

Unit-2

Herbal Drug Technology

B.Pharma 6th Sem Notes

Unit: 2

Nutraceuticals

- General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina

Herbal-Drug and Herb-Food Interactions:

- General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions:
- Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra

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Nutraceuticals

Definition:

- The term *Nutraceutical* is derived from “*Nutrition*” and “*Pharmaceutical*”. It refers to any food or part of a food that provides **medical or health benefits**, including the prevention and treatment of disease.
- In simple terms, nutraceuticals are **products derived from food sources** that offer **extra health benefits** in addition to their basic nutritional value.

General Aspects

- They are **bioactive compounds** that promote health, improve immunity, delay aging, and prevent chronic diseases.
- These products occupy a **midway position between food and medicine**.

Examples: Vitamins, minerals, probiotics, omega-3 fatty acids, herbal extracts (like turmeric, garlic, ginseng, etc.)

Market and Growth

- The **global nutraceutical market** is rapidly growing due to increased health awareness, urbanization, and lifestyle-related diseases.
- The **Indian nutraceutical market** is one of the fastest-growing in the world.
 - **Estimated size:** Over **USD 10 billion** and expected to reach **USD 25 billion by 2030** (approximate industry estimates).
- Major factors driving growth:
 - Increasing awareness about health and fitness.
 - Rising incidence of chronic diseases (diabetes, obesity, heart diseases).
 - Shift from curative to **preventive healthcare**.
 - Easy availability of nutraceutical products through pharmacies, online stores, and supermarkets.
- **Leading companies in India:**
Himalaya, Amway, Dabur, Patanjali, Herbalife, and Abbott.

Scope

- **Preventive healthcare:** Nutraceuticals are used to prevent lifestyle diseases like diabetes, hypertension, and cardiovascular disorders.
- **Therapeutic use:** Some nutraceuticals are used as adjunct therapy with modern medicine (e.g., Omega-3 with heart drugs).
- **Sports nutrition:** Supplements for muscle building, energy, and endurance.
- **Cosmeceuticals:** Nutraceuticals used for skin, hair, and beauty care (e.g., collagen, vitamin E).
- **Geriatric nutrition:** Products designed for elderly health and immunity.



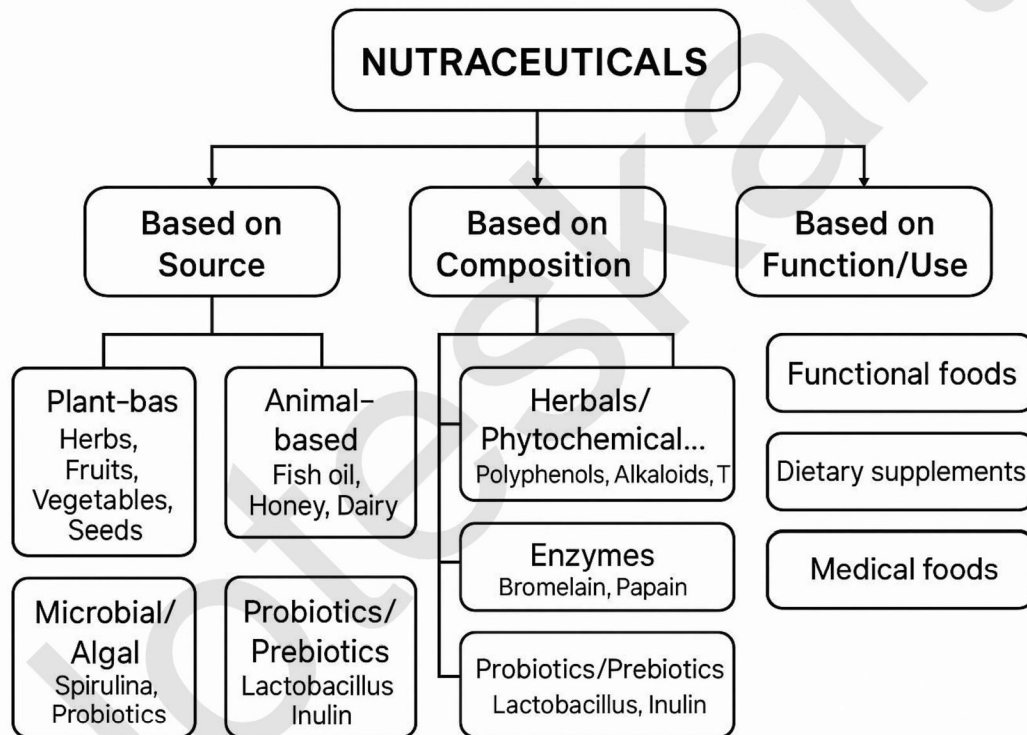
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Types of Market-Available Nutraceutical Products

