Pharmacognosy

Adulteration and Evaluation of Crude drugs
Unit 3rd
Objectives

On completion of this lesson, you would be able to know:

- Methods of adulteration of Crude Drugs
- Commonly used substitutes in adulteration
- Evaluation for determining adulterants
Adulteration and Evaluation

• Adulteration involves incorporation of impurities.

• Includes spoilage deterioration admixture.

• Genuine drugs are intentionally substituted.

• With spurious, inferior, defective or harmful substances.
Adulteration of Crude Drugs

- Adulteration is the debasement of Genuine materials
- Adulteration is done when
  - There is scarcity of crude drugs or
  - Cost of the drug is high even though there is no scarcity
- The drug is either partially or completely substituted
- The adulterant used must be having same morphological characters as that of genuine drug
- In case of powdered drugs colour, texture and density taken into consideration
Methods of Adulteration

1. Manufacture of Substitutes:

   Adulterants are artificially manufactured so as to resemble the genuine drug morphologically.

   Ex. Pieces of Basswood into correct size & shape of Nutmeg and sprayed with volatile oil

   Flour dough moulded into correct size & shape and dipped into red ink and writing ink so as to resemble Ergot
Methods of Adulteration

2. Substitution of superficially similar but cheaper natural materials obtained from same species
   Ex. Addition of Clove stalks to genuine Cloves
   Substitution of Digitalis purpurea with leaves of Digitalis thapsi

3. Substitution of inferior commercial varieties
   Ex. Substitution of Alexandrian Senna with Indian Senna
   Substitution of Capsicum annum fruits with Capsicum minimum
Methods of Adulteration

4. Substitution with exhausted materials
   
   Ex. Exhausted Cloves substituted to genuine Cloves
   
   Exhausted Ginger to genuine Ginger
   
   Exhausted Benzoin to genuine Benzoin

5. The presence of extraneous matter if in excess forms adulteration
   
   Ex. Presence of clove stalks and fruits in Cloves
   
   Presence of stems and other parts in Belladonna
Methods of Adulteration

6. Addition of synthetic principles to fortify inferior varieties

   Ex. Addition of synthetic Citral to oil of Lemon
   Addition of synthetic balsamic acids to Tolu Balsam

7. Powdered drugs

   Ex. In case of powdered drugs colour, texture and density of the powder taken into consideration irrespective of its origin.
Faulty collection

- In some cases the quantity of medicinal constituents reaches the maximum at a particular season.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Season</th>
<th>age stage of maximum activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solanaceous drugs</td>
<td>Summer</td>
<td>flowering stage of Plant</td>
</tr>
<tr>
<td>Rauwolfia</td>
<td>Autumn</td>
<td>3 to 4 years old plant</td>
</tr>
<tr>
<td>Coriander</td>
<td>When fully grown and ripe</td>
<td></td>
</tr>
<tr>
<td>Linseed</td>
<td>When fully ripe</td>
<td></td>
</tr>
<tr>
<td>Colchicum corm</td>
<td>Early summer</td>
<td></td>
</tr>
</tbody>
</table>
Pyrethrum flower - Half or $2/3$rd open flower
Wild cherry bark - Autumn bark of young stem
Male fern - Late autumn
Belladonna root - Root of 3 to 4 years old plant
Rasna - 4 to 10 years of age
Opium - Collected in afternoon when sky is clear
<table>
<thead>
<tr>
<th>Drug</th>
<th>Official drug</th>
<th>Substituent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aconite</td>
<td>Aconitum napellus</td>
<td>-Aconitum deinorhizum</td>
</tr>
<tr>
<td>Guggul</td>
<td>Commiphora mukul</td>
<td>- Commiphora roxburghii</td>
</tr>
<tr>
<td>Myrrh</td>
<td>Commiphora molmol</td>
<td>- Commiphora erythaea</td>
</tr>
<tr>
<td>Pale catechu</td>
<td>Uncaria gambier</td>
<td>- Acacia deinorhizum</td>
</tr>
</tbody>
</table>
Belladonna - Atropa belladonna

