CBS Confident Pharmacy Series

Fourth Edition

Pharmacognosy

for First Year Diploma in Pharmacy

Course Code: ER20-13T

According to the latest syllabus prescribed by Pharmacy Council of India under Regulation 7 of the Education Regulations, 2020, for Diploma in Pharmacy course, implemented with strict compliance from 2021–2022 academic session.



VN Raje

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Strictly Based on PCI New Syllabus as per ER-2020

Salient Features

- Lucid and easy language
- To the point answers
- Remembering the concepts in the simplest way
- Infusing confidence in the reader to appear in the board examinations

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VN Raje M Pharm

Principal
Gourishankar Education Society's
GES College of Pharmacy (D Pharm)
Limb, Satara, Maharashtra

CBSPD

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Corporate Office: 204 FIE, Industrial Area, Patparganj, New Delhi-110092
Ph: +91-11-49344934; Fax: +91-11-49344935; Website: www.cbspd.com; www.eduport-global.com;
E-mail: eresources@cbspd.com; marketing@eduport-global.com

Head Office: CBS PLAZA, 4819/XI Prahlad Street, 24 Ansari Road, Daryaganj, New Delhi-110002, India.
Ph: +91-11-23289259, 23266861, 23266867; Fax: 011-23243014; Website: www.cbspd.com;
E-mail: publishing@cbspd.com; eduportglobal@gmail.com.

Branches

- **Bengaluru:** Seema House 2975, 17th Cross, K.R. Road, Banasankari 2nd Stage, Bengaluru - 560070, Karnataka Ph: +91-80-26771678/79; Fax: +91-80-26771680; E-mail: bangalore@cbspd.com
- **Chennai:** No.7, Subbaraya Street Shenoy Nagar Chennai - 600030, Tamil Nadu
  Ph: +91-44-26680620, 26681266; E-mail: chennai@cbspd.com
- **Kochi:** 36/14 Kalluvilakam, Lissie Hospital Road, Kochi - 682018, Kerala
  Ph: +91-484-4059061-65; Fax: +91-484-4059065; E-mail: kochi@cbspd.com
- **Mumbai:** 83-C, 1st floor, Dr. E. Moses Road, Worli, Mumbai - 400018, Maharashtra
  Ph: +91-22-24902340 - 41; Fax: +91-22-24902342; E-mail: mumbai@cbspd.com
- **Kolkata:** No. 6/B, Ground Floor, Rameswar Shaw Road, Kolkata - 700014
  Ph: +91-33-22891126 - 28; E-mail: kolkata@cbspd.com

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Preface to the Fourth Edition

The fourth edition of the book builds self-confidence in students which helps to get success in the examinations. The book has been written to meet the requirements of students of Diploma in Pharmacy (D Pharm) in accordance with the new revised syllabus ER-2020 prescribed by Pharmacy Council of India.

This book is small and humble effort has been put in for compiling necessary information on the subject. An attempt has been made to demystify and simplify the basic concepts for the students of pharmacy and to enable them get an evergreen success in MSBTE examinations.

The salient features of the present book are:

- Lucid and easy language
- To the point answers
- Remembering facts in the simplest way
- Infusing confidence in the reader to appear in the board examinations.

Hence the series is named

CBS Confident Pharmacy Series

I am confident that this book will be useful to both the students and the teachers of Diploma in Pharmacy as well as the candidates desiring to succeed in competitive examinations for better job opportunities in pharmacy profession such as hospital pharmacists in PHCs, civil hospitals, etc.

Raje Vijay N

to
my beloved family

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I wish all my beloved students to have a great success in the board examinations.

Raje Vijay N

Syllabus

(As per ER 2020)

Pharmacognosy

1. Definition, history, present status and scope of pharmacognosy.
2. **Classification of drugs:** Alphabetical, Taxononical Morphological, Pharmacological, Chemical, Chemotaxonomical.
3. **Quality control of crude drugs:** Different methods of adulteration of crude drugs, evaluation of crude drugs.
4. Brief outline of occurrence distribution, isolation, identification tests, therapeutic activity and pharmaceutical applications of alkaloids, terpenoids, glycosides, volatile oils, tannins and resins.
5. Biological source chemical constituents and therapeutic efficacy of the following categories of crude drugs.
   a. Laxatives—Aloes, Castor oil, Ispaghula, Senna.
   b. Cardiotonics—Digitalis, Arjuna, Squill.
   c. Carminatives and GIT regulators—Coriander, Fennel, Cardamom, Ginger, Clove, Black peper, Asfoetida Nutmeg, Cinnamon.
   d. Astringent—Myrobalan, Black catechu, Pale catechu, Galls.
   e. Drugs acting on nervous system—Hyoscyamus, Belladonna, Ephedra, Opium, Tea leaves, Coffee seeds, Coca, Ashwagndha.
   f. Anti-hypertensive—Rauwolfia
   g. Anti-tussives—Tolu balsam, Vasaka, Tulsi
   h. Anti-rheumatics—Colchicum seed, Guggul
   i. Anti-tumor—Vinca, Podophyllum
   j. Anti-leprotics—Chaulmoogra oil
   k. Anti-diabetics—Pterocarpus, Gymnema
   l. Diuretics—Gokhru, Punarnava

m. Anti-dysenterics—Ipecacunha
n. Antiseptics and disinfectants—Benzoin, Myrrh, Neem, Turmeric
o. Antimalarials—Cinchona, Artemisia
p. Oxytocics—Ergot
q. Vitamins—Cod liver oil, Shark liver oil
r. Enzymes—Papaya, Diastase, Pancreatin, yeast
s. Phamaceutical Aids—Kaolin, Lanolin, Beeswax, Acacia, Tragacanth, Sodium alginate, Agar, Guar gum, Gelatin.
t. Miscellaneous—Squill, Galls, Pale Catechu Ashwgandha, Vasaka, Tulsi, Guggul

6. **Plant fibers used as surgical dressing:** Cotton, Silk, Wool and Regenerated fibers, Sutures—Surgical Catgut and ligatures.
7. a. Basic principles involved in the alternative system of medicine like: Ayurveda, Sidhha, Unani and Homeopathy
   b. Method of preparation of Ayurvedic formulations like: Arita, Asava, Gutka, Taila, Churna, Lehya and Bhasma.
8. Role of Medicinal and Aromatic Plants in national economy and their export potential.
9. **Herbs as health food:** Brief introduction and therapeutic applications of: Nutraceuticals, Antioxidants, Probiotics, Prebiotics, Dietary fibers, Omega-3-fatty acids, spirulina, Carotenoids, Soya and Garlic.
10. **Herbal cosmetics:** Sources, chemical constituents, commercial preparations, therapeutic and cosmetic uses of: Aloevera gel, Almond oil, Lavender oil, Olive oil, Rosemary Oil, Sandalwood oil.
11. Phytochemical investigation of durgs.

Contents

Preface to the Fourth Edition *v*

1. **History and Scope of Pharmacognosy** 1
2. **Classification of Crude Drugs** 7
3. **Systematic Study of Drugs** 13
4. **Collection and Preparation of Crude Drugs for Market** 17
5. **Chemical Nature of Natural Drugs** 25
6. **Surgical Fibres, Sutures and Dressings** 39
7. **Adulteration, Drug Evaluation and Significance of Pharmacopoeial Standards** 46
8. **Pharmacological Grouping of Natural Drugs** 58
   - A. **Laxatives** 58
   - B. **Cardiotonics** 61
   - C. **Carminatives and gastrointestinal regulators** 63
   - D. **Astringents** 69
   - E. **Drugs acting on central nervous system** 72
   - F. **Antihypertensives** 77
   - G. **Antitussives** 78
   - H. **Antirheumatics** 79
   - I. **Antitumour** 81
   - J. **Antileprotics** 82
   - K. **Antidiabetics** 83
   - L. **Antidysenterics** 84
   - M. **Diuretics** 85
   - N. **Antiseptics and disinfectants** 86

O. **Antimalarials** 88
P. **Oxytocics** 90
Q. **Vitamins** 92
R. **Enzymes** 93
S. **Perfumes and flavouring agents** 95
T. **Pharmaceutical aids** 98
U. **Miscellaneous natural drugs** 104

9. **Basic Principles Involved in the Alternative Systems of Medicines (Ayurveda, Siddha, Unani and Homeopathy)** 109
10. **Methods of Preparations of Ayurvedic Formulations** 117
11. **Role of Medicinal and Aromatic Plants in National Economy** 122
12. **Herbs as Health Food** 125
13. **Herbal Cosmetics** 134
14. **Phytochemical Investigation of Drugs** 140
15. **Gross Anatomical Studies of Some Crude Drugs** 150

Appendix

A. *Distinguish/Difference Between* *155*
B. *Chemical Tests of the Crude Drugs* *165*
C. *Morphological Characters of the Crude Drugs* *178*
D. *Summary Chart of Crude Drugs* *184*
E. *Families of Crude Drugs* *205*

CHAPTER 1

History and Scope of Pharmacognosy

1. **Pharmacognosy:** Pharmacognosy is defined as a systematic and scientific study of structural, physical, chemical and biological characters of crude drugs including the study of their history, cultivation, collection and preparation for market.
2. **Laxatives/purgatives:** The drugs which promote defaecation are called laxatives, e.g. castor oil, senna, rhubarb, aloes, ispaghula.
3. **Cardiotonics:** The drugs which increase the force of cardiac muscles and stimulate the activity of heart are called cardiotonics, e.g. digitalis, arjuna.
4. **Carminatives:** The drugs which expel the gases from GIT by increasing peristalsis are called carminatives, e.g. fennel, coriander, cardamom, ginger, clove, cinnamon, clove.
5. **Astringents:** The drugs which cause precipitation of superficial proteins are called astringents, e.g. black catechu, pale catechu.
6. **Analeptics:** The drugs which stimulate the central nervous system are known as analeptics or CNS stimulant, e.g. nux vomica, lobeline.
7. **Antihypertensives:** The drugs which reduce elevated blood pressure to the normal level are called antihypertensive, e.g. rauwolfia.
8. **Antitussives:** The drugs which are used in the treatment of cough are called antitussives/anticough agents, e.g. vasaka, tulsi, tolu balsam.
9. **Antirheumatics:** The drugs which are used in the treatment of rheumatism are called antirheumatics, e.g. guggul, colchicum.
10. **Antitumour/anticancer agents:** The drugs which are used in the treatment of cancer are called anticancer agents/drugs, e.g. vinca.