- **Single-herb standardized extracts** (e.g., standardized gingerol extract)
- **Multi-herb formulations** (combinations for metabolic support, immunity, etc.)
- **Fortified/functional foods** (e.g., omega-3 fortified eggs)
- **Powders, capsules, tablets, syrups, drinks**
- **Probiotic and prebiotic preparations**
- **Protein blends and algal supplements (spirulina)**

Classification of Nutraceuticals

Classification of Nutraceuticals:



Health Benefits & Role in Specific Diseases

Nutraceuticals often act as adjuncts or preventive agents. They are seldom definitive cures; clinical decisions should rely on high-quality evidence and physician guidance.

Diabetes Mellitus

Possible roles:

- Reduce postprandial glucose (inhibit α -glucosidase/slow carbohydrate absorption)
- Improve insulin sensitivity (insulinotropic or insulin-sensitizing effects)
- Antioxidant protection of pancreatic β -cells



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Representative nutraceuticals:

- **Fenugreek** (galactomannans, 4-hydroxyisoleucine) — slows carbohydrate absorption and exhibits insulinotropic effects.
- **Ginger** — insulin-sensitizing and anti-inflammatory properties.
- **Amla** — antioxidant, may modulate glucose metabolism.

Cautions: Herb–drug additive hypoglycemia when combined with antidiabetic drugs.

Cardiovascular Diseases (CVD)

Possible roles:

- Lipid-lowering, antioxidant protection of LDL, antiplatelet effects, mild BP reduction

Representative nutraceuticals:

- **Garlic** (allicin, sulfur compounds) — modest LDL lowering and antiplatelet effects.
- **Spirulina** — may improve lipid profile.
- **Ginkgo** — microcirculatory effects (caution with bleeding risk).

Caution: Additive bleeding risk with anticoagulants/antiplatelets.

Cancer (chemoprevention / supportive care)

Possible roles:

- Antioxidant-mediated protection, anti-inflammatory action, induction of apoptosis, inhibition of angiogenesis (mostly chemopreventive or adjunctive).

Representative nutraceuticals:

- **Amla** — strong antioxidant profile.
- **Ginseng** (ginsenosides) and **ginger** (gingerols) — in vitro anti-proliferative data; ginger useful as antiemetic in chemotherapy-induced nausea.

Caution: High-dose antioxidants may theoretically interfere with certain chemotherapies — consult oncologist.

Irritable Bowel Syndrome (IBS) & Gastrointestinal Diseases

Possible roles:

- Modulation of gut motility and sensation
- Mucosal protection
- Microbiome modulation via prebiotics

Representative nutraceuticals:



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- **Chicory** (inulin) — prebiotic that enhances beneficial bacteria.
- **Fenugreek** — mucilage soothes mucosa.
- **Ginger** — prokinetic/antiemetic; reduces nausea.
- **Spirulina** — general GI mucosal support (nutritional).

Other GI Disorders (gastritis, dyspepsia, PUD support)

- **Ginger** — used for dyspepsia and delayed gastric emptying.
- **Amla** — gastroprotective potential via antioxidant mechanisms.
- **Chicory/inulin** — supports colonic health and regularity.

Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina

Alfalfa (*Medicago sativa*)

- **Family:** Fabaceae
- **Parts used:** leaves, sprouts, seeds
- **Phytochemistry:** proteins, chlorophyll, flavonoids, coumestans, saponins, vitamins (A, C, K), minerals (Ca, Mg, K)
- **Uses:** nutritive tonic, mineral/vitamin supplement; sprouted seeds are high-quality protein and micronutrients
- **Pharmacognosy:** saponins and fiber may lower cholesterol; sprouts are prone to microbial contamination — Good Manufacturing Practices important
- **Safety:** may stimulate immune responses (caution in autoimmune disease); raw sprouts risk of bacterial contamination

Chicory (*Cichorium intybus*)

- **Family:** Asteraceae
- **Parts used:** roasted root (coffee substitute), leaves
- **Phytochemistry:** inulin (fructan), sesquiterpene lactones, polyphenols, volatile oils
- **Uses:** prebiotic (inulin), digestive bitter (stimulates appetite), mild hepatoprotective claims
- **Pharmacognosy:** inulin is a soluble fiber that favors bifidobacteria; sesquiterpene lactones cause bitterness and digestive stimulation
- **Safety:** generally safe; rare allergic dermatitis



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Ginger (*Zingiber officinale*)

- **Family:** Zingiberaceae
- **Part used:** rhizome (fresh/dried)
- **Phytochemistry:** gingerols (6-gingerol), shogaols, paradols, volatile oils (zingiberene)
- **Uses:** antiemetic, carminative, prokinetic, anti-inflammatory, antiemetic in pregnancy (with caution)
- **Pharmacognosy:** gingerols/shogaols modulate COX/LOX and several molecular targets; ginger improves gastric emptying and reduces nausea
- **Safety:** generally safe; high doses can cause heartburn, and possible additive antiplatelet effects

Fenugreek (*Trigonella foenum-graecum*)

- **Family:** Fabaceae
- **Part used:** seeds (also leaves)
- **Phytochemistry:** galactomannans (mucilage), 4-hydroxyisoleucine, saponins (diosgenin-like), alkaloids
- **Uses:** hypoglycemic adjunct (slows absorption and stimulates insulin), lactation stimulant (galactagogue), hypolipidemic claims
- **Pharmacognosy:** mucilage reduces glucose absorption; 4-hydroxyisoleucine shows insulinotropic actions in vitro
- **Safety:** may cause GI upset, maple-syrup scent in body fluids; avoid high doses in pregnancy (uterine stimulant)

Garlic (*Allium sativum*)

- **Family:** Amaryllidaceae
- **Part used:** bulb (fresh, powdered, aged extract)
- **Phytochemistry:** alliin → allicin (through alliinase), ajoene, diallyl sulfides
- **Uses:** antimicrobial, lipid-lowering, modest antihypertensive, antiplatelet effects
- **Pharmacognosy:** sulfur compounds are heat-sensitive; different preparations (raw, aged, odorless) differ in allicin content and activity
- **Safety:** bleeding risk with anticoagulants; GI irritation and odor; topical irritant in concentrated forms



Honey

- **Source:** bee product (*Apis* spp.) derived from floral nectar
- **Phytochemistry:** sugars (fructose, glucose), enzymes (glucose oxidase), flavonoids, phenolic acids; in some (e.g., manuka) non-peroxide activity
- **Uses:** nutritive sweetener, cough relief (>1 year), topical wound healing (due to osmotic effect, low pH, H₂O₂, methylglyoxal in manuka)
- **Pharmacognosy:** composition varies with botanical source; standardization (e.g., MGO in manuka) used for activity claims
- **Safety:** contraindicated for infants <1 year (botulism risk)

Amla (*Emblica officinalis* / *Phyllanthus emblica*)

- **Family:** Phyllanthaceae
- **Part used:** fruit
- **Phytochemistry:** very high vitamin C, tannins (emblicanin A/B), flavonoids, polyphenols
- **Uses:** antioxidant, gastroprotective, hair/skin traditional uses, general tonic
- **Pharmacognosy:** combination of ascorbic acid and hydrolyzable tannins gives strong antioxidant properties
- **Safety:** generally safe; high acidity may aggravate reflux in sensitive individuals

Ginseng (*Panax* spp.)