Scopola carniolica

Phytolacca decandra

Digitalis - Digitalis purpurea

Verbascum thapsus

(Species) - Adulterants

Sympt tum Officinale Primula Vulgaris
<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Genus</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cascara bark</td>
<td>Rhamnus</td>
<td>Rhamnus californica</td>
</tr>
<tr>
<td></td>
<td></td>
<td>purshiana</td>
</tr>
<tr>
<td>Tragacanth</td>
<td>Astragalus</td>
<td>Sterculia urens</td>
</tr>
<tr>
<td>Cinnamon</td>
<td>Cinnamonum</td>
<td>Cinnamonum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>zeylanicum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cassia</td>
</tr>
</tbody>
</table>
Improper Preparation

- Before marketing several drugs are to be prepared inert or undesirable part is discarded if not done lead to adulteration.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Officially used part</th>
<th>Unwanted part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ginger</td>
<td>Rhizome freed from Cork</td>
<td></td>
</tr>
<tr>
<td>Male Fern</td>
<td>Rhizome and leaf bases Roots</td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>Dried out part Spongy inner</td>
<td></td>
</tr>
<tr>
<td>Lemon peel</td>
<td>pericarp part of pericarp</td>
<td></td>
</tr>
<tr>
<td>Quillaia bark</td>
<td>Inner part of Rhytidoma bark</td>
<td></td>
</tr>
</tbody>
</table>
• Tamarind - Fruits free from - Outer part of brittle outer part pericarp
• Clove - Freed from stalks - Excess stalk
- Neglect of proper conditions for drying
- Leads to adulteration in some drugs
<table>
<thead>
<tr>
<th>Drug</th>
<th>Faulty Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cochicum corm</td>
<td>Drying at temperature $65^0$ which accelerate the rate of hydrolysis of colchicines</td>
</tr>
</tbody>
</table>
Digitalis leaves in wet condition for period which provide suitable atmosphere for hydrolysis of glycosides by enzyme or drying above 60°C also leads to hydrolysis of glycosides.
• Gentian - Allowing excessive fermentation before drying in which sugars are converted into alcohol and carbon dioxide which leads to reduction in water soluble extractive value.
• Cod-liver oil - Excessive heat used in separating the oil from liver tissues effect the vitamin content as well as odour and colour.
• Improper Storage:

• The quality value and medicinal potency
• Impaired or destroyed by action of
  - Moisture
  - Temperature
  - Microorganisms
• Drug becomes unfit for human consumption
• To be considered adulterated
• Cascara bark - To be stored at least for one year before being medicinally utilized

• Ergot - Should be kept entire after removal of fat and stored in cool place to prevent attack by insects moulds and bacteria
• Colophony - Should be stored only in lump form
• Male Fern - To be used after the internal green colour is lost.
• Digitalis - To be stored in air tight containers protected from sunlight
• Belladonna
• Hyoscyamus
• Stramonium
• Cord-liver oil - Air tight amber coloured bottles away from sunlight in cool place.
• Deliberate Adulteration:

Gross Substitution by entirely different Plant Material

Some times in place of genuine drug substitute

Product similar in appearance to the genuine

Due to scarcity or purely for making profit.
Due to their morphological resemblance

- They are marketed as adulterant

<table>
<thead>
<tr>
<th>Drug</th>
<th>Substitutional Drug</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashoka:</td>
<td></td>
</tr>
<tr>
<td>Saraca indica</td>
<td>Tremna orientalis</td>
</tr>
<tr>
<td>Kurchi:</td>
<td></td>
</tr>
<tr>
<td>Holarrhena antidysenterica</td>
<td>Wrightia tinctoria</td>
</tr>
</tbody>
</table>
• Rauwolfia - Rauwolfia canescens
  (Rauwolfia serpentina)
• Senna (Cassia aungustifolia) - Cassia auriculata
• Nux vomica - S. nuxblanda
  (Strychnos nux-vomica) - S. potatorum
- Substitution by spent or exhausted material
  - Many costly crude drugs are extracted
  - For one or more active constituents or
  - Essential oil partially or completely
  - Same drug is admixed with the genuine drug
<table>
<thead>
<tr>
<th>Drug</th>
<th>Component extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fennel</td>
<td>- Volatile oil</td>
</tr>
<tr>
<td>Clove</td>
<td></td>
</tr>
<tr>
<td>Coriander</td>
<td></td>
</tr>
<tr>
<td>Liquorice</td>
<td>- Glycyrrhizin and other water soluble components</td>
</tr>
<tr>
<td>Jalap</td>
<td>- Resin</td>
</tr>
</tbody>
</table>
• Capsicum - Capsaicin
  Pungent Principle

