants, glycosides, and polyphenols, which contribute to antioxidant, adaptogenic, antidiabetic, immunomodulatory, and digestive-supporting properties. Physicochemical evaluation demonstrated excellent flow characteristics, with a bulk density of 1.15 g/ml, tapped density of 1.30 g/ml, Hausner ratio of 1.15, Carr's index of 9.5%, and angle of repose of 25.5°, indicating suitability for powder-based dosage forms. An ash value of 12.2% confirmed the presence of natural minerals and minimal contamination. The formulation process, including aqueous Soxhlet extraction and optimized blending techniques, ensured the preservation of phytoconstituents and product uniformity. Natural sweetening and preservative agents enhanced palatability and shelf-life while maintaining a clean-label profile. Overall, the nutraceutical powder exhibits significant potential as a daily dietary supplement, with future scope for development into commercial products such as capsules, sachets, or instant drink formulations

Keywords: Nutraceuticals, Functional food, Powder formulation, Physicochemical evaluation, Health supplements

I. INTRODUCTION

Nutraceuticals represent a rapidly growing segment of the health and wellness industry that bridges the gap between nutrition and pharmaceuticals. The term "nutraceutical" was coined by Dr. Stephen DeFelice in 1989, combining the words "nutrition" and "pharmaceutical." Nutraceuticals are food or food products that provide health and medical benefits, including the prevention and treatment of disease. They can be considered as non-specific biological therapies used to promote general well-being, control symptoms, and prevent malignant processes. The idea behind nutraceuticals is rooted in the concept that food can play a crucial role in maintaining health, managing disease, and improving quality of life(Maddi Viss etal.,)

The importance of nutraceuticals lies in their ability to provide physiological benefits or protection against chronic diseases. These products include dietary supplements, functional foods, medicinal foods, and pharmaceuticals (foods fortified with added ingredients like omega-3 fatty acids, antioxidants, or probiotics). Unlike pharmaceuticals, which are strictly regulated and intended to cure or treat diseases, nutraceuticals aim to support the structure or function of the body. With the increasing awareness about the link between diet and health, nutraceuticals have emerged as essential tools for preventive healthcare.

Nutraceuticals can be classified in various ways, including based on their source (plant-based, animal-based, microbial), mechanism of action, chemical nature, or intended use. One popular classification is into three broad categories: dietary supplements, functional foods, and medical foods. Dietary supplements include vitamins, minerals, herbs, amino acids, enzymes, and other bioactive compounds intended to supplement the diet. Functional foods are ordinary foods enhanced with additional ingredients or modified to provide health benefits beyond basic nutrition, such as fortified cereals or yogurts with added probiotics. Medical foods, on the other hand, are formulated for the dietary management of a specific disease and are consumed under medical supervision.

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Nutraceuticals are found in a wide variety of natural sources. For example, flavonoids and polyphenols found in fruits and vegetables exhibit antioxidant properties that help in reducing oxidative stress and inflammation. Omega-3 fatty acids, commonly found in fish oil, are known for their cardioprotective effects. Probiotics such as Lactobacillus and Bifidobacterium strains help in maintaining a healthy gut microbiota and improving digestive health. Fibers from whole grains, fruits, and vegetables contribute to improved metabolic health and better glycemic control. Amino acids like glutamine and arginine play a role in muscle repair, immune function, and wound healing. Herbs such as turmeric (containing curcumin), garlic, and ginseng have long been used in traditional medicine for their therapeutic properties and are now being incorporated into nutraceutical formulations.

The global nutraceutical market has witnessed exponential growth in recent decades due to increasing consumer awareness about the relationship between diet and health, aging populations, lifestyle diseases, and rising healthcare costs. Consumers are increasingly seeking natural alternatives to pharmaceutical drugs for managing chronic diseases such as obesity, diabetes, cardiovascular diseases, cancer, and arthritis. The rise in lifestyle-related diseases has fueled the demand for preventive healthcare, of which nutraceuticals are a key component. Furthermore, the COVID-19 pandemic has highlighted the importance of boosting immunity and maintaining overall health, leading to a surge in the consumption of immune-supporting nutraceuticals such as vitamin C, vitamin D, zinc, and herbal supplements.

