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NUTRACEUTICAL – NEW ERA OF MEDICAL AND HEALTH

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A B S T R A C T :

Nutraceuticals are food types or nutrients that are good for your health. These consist of, but are not restricted to, citrus fruits, milk, cereals, vitamins, minerals, nutritional supplements, non-processed meals with antioxidants, and dairy products that have been fortified. There is currently no agreed-upon definition of nutraceuticals. Collagen Peptides: Support skin elasticity and hydration, slowing the aging process by promoting the production of collagen in the skin. Nutraceuticals are seen as a natural alternative to synthetic drugs. They provide health benefits without the side effects that are often associated with pharmaceuticals. Many people prefer natural compounds for managing conditions like arthritis, high cholesterol, or inflammation. These herbs serve as both food supplements and medicines, providing preventive care and therapeutic effects due to their rich chemical composition. Health Benefits: Antimicrobial, cardiovascular health, antioxidant, anticancer. Sustainability and Plant-based Nutraceuticals With an increasing focus on sustainability, plant-based nutraceuticals are likely to experience growth. plant-derived compounds such as polyphenols, flavonoids, and phytosterols offer promising applications in nutraceuticals, aligning with globalsustainability goals. nutraceuticals are increasingly being considered vital for preventive healthcare due to their role in mitigating chronic diseases such as cardiovascular disease, cancer, and diabetes. As consumers shift toward health-conscious lifestyles, the demand for functional foods and nutraceuticals is expected to grow significantly.

Keywords: Nutraceuticals, cholesterol, Antimicrobial, Globalsustainability, Inflammation

INTRODUCTION

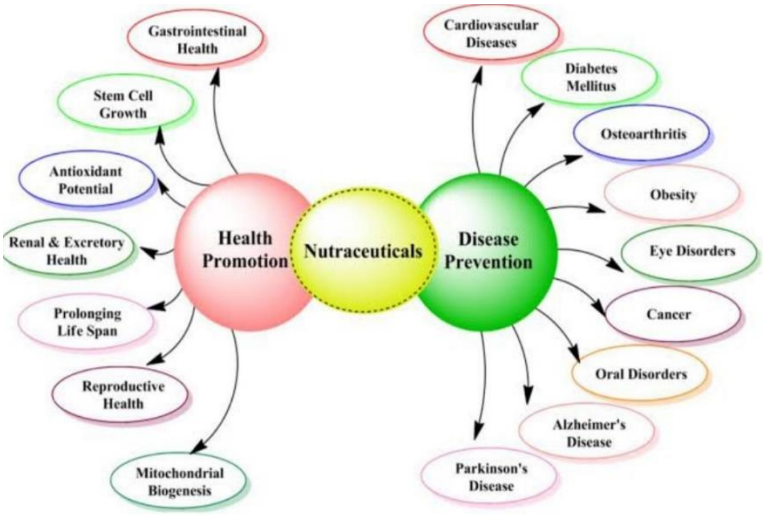
The term “nutraceutical”, has been coined in 1989 by Stephen DeFelice, founder and chairman of the Foundation for Innovation in Medicine (DeFelice, 1989), and it is a portmanteau of the words “nutrition” (indicating a nourishing food or food component) and “pharmaceutical” . It designates a food, or portion of a food, that possesses medicinal properties in addition to their nutritional worth. The food may be derived from plants or animals. The Millennium Challenge is increasingly being used as justification for their use.

Beyond food and prior to medication, nutraceuticals may be a potent toolkit for treating and preventing pathological disorders, for instance in patients who might not be candidates for traditional pharmaceutical therapy(1).

Dietary fiber, prebiotics, probiotics, polyunsaturated fatty acids, antioxidants, and other herbal/natural food kinds are among the food products employed as nutraceuticals(2)

The extra artificial food items taken orally as tablets, capsules, powder, soft gels, or liquids are called supplements. Among the nutritional components that are supplemented are vitamins, minerals, herbs or other botanicals, amino acids, enzymes, tissues from organs or glands, or extracts. Certain dietary supplements, like melatonin for jet lag, might be helpful, while ginkgo for dementia might not be that helpful (3) Plants are one of the most important sources of food and medicine for humans. The increasing knowledge of plant nutrition, medicine and biotechnology has significantly changed and changed the concepts of food, health and agriculture. With the advancements in the world of medicine and nutrition, natural products and health promoting foods have gained the attention of health professionals and the general public(4)

The demand for both herbal and non-herbal extracts is steadily rising worldwide. Ginkgo biloba has been utilized extensively as a nutraceutical for boosting cognitive function, and green tea has been used for weight loss and cancer treatment. Because it helps treat arthritis, glucosamine has seen the biggest increase in demand. In the US, the nutraceutical market is worth roughly $86 billion(5) (Nutraceuticals are food types or nutrients that are good for your health. These consist of, but are not restricted to, citrus fruits, milk, cereals, vitamins, minerals, nutritional supplements, non-processed meals with antioxidants, and dairy products that have been fortified. There is currently no agreed-upon definition of nutraceuticals (6). (This method not only denied them due recognition and criticism, but it also had the potential to validate false theories, mislead medical professionals, and endanger patients. Moreover, given that physicians did not have standard qualifications, some lay practitioners would face challenges in accessing this knowledge. Overall, there was little to no agreement on how to use nutraceuticals correctly, and information about them was not widely shared.(7). Of the approximately 6,000 higher plant species, 6,000 vascular plant species, 6,000 types of higher plants, and an estimated 6,000 plant species found in Pakistan, 12% are used to treat diseases, particularly those that affect humans and animals and for which herbal medicines are commonly used (Shinwari, 2011). Because of this, some plant species are believed to be exclusive to a certain ailment; nevertheless, plants can occasionally be used for a number of purposes,and women are the primary users of plants for medicinal purposes,followed by children(8)



