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HERBAL DRUG TECHNOLOGY

UNIT 1

TOPIC :

- **Herbs as raw materials**

Definition of herb, herbal medicine, herbal medicinal product,
herbal drug preparation Source of Herbs

Selection, identification and authentication of herbal materials

Processing of herbal raw material



Definition of Herb, Herbal Medicine, Herbal Medicinal Product, Herbal Drug Preparation Sources of Herbs

- Herbal medicines have been used since ancient times for prevention and treatment of diseases. Plants contain naturally occurring chemical substances called phytoconstituents which possess medicinal activity. Herbal drugs are widely used in traditional systems such as:
 - Ayurveda
 - Unani
 - Siddha
 - Homeopathy
 - Traditional Chinese Medicine
- The study of herbal medicines is important in pharmacy because many modern drugs are derived from plants.

Definition of Herb

- ⇒ A herb is a plant or plant part that is used for medicinal, therapeutic, flavoring, aromatic, or cosmetic purposes.
- ⇒ According to the World Health Organization:
- ⇒ Herbs include crude plant materials such as leaves, flowers, fruits, seeds, stems, wood, bark, roots, rhizomes, and other plant parts which may be entire, fragmented, or powdered.

Examples

- Tulsi
- Neem
- Ginger
- Turmeric
- Aloe vera

Definition of Herbal Medicine

- Herbal medicines are medicinal products containing active ingredients obtained from plants or plant materials used for treatment, prevention, or diagnosis of diseases.

These medicines may contain:

- Whole plant
- Plant extracts
- Processed plant materials
- Purified phytochemicals

Characteristics

- Natural origin
- Contain phytochemicals
- Fewer side effects (generally)
- Used in traditional medicine systems

Examples

- Ashwagandha preparations
- Senna tablets
- Aloe vera gel
- Turmeric capsules

Definition of Herbal Medicinal Product

- A Herbal Medicinal Product (HMP) is a finished, labeled medicinal product that contains herbal substances or herbal preparations as active ingredients.

It may include:

- One herb
- Combination of herbs
- Processed herbal preparations

Components

- Active herbal ingredient
- Excipients
- Suitable dosage form

Dosage Forms

- Tablets
- Capsules
- Syrups
- Ointments
- Powders
- Tinctures

Examples

- Ayurvedic cough syrup
- Herbal liver tonic
- Neem cream
- Herbal anti-diabetic tablets

Definition of Herbal Drug Preparation

- A herbal drug preparation is obtained by processing herbal materials through extraction, purification, distillation, drying, fermentation, or other methods.
- These preparations are made to concentrate active constituents.

Methods Used

- Extraction
- Distillation
- Expression
- Fractionation
- Purification
- Fermentation

Types of Herbal Preparations

1. Extracts
2. Tinctures
3. Decoctions
4. Infusions
5. Essential oils
6. Powders
7. Juices

Examples

- Ginger extract
- Peppermint oil
- Neem tincture
- Aloe juice

Sources of Herbs

- Herbs are obtained from different natural sources. The major source is the plant kingdom, but some herbal materials may also come from marine and microbial sources.

1. Plant Sources

- Plants are the primary source of herbal drugs. Different parts of plants contain medicinally active constituents.

Different Plant Parts Used as Herbs

Plant Part	Description	Examples
Leaves	Rich in volatile oils and glycosides	Senna, Tulsi
Roots	Contain alkaloids and starch	Rauwolfia, Ashwagandha
Bark	Rich in tannins and alkaloids	Cinchona, Cinnamon
Flowers	Contain pigments and oils	Clove, Chamomile
Fruits	Contain vitamins and acids	Amla, Fennel
Seeds	Rich in oils and proteins	Nux vomica, Castor
Rhizomes	Underground stems	Ginger, Turmeric
Whole plant	Entire plant used	Brahmi, Centella

Classification of Plant Sources

A. Wild Herbs

These plants grow naturally in forests and uncultivated areas.

Advantages

- Easily available
- Less cultivation cost

Disadvantages

- Quality variation
- Seasonal availability

Examples

- Neem
- Amla

B. Cultivated Herbs

These herbs are grown under controlled conditions.

Advantages

- Better quality control
- High yield
- Continuous supply

Examples

- Mint
- Aloe vera
- Ashwagandha

2. Marine Sources

- Some medicinal herbs and bioactive substances are obtained from marine organisms such as:
 - Seaweeds
 - Marine algae

Uses

- Nutritional supplements
- Anticancer research
- Antioxidants

Examples

- Agar
- Alginic acid

3. Microbial Sources

- Certain microorganisms produce substances used in herbal and pharmaceutical preparations.