In terms of regulatory framework, nutraceuticals exist in a gray area between food and medicine, and regulations vary widely across countries. In the United States, the Food and Drug Administration (FDA) regulates nutraceuticals as dietary supplements under the Dietary Supplement Health and Education Act (DSHEA) of 1994. In India, the Food Safety and Standards Authority of India (FSSAI) governs the production and sale of nutraceuticals. The European Union, Japan, Canada, and other countries have their own distinct regulatory frameworks. These regulations often pertain to labeling, claims, manufacturing standards, and safety assessment. While these frameworks aim to ensure product safety and consumer protection, the lack of standardized global regulations sometimes leads to confusion and inconsistency in product quality and claims.

The development of nutraceuticals involves a multidisciplinary approach including food science, nutrition, biochemistry, pharmacology, and biotechnology. The process typically begins with identifying bioactive compounds in natural sources followed by extraction, purification, formulation, and validation of efficacy and safety. Advances in biotechnology and nanotechnology have opened new avenues in nutraceutical research, such as nanoencapsulation for improving bioavailability and targeted delivery of nutraceuticals. Omics technologies like genomics, proteomics, and metabolomics are increasingly used to understand the mechanisms of action and identify biomarkers for personalized nutrition.

INGREDIENTS

GUVAVA

Fig. Guava fruit

Nutritional and Therapeutic Value: Guava is rich in vitamin C, dietary fibres, antioxidants (like quercetin and lycopene), and essential minerals such as potassium and folate. These nutrients contribute to its strong antioxidant, anti-inflammatory, antimicrobial, and cardioprotective effects. It supports digestion, boosts immunity, helps manage blood pressure, and improves lipid profiles.

Medicinal Uses of Leaves and Fruit: Guava leaves possess antidiabetic properties by inhibiting carbohydrate-digesting enzymes, and they exhibit antimicrobial activity against bacteria causing diarrhoea and infections. Both the fruit and leaf extracts are widely used in nutraceutical formulations for managing diabetes, digestive issues, infections, and for overall health maintenance

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ORANGE

Fig. Orangefruit

Rich Source of Nutrients and Antioxidants: Orange is an excellent source of vitamin C, flavonoids (like hesperidin), beta-carotene, and dietary fiber. These compounds provide strong antioxidant properties, support immune function, improve skin health, and help in neutralizing free radicals, thereby reducing oxidative stress.

Health Benefits and Medicinal Uses: Oranges promote cardiovascular health by lowering blood pressure and cholesterol levels, aid digestion, and support hydration. The flavonoids in oranges also have anti-inflammatory and anticancer properties, making them valuable in preventing chronic diseases and supporting overall wellness.

MORINGA

Fig. MoringaPlant

Highly Nutritious: Moringa is rich in vitamins A, C, E, calcium, iron, and protein. Its leaves are especially valued for their high antioxidant and anti-inflammatory properties, making it useful for boosting immunity and overall health.

Medicinal Benefits: Moringa helps manage blood sugar, cholesterol, and blood pressure. It also has antimicrobial, anti-cancer, and liver-protective effects, making it a popular ingredient in nutraceutical products like powders, teas, and capsules.

TULSI

Fig. Tulsi Plant

Rich in Medicinal Compounds: Tulsi contains powerful bioactive compounds like eugenol, ursolic acid, and rosmarinic acid, which provide strong antioxidant, anti-inflammatory, and adaptogenic effects. It helps protect the body from oxidative stress and supports immune health.

Therapeutic Uses: Tulsi is widely used in Ayurvedic medicine for its antistress, antidiabetic, antimicrobial, and respiratory-protective properties. It helps manage cough, cold, asthma, and also supports blood sugar and heart health. Tulsi is often consumed as tea, extract, or capsule in nutraceutical formulations.

ASHWAGANDHA

Fig. Ashwagandha root

Powerful Adaptogen and Nutraceutical Herb: Ashwagandha is known for its adaptogenic properties, helping the body manage stress and anxiety. It contains active compounds like with alkaloids, which provide anti-inflammatory, antioxidant, and immune-boosting effects.

Therapeutic Benefits: Ashwagandha supports brain function, enhances energy levels, improves sleep quality, and helps regulate blood sugar and cortisol levels. It is commonly used in nutraceuticals for stress relief, vitality, hormonal balance, and overall well-being.

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ROLE OF INGREDINETS AS NUTRACEUTICALS

1. GUAVA

Antioxidant Activity: Guava contains vitamin C, flavonoids (e.g., quercetin), and other polyphenols that scavenge free radicals and reduce oxidative damage, which is beneficial in preventing aging and chronic diseases.

Antidiabetic Activity: Guava leaf extract inhibits alpha-glucosidase and reduces postprandial blood glucose levels. It improves insulin sensitivity and helps regulate blood sugar levels.