- **Family:** Araliaceae
- **Parts used:** root (*Panax ginseng* (Asian), *Panax quinquefolius* (American))
- **Phytochemistry:** ginsenosides (saponins), polysaccharides, peptides
- **Uses:** adaptogen (fatigue reduction), cognitive support, immunomodulation, mild metabolic effects
- **Pharmacognosy:** ginsenosides modulate CNS neurotransmitters, immune cells, and endothelial function; profile varies by species and processing (white vs. red ginseng)
- **Safety:** insomnia, nervousness at high doses; interactions with warfarin and hypoglycemic drugs possible

Ashwagandha (*Withania somnifera*)

- **Family:** Solanaceae
- **Parts used:** root and leaves



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- **Phytochemistry:** withanolides (steroidal lactones), sitoindosides, alkaloids
- **Uses:** adaptogen, anxiolytic, stress modulation, possible neuroprotective effects
- **Pharmacognosy:** withanolides affect the HPA axis and GABAergic signalling; extracts are standardized to withanolide content in many products
- **Safety:** generally safe in recommended doses; high doses or pregnancy avoidance recommended; additive sedation with CNS depressants

Spirulina (*Arthrospira platensis* / *A. maxima*)

- **Source:** cyanobacterium (microalga) — whole dried biomass used as supplement
- **Phytochemistry:** high-quality protein (60–70%), phycocyanin, B-vitamins, iron, essential fatty acids, pigments
- **Uses:** nutritional supplement, anemia adjunct (iron content), antioxidant and immune support
- **Pharmacognosy:** phycocyanin is an antioxidant/anti-inflammatory pigment; product safety depends on controlled cultivation to avoid microcystin contamination
- **Safety:** contamination risk — source certification essential; rare allergic reactions

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HERBAL-DRUG AND HERB-FOOD INTERACTIONS

(General Introduction, Classification, and Study of Important Herbs)

GENERAL INTRODUCTION

Herbal-drug interaction occurs when a herbal product alters the **absorption, distribution, metabolism or excretion (ADME)** of a drug, or modifies its **pharmacological action**.

Herb-food interaction occurs when food or dietary items change the effect, absorption, or activity of a herbal product or drug.

These interactions may cause:

- Reduced therapeutic effect of drugs
- Increased toxicity
- Unexpected adverse reactions
- Failure of treatment

CLASSIFICATION OF INTERACTIONS

A. Based on Nature of Interaction

1. Pharmacokinetic Interactions (ADME)

Herbs change the amount of drug in the body by altering:

- **Absorption**
 - e.g., high-fiber herbs reduce absorption of some drugs
- **Distribution**
 - protein-bound herbs may displace drugs
- **Metabolism**
 - some herbs induce or inhibit **CYP450 enzymes**
- **Excretion**
 - affect renal blood flow or transporter proteins

2. Pharmacodynamic Interactions

Herbs change the **effect** of drugs (synergistic or antagonistic):

- Additive action
- Opposing action
- Toxicity due to combined effects

B. Based on Clinical Outcome



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1. **Reduced drug efficacy** (treatment failure)
2. **Increased drug toxicity**
3. **New or unexpected adverse effects**
4. **Beneficial interaction** (rare but possible)

DETAILED STUDY OF IMPORTANT HERBS & INTERACTIONS

Below is an easy exam-ready explanation of each herb, its **active constituents**, **possible side effects**, and **important drug interactions**.