Literature review

Sr. No	Title of paper	Author	Year	Information
1	Formulation and Evaluation of Bridelia ferruginea and Canthium glabriflorum Herbal Capsules	Raphael Johnson	2011	The granulations of the extracts were analyzed before encapsulation into hard gelatin capsules, and the performances of the capsules were then evaluated through in vitro dissolution studies
2	Development of oral capsules from Enterica herbal decoction-a traditional remedy for typhoid fever in Ghana	Doris Kumadoh1, 3*, Joseph Adotey2, 3, Kwabena Ofori-Kwakye3	2015	The study aimed to develop oral capsules from Enterica herbal decoction used in Ghana for the treatment of typhoid fever and produced by the Centre for Scientific Research into Plant Medicine (CSRPM)
3	Patented Herbal Formulations and their Therapeutic Applications	Mohamed Musthabaa , Sanjula Babootaa,	2010	liver disease, human immunodeficiency, asthma and rheumatological disorders
4	Standardization, preparation and evaluation of an ayurvedic polyherbal formulation in capsule dosage form suitable for use in clinical trials	Harshika Awasthi1 , Dayanandan Mani2 *, Rajendra Nath1 ,	2014	Application of modern scientific tools and techniques is important for the quality evaluation and standardization of polyherbal formulations
5	Development of herbal capsules containing mulberry leaf and black tea extracts using the modified liquisolid techniques	kansuphak noppharata, napaphak jaipakdeeb,c*, ekapol limpongsa	2019	Obesity is associated with metabolic disorders, namely hyperglycemia, and hyperlipidemia
6	Dosage forms of herbal medicinal products and their stability considerations-an overviewdosage forms of herbal medicinal products and their stability considerations-an overview	Anuradha Nischal1 , Kauser Usman3	2016	Over the last three decades, there has been a huge increase in use of herbal products across the world. About 80% of the world's population, especially those in developing countries, uses herbal medicines as part of their primary health care need
7	Capsule Formulation Essay of Herbal Extracts of Trunk Bark of Anogeissus leiocarpus (DC) Guill. Et Perr. (Combretaceae) for the Treatment of Hypertension	Ouedraogo Salfo1, Sombie C. Bavouma2, Diawara Zime Hermine2	2021	The burden of cardiovascular disease is overgrowing in Africa, that it has become a public health problem throughout the African Region
8	Formulation and In Vitro Evaluation of Oral Capsules and Suspension from the Ethanolic Extract of Cola nitida Seeds for the Treatment of Diarrhea	Fredrick W. A. Owusu , 1 Christiana O. Asare , 2 Philomena Enstie , 3 Ofosua Adi-Dak	2021	Diarrhea can be defined as the passage of three or more loose or watery stools over a 24-hour period or more frequent passage of stools than normal for an individual.
9	Formulation of oral capsules from asena herbal decoction used traditionally in ghana for the	Doris Kumadoh1 *, Joseph Adotey2 , Kwabena Ofori-Kwakye	1833	The study sought to transform Asena herbal decoction produced by the Centre for Scientific Research into Plant Medicine (CSRPM), Mampong-Akwapim, Ghana,

	treatment of arthritis			**into oral capsules**
10	**Formulation of Herbal Capsule Containing Trigonella Foenum-Graecum Seed Extract for the Treatment of Diabetes**	**Divya Jyothi*1, Marina Koland2 , Sneh Priya2 , Jainey Puthenveetil James3**	**2017**	**Trigonella foenum-graecum (fenugreek) seeds are reported to contain multiple antidiabetic constituents and hence widely used for the treatment of diabetes mellitus**

TARGETTED ORGAN INFORMATION:

1. *CARDIOVASCULAR SYSTEM:*

Omega-3 Fatty Acids: Found in fish oil, they help reduce triglyceride levels and inflammation, supporting heart health and preventing cardiovascular diseases like atherosclerosis and hypertension.Coenzyme Q10 (CoQ10): An antioxidant that improves energy production in heart cells and reduces the risk of heart failure(9)

2. BRAIN AND NERVOUS SYSTEM:

Ginkgo Biloba: Known for its neuroprotective effects, it enhances blood flow to the brain, potentially improving cognitive function and slowing age-related cognitive decline. Curcumin (from turmeric): Exhibits anti-inflammatory and antioxidant properties, potentially beneficial in preventing neurodegenerative conditions such as Alzheimer's disease(10)

3. DIGESTIVE SYSTEM:

Probiotics: Beneficial bacteria like Lactobacillus and Bifidobacterium improve gut health, alleviate irritable bowel syndrome (IBS) symptoms, and support the immune system. Prebiotics: Non-digestible fibers (e.g., inulin) that promote the growth of beneficial gut bacteria, improving overall digestive function (11)

4. IMMUNE SYSTEM:

Vitamin C: An essential nutrient that boosts immune function by supporting various cellular functions of the immune system. It enhances the production of white blood cells to fight infections. Echinacea: A plant commonly used to reduce the duration and severity of colds by modulating immune responses(12).

5. MUSCULOSKELETAL SYSTEM:

Glucosamine and Chondroitin: These compounds support joint health and reduce symptoms of osteoarthritis by promoting cartilage repair and reducing inflammation. Calcium and Vitamin D: Vital for bone health, preventing osteoporosis and promoting the maintenance of strong bones(13)

6. LIVER:

Silymarin (Milk Thistle): Known for its liver-protective properties, silymarin helps in the regeneration of liver cells and protects the liver from toxins and oxidative damage. Green Tea Extract: Rich in polyphenols, green has been shown to protect the liver from damage caused by fat accumulation and improve liver enzyme levels(14)

7. SKIN:

Collagen Peptides: Support skin elasticity and hydration, slowing the aging process by promoting the production of collagen in the skin. Vitamin E: An antioxidant that protects skin cells from oxidative damage caused by UV rays, pollution, and aging(15)

WHY NUTRACEUTICALS?

It is impossible for a great number of us to obtain enough nourishment from our regular diet. Second, the environment in which we live is extremely dangerous due to pollution and pesticides, which interfere with our bodies' natural ability to manage them.Drugs usually create adverse effects because they are not natural to the body; nevertheless, we may strengthen our bodies and add vitality with high-quality supplements that the body can absorb and use(16) .

Nutraceuticals are rich in bioactive compounds that can help prevent chronic diseases like cardiovascular disease, diabetes, and cancer. They contain vitamins, minerals, antioxidants, and other functional compounds that support the body’s immune system and overall health. For instance, omega-3 fatty acids from fish oil are known for reducing the risk of heart disease. (17)

Nutraceuticals are seen as a natural alternative to synthetic drugs. They provide health benefits without the side effects that are often associated with pharmaceuticals. Many people prefer natural compounds for managing conditions like arthritis, high cholesterol, or inflammation(18). Nutraceuticals like vitamins C, D, and zinc play a crucial role in boosting the immune system, which is essential in combating infections and maintaining overall

health. They are also effective in reducing inflammation, which is linked to a range of chronic diseases.(19)Certain nutraceuticals have been shown to support mental health by improving mood, reducing anxiety, and enhancing cognitive function. For example, omega-3 fatty acids and herbal extracts like ginkgo biloba are used to support brain health and cognitive function(20).

WHY NUTRACEUTICAL SEEMS ATTRACTIVE?

People ingest large amounts of phenolics on a daily basis from a variety of foods.