11. **Antileprotics:** The drugs which are used in the treatment of leprosy are called antileprotic drugs, e.g. chaulmoogra oil.
12. **Antidiabetics/hypoglycemic agents:** The drugs which are used in the treatment of diabetes mellitus are known as antidiabetic drugs, e.g. gymnema, pterocaprus.
13. **Diuretics:** The drugs which increase the formation and excretion of urine are called diuretics, e.g. gokharu, punarnava.
14. **Antiseptics:** The drugs which kill the microbes when applied to living tissues are called antiseptics, e.g. benzoin, neem, myrrh, curcuma, turmeric.
15. **Disinfectants:** The drugs which kill the bacteria and their spore when applied to nonliving tissue are called disinfectants, e.g. benzoin, myrrh, neem, curcuma, turmeric.
16. **Antimalarials:** The drugs which are used in the treatment of malaria are called antimalarial agents, e.g. cinchona.
17. **Oxytocics/Ecbolics:** The drugs which stimulate the uterine contraction and expel the contents of uterus are called oxytocics, e.g. ergot.
18. **Vitamin:** Vitamins are organic substances present in small amounts in natural foodstuffs and are essential for growth of body and normal metabolism, e.g. shark liver oil (vitamin A), amla (vitamin C).
19. **Enzymes:** Enzymes are the protein substances which catalyse various biochemical reactions, e.g. papain, diastase, yeast.
20. **Perfumes:** These are the substances made from natural or synthetic materials which are used for creating a pleasant odour, e.g. rose, jasmine, sandalwood, citronella.
21. **Flavouring agents:** These are the agents used to give a pleasant flavour to the formulation, e.g. peppermint oil, lemon oil, orange oil, lemon grass oil.
22. **Pharmaceutical aids:** The substances which are of little or no therapeutic value but are essentially used in the manufacture of or compounding of various pharmaceutical products are known as pharmaceutical aids, e.g. honey, starch, acacia, gelatin.
23. **Crude drug:** It means the drugs occurring in natural forms.
24. **Source of crude drug:** Crude drugs are obtained from plant, animals or minerals which are known as source of crude drugs.

25. **Organised drugs:** The drugs which have a definite cellular structures are called organised drugs, e.g. fennel, cinchona.
26. **Unorganised drugs:** The drugs which do not show a definite cellular structure are called unorganised drugs, e.g. acacia, tragacanth.
27. **Aphrodisiac:** The agents which stimulate the sexual desire are called aphrodisiacs, e.g. gokharu.
28. **Technical products:** The drugs from natural sources which are used in the industries like food industries are called technical products, e.g. ginger, cardamom, caraway.
29. **Technical use:** The use of drug other than pharmacological use is called technical use.
30. **Substitute:** Substitutes are the drugs having less percentage of active constituents and are added to the genuine drug.
31. **Adulterants:** Adulterants are the substances purposefully added in original drug to increase profit in marketing and they look similar to original drug but do not contain any active chemical constituent.
32. **Barks:** Barks are the external tissues of stem.
33. **Fracture:** The transverse broken surface of the bark is known as fracture.
34. **Balsams:** The oleoresins which contain benzoic acid or cinnamic acids are termed balsams, e.g. balsam of Tolu, balsam of Peru, storax, benzoin.
35. **Sialogogue:** The drugs which increase the secretion of saliva are called sialogogue, e.g. tobacco.
36. **Galactogogue:** The drug which increases the secretion of milk are called galactogogue, e.g. shatavari.
37. **Cholagogue:** The drug which increases secretion of bile, e.g. turmeric.
38. **Hydrogogue:** The drugs which promote watery evacuation of the bowel are called hydrogogue, e.g. jalap, calomel.
39. **Emmenagogue:** The substances which stimulate the menstrual flow are called emmenagogue.
40. **Stomachics:** The substances which increase the secretion of gastric juice and the functional activity of stomach are called stomachics, e.g. dill, fennel, coriander, gentian.

Q 1. How following scientists contributed in development of pharmacognosy?

1. **Galen**
- He was a Greek scientist.
- He found method of extraction.
- He developed "galenical pharmacy".
- Galenicals prepared are decoction, infusion.

2. Seydler
- Seydler coined the term pharmacognosy
- He was a German scientist.
- He wrote the book *Pharmacognostica Gignostica.*
- When he was a student, he published his thesis on "Sarspirella". The title of this thesis was "Analecta Pharmacognostica".
- He introduced the term "pharmacognosy" from two words:
- 'Pharmakon' means a drug
- 'Gnosis' means knowledge of.
- He explained the term as "knowledge of drugs".

3. Dioscoride
- He was a Greek physician.
- He described several plants of medicinal importance.
- His book is *De Materia Medica*.
- *Materia medica* is the text in which all natural products utilized by physicians were compiled together to form materia medica giving their detailed information.

4. Hippocrates
- He was a Greek physician.
- He is known as "father of medicine".
- He has contributed to pharmacognosy by his study on "anatomy and physiology of human beings".

5. Aristotle
- He was a Greek philosopher.
- He explained his theory as the "Origin of Universe", the sun and earth.
- He studied the animal kingdom.
- He suggested the principle of classification of animals.

6. Sushruta

- He was an Indian surgeon and physician.
- He knew about 1500 drugs.
- He used to operate GIT.
- His collection is named "Sushruta Samhita".

7. Charak

- He was an Indian physician.
- He knew about 700 drugs.
- The drugs were obtained from plants and minerals.
- His collection is named "Charak Samhita."

Scientists	*Contribution*
i. Galen	Extraction method
ii. Seydler	"Pharmacognostica Gignostica"
iii. Dioscoride	"De Materia Medica"
iv. Hippocrate	"Father of Medicine"
v. Aristotle	"Animal kingdom"/classification of animals.

Q 2. Give the scope of pharmacognosy. Explain history of pharmacognosy.

Scope of Pharmacognosy

- To provide knowledge of the natural plant and animal drugs.
- To provide knowledge of active constituents of drugs.
- To understand identification, extraction, purification, standardization and formulation of drugs.
- To find out adulteration in the drugs.
- Knowledge of pharmacognosy is useful in production of spices, cereals, paper, fabrics, paints, and also Bekari productions.

History of Pharmacognosy

- In Papyrus Ebers, an old documents, written in 1500 BC, Egyptions were aware of medicinal uses of several plants and animals and human anatomy also.
- The great Greek physician "Hippocrates" known "father of medicine" studied the human anatomy and physiology.
- Aristotle philosopher is well known for his studies on "animal kingdom".

- Theophrastus is well known for study on "plant kingdom".
- Dioscoride, a Greek physician, described several plants of medicinal importance in "De Materia Medica".
- Galen, a Greek scientist, described the method of extraction of active constituent of crude drugs.
- Seydler, a German scientist, coined the term pharmacognosy in 1815 in his work entitled "Analecta Pharmacognostica".

Q3. Write a note on "present status and future prospects of pharmacognosy."

- Pharmacognosy is concerned with the study of crude drugs of vegetable and animal origins.
- Plants are still a potent source of therapeutic agents.
- Now the people have realized the utility of drugs from natural origin which are not only economical but also very safer too and also easily available.
- All over the world the demand of herbal drug is increased tremendously.
- About 80% of the world population depends on crude drugs.
- Medicinal plants are of great value in the field of treatment and cure of diseases.
- It has been universally accepted fact that the plant drugs and remedies are found more safer than synthetic medicines for curing most of the complex diseases.
- In western world, as people are becoming aware of the potency and side effect of the synthetic drugs. Thus there is an increasing interest in the plant-based remedies with a basic approach towards nature.
- Active constituents from plant sources have lead to rapid developments in pharmacognosy and phytochemistry.
- Modern pharmacognosy has been developed rapidly due to the improvement made in the technology of isolation processes such as column, paper, thin layer, gas–liquid chromatographic procedures.
- Availability of modern state-of-the-art facility like structure determination and pharmacological screening helps to improve status of pharmacognosy.
- Rapid developments in the field of chemistry, biochemistry and pharmacology have further supported advancements in pharmacognosy.