Examples

- Yeast products
- Fermented herbal preparations

4. Mineral Sources in Herbal Systems

- Traditional herbal systems sometimes combine herbs with natural minerals.

Examples

- Kaolin, Talc
- Shilajit

Methods of Collection of Herbs

1. Wild Collection

- Collected from forests and natural habitats.

2. Cultivation

- Grown scientifically in farms.

3. Harvesting

- Collected at proper maturity stage for maximum active constituents.

Advantages of Herbal Medicines

- Natural and economical
- Easily available
- Better patient acceptance
- Suitable for chronic diseases
- Fewer adverse effects

Disadvantages of Herbal Medicines

- Slow action
- Lack of standardization
- Possible contamination
- Variation in potency
- Limited scientific evidence for some herbs

Applications of Herbal Medicines

- Treatment of diseases
- Health supplements
- Cosmetics
- Nutraceuticals
- Immunity boosters

Selection, Identification and Authentication of Herbal Materials

- Herbal materials are widely used in preparation of herbal medicines and pharmaceutical products. The quality, safety, and efficacy of herbal drugs depend on proper:
 1. Selection
 2. Identification
 3. Authentication
- Incorrect identification or adulteration may lead to:
 - Loss of therapeutic effect
 - Toxicity
 - Poor quality products
- Therefore, evaluation and authentication of herbal materials are essential in pharmaceutical sciences.

Herbal Materials

Herbal materials include:

- Whole plants
- Plant parts
- Fresh or dried materials
- Algae
- Fungi
- Lichens

Examples:

- Leaves of Senna
- Roots of Ashwagandha
- Rhizomes of Ginger

- Bark of Cinchona

1. Selection of Herbal Materials

- Selection of herbal materials is the process of choosing suitable medicinal plants or plant parts based on quality, purity, therapeutic value, and safety.

Objectives of Selection

- To obtain high-quality crude drugs
- To ensure therapeutic efficacy
- To avoid adulteration and contamination
- To maintain standardization
- To ensure patient safety

Criteria for Selection of Herbal Materials

1. Correct Botanical Source

The herb must belong to the correct:

- Family
- Genus
- Species

Example

- Ginger: *Zingiber officinale*
- Turmeric: *Curcuma longa*

Wrong species may produce harmful effects.

2. Plant Part Used

Correct plant part should be selected because active constituents vary in different parts.

Plant	Useful Part
Senna	Leaves
Clove	Flower buds
Ginger	Rhizome
Cinnamon	Bark

3. Geographical Source

Climate and soil affect quality of herbs.

Example

- Himalayan herbs may differ chemically from tropical herbs.

Factors:

- Temperature
- Rainfall
- Altitude
- Soil type

4. Time of Collection

Medicinal value depends on harvesting season and maturity.

Plant Part	Best Collection Time
Leaves	Before flowering
Roots	After maturation
Flowers	At blooming stage
Seeds	After ripening

5. Organoleptic Quality

Herbs should possess normal:

- Color
- Odor
- Taste
- Size
- Texture

Abnormal appearance indicates deterioration.

6. Purity

Herbal materials should be free from:

- Dust
- Insects
- Fungi
- Foreign matter
- Chemical contaminants

7. Active Constituents

Selection depends on presence of desired phytochemicals such as:

- Alkaloids
- Glycosides
- Tannins
- Volatile oils
- Flavonoids

8. Safety

Herbal materials should be:

- Non-toxic
- Free from pesticides
- Free from heavy metals
- Free from microbial contamination

Sources of Herbal Materials

Herbs may be obtained from:

- Wild sources
- Cultivated sources
- Commercial suppliers
- Herbal gardens

2. Identification of Herbal Materials

- Identification is the process of determining the correct identity of a herbal material using scientific methods.
- It confirms that the material belongs to the intended plant species.

Importance of Identification

- Prevents adulteration
- Ensures therapeutic efficacy
- Maintains quality control
- Avoids toxic substitutes
- Essential for standardization

Methods of Identification

1. Organoleptic Evaluation

Identification based on sensory characteristics.

Parameters

- Color
- Odor
- Taste
- Shape
- Size
- Texture

Example

- Clove has aromatic odor
- Ginger has pungent taste

Advantages

- Simple
- Economical
- Quick method

Disadvantages

- Less accurate
- Requires experience

2. Macroscopic Evaluation

Study of external morphology visible to naked eye.

Characteristics Studied

- Shape
- Surface
- Fracture
- Dimensions
- Arrangement

Example

- Cinnamon bark appears rolled and thin.

3. Microscopic Evaluation

Study of internal structures using microscope.