- Side effects are infrequent with them.
- Their half-lives are comparatively long.
- They are readily available without a prescription and don't require an appointment with a healthcare provider

1. PREVENTIVE HEALTHCARE

Nutraceuticals are known for their ability to prevent diseases by improving overall health. They offer an alternative or complement to traditional pharmaceutical treatments by addressing nutritional deficiencies and promoting wellness (21)

2.NATURAL AND SAFE

Consumers are increasingly shifting towards natural remedies for their health. Nutraceuticals, often derived from food sources, are perceived as safer compared to synthetic drugs, as they are seen as less likely to have adverse effects(22)

3. AGING POPULATION AND CHRONIC DISEASES

With an aging global population and the rise of chronic diseases like diabetes, heart disease, and cancer, nutraceuticals have been proposed as adjuncts or alternatives to traditional medical treatments(23)

4. COST-EFFECTIVENESS

Compared to long-term pharmaceutical treatments, nutraceuticals are often more cost-effective in managing chronic conditions and maintaining health, which makes them appealing in both developing and developed nations(24).

5. GROWING CONSUMER AWARENESS

Increasing awareness and education about the role of nutrition in health have driven the demand for nutraceuticals. Consumers are more proactive in taking control of their health through supplements and functional foods (25).

6. INNOVATIONS IN BIOTECHNOLOGY

The growth of biotechnological advancements has made it easier to extract, purify, and enhance nutraceutical ingredients, leading to more potent and specific products tailored for different health conditions(26).

CLASSIFICATION

1. TRADITIONAL

- Chemical constituents: Nutrients, Herbals, Phytochemicals
- Probiotic organisms
- Nutraceutical enzymes

2. NON TRADITIONAL

- Fortified nutraceuticals
- Recombinant nutraceuticals.

3. SUBSTANCE WITH ESTABLISHED NUTRITIONAL FUNCTIONS

- Vitamins
- Minerals
- Amino acids

- Fatty acids

4. HERBS (OR)BOTANICAL PRODUCTS
5. REAGENTS DERIVED FROM OTHER SOURCES

- Pyruvate
- Chondroitin sulphate
- Steroid hormone precursors

6. ROBIOTICS AND PREBIOTICS

8. PFUNCTIONAL FOODS
7. POLYUNSATURATED FATTY ACIDS

9. ANTIOXIDANT VITAMIN

10. POLYPHENOLS

11. SPICES

HERBS USE AS S NEUTRACEUTICAL

1***. TURMERIC (Curcuma longa)***

- **Family**: Theaceae
- **Key Chemical Constituents**: Polyphenols (epigallocatechin gallate or EGCG), caffeine, theanine
- **Health Benefits**: Antioxidant, promotes weight loss, cardiovascular health, anticancer

MOA: Curcumin influences other cell signaling pathways, including COX-2, LOX, and MAPK, which are involved in inflammation and immune responses. This modulation may help reduce chronic disease risk.
Anti-inflammatory effects: Curcumin inhibits molecules in the inflammatory pathway, particularly NF-kB (nuclear factor kappa-light-chain-enhancer of activated B cells). NF-kB plays a key role in controlling the body's inflammatory response. By inhibiting NF-kB, curcumin reduces inflammation, which may help in conditions like arthritis, digestive disorders, and cardiovascular disease.

Figure 1

2. GINGER (Zingiber officinale)

- **Family**: Zingiberaceae
- **Key Chemical Constituents**: Gingerols, shogaols, zingerone, volatile oils
- **Health Benefits**: Antiemetic, anti-inflammatory, aids digestion, alleviates nausea

MOA:
Anti-inflammatory Effects: Ginger's compounds inhibit enzymes like cyclooxygenase (COX) and lipoxygenase (LOX), which are involved in producing pro-inflammatory chemicals (prostaglandins and leukotrienes). This helps reduce inflammation and can alleviate pain in conditions like arthritis

Digestive Aid: Ginger stimulates bile production and gastric secretions, aiding in the breakdown and absorption of food. It also increases gastrointestinal motility, which can help reduce bloating, indigestion, and nausea.

Figure 2

3. GARLIC (Allium sativum)

- **Family**: Amaryllidaceae
- **Key Chemical Constituents**: Allicin, alliin, sulfur compounds (diallyl disulfide, diallyl trisulfide)
- **Health Benefits**: Antimicrobial, cardiovascular health, antioxidant, anticancer

MOA:

Blood Pressure Reduction: Garlic can promote the production of nitric oxide, a molecule that helps blood vessels relax, which can reduce blood pressure.

Cholesterol Regulation: Garlic has been shown to reduce total and LDL ("bad") cholesterol while potentially increasing HDL ("good") cholesterol levels.

Blood Clot Prevention: Compounds in garlic can inhibit platelet aggregation, reducing the risk of blood clots and thereby lowering the risk of heart attack and stroke.

Figure 3

4. ***ALOE VERA (Aloe barbadensis)***

- **Family**: Asphodelaceae
- **Key Chemical Constituents**: Anthraquinones (aloin, barbaloin), polysaccharides (acemannan), enzymes, vitamins
- **Health Benefits**: Skin healing, anti-inflammatory, digestive health, immune boosterAntioxidant Activity:

MOA:

Aloe vera is rich in vitamins C, E, and beta-carotene, which act as antioxidants. These compounds help reduce oxidative stress, protecting cells from damage by free radicals.

Figure 4

5. GREEN TEA (Camellia sinensis)

- **Family**: Theaceae
- **Key Chemical Constituents**: Polyphenols (epigallocatechin gallate or EGCG), caffeine, theanine
- **Health Benefits**: Antioxidant, promotes weight loss, cardiovascular health, anticancer

MOA:

Blood Sugar Regulation: EGCG may help improve insulin sensitivity, which aids in better blood sugar control, reducing the risk of developing type 2 diabetes.

Brain Health and Alertness: Caffeine and L-theanine in green tea work together to improve brain function, enhancing focus, alertness, and relaxation without causing jitteriness

Figure 5

6. ***ASHWAGANDHA (Withania somnifera)***

- **Family**: Solanaceae
- **Key Chemical Constituents**: Withanolides, alkaloids (somniferine)
- **Health Benefits**: Adaptogen, stress relief, cognitive enhancer, immune system support

MOA:

Adaptogenic and Stress-Reducing Effects

Ashwagandha is best known as an adaptogen, meaning it helps the body adapt to stress. It acts on the hypothalamic-pituitary-adrenal (HPA) axis, helping to regulate cortisol (the body's primary stress hormone). This results in decreased cortisol levels and a reduced overall stress response, promoting calmness and reducing anxiety.