CHAPTER 2

Classification of Crude Drugs

Q 1. What is the need/importance of classification of crude drugs?/ Why the drugs are classified?/Give the object of classification of drugs.

Need of Classification

- It makes a simple study of drugs.
- Easy to study and remember properties of group of drugs.
- It saves the time.
- It is useful for effective use of knowledge.
- Huge number of drugs are in nature, it is very difficult to study them separately.
- It gives correct and accurate information about the drug.
- To help in practical work.

Q 2. Enlist/name/state/give various methods/systems of classification of crude drugs.

- Alphabetical method.
- Taxonomical method.
- Morphological method/organoleptic method.
- Chemical method.
- Pharmacological method.
- Chemotaxonomical method.
- As per source.
- As per nature of drugs.

Q 3. Explain alphabetical method of classification of drugs.

Alphabetical Method

In this method, the drugs are mentioned alphabetically. This method is commonly used in preparing universal, official reference books.

Merits

- Useful method for books such as BP, BPC, USP, IP.
- Simple method.
- Location and tracing of drug is easy.
- Addition of drug is easy.
- No technical person is required for handling the system.

Demerits

- Original source is not clear by this classification.
- Scientific nature of drug cannot be identified by this method, whether the drug is organised or unorganised.

Q 4. Write in brief about toxonomical method of classification of drugs.

Taxonomical Method

- This is a botanical type of classification.
- It is applicable to living organisms only (drugs obtained from plant, animals and microorganisms).
- Taxonomy helps in systematic classification of living organisms.
- In this method various steps are taken for proper classification.
- Each step indicates certain characters:
  i. Kingdom
  ii. Subkingdom
  iii. Phylum
  iv. Subphylum
  v. Class
  vi. Subclass
  vii. Division
  viii. Order
  ix. Family
  x. Genus
  xi. Species.

Merits

- It helps in determining scientific name of living organism.
- It explains some characters of plants.

Demerits/Limitations

- Nonliving drugs cannot be classified.

- If characters of two families are very close, then classification becomes difficult.
- Technical person is required for classification of drugs.

Q 5. Describe the chemotaxonomical method of classification of crude drugs.

- It is the latest method which brings together advantages of chemical method and taxonomical method.
- This method gives details of taxonomy (family) and active chemical constituent of the drug.
- For example:
  i. Ginger can be explained as:
  Biological source: Ginger is obtained from rhizomes of *Zingiber officinale*.
  Family: Zingiberaceae.
  Chemical constituents: It contains not less than 2% of volatile oil.
  ii. Nux vomica
  Biological source: It is obtained from dried, seeds of *Strychnos nux-vomica.*
  Family: Ligniaceae.
  Chemical constituents: It contains not less than 1.2% of strychnine.

Merits

- It gives information of family and chemical constituents.
- It is a scientific method.
- It also gives information about 1% of chemical constituent present in the drug.

Demerit

Skilled and qualified person is required for classification of drugs.

Q 6. Discuss chemical method of classification of crude drugs.

Chemical Method of Classification

- In this method the drugs are classified according to the nature of active chemical constituent present in the drug.
- Active chemical constituents are mainly responsible for physiological or pharmacological actions.
- The method of classification is as follows:
  i. Carbohydrates, e.g. starch, honey.
  ii. Proteins, e.g. gelatin, wool.

iii. Lipids, e.g. arachis oil, beeswax
iv. Vitamins, e.g. cod liver oil, shark liver oil.
v. Enzymes, e.g. yeast, papaine.
vi. Tannins, e.g. catechu.
vii. Resins, e.g. asafoetida, myrrh.
viii. Alkaloids, e.g. cinchona, ipecac.
ix. Glycosides, e.g. digitalis, aloe.
x. Volatile oils, e.g. fennel, coriander.
xi. Gums, e.g. acacia.
xii. Mucilages, e.g. agar, tragacanth.

Merits

- Chemical constituents are known.
- Medicinal uses are known.
- It explains physical and chemical properties of active constituent.
- It helps in extraction process during selection of menstruum.
- It gives information about pharmacological action of drug.
- Helpful for identification of mainly unorganised drugs.
- It helps in proper storage of drugs.

Demerits

- If drug contains two or more constituents, then it is difficult to classify.
- Drugs of different origin may grouped under similar chemical title.
- The technical person having the knowledge of chemical constituents is necessary.
- Variations in the % of chemical constituents may confuse during classification.
- Adulterated drugs may misguide during classification.

Q 7. Explain pharmacological method of classification of crude drugs. Give its merits and demerits.

Pharmacological Method of Classification

- In this method drugs are classified as per pharmacological action or physiological action of active constituent.
- It should be noted that some drugs may produce more than one pharmacological effects and then classification becomes more complex.

- In this method the drugs are classified as per actions and uses:
  i. Carminative, e.g. coriander, clove.
  ii. Purgatives, e.g. senna, castor oil.
  iii. Cardiotonics, e.g. digitalis, squill.
  iv. CNS stimulants, e.g. nux vomica.
  v. Diuretics, e.g. gokharu, punarnava.
  vi. Oxytocics, e.g. ergot.
  vii. Antimalarials, e.g. cinchona.
  viii. Anticancer, e.g. vinca.
  ix. Antirheumatics, e.g. guggul, colchicum.
  x. Bitters, e.g. Cinchona, Gention.
  xi. Antidysenteric, e.g. ipecacuhna.

Merits/Advantages

- Nature of physiological action can be understood.
- Nature of pharmacological action can be understood.
- Gives exact idea about the storage and uses of drug.
- Medicinal uses are understood.
- The drugs whose chemical constituents are not known can be classified.

Demerits/Limitations

- Difficult to classify the drug showing many pharmacological actions.
- Does not give idea about chemistry of chemical constituent.
- No idea about mechanism of action of drug.
- Does not give idea about doses of drugs.
- In classification adverse (–ve) effects are not mentioned.
- Do not give idea about morphology of a drug.
- Knowledge of pharmacology is required for classification of drugs.
- Contraindications of drugs are not mentioned, thus may produce dangerous effects.

Q 8. Describe morphological/organoleptic method of classification of crude drugs.

Morphological/Organoleptic Classification

In this method the drugs are classified according to the parts of plant (drug) like leaves, fruits, flowers, woods, barks, extracts, gums, etc.

Parts of Plants

- *Barks:* Arjuna, cinchona.
- *Flowers:* Clove, saffron.
- *Leaves:* Senna, digitalis.
- *Fruits:* Fennel, coriander.
- *Seeds:* Nux vomica, linseed.
- *Rhizome:* Ginger.
- *Stems:* Vasaka.
- *Flowering tops:* Tulsi.
- *Bulbs:* Garlic.
- *Tubers:* Aconite.

Merits

- It gives an idea about the morphological characters of drugs.
- It is a convenient method for students for practical purposes.
- Addition of drugs in system is easy.
- Location and tracing of drug is easy.
- Adulterant can be identified easily.
- Method is helpful in deciding purity of drug.
- It gives idea about chemical constituents/composition of drug, e.g. leaves, rhizomes, tubers contain starch.

Disadvantages/Demerits

- Does not give an idea about biological sources and uses of drugs.
- The drugs which do not have exact morphological form cannot be classified by this method.
- When different parts of plant contain different chemical constituents, it is difficult to classify them.
- The method is applicable to entire crude drug only.
- The quantity of drug required for classification is more.

CHAPTER 3

Systematic Study of Drugs
(Scheme of Pharmacognostic Studies)

Q 1. Explain the terms in short.

1. Title/Official Title (Official Source)

- Title is the official name of the drug.
- It is the name of drug mentioned in official books like IP, BP, NF, etc.
- The title is in English or Latin.
- The title is always written in capital letters.
- In various pharmacopoeia different titles of the same drugs may be suggested.
- Examples: GINGER, FENNEL.

2. Synonym

- Synonyms are the alternative names of the drug.
- Synonyms are in regional languages.
- They are used in specific geographical areas.
- Pharmacopoeia of India recognises synonyms in English and Hindi languages.
- Synonym helps in collecting information available in various regions.
- Examples: Ginger.
  Synonyms: Adrak (Hindi)
  Ale (Marathi).

3. Geographical Source

- It informs the geographical places where the plants or animals occur naturally and where the drug is obtained commercially.
- It helps in knowing atmospheric conditions required for the plants and animals.

4. Biological Source (Biological Origin)

- The drug can be obtained from plant source or animal source which is named biological source. It may be of two types:
  i. *Botanical source:* It means drug is obtained from plant, e.g. arjuna consists of dried stem bark of the plant known as *"Terminalia arjuna"*.
  ii. *Animal source:* It means drug is obtained from animals, e.g. shark liver oil is obtained from shark fish.
- Importance of biological source: It gives information about:
  i. Source—plant/animal.
  ii. Parts of plant/animal.
  iii. Maturity state of parts of plants.
  iv. Scientific name of plant/animal.
  v. Method of collection of drug.
  vi. Family and scientific name of the drug.
  vii. Pharmacopoeial standards.