Antimicrobial Activity: Guava extracts exhibit antibacterial and antifungal activity against pathogens like Escherichia coli, Staphylococcus aureus, and Candida species. This makes it effective in treating infections, diarrhea, and oral diseases.

2. MORINGA

Anti-inflammatory Activity: The flavonoids and tannins in guava possess significant anti-inflammatory properties, helping reduce inflammation in conditions like arthritis and gastrointestinal issues.

Anticancer Activity: Lycopene and other antioxidants in guava may help in reducing the risk of certain cancers (especially prostate and breast cancer) by inhibiting cell proliferation and promoting apoptosis in cancer cells.

Cardioprotective Effects: Guava improves heart health by lowering blood pressure, reducing LDL (bad) cholesterol, and improving HDL (good) cholesterol levels, primarily due to its potassium, fiber, and antioxidant content.

Hepatoprotective Effects: Studies show guava leaf extracts can protect the liver from damage caused by toxins or oxidative stress, aiding in liver function improvement.

Wound Healing: Topical application of guava extracts has been shown to enhance wound healing due to its antimicrobial and tissue-repair properties.

3. MORINGA

Antioxidant Activity: Moringa contains quercetin, chlorogenic acid, and vitamin C, which neutralize free radicals and protect cells from oxidative damage. This helps prevent aging and degenerative diseases.

Anti-inflammatory Activity: Compounds like isothiocyanates and flavonoids reduce inflammation, making moringa useful in treating chronic inflammatory conditions such as arthritis and asthma.

Antidiabetic Activity: Moringa helps lower blood glucose levels by enhancing insulin secretion and sensitivity. It also inhibits enzymes involved in carbohydrate digestion.

Antimicrobial Activity: Moringa extracts exhibit antibacterial, antiviral, and antifungal effects against a wide range of pathogens, including E. coli, Salmonella, and Staphylococcus aureus.

Cardioprotective Effects: Moringa reduces cholesterol levels, prevents lipid peroxidation, and regulates blood pressure, supporting heart health.

Hepatoprotective Effects: Moringa leaf and seed extracts help protect the liver from toxin-induced damage by enhancing antioxidant enzyme activity and reducing inflammation.

Neuroprotective Activity: Its antioxidants and vitamins support cognitive function, protect brain tissue from oxidative stress, and may help in managing neurodegenerative disorders like Alzheimer's.

Anti-cancer Activity: Moringa contains bioactive compounds such as niazimicin and benzyl isothiocyanate that exhibit anticancer properties by inhibiting tumor cell growth and inducing apoptosis.

Wound Healing: Moringa promotes faster wound healing due to its antimicrobial, anti-inflammatory, and cell-regenerative effects.

4. TULSI

Adaptogenic (Anti-Stress) Activity: Tulsi modulates the stress response by balancing cortisol levels and enhancing mental clarity, reducing anxiety and fatigue.

Antioxidant Activity: The flavonoids and phenolic compounds in Tulsi scavenge free radicals, reducing oxidative stress and protecting against cellular damage and aging.

Anti-inflammatory Activity: Tulsi reduces inflammation by downregulating pro-inflammatory cytokines, making it beneficial in conditions like arthritis, asthma, and inflammatory bowel disease.

Antimicrobial Activity: Tulsi exhibits strong antibacterial, antiviral, and antifungal actions against pathogens such as Staphylococcus aureus, E. coli, and even certain strains of influenza and herpes viruses.

Immunomodulatory Effects: Tulsi enhances immune responses by stimulating the production of immune cells and antibodies, supporting the body's defense against infections.

Antidiabetic Activity: Tulsi helps lower blood glucose levels by improving insulin sensitivity and

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glucose metabolism, making it useful in managing type 2 diabetes.

Cardioprotective Effects: Tulsi reduces blood lipid levels, regulates blood pressure, and prevents oxidative damage to heart tissues, supporting cardiovascular health.

Hepatoprotective Activity: Tulsi protects the liver from chemical-induced damage by enhancing detoxification enzymes and reducing inflammation.

Anti-cancer Properties: Certain phytochemicals in Tulsi such as eugenol and apigenin have shown potential in inhibiting cancer cell growth and inducing apoptosis.

Respiratory Support: Tulsi is traditionally used to relieve symptoms of cold, cough, bronchitis, and asthma by acting as an expectorant and soothing the respiratory tract.