Figure 6

7. ***FENUGREEK (Trigonella foenum-graecum)***

- **Family**: Fabaceae
- **Key Chemical Constituents**: Saponins, alkaloids (trigonelline), flavonoids, galactomannan
- **Health Benefits**: Supports blood sugar control, anti-inflammatory, improves lactation

MOA:

Blood Sugar Regulation: Fenugreek has been shown to help regulate blood glucose levels. Its high soluble fiber content may slow the absorption of carbohydrates, leading to a more gradual rise in blood sugar. Additionally, compounds like 4-hydroxyisoleucine may enhance insulin sensitivity and secretion, which can support better blood sugar control.

Figure 7

8. HOLY BASIL (Ocimum sanctum)

- **Family**: Lamiaceae
- **Key Chemical Constituents**: Eugenol, ursolic acid, rosmarinic acid, flavonoids
- **Health Benefits**: Adaptogen, reduces stress, antioxidant, supports respiratory health

MOA:

Antioxidant: Holy Basil contains flavonoids and phenolic acids that act as antioxidants, helping to neutralize free radicals and protect the body's cells from damage, which can reduce the risk of chronic diseases.

Cardioprotective: There is evidence that Holy Basil helps protect the heart by lowering cholesterol levels and improving overall cardiovascular health

Figure 8

9. LICORICE (Glycyrrhiza glabra)

- **Family**: Fabaceae
- **Key Chemical Constituents**: Glycyrrhizin, flavonoids (liquiritigenin), saponins
- **Health Benefits**: Anti-inflammatory, digestive health, immune booster, sore throat relief

MOA:

Electrolyte imbalance: Long-term or excessive consumption can lead to low potassium levels, which might cause muscle weakness, arrhythmia, and other issues.Cortisol effects: Glycyrrhizin inhibits the enzyme 11β-hydroxysteroid dehydrogenase type 2, which normally converts cortisol to its inactive form. This may lead to elevated cortisol levels in the body, which can contribute to symptoms like fatigue, weight gain, and high blood pressure.

Figure 9

10 Amla (Emblica officinalis)

- **Family:** Phyllanthaceae
- **Key Chemical Constituents**: *Vitamin C, Flavonoids, Tannins, Minerals*

Health Benefits:

- **Antioxidant:** Amla's high antioxidant content helps protect against cellular damage from free radicals.
- **Anti-inflammatory:**The presence of tannins and other compounds contributes to its anti-inflammatory properties.
- **Antimicrobial:** Amla exhibits antimicrobial activity, potentially useful in combating infections.
- **Immunity:** Amla is known to improve immunity and fight against various diseases.
- **Hair Health:** Amla is used in Ayurvedic practices for hair strengthening and scalp nourishment.
- **Digestive Health:** Amla can aid in digestion, prevent indigestion, and control acidity.
- **Other Traditional Uses:** Amla is used in Ayurvedic medicine for various ailments, including diarrhea, jaundice, headaches, inflammation, and as a tonic.
- **Potential Benefits:** Amla has potential benefits for heart health, diabetes management, and cancer prevention
- **Mechanism of Action (MOA)**:

- **Antioxidant Activity:** Amla's antioxidant properties are primarily attributed to the presence of vitamin C, flavonoids, and other polyphenols, which help neutralize free radicals and prevent oxidative stress.
- **Anti-inflammatory Activity:** The tannins and other compounds in amla contribute to its anti-inflammatory effects by modulating inflammatory pathaway.

Figure. 10

AREA COVERED BY NUTRACEUTICAL PRODUCTS

Nutraceuticals have addressed every therapeutic area, including anti-arthritic, pain relievers, cold and cough, sleeping disorders, digestion, and the prevention of some cancers, as well as osteoporosis, blood pressure, cholesterol, depression, and diabetes.

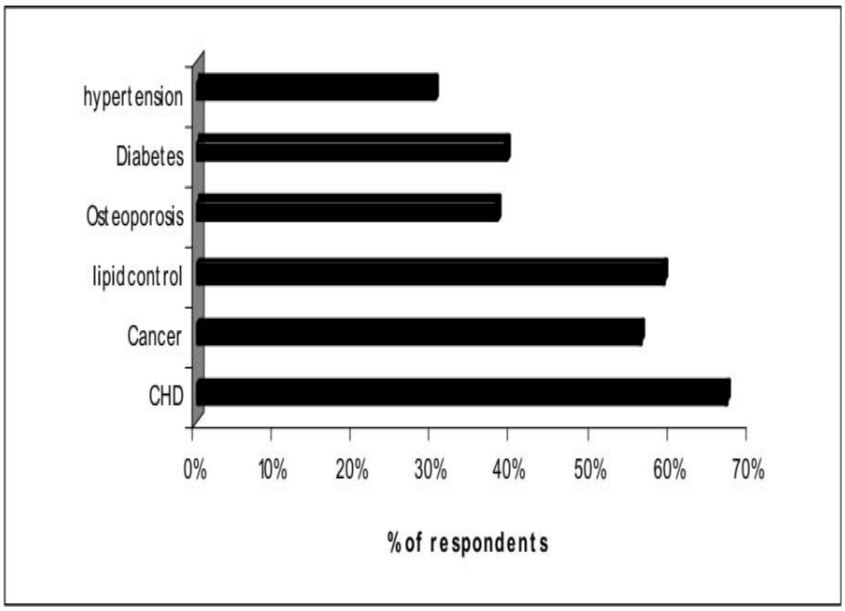


Table 1 : Percentage area covered by nutraceutical products (28)

FORMULATION OF CAPSULE

1 ***SOURCE OF RAW MATERIALS*:**

- Fenugreek seeds are obtained from Pro Nature Organic Fenugreek Methi Seed
- Other excipient are available in a college such as a (lactose, starch , magnesium stearate)
- Quality of Raw Materials: Ensuring high-quality raw materials free from contaminants such as pesticides, heavy metals, or pathogens(29)

INGREDIENT TABLE

Ingredients	Quantity
Fenugreek seeds	**2g**
Amla Powder	**2g**
Lactose Monohydrate (Filler)	**1.5g**
Starch powder (disintegrant, binder, and lubricant)	**400mg**
Magnesium stearate(lubricant)	**120mg**
Talc (glidant)	**120mg**
Methyl Parabin (preservative)	**0.5 mg**

2. EXTRACTION OF BIOACTIVE COMPOUNDS:

- Mechanical or Physical Methods: Grinding raw materials to increase extraction efficiency(31)

Extraction:

Step 1: Preparation of Fenugreek Seeds powder Clean the fenugreek seeds to remove impurities.