5. Collection

- It gives information about process of collection of parts of plant and prevention of damage to the plant during collection.
- The collection gives knowledge of their chemical constituents responsible for therapeutic action.
- Collection is considered for its purity of drugs.
- Generally the plants are collected when they are rich in their chemical constituents.
- The drugs containing thermolabile substances and volatile oils are collected at low temperature.
- Thus, choice of collection depends upon the chemical constituents of the plants.

6. Cultivation

- It explains agricultural aspects.
- It explains scientific process of cultivation of plants.
- Cultivation means a systematic reproduction of plant.
- It informs about:
  i. Method of reproduction of plant.
  ii. Required rainfall and water supply.
  iii. Nature of soil to be used.
  iv. Fertilizers required.
  v. Plant protection involves used of insecticides.
  vi. Mechanical methods, e.g. cutting, scraping, burning, etc.

- Cultivation helps in complete growth of plant and it maximizes active chemical constituent of the drug.

7. Preparation of Drugs for Market

It includes various steps like removal of unwanted parts of plants, drying, packing and transportation.

8. Morphology/Morphological Characters (Organoleptic Characters)

- It is also known as macroscopy.
- Morphology means the study of external characters or parts of the plants.
- The external characters or sensory characters of the plant are known as morphological characters or organoleptic characters.
- Observations like appearance, surface, size, shape, colour, odour, taste are taken with sensory organs, hence are also known as organoleptic characters.

9. Microscopy/Microscopical Characters (Histological Characters)

- Microscopy involves the study of microscopical features such as TS, LS and observed under microscope.
- The characters which are observed under microscope are called microscopic characters/histological characters.
- The specific microscopic characters such as stomata, trichomes, starch grains helps in evaluation of drugs.

10. Chemical Constituent/Active Constituent/Active Principle

It means main constituent of the drug which produces a therapeutic action.

- A drug may contain many chemical constituents.
- Some of the chemical constituents are capable of producing physiological and pharmacological actions on human body and other animals. Some drugs contain several constituents which are inert.
- The unorganised drugs are identified and confirmed by chemical constituents.
- *Example:* Cinnamon
  Chemical constituents
  i. Volatile oils
  ii. Tannins
  iii. Mucilages
    - Volatile oil is the main chemical constituents.
    - The mucilage and tannins are inactive constituents.

11. Substitute/Substituent

- Substituents are the alternative varieties of the drugs having less percentage of active constituents and are added to genuine drug.
- Substitutes are the unwanted parts of the plant present in original drug like leaf or roots of the same plants and sometimes other variety of drugs are mixed in the original drug.
- *Examples:*
  i. *Senna:* Substitutes—dog senna, Japanese senna.
  ii. *Digitalis leaf:* Substitutes—other parts of digitalis plant looking similar to that of digitalis leaf or digitalis lanata variety.

12. Adulterants

Adulterants are the substances purposefully added in the original drug to increase profit in marketing and they look similar to the original drug but does not contain any active constituent.

- The process of worthless admixtures in the genuine is known as adulteration.
- Adulterated mixture may prove dangerous to the patients.
- Adulteration is profit-oriented process.
- Powders and oil can be easily adulterated.
- Adulterants are sometimes similar to genuine drug in respect of morphological characters such as size, shape, small, etc. but do not have any chemical constituents.
- *Example*
  i. The seeds of Strychonus nux-vomica are adulterated with that of "*Strychonus blanda*" which do not contains strychnine.
  ii. Ginger is adulterated with exhausted ginger.

13. Uses

Uses of drugs mean the actual physiological and pharmacological effects produced by drug on human body and other animals.

- *Therapeutic uses/pharmacological uses:* It means use of drugs in the treatment of diseases or disorders.
- *Pharmaceutical uses:* When a drug is used for other purposes than its medicinal use, they are commonly known as pharmaceutical uses (technical uses), e.g. fennel, ginger as flavouring agents and turmeric as colouring agents.

CHAPTER 4

Collection and Preparation of Crude Drugs for Market

Q 1. Explain the term "collection" in the preparation of crude drugs for market.

Collection of Crude Drugs

- Collection gives information about the process of collection of parts of plant and prevention of damage to the plant during collection.
- The collection gives knowledge of their chemical constituents responsible for therapeutic actions.
- Collection is considered for its purity.
- Choice of collection of drugs depends upon type of chemical constituents of plant.
- Generally the plants are collected when they are rich in their chemical constituents.
- The drugs containing thermolabile substances and volatile oils are collected at low temperature.
- The collection of drug may involve the maximum concentration of active constituent.
- Collection should be done in a proper environmental conditions.

Examples

- The drugs which constitute the leaf and flowering tops of the plants are collected just before they reach their flowering stage, e.g. senna, digitalis, belladona.
- The barks are generally collected in spring environment, i.e. in the early summer.
- The fruits are collected depending upon the parts of fruit which are pharmaceutically important.
- Rhizomes are collected after full vegetative growth of the plant.
- The unorganised drugs such as gums, resins are collected as soon as they ooze out of the plant.

Q 2. Explain "garbling/dressing" in preparation of crude drugs for market.

Garbling/Dressing

"Garbling is the process in which there is a removal of soil, dirt and foreign organic parts of the same plant or nonconstituting drug."

- Garbling is the next step in the preparation of crude drug for market after drying.
- If such foreign material is permitted in the crude drugs, the quality of drug will be reduced. Hence, the percentage of foreign material should be such that it should pass the pharmacopoeial limits.

Examples

- Drugs constituting rhizomes are separated carefully from roots or rootlets and also from stem bases.
- The pieces of iron must be removed with magnet in cases of castor seeds before crushing and by shifting.
- The pieces of bark should be removed by peeling in processing of gum acacia.
- The excessive stems in case of lobelia and stramonium are needed to be removed.

Importance of Garbling

- It improves quality of drug.
- It improves purity of drug.
- It gives shining appearance to the drug.
- It increases stability of drug.
- Garbling increases market value of the product.

Q 3. Explain "drying" in preparation of crude drugs for market.

Drying

Drying means complete removal of water from the drugs.

- Before marketing a crude drug, it is necessary to dry the drug to get a good pharmaceutical appearance to the drugs.
- Drying should be done without loss of chemical constituents.
- Drying consists of removal of sufficient moisture content of crude drug. So as to improve its quality and to prevent growth of micro-organisms.

- Drying also inhibits partially the enzyme reactions.
- The slicing, cutting into small pieces is done to increase the rate of drying.

Types of drying

- Natural drying.
- Artificial drying:
  - i. Tray dryers
  - ii. Vacuum dryers
  - iii. Spray dryers.

1. Natural Drying/Sun Drying

- It may be either direct sun, drying or drying in the shade.
- If the natural colour of drug and the volatile principles of the drugs are to be retained, then drying in shade is preferred.
- If the contents of the drugs are quite stable to temperature and sunlight, then the drugs can be dried directly in sunlight.

2. Artificial Drying

It is done by using the following devices.

i. *Tray dryers (an oven):* The drugs which do not contain volatile oils and are quite stable to heat are dried in tray dryers.

ii. *Vacuum dryers:* The drugs which are sensitive to higher temperatures, are dried by this process, e.g. tannic acid, digitalis leaves.

iii. *Spray drying:* Some drugs which are highly sensitive to atmospheric conditions and also to temperature of vacuum drying are dried by spray drying method, e.g. papaya latex, pectin, tannins are dried by spray drying.

Q 4. Explain "harvesting" in the preparation of crude drugs for market.

- Harvesting is an important operation in the cultivation technology.
- Harvesting can be done correctly by skilled workers.
- It is a hard job and may not be economical.
- In some cases, the harvesting may be done by mechanical devices.
- The underground drugs like roots, rhizomes, tubers, etc. are harvested by mechanical devices such as diggers or the lifters.

- The tubers and roots are thoroughly washed in water to remove earthy matter.
- Many times flowers, seeds and small fruits are harvested by a special device known as seed strippers.
- The technique of beating the plant with bamboos is used in case of cloves.
- The cochineal insects are collected from branches of cactus by brushing.
- Fennel, coriander and caraway plants are uprooted and dried. After drying either they are thrashed or beaten and the fruits are separated by winnowing.

Q 5. Explain "packing" in the preparation of crude drugs for market.

- "Packing" is a technique in which drug is packed in a container which protects the drug from contamination.
- The climatic conditions during transportation and storage should be considered while packing the drugs.
- Packing improves quality and stability of the drugs.

Examples

- Colophony and balsam of tolu are packed in kerosene tin.
- Asafoetida is stored in well-closed containers to prevent loss of volatile oils.
- Cod liver oil is very sensitive to sunlight, hence it should be stored in light-resistant containers.
- The drugs which are very sensitive to moisture and are costly, should be packed very carefully in airtight containers, e.g. digitalis, ergot.
- The drugs like roots, seeds and others which do not need special attention are packed in gunny bags. While in some cases bags are coated with polythene internally.
- Packing also protects the drug from damage during transportation.

Q 6. Give the method of cultivation and collection of "senna" leaf.

Cultivation

- The senna plants are cultivated by sowing the seeds.
- The seeds are mixed with sand before cultivation.
- The sowing of seed can be carried out in the month of March, April or November, December.