A. HYPERICUM (ST. JOHN'S WORT)

Botanical name: *Hypericum perforatum*

Active constituents: Hypericin, Hyperforin

Common uses:

- Mild to moderate depression
- Anxiety
- Sleep disorders

Major interactions:

✓ **Strong inducer** of CYP3A4, CYP2C9, CYP2C19, and P-glycoprotein → *decreases blood levels of many drugs.*

Drugs affected:

- Oral contraceptives → **treatment failure, unwanted pregnancy**
- Warfarin → **reduced anticoagulation**
- Cyclosporine → **organ transplant rejection**
- Antiretrovirals (HIV drugs) → reduced effect
- Anticancer drugs → treatment failure
- SSRIs → **serotonin syndrome**

Side effects:

- Photosensitivity
- GI upset
- Restlessness



B. KAVA-KAVA

Botanical name: *Piper methysticum*

Active constituents: Kavalactones

Common uses:

- Anxiolytic
- Sedative

Major safety issue:

✓ **Hepatotoxicity** (liver damage) → most significant concern

Interactions:

- Additive sedation with:
 - Benzodiazepines
 - Alcohol
 - Barbiturates
- Increases toxicity of hepatotoxic drugs (e.g., paracetamol)

Side effects:

- Liver failure (rare but serious)
- Yellowish skin
- Drowsiness
- Ataxia

C. GINKGO BILOBA

Botanical name: *Ginkgo biloba*

Active constituents: Ginkgolides, Bilobalide

Common uses:

- Memory enhancer
- Dementia
- Peripheral vascular disease

Major interactions:



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✓ **Increases bleeding risk**

Drugs affected:

- Aspirin
- Warfarin
- Clopidogrel
- NSAIDs

Side effects:

- Headache
- GI upset
- Allergic skin reactions
- Rare seizures

D. GINSENG

Botanical name: *Panax ginseng* / *Panax quinquefolius*

Active constituents: Ginsenosides

Common uses:

- Adaptogen (stress relief)
- Energy booster
- Immunity enhancer

Interactions:

- May reduce the effect of **warfarin**
- Additive effect with antidiabetic drugs → **hypoglycemia**
- Interacts with MAO inhibitors → **hypertension**

Side effects:

- Insomnia
- Nervousness
- Palpitations

E. GARLIC

Botanical name: *Allium sativum*



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Active constituents: Allicin, Ajoene

Common uses:

- Hyperlipidemia
- Hypertension
- Antimicrobial

Interactions:

✓ **Increases risk of bleeding**

Drugs affected:

- Warfarin
- Aspirin
- Clopidogrel
- NSAIDs

Other interactions:

- May reduce levels of protease inhibitors (HIV drugs)

Side effects:

- Bad breath
- Heartburn
- GI irritation

F. BLACK PEPPER (Piper / Pepper)

Botanical name: *Piper nigrum*

Active constituent: Piperine

Common uses:

- Bioavailability enhancer
- Digestive stimulant

Major interactions:

✓ Piperine **inhibits CYP450 enzymes and P-glycoprotein** → increases drug levels.

Drugs affected:

- Phenytoin
- Carbamazepine



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- Theophylline
- Propranolol
- Rifampicin
- Many others due to broad enzyme inhibition

Side effects:

- GI burning
- Skin irritation (topical)

G. EPHEDRA (Ma Huang)

Botanical name: *Ephedra sinica*

Active constituents: Ephedrine, Pseudoephedrine

Common uses:

- Weight loss
- Bronchodilator
- Stimulant

Major interactions:

✓ Strong stimulant → increases BP and heart rate

Dangerous with:

- MAO inhibitors → **hypertensive crisis**
- Stimulant drugs → tachycardia
- Antihypertensive drugs → reduces their effect
- Caffeine → severe CNS and cardiac stimulation

Side effects:

- Palpitations
- Hypertension
- Stroke, MI (reported)
- Anxiety
- Insomnia

(Many countries have banned ephedra-containing supplements.)



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