5. ASHWAGANDHA

Adaptogenic and Anti-Stress Activity: Ashwagandha reduces cortisol levels and balances the hypothalamic-pituitary-adrenal (HPA) axis, helping the body resist physical, mental, and emotional stress.

Antioxidant Activity: Ashwagandha enhances the activity of antioxidant enzymes like superoxide dismutase (SOD) and catalase, protecting cells from oxidative damage and aging.

Neuroprotective and Cognitive Benefits: It improves memory, concentration, and learning abilities. It is also being researched for its potential role in preventing neurodegenerative disorders like Alzheimer's and Parkinson's diseases.

Antianxiety and Antidepressant Effects: Ashwagandha exhibits GABA-like effects, helping reduce anxiety and depression without causing drowsiness or dependency.

Immunomodulatory Activity: Ashwagandha stimulates the immune system by enhancing white blood cell production and increasing antibody responses, making it effective in fighting infections.

Anti-Inflammatory Effects: The withanolides present in Ashwagandha suppress pro-inflammatory mediators like TNF-α and IL-6, helping in conditions like arthritis and inflammatory diseases.

Antidiabetic Activity: Ashwagandha improves insulin sensitivity and helps lower blood glucose levels, supporting the management of type 2 diabetes.

Reproductive Health and Hormonal Balance: In men, it improves testosterone levels, sperm quality, and fertility. In women, it supports hormonal balance and alleviates symptoms of stress and fatigue.

Cardioprotective Effects: It helps reduce cholesterol and triglyceride levels, regulates blood pressure, and protects heart tissues from oxidative stress.

Anti-cancer Properties: Withaferin A and other withanolides have shown potential in inhibiting cancer cell growth, inducing apoptosis, and preventing metastasis in various cancers (e.g., breast, prostate, and colon).

FORMULATION TABLE

S.No	Ingredients	Quantity in gm	Active constituents	Uses
1	Guava powder	20gm	Vitamin c	Antioxidants
2	Moringa	10gm	Vitamin A,B(B1,B2,B3,B6) C,D,E,Minerls (ca+, zn, Mg, Fe, k, cu)	Antioxidants
3	Basil	5gm		Anticancer, Antidiabetic
4	Sucrose	5gm		Sweeting agent
5	Ashwagandha	5gm	Sito in glycoside	Boost memory
6	Cinnamon	1gm	-	Preservatives
7	Orange peel powder	4gm	Vitamin C,A,B1,B3,B6	Antioxidants

METHOD OF EXTRACTION

ORANGE

- Orange powder can be used in dry form. Orange powder is already available in the market which can be used directly but may have artificial preservative. So by preparing in the lab , we can get more and better products.
- Firstly of all, take approximately 1000gm orange fruits
- Wash them and cut them and dry

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- Now cut them into small pieces and grate or grind them coarsely without losing their water
- Now spread this over a clan butter paper
- We can sun dry them or we can dry them into hot air oven
- After complete drying they will leave moisture and become complete dry
- Now grind them into fine powder
- Pass from the appropriate sieve
- Now assemble the soxhlet apparatus by cleaning allots parts
- Take vehicle as a water
- About 30gm of powder is taken and wrapped in filter paper
- Now add this powder drug entrapped in filter paper into the timble of the soxhlet apparatus
- Place dover a heating metal
- Now heat it and continue the cycles until men strum get completely clear
- Collect the extract from the round bottom flask
- Placed in evaporating dish and evaporate it until dry powder drug is found

MORINGA

- Moringa powder can be used in dry form. Moringa powder is alredy available in the market which can be directly but may have artificial preservatives. So, by preparing in the lab, we can get more and better products.
- First of all , take approximately 500gm leaf
- Wash them and cut them over the root
- Now spread this over a clean butter paper
- Wc can sun dry them or we can dry them into hot air oven
- After complete drying they will leave moisture and become completely dry
- Now grind them into fine powder
- Pass from the appropriate sieve
- Now assemble the soxhlet apparatus by cleaning allots parts
- Take vehicle as a water
- About 30gm of powder is taken and wrapped in filter paper
- Now add this powdered drug entrapped in filter paper into the thimble of the soxhlet apparatus
- Place dover a heating metal
- Now heat it and continue the cycles until men strum get completely clear
- Collect the extract from the round bottom flask
- Placed in evaporating dish and evaporate it until dry powdered drug is found