- Dry the seeds completely to avoid moisture interference.
- Grind the seeds into a coarse powder to increase surface area and enhance extraction efficiency(32)

Step 2: Selection of Solvent

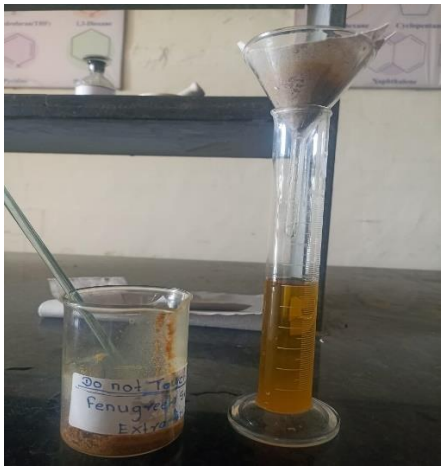
- Use ethanol (70–95%) as the extraction solvent. A solvent-to-seed ratio of 1:10 (1 part seeds to 10 parts ethanol) is recommended for effective extraction.(33)

Step 3: Maceration Process

- Place the ground fenugreek seeds powder into a clean glass container.
- Pour ethanol over the seed powder, ensuring they are completely submerged.
- Stir the mixture to distribute the solvent evenly.
- Cover the container to prevent solvent evaporation.
- Allow the mixture to stand for 24 to 72 hours at room temperature.
- Stir to enhance the extraction process.(34)

Step 4: Filtration

- After maceration, filter the mixture using filter paper to separate the extract from the seed residue.Press the residue to recover as much extract as possible.(35)



Step 5: Concentration

- Gentle heating at a low temperature (below 50°C) to prevent degradation of bioactive compounds.then obtain solid active ingredient and evaporate the solvent(36)

Step 6: Storage of Extract

- Store in a cool, dry place to extend shelf life.(37)

METHOD OF PREPARATION

Fenugreek and Amla granules were prepared by wet granulation method.

Preparation

- Take a Powder extract of Fenugreek seeds and Amla
- In suitable container.
- Viscous sticky extract was mixed with lactose till it produces coherent mass.(38)
- Then required quantity of starch powder (5%) was added and then powder blend was passed through sieve no 12 to produce granules. Granules were gently spread and dried at temperature below 60°C. Dry granules were weighed and their weight was recorded.
- were mixed with granules other ingredients such as starch powder,
  talc and magnesium stearate Methyl paraben were added in required quantities.Which given in above table.
- Further dry granules were regranulated by passing through Sieve to get uniform sized granules. (39)

CAPSULE FILLING

Hard gelatin capsules are a popular dosage form used in pharmaceuticals and dietary supplements to deliver drugs or nutrients. They are tasteless, odorless, and easy to swallow.

1. **Preparation**:

- Wash hands properly and wear gloves and a mask.

- Clean and sanitize the workspace.
- Weigh the required amount of powder.

Separating Capsules:

- Take the empty hard gelatin capsules.
- Hold the capsule and gently separate the cap from the body.

Filling the Capsule Body:

- Place the body part of the capsule upright .
- Use a spatula to fill the powder or granules into the body.
- Lightly tap or press to settle the powder and add more if necessary.

Closing the Capsule:

- Place the cap back onto the filled body.
- Press firmly to lock the capsule securely.

Cleaning:

- Remove any powder from the outside of the capsules using a soft brush .(40)

Evaluation of Nutraceutical capsule

Pre-formulation study well

Phytochemical evaluation:

Molisch's test (for carbohydrates):

- Take 1 g of the sample in a dry test tube
- Take 2 ml of distilled water in a sample
- Add 2 to 3 drops of Molisch's reagent to the solution.
- Observe the colour change at the junction of the two layers.
- Mayers test :
- Sample + Mayer's reagent
- Observe the colour
- Dragendorff's Test :
- Take the sample in test tube
- Add a few drops of Dragendorff's reagent to the filtrate.
- Observe the reaction.

Pre-compressional studies of powder blend granules :

- Bulk density : It is the ratio of bulk mass of powder to the bulk volume. It is denoted by ρb. Bulk density is used to find out homogenecity.
- Bulk density (ρb) = M/Vb
- (ρb) = 6.5/13
  = 0.55
- Where,
- M = mass of the sample,
- Vb =bulk volume

Tapped density : It is the ratio of the weight of powder to the minimum. volume occupied in measuring cylinder. Tapped density is determined by placing a graduated cylinder containing a known mass of drug or formulation on a mechanical tapper apparatus which is operated at fixed no. of taps until the powder bed reached a minimum volume.

Tapped density (ρt) = weight of powder blend/Minimum volume occupied by cylinder

(ρt) = 6.5 / 9 = 0.72

Carr's index : Based on the apparent bulk density and the tapped density, the percentage compressibility of the powder mixture was determined by the following formula.

Carr"s index = Tapped density-Bulk density × 100/Tapped Density

Hausner Ratio : The Hausner Ratio is a measure of the flowability of a powder.

Hausner Ratio = Bulk Density/Tapped Density

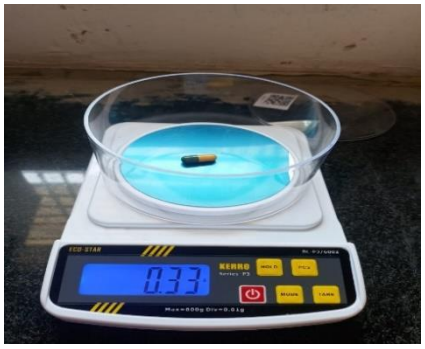
Angle of repose : The maximum angle of inclination from the horizontal at which a pille of loose , granular material can stand without collapsing. (23)

QUALITY CONTROL TEST

- **Physical Characteristics**
  Appearance:
  Shape: Cylinder with hemispherical end.
  Size: 2 [capacity 250 mg](41)

- **Determination of uniformity of weight**
  Twenty capsules were selected. Each capsule was weighed on an analytical balance, carefully emptied of its content, the shells reweighed and the weight of content determined.
  The collective weight of content, average weight of content per capsule and mean were calculated.(42)
  Variation in capsule weight is (+_1)





Disintegration test

- Place one capsule in each of the 6 tubes of the basket-rack assembly.Place a disc in each tube (if specified).
- Fill the beaker with the test medium (usually 900 mL) and maintain the temperature at 37 ± 2°C. Operate the apparatus so that the basket moves up and down (28-32 cycles per minute).
- Observe the capsules during the movement. Continue the test for the time specified in the monograph (usually 30 minute).(43)

Dissolution Tests

- Prepare the Dissolution Medium:
- Use 900 mL of medium (l water) in a beaker. Heat it to 37°C (body temperature).
- Set Up the Apparatus: Use a dissolution tester with Basket method (Apparatus I)
- Place the Capsule: Put one capsule into the basket or directly into the medium under the paddle.
- Start the Machine:Rotate the basket or paddle at a fixed speed (usually 50 rpm).