Structures Observed

- Stomata
- Trichomes
- Fibers
- Starch grains
- Calcium oxalate crystals
- Xylem and phloem tissues

Importance

Useful in powdered crude drugs.

4. Physical Evaluation

Includes determination of:

- Moisture content
- Ash value
- Extractive value
- Volatile oil content
- Swelling index
- Foaming index

5. Chemical Evaluation

Identification using chemical tests.

Includes

- Color reactions
- Precipitation tests

- Fluorescence tests

Examples

- Alkaloid tests
- Glycoside tests
- Tannin tests

6. Chromatographic Methods

Used for separation and identification of phytochemicals.

Techniques

- TLC (Thin Layer Chromatography)
- HPLC (High Performance Liquid Chromatography)
- GC (Gas Chromatography)

Advantages

- Accurate
- Sensitive
- Reliable

7. Spectroscopic Methods

Used for characterization of compounds.

Methods

- UV spectroscopy
- IR spectroscopy
- NMR spectroscopy
- Mass spectroscopy

8. DNA Fingerprinting

Modern method for precise identification.

Advantages

- Highly accurate
- Detects adulteration
- Useful for closely related species

Techniques

- PCR
- RAPD
- DNA barcoding

3. Authentication of Herbal Materials

- Authentication is the confirmation that the herbal material is genuine, original, and free from adulteration.
- It ensures that the herb matches official standards.

Importance of Authentication

- Ensures drug safety
- Prevents adulteration
- Maintains quality and efficacy
- Essential for regulatory approval

Methods of Authentication

1. Botanical Authentication

Performed by taxonomists using:

- Botanical name
- Morphology
- Taxonomic classification

2. Pharmacognostic Authentication

Includes:

- Macroscopy
- Microscopy
- Histology

3. Chemical Authentication

Confirmation through:

- Chemical markers
- Chromatographic profile
- Phytochemical screening

4. Biological Authentication

Uses biological activity studies.

Example

- Antimicrobial activity, Anti-inflammatory tests

5. Molecular Authentication

DNA-based authentication techniques.

Advantages

- Very specific
- Detects substitution and adulteration

Adulteration of Herbal Materials

- Adulteration is the substitution or mixing of genuine herbal drugs with inferior, fake, or harmful substances.

Types of Adulteration

Type	Description
Substitution	Replacing original drug with another
Artificial adulteration	Adding synthetic materials
Inferior quality	Mixing low-grade material
Exhausted drugs	Using drugs after extraction
Foreign matter	Dust, sand, insects

Detection of Adulteration

- Microscopic examination
- Chemical tests
- TLC fingerprinting
- DNA analysis
- Organoleptic evaluation

Quality Control of Herbal Materials

Parameters Evaluated

1. Purity Tests

- Foreign matter
- Microbial contamination

2. Physicochemical Tests

- Ash value
- Moisture content

3. Chemical Tests

- Marker compounds

4. Toxicological Tests

- Heavy metals
- Pesticide residues

Processing of Herbal Raw Materials

- Processing of herbal raw materials involves various operations carried out after collection of medicinal plants to preserve their:
 - Quality
 - Purity
 - Potency
 - Stability
- Proper processing is essential because crude herbal materials are highly susceptible to:
 - Microbial contamination
 - Insect attack
 - Moisture damage
 - Loss of active constituents
- Processing converts raw herbal materials into suitable forms for:
 - Storage
 - Manufacturing
 - Medicinal use
- Processing of herbal raw materials is the series of physical, chemical, and mechanical operations performed on medicinal plant materials after harvesting to obtain safe, stable, and effective herbal products.

Objectives of Processing

- To preserve active constituents
- To prevent deterioration
- To reduce moisture content
- To improve shelf life
- To remove contaminants and foreign matter
- To prepare material for formulation

- To maintain therapeutic efficacy

Steps in Processing of Herbal Raw Materials

The major steps include:

1. Collection
2. Harvesting
3. Cleaning
4. Drying
5. Garbling
6. Grinding and size reduction
7. Packaging
8. Storage
9. Preservation

1. Collection of Herbal Materials

- Collection is the gathering of medicinal plants or plant parts from wild or cultivated sources.

Sources of Collection

A. Wild Collection

Plants collected from forests and natural habitats.

Advantages

- Economical
- Easily available

Disadvantages

- Variable quality
- Risk of adulteration

B. Cultivated Collection

Plants grown under controlled conditions.

Advantages

- Better quality control
- Uniformity

Factors Affecting Collection

Factor	Importance
Season	Influences active constituents
Plant age	Affects potency

Climate	Alters phytochemical content
Time of collection	Important for maximum activity

2. Harvesting

- Harvesting is the process of collecting medicinal plant parts at the proper stage of growth and maturity.