Requirements

- Soil should have water nonretaining property and should be red and black colour.
- The rainfall should be heavy about 1500 to 3000 mm/year.
- Temperature should be warm about 25°C average temperature.

Process

- The seeds are sown in nursery beds.
- They germinate within 3 weeks.
- After germination within 15 days, the young plants are transferred into farms.

Collection

- The plants are allowed to grow for 3–5 months.
- The flowering tops are cut off periodically to ensure maximum branching.
- When the leaflets have measurable thickness in the month of September or February, the leaves are manually collected.

Other Processes

- The leaflets are subjected to harvesting.
- In the process, large pieces of stems, flowers, seeds are rejected.
- The leaflets are spread on floor and dried in shelves.
- A care is taken that overlapping of leaflets is avoided during drying.
- The leaflets loose about 50–60% of their weights.
- Yellowish green coloured leaves are selected.
- They are packed in gunny bags under pressure and marketed.

Q 7. What are the methods of cultivation and collection of digitalis leaves?

Digitalis Leaves

Cultivation

It needs sandy, light soil, rich in calcium and traces of magnesium. Rainfall about 1500 mm/year. Average temperature of 15°C.

Process

- Soil is sterilized by steam before sowing the seeds.
- Seeds are mixed with fine sand and sown in nursery beds in the month of March or April.

- Two to three weeks are required for germination.
- The young plants are transplanted in the month of September to November.
- The area under cultivation is kept free from weeds.

Collection

- In the first year, the plants bear rosette leaves and in the second year sessile leaves.
- The plant flowers in the month of April and is followed by fruiting.
- Before that the leaves are manually collected in afternoon hours.
- If the plants are to be allowed to grow, the flowering tops are removed.

Other processes

- The digitalis leaves are immediately taken to drying centre.
- Leaves are spread on the trays with fine wire netting bottom.
- They are dried in vaccum dryers.
- The temperature of drying is maintained below 60°C and continued till leaves contain moisture less than 5%.
- The leaves are packed in airtight containers along with suitable dehydrating agent.

Q 8. What are the methods of cultivation and collection of opium?

Opium

Cultivation

- Cultivation of opium is controlled and monitored by Government of India.

Requirements

- Soil water nonretaining grey or whitish coloured.
- Temperature: Average temperature is 35°C.
- Rainfall: About 100 mm/year.

Process of Cultivation

- Cultivation is carried out by sowing the seeds.
- The seeds are mixed with sand and scattered on the land.
- Distance between two plants to be maintained is about 25 cm.
- The seeds are germinated within two weeks.

Collection

- In the month of February or March in the afternoon or evening hours, the vertical incisions are taken.
- The incisions are taken from top to bottom of the fruit.
- Three to four incisions are taken at a time.
- Whitish latex comes out of fruits in the early morning.
- Using a blade, latex is collected.
- Latex is dried and packed as per the norms stated by Government of India.
- For transportation and marketing along with possession of the drug, appropriate licences are required.

Q 9. Give the method of cultivation and collection of Rauwolfia.

Rauwolfia

Cultivation

- The plants grow in wide ranges of atmospheric conditions.
- Soil should be rich in clay and water nonretaining.
- The pH of soil should be 4.
- Temperature of about 10 to 38°C.
- Rainfall: 250 to 500 mm.

Process of cultivation

- Plants are propogated using sexual method as well as vegetative method.
- The seeds are sown after selecting healthy seeds into nursery beds.
- Sowing is carried out in the month of May and June.
- The young plants are transferred into the forms in August or September.
- Distance between two plants should be about 30 cm.
- In vegetative method root cuttings are used.
- The plants are provided with chemical fertilizers like urea and ammonium sulphate.

Collection

- When the plants are about 3 to 4 years old, they are uprooted.
- The stem bases are separated.
- The roots are washed and dried in air.
- Then they are packed and marketed.

Q 10. What are the methods of cultivation and collection of ergot?

Ergot

Cultivation

- Ergot is a fungus.
- Some part of the life cycle of the fungus is completed in soil or air and another part of life cycle is completed on rye plant.
- The fungus growth can be developed artificially.
- Ascospores are developed in a nutrient medium.
- The colonies are collected and diluted with H_2O.
- The solution is spread over rye plant.
- The sclerotia produced, fall on the grounds and they are collected.

Collection

- The collection is either manual process or mechanical process.
- They are placed in 30% solution of NaCl.
- The matured and well-developed sclerotia float on the surface.
- After collection sclerotia are dried thoroughly and stored in dark coloured containers along with suitable dehydrating agent and marketed.

CHAPTER 5

Chemical Nature of Natural Drugs
(Alkaloids, Glycosides, Tannins, Resins, Vitamins, etc.)

Q 1. Define alkaloids. Classify alkaloids giving suitable examples.

Alkaloids

The alkaloids are basic nitrogenous organic products of plant origin, having marked physiological actions when administered internally.

Classification of Alkaloids

Alkaloids are divided into two main classes:

a. *Nonheterocyclic alkaloids:* Ephedrine (ephedra), colchicine (colchicum).

b. *Heterocyclic alkaloids:*

Types of alkaloids	*Examples*	*Source*
1. Tropane	Atropine	Datura
2. Quinoline	Quinine	Cinchona
3. Indole	Strychnine	Nux-vomica
4. Isoquinoline	Papaverine	Opium
5. Phenanthrene	Morphine	Opium
6. Purine	Caffeine	Tea
7. Pyrrole and pyrolidine	Nicotine	Tobacco
8. Pyridine and piperidine	Lobeline	Lobelia
9. Imidazole	Pilocarpine	Pilocarpus
10. Terpenoid	Aconitine	Aconite

Q 2. Give the properties and role of alkaloids in plants.

Properties of Alkaloids

- Alkaloids are colourless, solid and crystalline.
- Alkaloids are insoluble in water but soluble in organic solvents.

- Alkaloids in the salt form are water soluble and insoluble in organic solvents.
- Alkaloids are optically active being usually levorotatory.
- Alkaloids are highly potent medicaments and possess curative properties.
- Alkaloids are biosynthesized due to participation of several amino acids and enzymatic systems.

Role of Alkaloids in Plants

- Alkaloids are nitrogenous organic compounds.
- Alkaloids are basic in nature and so they can react with acid molecules easily.
- Alkaloids are metabolic products and so they are produced, stored and utilized whenever necessary.
- The plants consider alkaloid molecules as source of nitrogen atom. They are utilized in protein synthesis and synthesis hormones.
- The alkaloids are generally associated with acids and so they can act as carriers of acid molecules.
- The alkaloids help in maintenance of regular physiological activities like growth and reproduction.
- The alkaloids are protective agents.
- The alkaloids are detoxicating agents.
- Amount of alkaloids changes from time to time in a day and from season to season in a year.

Q 3. Explain various chemical tests for alkaloids.

Chemical Tests for Alkaloids

Precipitation Tests

- *Mayer's test:* Alkaloids give cream or pale yellow precipitate with Mayer's reagent (potassium mercuric iodide solution).
- *Dragendorff's test:* Alkaloids give brown or reddish brown coloured precipitate with Dragendorff's reagent (potassium bismuth iodide solution).
- *Wagner's test:* Alkaloids give brown or reddish brown coloured precipitate with Wagner's reagent (iodine and potassium iodide solution).

- *Hager's test:* Alkaloids with Hager's reagent give yellow precipitate (saturated solution of picric acid).

Q 4. Give the general methods of extraction of alkaloids.

Extraction Method of Alkaloids

The objective of extraction process is to separate alkaloid molecules from all other molecules.

Laboratory Method of Extraction of Alkaloids

- The drug sample is powdered.
- The sample is treated with strong base (NaOH).
- The added base reacts with acid molecules present along with alkaloids.
- The products formed are neutralized products, i.e. salt and water.
- The salts formed are soluble in water, so the mixture is washed with H_2O. It forms aqueous phase. The alkaloid molecules get isolated from aqueous phase.
- A small quantity of any suitable organic solvents is added 4 to 5 times. The organic solvents dissolve the alkaloid molecules in it.
- Now in the mixture there are two phases—aqueous phase and organic phase. These two phases can be separated using suitable apparatus like separating funnel.
- The organic phase is collected in evaporating dish.
- After heating the organic solvent gets evaporated and residue of alkaloid is obtained.

Nowadays extraction can be done by using chromatography technique.

Q 5. Give the therapeutic effects/uses/applications of alkaloids.

Alkaloids are highly potent medicaments and possess curative properties.

- It has narcotic action, e.g. morphine.
- It has tranquillizer action, e.g. reserpine.
- It is a nerve stimulant, e.g. strychnine.
- It is a local anaesthetic, e.g. cinchocaine, cocaine.
- It is an antispasmodic, e.g. atropine.
- It is a CNS stimulant, e.g. caffeine.
- It is an antimalarial, e.g. quinine.

Q 6. What are glycosides? How are they classified?