- Take Samples:At set time points (like 5, 10, 30 minutes), take small samples of the liquid.
- Filter the Sample: Filter each sample to remove particles.
- Measure Drug Release. Use a UV spectrophotometer to check how much drug has dissolved.
- Compare with Standard: Calculate the percentage of drug released and compare with the expected value.(43)

RESULT AND DISCUSSION

Phytochemical Evaluation Hearbs

- **Molisch test :** The appearance of purple colour indicate the presence of carbohydrates.
- **Mayers test :** Yellow precipitation indicate alkaloids are present.
- **Dragon drop test :** Raddish broun precipitation indicate the presence of alkoloides .

Test performed for fenugreek seed extract

Sr .No	Parameters	Result
1	Molisch test	Carbohydrate present
2	Mayers test	Alkaloids present
3	Dragon drop test	Alkaloids present

Test performed for Amla powder
Biuret Test : A violet or pink color indicates the presence of proteins.
Ninhydrin Test : violet colour indicate the presence of amino acids.

Sr. No	Parameters	Result
1	Molisch Test	Carbohydrate present
2	Biuret Test	Presence of proteins
3	Ninhydrin Test	Amino acids present

Organolaptic Evaluation Of Granules

Sr.No	Parameters	Observation
1	Colour	Yellowish
2	Odor	Sour and slightly pungent
3	Appearance	Granules

Organolaptic Evaluation Of Capsule

Sr . No	Parameters	Observation
1	Colour	Yellow Green
2	Odor	Odorless
3	Appearance	Hard gelatin

Rheological Evaluation

Sr No.	Parameters	Result
1	Bulk density	0.55
2	Tapped density	0.72
3	Angle of repose	22.2
4	% Carrs index	6.57
5	Houseners ratio	1.07

Physical characterization of fenugreek capsule

Sr No.	Weight Variation (Mg)	Disintegration Test (Min)	Dissolution time(Min)
1	330	15	28
2	320	14	26
3	330	15	27

Nutraceuticals represent a promising frontier in the integration of nutrition and health care.
As our understanding of the relationship between diet, lifestyle, and disease continues to evolve, nutraceuticals have emerged as a valuable tool for preventive healthcare and disease management.
By harnessing the health benefits of functional foods, dietary supplements, and herbal products, nutraceuticals offer innovative solutions to promote overall well-being and enhance quality of life.
The use of nutraceuticals must be approached cautiously, nevertheless. To maximize their advantages and reduce any potential risks, it is essential to ensure that claims are safe, high-quality, and supported by evidence.
Establishing policies and standards for nutraceutical products will require cooperation from researchers, medical experts, and regulatory agencies.

In vivo and In vitro study of capsules

The antidiabetic effects of various capsule formulations were assessed in diabetic rats induced by streptozotocin, with the results compared to those of capsules containing crude fenugreek seed powder . In this study, hyperglycemia was noted in the rats three days after STZ induction. When compared to normal rats, the STZ-diabetic rats exhibited an increase of over four times in blood glucose levels. The antidiabetic effect of fenugreek formulations demonstrated that Capsules significantly ($p \leq 0.001$) lowered blood glucose levels in diabetic rats by 58.90% and 64.72%, respectively, after a 15-day treatment period, in comparison to the diabetic control group. Administration of fenugreek formulations in STZ-induced diabetic rats began to decrease fasting blood glucose levels after five days and resulted in normoglycemia after 15 days.

Fasting blood sugar levels in rats receiving oral formulations

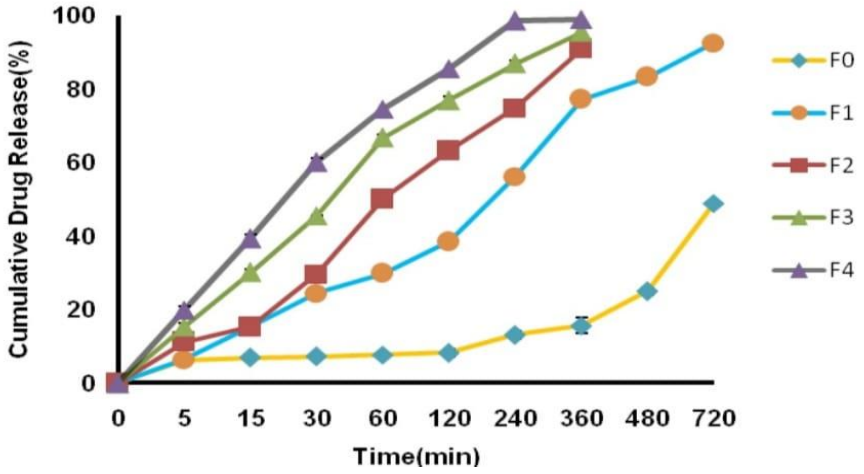
Groups Treatment Fasting blood sugar level in mg/dL

Group	Treatment	Day 0	Day 5	Day 10	Day 15
1	Normal Control	76	75	74	74
2	Diabetic Control	278	281	286	292
3	Capsule F1	279	180	135	120

In vitro dissolution study of capsules

An in vitro dissolving investigation was conducted to ascertain the rate and amount of trigonelline release from capsule formulations. The percentage release of trigonelline from formulation was determined to be 77.06 ± 1.01 after 6 hours, according to the dissolution profile of fenugreek capsules. Dissolution studies were carried out for an additional 12 hours in order to achieve a 92% drug release because the release of trigonelline. Trigonelline releases slowly and incompletely because fenugreek contains a high percentage of mucilage, a naturally occurring gummy material found in seed coatings.
Fenugreek extract creates a thick, sticky mass when it comes into contact with liquids, which causes the release of the drug from the granules to be delayed. The mucilage obtained from fenugreek seeds has also been identified as a binding agent, suspending agent, gelling agent, and release-retarding material in solid dosage forms. Since formulation not yield satisfactory drug release, the incorporation of sodium starch glycolate (SSG) as a superdisintegrant into fenugreek capsules was carried out to enhance drug release. To investigate the impact of varying amounts of superdisintegrants,

three were created, containing 2%, 3%, and 5% sodium starch glycolate as a superdisintegrant, respectively. The dissolution profiles of capsules indicated that over 90% of the drug was released after 6 hours. It was noted that as the concentration of sodium starch glycolate increased, both the rate and extent of drug release from formulations. Thus, the characteristics of the release were notably affected by the amount of superdisintegrants utilized. SSG functions as a superdisintegrant by swiftly absorbing water and swelling, which leads to a significant increase in the volume of the granules, ultimately resulting in quick and uniform disintegration. The dissolution profiles of the formulated capsules were also compared to the drug release from capsules made by directly encapsulating fenugreek seed powder.