TULSI

- Tulsi leaf can be used in dry from .
- First of all take approximately 500gm tulsi leaf
- Wash them
- Now spread this over a clean butter pape
- We can sun dry them or we can dry them into hot air oven
- After complete drying they will leave moisture and become completely dry
- Now grind them into fine powder
- Pass from the appropriate sieve
- Now assemble the soxhlet apparatus by cleaning allots parts
- Take a vehicle as a water
- About 30gm of powder is taken and wrapped in a filter paper
- Now add this powdered drug entrapped in filter paper into the thimble of the soxhlet apparatus
- Place dover a heating metal
- Now heat it and continue the cycle until men strum get completely clear
- Collect the extract from the round bottom flask
- Placed in evaporating dish and evaporate it until dry powdered drug is found

All the remaining ingredients were divided into fine powder using motor pastel.

Preparation of powder

1. Weigh all the dry ingredients as mentioned in the formulation table accordingly.

2. Mix it into the mortar and pestle gently.

3. Now add a colouring agent, sweetening agent, and preservative to it.

4. Now mix all the ingredients to get the final powder.

5. Weigh it and pass it through the sieve.

6. Nutraceutical powder is ready.

Fig. Nutraceutical Powder

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II. RESULT AND DISCOUSION

Table 1. Phytochemical Test Data Table

S.No	Ingredient	Alkaloids Test (Mayer's/ Wagner's)	Flavonoids Test (Shinoda)	Tannins Test (Ferric Chloride)	Saponins Test (Foam test)	Glycosides Test (Keller-Killiani)	Phenols Test (Ferric Chloride)	Terpenoids Test (Salkowski)
1	Guava powder	+	+	+	+	+	+	+
2	Moringa	+	+	+	+	+	+	+
3	Basil	+	+	+	+	+	+	+
4	Sucrose	-	-	-	-	-	-	-
5	Ashwagandha	+	±	±	+	+	±	+
6	Cinnamon	+	+	+	±	±	+	+
7	Orange peel powder	+	+	+	+	+	+	+

- + : Present
- ± : Moderately present / variable results
- – : Absent or negligible

Table 2. Evaluation parameters for Nutraceutical Powders

S. NO.	TEST	OBSERVED VALUE
1.	Bulk density	1.15gm/ml
2.	Tapped density	1.30
3.	Hausner Ratio	1.15
4.	Angle of Repose	25.5
5.	Car's Index	9.5
6.	Ash Value	12.2

III. CONCLUSION

The present formulation successfully combines multiple nutritionally and therapeutically potent ingredients, including Guava, Moringa, Tulsi (Basil), Orange Peel, Ashwagandha, Cinnamon, and Sucrose, to produce a health-promoting nutraceutical powder. These ingredients provide a rich spectrum of bioactive constituents such as vitamins (A, B-complex, C, D, E), essential minerals (Ca, Fe, Zn, Mg, K, Cu), antioxidants, glycosides, flavonoids, and polyphenols. Together, these contribute to antioxidant, antidiabetic, adaptogenic, immunomodulatory, and digestive-supporting effects, making the formulation effective in promoting overall health and preventing chronic diseases.

From a physicochemical evaluation perspective, the powder exhibited favorable flow and compaction properties. The bulk density was found to be 1.15 gm/ml and the tapped density was 1.30 gm/ml, indicating good packing characteristics. The Hausner ratio was calculated to be 1.15, and the Carr's index was 9.5%, both of which suggest excellent flow properties. Additionally, the angle of repose was measured at 25.5°, further confirming the powder's good flowability, which is essential for uniform mixing and dosage consistency in powder-based formulations. The ash value of 12.2% is within acceptable limits, reflecting the presence of natural mineral content while also indicating low contamination or inorganic impurities.

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The use of Soxhlet extraction with water ensures a safe, cost-effective, and eco-friendly method of isolating active compounds without harmful solvents. The drying, grinding, sieving, and blending steps were optimized to maintain the integrity of phytoconstituents and to produce a uniform, free-flowing, and palatable powder. Natural sweetening and preservation agents like sucrose and cinnamon not only improve taste and shelf stability but also align with consumer demand for clean-label products.

In conclusion, the formulated nutraceutical powder demonstrates excellent physicochemical characteristics, along with proven therapeutic benefits from its ingredients. This formulation offers great promise as a daily dietary supplement for improving general wellness and preventing various chronic conditions. With further clinical validation, it can be developed into commercially viable forms such as capsules, sachets, or instant drink powders. It reflects an effective blend of traditional knowledge and modern formulation science.

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