Glycosides

Glycosides are organic compounds which on hydrolysis give one or more molecules of sugar of one nonsugar molecule. Sugar molecule is called glycon and nonsugar molecule is called aglycone or genin.

$$\text{Glycoside} \xrightarrow{\text{Hydrolysis}} \underset{\text{(Glycon)}}{\text{Sugar}} + \underset{\text{(Aglycone)}}{\text{Nonsugar}}$$

Classification of Glycosides

a. Depending upon Glycone Present

Glucose	→	Glucoside
Fructose	→	Fructoside
Rhamnose	→	Rhamnoside

b. As per Linkage

- C-glycosides: Carbon linkage, e.g. sennosides in senna.
- O-glycosides: Flavone glycosides, e.g. amygdalin in bitter almond.
- N-glycosides, e.g. sinigrin in black mustard.
- S-glycosides, e.g. prunassin in wild cherry bark.

c. As per Chemical Nature of Aglycone

- Cyanogenetic glycosides: On hydrolysis give one of the molecules of H, C, N, e.g. prunassin in wild cherry.
- Saponin glycosides: Form soap solution in water, e.g. glycerrhizine in glycerrhiza.
- Cardiac glycosides: Digitoxigenin.
- Thiocyanate glycosides, e.g. sinigrin.
- Phenolic glycosides, e.g. salicin, rhein.
- Steroidal glycosides, e.g. digitalis glycosides.

d. As per Pharmacological Method

- Cardiotonics, e.g. digitalis.
- Laxative, e.g. senna.
- Bitter tonics, e.g. picrorrhiza.
- Expectorants, e.g. glycerrhiza.

Q 7. Define and classify volatile oils giving suitable examples. Give the properties and uses of volatile oils.

Volatile oils are odourous volatile principles of plant and animal sources which are easily evaporable.

Classification of Volatile Oils

- Alcohol containing volatile oils, e.g. peppermint, cardamom.
- Aldehyde containing volatile oils, e.g. cinnamon, lemon, orange.
- Hydrocarbon containing volatile oils, e.g. turpentine.
- Ketone containing volatile oils, e.g. caraway.
- Oxide containing volatile oils, e.g. eucalyptus.
- Phenolic-ester containing volatile oils, e.g. fennel, Nutmeg.
- Phenol containing volatile oils, e.g. clove.

General Properties of Volatile Oils

- They have characteristic odour.
- They have high retractive index.
- Most of volatile oils are optically active.
- They are either colourless or rarely coloured.
- They have aromatic taste.
- They are insoluble in water and soluble in ether, alcohol, etc.
- They have good essence. The oils are called essence oils.

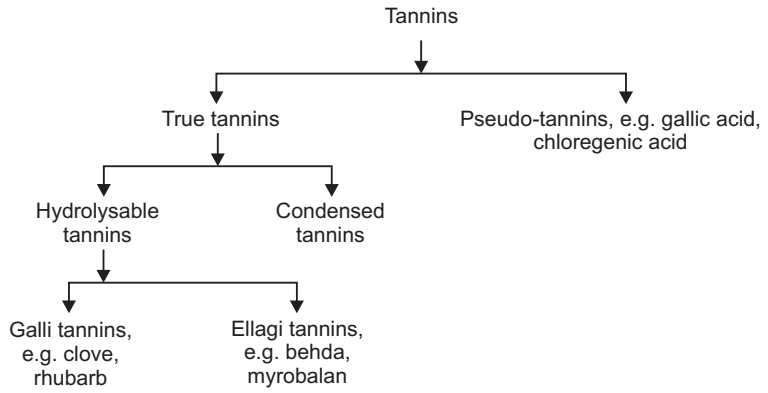
Uses of Volatile Oils

- As flavouring agents and perfumes.
- As carminatives.
- As stomachic.
- Externally, counterirritant.
- As a spices.
- As a local anaesthetic.

Q 8. Define tannins. Classify tannins giving suitable examples.

Tannins are the derivatives of polyhydroxy benzoic acid and are capable of precipitating proteins.

Classification of Tannins



I. True Tannins

These are amorphous compounds soluble in water having high molecular weight. They are of two types:

i. *Hydrolysable Tannins*

These types of tannins can be hydrolysed with the help of mineral acids (HCl, HNO_3, H_2SO_4), hence called hydrolysable tannins. They are of two types:

a. *Galli tannins:* The hydrolysis product is gallic acid, e.g. clove, rhubarb.

b. *Ellagi tannins:* The hydrolysis product is ellagic acid, e.g. behda, myrobalan.

ii. *Condensed Tannins*

They cannot be hydrolysed. If they are subjected for hydrolysis, the molecules break downs and the decomposition product "phlobaphene" is obtained and so they are known as phlobatannins. Phlobaphene is insoluble in water and red in colour, e.g. catechu.

II. Pseudo-tannins

These are tannin-like substances having low molecular weights, e.g. gallic acid, chlorgenic acid.

Q 9. Give the properties, uses and chemical tests for tannins.

Properties of Tannins

- Tannins are soluble in water, dilute alkalies, alcohol, glycerine.
- Tannins are insoluble in other organic solvents.
- Tannins have a bitter and astringent in taste.

- Tannins combine with skin proteins and precipitates them.
- On hydrolysis by enzymes, tannins decompose mainly into glucose and gallic acid.

Uses of Tannins

- As astringents.
- Causes contraction of smooth muscles.
- Used in leather industry, inks and dyes.
- Used in food processing, food ripening and in manufacturing of tea, cocoa.
- In treatment of mouth and throat infections.

General Chemical Tests for Tannins

1. *Gold beater skin test:* A piece of gold beaters skin (membrane of intestine of ox) + 2% dilute HCl, wash with distilled water. Add tannin solution. Allow it to react for 5 minutes. Add 1% ferrous sulphate solution.
   – *Observation:* Brown to black colour shows positive test for tannins.
2. *Phenazone test:* 5 ml of aqueous drug extract + 0.9 gm sodium acid phosphate ($NaHPO_4$), warm, cool, filter to get filtrate.
   Add 2% phenazone solution → coloured precipitate is observed.
3. *Catechin test:* Take drug extract of tannin solution and boil a dip matchstick in it. Dry in air. Add a drop of concentration of HCl → purple or violet coloured is observed (condensed tannins).
4. Tannins with aqueous $FeCl_3$ solution gives blue, black or green colour.
5. Tannins, when treated with 1% gelatin solution and 10% NaCl solution, a precipitate is observed.

Q 10. What are resins? Classify resins with suitable examples, mention the properties of resins.

Resins

Resins are amorphous, translucent solids or semisolids or liquid substances usually obtained as an exudate from plants.

Resins are either metabolic or pathological products.

Classification of Resins

Depending upon the functional group present, resins are classified as:

- Acid resins, e.g. colophony.
- Ester resins, e.g. benzoin, storax.

- Resin alcohols, e.g. balsam of Peru.
- Mixed resins (resin combinations):
  i. Gum-resins, e.g. Canada balsam.
  ii. Oleo-resins e.g. capsicum (combination of volatile oil and resin).
  iii. Oleo-gum-resin, e.g. asafoetida, guggul, myroh.
  iv. Glycoresins: Combination of sugar and resin.
  v. Balsams: They are the derivatives of acids like benzoic acid and cinnamic acid, e.g. balsam of Peru, balsam of Tolu.

General Properties of Resins

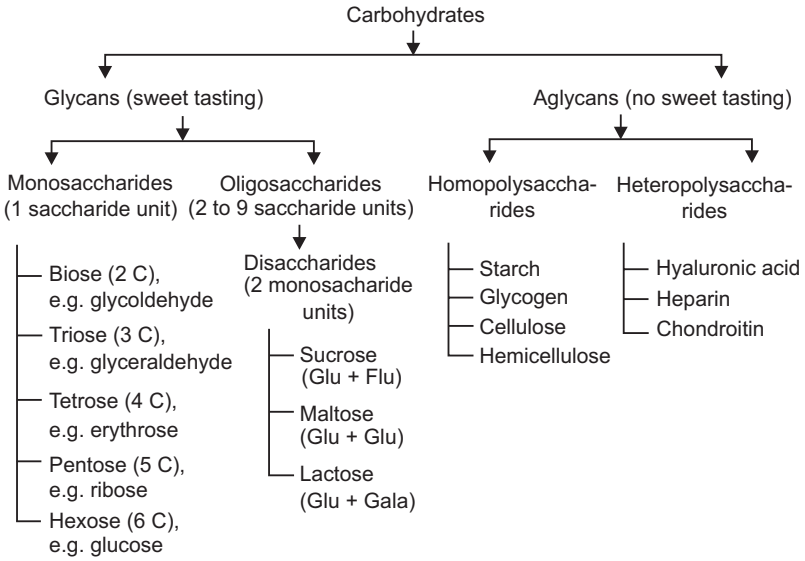
- Amorphous in nature.
- Insoluble in water.
- They are end products of metabolism.
- On heating they soften and finally melt.
- Dissolve in alcohol, chloroform and ether.
- Burn with characteristic smoky flame.

Q 11. Define and classify carbohydrates giving suitable examples.

Carbohydrates

Carbohydrates are polyhydroxy aldehydes or polyhydroxy ketones or compounds which on hydrolysis gives either of above.

Classification



Q 12. Write a note on 'gums' and 'mucilages'.

Gums

Gums are pathological products formed after any injury to the plant.