FUTURE PROSPECTS OF NUTRACEUTICLES

The future of nutraceuticals, which are food-derived products offering health benefits beyond basic nutrition, is a growing area of research and development. Many experts and studies have explored the potential of nutraceuticals in preventive health care, chronic disease management, and personalized nutrition. Below are some key prospects of nutraceuticals along with their references by notable authors and experts in the field:

- **Preventive health care**
  Nutraceuticals are increasingly being considered vital for preventive healthcare due to their role in mitigating chronic diseases such as cardiovascular disease, cancer, and diabetes. As consumers shift toward health-conscious lifestyles, the demand for functional foods and nutraceuticals is expected to grow significantly (44).
- **Chronic disease management**
  nutraceuticals play a crucial role in managing chronic conditions such as diabetes, osteoporosis, and arthritis. As these conditions become more prevalent with aging populations, nutraceuticals could complement traditional medicine, offering natural alternatives with fewer side effects. (45)
- **Personalized nutrition**
  Nutrigenomics, the study of how nutrition interacts with genes, suggests that nutraceuticals tailored to an individual's genetic makeup could improve health outcomes and prevent disease more effectively than a one-size-fits-all approach. (46)
- **Aging population**
  The growing elderly population offers another area of expansion for nutraceuticals, particularly for promoting cognitive health, reducing inflammation, and improving joint function. nutraceuticals targeting age-related disorders will be in high demand, given the rise of neurodegenerative diseases such as Alzheimer's.(47)
- **Innovation in delivery systems**
  the need for innovation in the delivery of bioactive compounds found in nutraceuticals. Advances in nanotechnology, encapsulation techniques, and biopolymer systems could improve the bioavailability and efficacy of these compounds, making them more attractive to consumers.(48)
- **Sustainability and plant-based nutraceuticals**
  With an increasing focus on sustainability, plant-based nutraceuticals are likely to experience growth. plant-derived compounds such as polyphenols, flavonoids, and phytosterols offer promising applications in nutraceuticals, aligning with global sustainability goals.(49).
- **Regulatory frameworks and consumer trust**
  The evolving regulatory environment will play a significant role in the future of nutraceuticals. , clear regulatory guidelines and scientifically validated health claims will be essential for building consumer trust and ensuring the industry's growth(50)
  Each of these prospects points to a growing demand for nutraceuticals driven by technological advances, a focus on sustainability, and increasing consumer awareness of health and wellness. The research highlights that nutraceuticals have the potential to shift from being supplemental to becoming a core part of health care strategies globally(51)

CONCLUSION

The growing body of scientific research supports the efficacy of various nutraceuticals in addressing health issues ranging from chronic diseases to mental health conditions. Moreover, the increasing consumer interest in natural remedies and personalized nutrition further underscores the potential of nutraceuticals in modern medicine. However, it is essential to approach the use of nutraceuticals with caution. Ensuring quality, safety, and evidence-based claims is crucial for maximizing their benefits and minimizing potential risks. Collaborative efforts between researchers, healthcare professionals, and regulatory bodies will be vital in establishing guidelines and standards for nutraceutical products. As we move into this new era of medicine and health, embracing the integration of nutraceuticals into our healthcare systems can lead to more holistic, preventive, and personalized approaches to health. By prioritizing nutrition alongside traditional medical practices, we can foster a healthier population and reduce the burden of disease, ultimately paving the way for a brighter future in healthcare.

REFERENCE

1. (Dey P, Jain N, Nagaich U. Nutraceuticals: an overview of regulations. Int J Pharm Life Sci. 2018;9:5762–5766. • The article proposes an overview of the existing regulation outlining the difference between them in different contexts.)
2. (Murugesan, R., & Orsat, V. (2011). Spray Drying for the Production of Nutraceutical Ingredients—A Review. Food and Bioprocess Technology, 5(1), 3–14. https://doi.org/10.1007/s11947-011-0638-z)
3. (Banerjee, S. (2022). Safety concerns of dietary and herbal supplements for typical patients. International Journal of Pharmaceutical Chemistry and Analysis, 8(4), 141–144. https://doi.org/10.18231/j.ijpca.2021.027)
4. (Keservani, R. K., Kesharwani, R. K., Vyas, N., Jain, S., Raghuvanshi, R., & Sharma, A. K. (2010). Nutraceutical and functional food as future food: a review. Der Pharmacia Lettre, 2(1), 106–116.
5. (McClements, D. J. (2010). Edible nanoemulsions: fabrication, properties, and functional performance. Soft Matter, 7(6), 2297–2316. https://doi.org/10.1039/c0sm00549e)
6. (Mironidou-Tzouveleki, M.; Tzitzis, P. M. Medical Practice in the Ancient Asclepeion in Kos Island. Hell. J. Nucl. Med.)
7. (Santacroce, L.; Bottalico, L.; Charitos, I. A. Greek Medicine Practice at Ancient Rome: The Physician Molecularist Asclepiades. Med. (Basel, Switzerland) 2017,)
8. (Anwar, F., Latif, S., & Ashraf, M. (2006). Analytical characterization of hemp (Cannabis sativa) seed oil from different agro-ecological zones of Pakistan. Journal of the American Oil Chemists Society, 83(4), 323–329. https://doi.org/10.1007/s11746-006-1207-x)
9. "Omega-3 Fatty Acids in Cardiovascular Disease Prevention," American Journal of Clinical Nutrition, 2019.
10. "Neuroprotective Effects of Curcumin: Evidence from Animal and Human Studies," Journal of Alzheimer's Disease, 2020.
11. "The Role of Probiotics and Prebiotics in Gastrointestinal Health," Gastroenterology Clinics of North America, 2017.
12. "Immune-Enhancing Effects of Vitamin C," Nutrients, 2021.
13. "Glucosamine and Chondroitin for Osteoarthritis: Benefits and Risks," Arthritis Research & Therapy, 2020.
14. "Milk Thistle: A Comprehensive Review of Its Liver-Protective Effects," Hepatology International, 2018.
15. "Collagen Supplementation for Skin Health: A Review," Journal of Clinical and Aesthetic Dermatology, 2019.
16. (Keservani, R. K., Kesharwani, R. K., Vyas, N., Jain, S., Raghuvanshi, R., & Sharma, A. K. (2010). Nutraceutical and functional food as future food: a review. Der Pharmacia Lettre, 2(1), 106–116. https://www.scholarsresearchlibrary.com/articles/nutraceutical-and-functional-food-as-future-food-a-review.pdfp
17. Wildman, R. E. C. (Ed.). (2007). Handbook of Nutraceuticals and Functional Foods. CRC Press.)
18. Kalra, E. K. (2003). Nutraceutical—Definition and introduction. AAPS PharmSci, 5(3), 27-28. https://doi.org/10.1208/ps050325)
19. Calder, P. C. (2020). Nutrition, immunity, and COVID-19. BMJ Nutrition, Prevention & Health, 3(1), 74-92. https://doi.org/10.1136/bmjnph-2020-000085)
20. Grosso, G., Micek, A., Marventano, S., Castellano, S., & Pajak, A. (2014). Dietary n-3 PUFA, fish consumption and depression: A systematic review and meta-analysis of observational studies. Frontiers in Aging Neuroscience, 6, 58
21. Journal Reference: Ramaa, C. S., Shirode, A. R., Mundada, A. S., & Kadam, V. J. (2006). Nutraceuticals–an emerging era in the treatment and prevention of cardiovascular diseases. Current pharmaceutical biotechnology, 7(1), 15-23.
22. Journal Reference: Kalra, E. K. (2003). Nutraceutical-definition and introduction. AAPS PharmSciTech, 5(3), 27-28.
23. Journal Reference: Rajasekaran, A., Sivagnanam, G., & Xavier, R. (2008). Nutraceuticals as therapeutic agents: A review. Research Journal of Pharmacy and Technology, 1(4), 328-340.
24. Journal Reference: Hardy, G. (2000). Nutraceuticals and functional foods: Introduction and meaning. Nutrition, 16(7-8), 688-689.
25. Journal Reference: Gupta, R. C., Chang, D., Nammi, S., Bensoussan, A., Bilinski, K., & Roufogalis, B. D. (2010). Nutraceuticals in the management of metabolic disorders. Evidence-Based Complementary and Alternative Medicine, 7(3), 307-315.
26. Martirosyan, D. M., & Singh, J. (2015). A new definition of functional food by FFC: What makes a new definition unique?. Functional Foods in Health and Disease, 5(6), 209-223.
27. (Murugesan, R., & Orsat, V. (2011). Spray Drying for the Production of Nutraceutical Ingredients—A Review. Food and Bioprocess Technology, 5(1), 3–14. https://doi.org/10.1007/s11947-011-0638-z)
28. (Nirali Prakashan, 2002; p 542-549. 17.Sami Labs — pioneer in nutraceuticals. The Hindu Newspaper; Aug 05, 2002, Avaliable from: http://www.hinduonnet.com/thehindu/biz/2002/08/05/stori es/2002080500040200.htm