• Ginger - Gingerol
  Resin
  Volatile oil
• Tolu balsam - Benzoic and Benzoin
  Cinnamic acid
  Storax

• Tea and Coffee - Caffeine

• Cannabis - Tetra hydro Cannabinol
Adulteration with non-Plant Material

- Sometimes foreign / fictitious material mixed
- With the authentic drug.
  - Artificially manufactured similar looking
  - Material is sued as substitute
<table>
<thead>
<tr>
<th>Drug</th>
<th>Component Extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myrrh</td>
<td>Quartz and other mineral substances</td>
</tr>
<tr>
<td>Resins</td>
<td>Colophony</td>
</tr>
<tr>
<td>Clove and</td>
<td>Imitation material</td>
</tr>
<tr>
<td>Caraway</td>
<td>made of clay</td>
</tr>
</tbody>
</table>
- Balsam of Peru
- Benzyl benzoate
- Benzoin and Balsam of Tolu
• Nutmeg - Broken kernels moulded with clay or similarly shaped pieces of wood

• Oil of lemon - Mixture of terpenes and Citral

• Opium - Lead shots

• Asafoetida - Lime stones
• Substitution or Adulteration due to confusion in Vernacular name:
  
  - Several plants in India known by different vernacular
  
  - More confusion exists between common vernacular causes of this type of adulteration
<table>
<thead>
<tr>
<th>Common Name</th>
<th>Biologically different plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Punarnava</td>
<td>- Boerhavia diffusa</td>
</tr>
<tr>
<td></td>
<td>- Trianthema species</td>
</tr>
<tr>
<td></td>
<td>- Portulacastrum species</td>
</tr>
<tr>
<td>Brahmi</td>
<td>- Hydrocotyl asiatica</td>
</tr>
<tr>
<td></td>
<td>Herpestris monniera</td>
</tr>
</tbody>
</table>
• Shankhpushpi - Evolvulus alsinoides
  Convolvulus pluricaulis
  and Clitoria ternatea

• Rasna - Acorus calamus
  Alpinia officinarum
  Anacyclus pyrethrum
Adulteration in Powdered Drugs

- Besides the entire drugs the powdered drugs
- Also found to be adulterated.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Adulterant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ipecacuanha</td>
<td>Dextrin</td>
</tr>
<tr>
<td>Colocynth Ginger</td>
<td>Exhausted ginger powder</td>
</tr>
<tr>
<td>Barks</td>
<td>Brick powder</td>
</tr>
<tr>
<td>Olive stone</td>
<td>Liquorice</td>
</tr>
<tr>
<td>Capsicum</td>
<td>Gentian powder</td>
</tr>
<tr>
<td></td>
<td>Red sanders wood</td>
</tr>
</tbody>
</table>
Evaluation Detection of Adulteration:

- Evaluation of crude drug involves
- Confirmation of its Identity
- Determination of its Quality and Purity.
• If adulterated requires detection of nature of adulteration in the identified drug

• Before use of any plant drug

• Its identity should be thoroughly confirmed comparing morphological and microscopic characters

• Listed in Pharmacopoeial monograph comparing characters with authentic drug from herbarium.
• Considering the wide variations in source
• Crude drugs their chemical nature
• Biological activity
• Standard by different techniques
Summary

In this class we learnt about

• Types of adulterations

• Commonly used substitutes in adulteration

• Evaluation for determining adulterants
1. Volatile oil is not extracted from one of the following

   a. Fennel
   b. Coriander
   c. Jalap
   d. Clove
Quiz

1. Total balsamic acids are

   a. Benzoic and Cinnamic acid

   b. Cinnamic and salicylic acids

   c. Benzoic and salicylic acids

   d. All correct
Frequently Asked Questions

1. What are different types of adulterations?

2. What are the common substituants used for adulteration in crude drugs.