- The plants containing schizogenous ducts or glands can form the gums.
- These ducts or glands form and eliminates sticky, semiliquids.
- These substances prevent entry of microbes through injured area.
- The process of formation and deposition of gum is known as "gummosis" and the products as gums.
- Examples: Acacia gum, guar gum.

Mucilages

Mucilages are physiological products and can be obtained along with gums or any other constituents, e.g. tragacanth mucilage.

Q 13. Define and classify enzymes with suitable examples.

Enzymes are the chemical substances which catalyse various biochemical reactions, e.g. papain, yeast, diastase.

Classification

- *Oxido-reductases:* They catalyze oxidation-reduction reaction, e.g. tyrosinase.
- *Transferases:* They catalyse transfer reactions, i.e. transfer of groups, e.g. hexokinase.
- *Hydrolyases:* They catalyse hydrolytic reactions, e.g. esterases, phosphatase.
- *Lyases:* They catalyse cleavage reactions, e.g. aldolase, carboxylase.
- *Isomerases:* They catalyse isomerization reactions, e.g. epimerase.
- *Ligases:* These enzymes catalyse the formation of bond, e.g. DNA ligase.

Q 14. Define and classify vitamins giving suitable examples.

Vitamins

Vitamins are the organic compounds which are found in natural food-stuffs and essential for normal growth and metabolic functions of the body.

Classification

- Fat soluble vitamins: Vitamins A, D, E, and K.
- Water soluble vitamins:
  i. Vitamin C (Ascorbic acid)
  ii. Vitamin B complex group:
    - Thiamine (B_1)
    - Riboflavin (B_2)
    - Niacin (B_3)
    - Pyridoxin (B_6)
    - Pantothenic acid
    - Biotin
    - Folic acid
    - Lipolic acid (PABA)
    - Cyanocobalamin (vitamin B_{12}).

Q 15. Write a note on perfumes and flavouring agents.

Perfumes and Flavouring Agents

Perfumes (Per: Through, Fumes: Smoke)

- These are the substances made from natural or synthetic materials and are used for creating a pleasant odour.
- Perfumes are used to improve personal appearance in the society.
- They are used in cosmetics and in toilet preparations.
- The low quality perfumes are known as industrial odourants.
- Perfumes are mainly composed of volatile oils.
- Perfumes derived from plants are the volatile oils, also called essential oils.
- Perfumes obtained from animal source are long lasting, hence are called fixatives.

Examples

- *Flowers:* Rose, jasmine.
- *Stem:* Sandal.
- *Leaves:* Citronella.
- *Aerial parts:* Geranium.

Flavouring Agents

- These are the agents used to give a pleasant flavour to the formulations.

i. Flavouring agents improve psychological effect of the preparations.
ii. They are used to cover unpleasant odour and taste of the preparations.
iii. Flavouring agents should be selected carefully.
iv. It should not interact with substances present in the preparations.
v. They should be capable of covering unpleasant odour and taste, e.g.
   – *To cover acidic taste:* Orange and liquorice.
   – *To cover bitter taste:* Fennel and peppermint.
   – *To cover salty taste:* Lemon and orange.
vi. The flavours are made from natural sources are lemon, mint, orange, clove, lavendor, rose, etc.

Q 16. Explain the following chemical tests.

a. Keller-Kiliani test
b. Borntrager test

a. Keller-Kiliani Test for Digitoxose (for Cardiac Glycosides)

- 1 gm of powdered digitalis + 10 ml of 70% alcohol.
- Boil for 2–3 minutes and filter.
- Filtrate + 5 ml water + 0.5 ml lead acetate solution.
- Shake well and filter.
- Filtrate + equal volume of chloroform.
- Evaporate.
- Residue + acetic acid + 2 drops of $FeCl_3$.
- Transfer the mixture into test tube containing 2 ml of concentration H_2SO_4.

Observation

Reddish brown layer becomes bluish green in colour.

Conclusion

Digitoxose is present (cardiac glycoside).

b. Borntrager Test for Senna (Anthraquinone Glycosides)

- Powdered leaves of senna + dilute HCl.
- Boil and filter immediately.

- Cool the filtrate.
- Filtrate + chloroform.
- Shake well and separate organic solvent layer.
- Add dilute ammonia to layer of organic solvent.

Observation

Ammoniacal layer becomes pink and finally red.

Conclusion

Anthraquinone glycosides are present.

Q 17. Describe general method of collection of bark.

Barks are collected in a season when they contain maximum concentration and active constituent. Following are methods of collecting barks:

a. Felling Method

This is very old method of collecting barks. The tree is cut at base and bark is peeled out.

b. Uprooting Method

In this method, roots of the plants are drawn out of soil and bark is stripped off from roots and branches.

c. Coppicing Method

In this method, plant is allowed to grow for a definite period and then it is cut off at specific distance from soil. The stumps, which remain in ground are allowed to send shoots, which develop further independently yielding aerial parts.

These new parts are cut off and bark is collected from shoots.

Q 18. Define and classify terpenoids with examples.

Terpenoids are the hydrocarbons and their originated derivatives which are found in all volatile oils of plant or animal origin.

Classification of Terpenoids

Terpenoids are classified on the basis of isoprene units, i.e. C_5H_8.

1. Monoterpenes, e.g. camphor, tulsi, dill, coriander.
2. Sesquiterpenes, e.g. clove, sandalwood oil.
3. Diterpenoids, e.g. taxus.

4. Tritepenoids, e.g. ambergris.
5. Tetraterpenoids, e.g. annatto, crocus.
6. Polyterpenoids, e.g. rubber.

Q 19. State different techniques/methods of isolation of volatile oils.

1. Hydrodistillation

Method comprising of water distillation, water and steam distillation is used for extraction of volatile oil from herbal drugs. The fresh material is subjected to hydrodistillation in case of the leafy drug.

2. Enfleurage

This method is used for extraction of delicate perfumes. The fresh flower petals are mechanically spread on layer of fatty material, allowed to imbibe and exhausted petals are replaced by fresh material. The process is continued till fatty layer is saturated with volatile principles which are then extracted with lipid solvent.

3. Eucelle Method

This method is used for extraction of citrus oil, wherein oil cells in ring are ruptured mechanically using pointed projection by twisting raw material over them in clockwise direction either mechanically or manually.

Q 20. What are glycosides? How are they isolated from plant?

Glycosides

Glycosides are defined as organic compounds from plant or animal sources which on enzymatic or acid hydrolysis gives one or more sugar moieties along with nonsugar moieties.

Method of Isolation of Glycosides

Stass-Otto Method

The drug containing glycoside is finely powdered and the powder is extracted by continuous hot percolation using Soxhlet's apparatus with alcohol as solvent.

During this process, various enzymes present in plant parts are also deactivated due to heating. The thermolabile glycoside should be extracted at temperature below 45ºC. The extract is treated with lead acetate to precipitate tannin and thus eliminates nonglycosidal impurities. The excess of lead acetate is precipitated as lead sulphide by passing hydrogen sulphide gas through solution. The extract is filtered, concentrated to get crude glycosides.

From the crude extract the glycosides are obtained in pure form by making use of processes like crystallization, chromatographic techniques, etc.

Q 21. Describe the general method of isolation of tannins.

Isolation of Tannins

Both hydrolysable and condensed tannins are highly soluble in water and alcohol but insoluble in organic solvents like solvent ether, chloroform and benzene.

Tannin compounds can be easily extracted by water or alcohol. The general method for the extraction is by water or alcohol. The general method for the extraction of tannic acid from various galls is either with water saturated ether or with mixture of water alcohol and ether. In such cases the free acids like gallic and ellagic acid goes along with ether while true tannins gets extracted in water. If drug consists of chlorophyll or pigment, may be removed by ether. After extraction the aqueous and etheral layers are separated concentrated, dried and subjected to further isolation and purification using various separational techniques of chromatography.

CHAPTER 6

Surgical Fibres, Sutures and Dressings

Q 1. What are fibres? Classify surgical fibres with examples.

Fibres

Fibres are the elements which are synthesized or prepared from plant or animal and contain chain of molecules.

Classification of Fibres

- Plant fibres, e.g. cotton, banana, jute.
- Animal fibres, e.g. silk, wool.
- Mineral fibres, e.g. glass, asbestos.
- Synthetic fibres, e.g. rayon, nylon, terylene.

Q 2. Define surgical dressings. Give its essential requirements. Mention uses of surgical dressings.

Surgical Dressings

"The surgical dressings are the materials used for covering the wounds or injuries and to be applied singly or in combination."

Official/Essential Requirements

- They should be sterile.
- They should be stored in dry well-ventilated place at temperature not exceeding 25°C.
- They should be free from loose threads, ends and fibres.
- Adhesive products should not be allowed to freeze.
- Only permitted antiseptics should be used in a prescribed concentration.
- They should be dyed if mentioned in the monograph.
- They should be durable.
- They should be easy to handle at all stage.

Uses of Surgical Dressings/Functions

- They provide ideal conditions for wound healing.
- They remove wound exudates from the site.
- They give mechanical support to the tissues.
- They give protection to healing wound.
- They prevent infections.
- They protect the wounds from outside liquids.