29. Martirosyan, D. M., & Singh, J. (2015). "A new definition of functional food by FFC: what makes a new definition unique?" Functional Foods in Health and Disease, 5(6), 209-223.
30. Pandey, M., Verma, R. K., & Saraf, S. A. (2010). "Nutraceuticals: New era of medicine and health." Asian Journal of Pharmaceutical and Clinical Research, 3(1), 11-15.
31. Shahidi, F., & Ambigaipalan, P. (2015). "Phenolics and polyphenolics in foods, beverages and spices: Antioxidant activity and health effects – A review." Journal of Functional Foods, 18, 820–897.
32. Pandey, M., Verma, R. K., & Saraf, S. A. (2010). "Nutraceuticals: New era of medicine and health." Asian Journal of Pharmaceutical and Clinical Research, 3(1), 11-15.
33. Shahidi, F., & Ambigaipalan, P. (2015). "Phenolics and polyphenolics in foods, beverages and spices: Antioxidant activity and health effects – A review." Journal of Functional Foods, 18, 820–897.
34. Martirosyan, D. M., & Singh, J. (2015). "A new definition of functional food by FFC
35. Shahidi, F., & Ambigaipalan, P. (2015). "Phenolics and polyphenolics in foods, beverages and spices: Antioxidant activity and health effects – A review." Journal of Functional Foods, 18, 820–897.
36. Martirosyan, D. M., & Singh, J. (2015). "A new definition of functional food by FFC: what makes a new definition unique?" Functional Foods in Health and Disease, 5(6), 209-223.
37. Shahidi, F., & Ambigaipalan, P. (2015). "Phenolics and polyphenolics in foods, beverages and spices: Antioxidant activity and health effects – A review." Journal of Functional Foods, 18, 820–897.
38. Martirosyan, D. M., & Singh, J. (2015). "A new definition of functional food by FFC: what makes a new definition unique?" Functional Foods in Health and Disease, 5(6), 209-223.
39. "Pharmaceutical tablet quality control tests: Current industry practices and future trends" by Patel, M., & Patel, P., Journal of Pharmacy and BioAllied Sciences, 2016.
40. "Dissolution testing of nutraceutical tablets: A comparative study" by Singh, A., & Choudhary, S., International Journal of Pharmaceutical Sciences and Research, 2019.
41. "Microbial quality of nutraceutical products: An overview" by Zhang, Y., & Wu, D., Journal of Food Microbiology, 2020.
42. Stability studies and quality assessment of nutraceutical formulations" by Jackson, S., Journal of Pharmaceutical and Biomedical Analysis, 2018
43. "Nutraceutical stability testing: A comprehensive approach" by Prasad, R., & Gupta, K., Journal of Applied Pharmaceutical Science, 2019
44. Shahidi, F., & Ambigaipalan, P. (2015). Nutraceuticals and bioactives from food: Their role in health promotion and disease prevention. Journal of Food Bioactives, 1(1), 1-1
45. DeFelice, S. L. (2013). The nutraceutical revolution: Fueling a powerful, new international market. Trends in Food Science & Technology, 19(1), 1-5.
46. Roberfroid, M. B. (2002). Functional food concept and its application to prebiotics. British Journal of Nutrition, 87(S2), S139-S143.
47. Ghosh, D., Scheepens, A., & Vellas, B. (2018). The aging brain: Impact of nutrients, nutraceuticals, and physical activity. Neurobiology of Aging, 66, 3-7.
48. McClements, D. J. (2020). Future prospects for nanotechnology in food: Bioactive delivery systems. Annual Review of Food Science and Technology, 11, 65-90.
49. Pandey, K. B., Rizvi, S. I., & Mishra, M. (2021). Plant-based nutraceuticals: Promising future for meeting the sustainability goals. Journal of Clinical Biochemistry and Nutrition, 68(2), 157-162.
50. Kalra, E. K. (2003). Nutraceutical-definition and introduction. AAPS PharmSciTech, 5(3), 27-30.
51. (Keservani, R. K., Kesharwani, R. K., Vyas, N., Jain, S., Raghuvanshi, R., & Sharma, A. K. (2010). Nutraceutical and functional food as future food: a review. Der Pharmacia Lettre, 2(1), 106–116. https://www.scholarsresearchlibrary.com/articles/nutraceutical-and-functional-food-as-future-food-a-review.pdf)