Importance of Proper Harvesting

- Maximum therapeutic value
- Higher yield of active constituents
- Better quality crude drugs

Harvesting Time for Different Plant Parts

Plant Part	Best Time
Leaves	Before flowering
Flowers	At full bloom
Fruits	At ripening
Seeds	After maturation
Roots/Rhizomes	Dormant season
Bark	Spring season

Methods of Harvesting

1. Manual Harvesting

Using hands or simple tools.

Advantages

- Less damage
- Selective collection

Disadvantages

- Time consuming

2. Mechanical Harvesting

Using machines.

Advantages

- Fast
- Suitable for large scale

Disadvantages

- Risk of damage

3. Cleaning

- Cleaning is removal of unwanted materials from crude herbs.

Purpose of Cleaning

- Remove dirt and dust
- Eliminate insects
- Remove foreign matter
- Prevent contamination

Methods of Cleaning

A. Washing

Used for roots and rhizomes.

Example

- Ginger
- Turmeric

B. Sieving

Removes dust and small impurities.

C. Hand Picking

Removal of unwanted materials manually.

D. Air Blowing

Removes lightweight impurities.

4. Drying

- Drying is the removal of moisture from herbal materials to prevent decomposition and microbial growth.

Objectives of Drying

- Prevent fungal growth
- Prevent enzymatic reactions
- Increase shelf life
- Preserve active constituents

Ideal Characteristics of Drying

- Uniform drying
- Minimal loss of volatile oils
- No decomposition of active constituents

Methods of Drying

1. Natural Drying

A. Sun Drying

Material dried under sunlight.

Advantages

- Cheap
- Simple

Disadvantages

- Loss of volatile oils
- Risk of contamination

B. Shade Drying

Drying under shade with ventilation.

Advantages

- Preserves color and volatile constituents

Examples

- Leaves
- Flowers

2. Artificial Drying

A. Hot Air Oven Drying

Controlled temperature drying.

Advantages

- Rapid

- Hygienic
- Uniform drying

B. Vacuum Drying

Drying under reduced pressure.

Advantages

- Suitable for heat-sensitive drugs

C. Freeze Drying (Lyophilization)

Water removed by sublimation.

Advantages

- Maintains biological activity
- Preserves sensitive constituents

Disadvantages

- Expensive

Factors Affecting Drying

Factor	Effect
Temperature	Excess heat destroys constituents
Humidity	Delays drying
Air circulation	Improves drying efficiency
Thickness of material	Affects drying speed

5. Garbling

- Garbling is the process of removing undesirable materials from dried crude drugs.

Materials Removed During Garbling

- Foreign matter
- Diseased parts
- Other plant parts
- Dust and stones

Importance

- Improves purity
- Enhances quality
- Prevents adulteration

6. Grinding and Size Reduction

- Grinding is reducing herbal material into smaller particles or powder.

Objectives

- Increase surface area
- Facilitate extraction
- Improve mixing in formulations

Equipment Used

- Mortar and pestle
- Hammer mill
- Pulverizer
- Cutter mill

Types of Powders

Type	Particle Size
Coarse powder	Large particles
Fine powder	Small particles

Very fine powder	Very small particles
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7. Packaging

- Packaging is enclosing processed herbal materials in suitable containers for protection and storage.

Objectives

- Protect from moisture
- Prevent contamination
- Prevent light exposure

Packaging Materials

Material	Uses
Glass containers	Volatile oils
Plastic containers	Powders
Paper bags	Dried herbs
Metal containers	Sensitive materials

Ideal Properties of Packaging

- Non-reactive, Airtight
- Moisture resistant
- Light resistant

8. Storage of Herbal Raw Materials

- Storage means keeping herbal materials under suitable environmental conditions to maintain quality.

Ideal Storage Conditions

- Cool temperature, Dry place
- Protection from sunlight
- Proper ventilation

Precautions During Storage

- Avoid moisture
- Prevent insect infestation
- Regular inspection
- Use airtight containers

Problems During Storage

Problem	Effect
Moisture	Fungal growth

Insects	Drug destruction
Light	Degradation

9. Preservation

- Preservation involves methods used to prevent spoilage and maintain stability of herbal materials.

Preservation Methods

A. Use of Preservatives

- Sodium benzoate
- Parabens

B. Refrigeration

Used for fresh herbal materials.

C. Vacuum Packing

Reduces oxidation and microbial growth.

Standardization During Processing

Standardization ensures:

- Uniform quality
- Consistent potency
- Safety and efficacy

Parameters Evaluated

- Moisture content
- Ash value
- Extractive value
- Active constituents
- Microbial load