Q 3. What are different types of surgical dressings (classification)?

Types of Surgical Dressings

- Fibres and related materials, e.g. wood cellulose.
- Carded products, e.g. absorbent cotton.
- Nonextensible, nonadhesive woven products, e.g. absorbent muslin cloth.
- Nonextensible adhesible woven products, e.g. belladona adhesive plasters.
- Extensible nonadhesive products, e.g. cotton bandage, elastic web bandage.
- Extensible adhesive woven products, e.g. elastic adhesive bandage, extension plaster.
- Nonwoven products, e.g. surgical adhesive tape.

Q 4. What are sutures? What are the properties of sutures? Give uses.

Sutures

Sutures are sterile threads or fibres used for stitching or sewing the tissues together.

Properties of Sutures

- They must be sterile.
- They should be non irritant.
- They should have finest possible gauge.
- They should have adequate strength.
- If absorbable, their time of absorption must be known.
- They are to be used once only.

Uses of Sutures

- Sutures are used for sewing the tissues together.
- Nylon sutures are used in skin and plastic surgery.
- Kangaroo tendons are specially used in hernia.
- Metallic sutures are used in general surgery.

Q 5. Define surgical sutures. How are they classified?

Surgical Sutures

"Surgical sutures are sterile threads or fibres used for stitching or sewing the tissues together."

Classification of Sutures

- Absorbable sutures:
  i. Sterile catgut
  ii. Sterile reconstituted collagen suture.
- Nonabsorbable sutures:
  i. Fibres, e.g. silk, cotton
  ii. Sterile linen suture, e.g. muslin
  iii. Sterile polyamide suture, e.g. nylon
  iv. Sterile polyester suture, e.g. terylene
  v. Sterile stainless and silver suture, e.g. metal springs.
- Haemostatic sutures:
  i. Oxidised cellulose
  ii. Absorbable gelatin sponge.

Q 6. What is surgical catgut? Give the method of preparation of catgut.

Surgical Catguts

"Surgical catguts are the sterile absorbable sutures made of fibres obtained from collagen of animals."

Preparation of Catgut

- Collagen is obtained from submucus connective tissues of small intestine of sheep.
- Intestine is cleaned of its contents.
- About 7.5 meters of intestine is selected.
- It is split length wise in 2 to 3 ribbons.
- Ribbons are separated by machines.
- Ribbons are stretched under tension and dried. It gives mechanical strength to the ribbons.

- Ribbons are tanned or hardened by soaking them in a solution of chromium salt.
- The dried ribbons are polished to obtain smooth string gauzed for its diameters.
- The fine fibres having uniform diameters and smoothness are then sterilized.

Q 7. How catguts/sutures are sterilized?

The sterilization of catgut is done by the following methods:

- *Chemical sterilization/iodine method:* In this method catguts are dipped in iodine and potassium iodide solution for 24 hours.
- *Sterilisation by irradiation:* This is the latest method. The catguts are exposed to gamma rays obtained from cobalt 60.
- *Sterilization by heat:* There are two methods:
  i. *Boilable catguts:* The catguts are placed in glass tube and are filled with some amount of Toulene and are heated. Then they are sterilized in autoclave. They are stored as a soaking material in distilled water.
  ii. *Nonboilable catguts:* The catguts are packed in plastic packets. They are placed in mixture of alcohol and water.

Q 8. Define the terms 'ligatures' and 'bandage'.

Ligatures

Ligatures are sterile threads or fibres used for tightening muscles, blood vessels, etc.

Bandage

A material which holds the dressing in place and applies pressure or support on injured parts is called bandage.

Q 9. Give the biological source, method of preparation and uses of cotton.

Cotton

- Synonym: Absorbent cotton, cotton wool, purified cotton, gossypol.
- Biological source: The drug is obtained from trichomes of seeds of "*Gossypium barbadense*".
- Family: Malvaceae.

Method of Preparation of Absorbent Cotton

- The cotton plant after flowering bears the fruits known as capsules.
- Each capsule is made up of 3 to 5 chambers known as cells/seeds.

- They are covered by large number of trichomes.
- Each seed covered with trichomes is known as balls.
- After collecting the balls, they are subjected to ginning process.
- In ginning process, trichomes are separated from seeds.
- These trichomes with some instrument are divided into two types depending upon the length, as short fibres and long fibres.
- The short fibres are used in surgical dressings. They are known as linters.
- The raw cotton contains wax, fats, colouring matter and iron impurities.
- To remove the impurities, the linters are taken to "cotton opener".
- The fibres are then treated with dilute NaOH solution under pressure for 10 to 15 hours. It separates wax and fat from fibres.
- The fibres are washed with water, bleached, dried and sterilized.
- *Chemical constituent:*
  i. 90% of cellulose.
  ii. 7 to 8% of moisture wax, fat, etc.

Storage

- To be stored in cool and dry place.
- They should be protected from light.

Uses

- As a surgical dressings as ligature and suture.
- As a filter media.
- As insulator.
- It absorbs blood, mucus, pus and prevents the wounds from infection.

Q 10. Write in brief about "wool".

Wool

- *Biological source:* They are obtained from the fleece of sheep ovis aries.
- *Family:* Bovidae.
- *Preparation:* The fleece of a sheep is cut and hairs are separated. Impurities like dust, grease are removed. The fibres are bleached, washed, dried sterilized and marketed.
- *Description:* Wool hairs are smooth, elastic, lustrous, curly, hygroscopic and slippery to touch.

- *Chemical constituents:* Keratin and cystine (amino acid).
- *Uses:*
  i. Surgical dressing as ligature and sutures.
  ii. Filter medium.
  iii. In crape bandages.

Q 11. Give the biological source, method of preparations and uses of "silk".

Silk

- *Biological source:* They are obtained from *cocoons* of *Bombyx mori* and other varieties of Bombyx.
- *Family:* Bombycidae.

Method of Preparation

- In the life cycle of silk worm larva is the main stage.
- The larvae have some special glands in oral cavities.
- They secrete the fibre known as sericin, which on exposure to air becomes hard and form the cocoon.
- The cocoons are collected and heated at a temperature 60° to 80°C in steam current.
- The cocoon get opened.
- They are placed in hot water to dissolve the gum like substances and fibres become soft.
- The fibres are separated, sterilised, packed and marketed.
- *Chemical constituents:* Silk contains a protein known as fibroin.
- *Uses:*
  i. In surgical dressings as a ligature and suture.
  ii. In manufacturing of sieves.
  iii. In textiles.

Q 12. Write in brief about regenerated fibres/viscose rayon.

Regenerated fibres are prepared from naturally produced long chain molecules and modified to give fibre.

Viscose Rayon

- *Synonym:* Regenerated cellulose, artificial silk.
- *Source:* Viscose rayon is a regenerated fibre prepared from the wood cellulose or *Picea abies*.

- *Family:* Pinaceae.
- *Description:*
  i. Rayon is a white, highly lustrous fibre
  ii. Its tensile strength varies from 2/3 to 1 and is about half of that of cotton.
  iii. On wetting the tensile strength is decreased to about 60%.
  iv. Rayon is a pure form of cellulose.
- *Chemical constituents:* It contains
  i. Cellulose
  ii. Hemicellulose
- *Uses:* Viscose rayon is used in the preparation of surgical dressing and fabrics.

Q 13. Write in brief about "Jute".

Jute

- *Synonym:* Gunny
- *Biological source:* They are obtained from phloem fibres of the stem bark of various species of the corchorus.
- *Family:* Tiliaceae
- *Preparation:* During the month of July, when plant is in flowering stage, the straight unbranched stems are cut, formed into bundles and put into stagnant water for 10–12 days. During this period, disintegration takes place and phloem and parenchymatous tissue of the bark get separated. Stripping is done and the fibres are cleaned and washed several times with water. The fibres thus obtained are bleached and dried by exposing them to sunlight. After drying, the jute fibres are graded according to colour, length and glossiness and sent to market.
- *Chemical constituents:* The jute contains true cellulose, hemi-cellulose, lignin.
- *Uses:* Jute is used in:
  i. Manufacture of tow's (stupa)
  ii. Padding splints
  iii. Filtering media
  iv. Preparation of coarse bags.

CHAPTER 7

Adulteration, Drug Evaluation and Significance of Pharmacopoeial Standards

Q 1. What is adulteration? What are different methods of adulteration?

Adulteration

"It is defined as worthless admixture of any material in the genuine drug."

Methods of Adulteration

- Mixing of materials obtained from the same source, e.g. bark can be adulterated by addition of stem pieces, cloves are mixed with cloves stalks.
- Mixing of closely related parts of plants, e.g. leaves are supposed to be adulterated if the sample contains excessive amount of petioles.
- Mixing of exhausted drugs: The containing volatile oils are commonly adulterated in this way, e.g. exhausted fennel is added to genuine fennel.
- Roots and rhizomes are supposed to be adulterated if soil attached is not removed completely, e.g. ginger, gentian have adulteration of soil attached with them.
- Mixing of natural substances appearing same as drugs, e.g. oils.
- Mixing of materials by making them similar to drug, e.g. tea granules can be adulterated by mud and tea powder by soil.
- Mixing of same part of the plant of different varieties, e.g. senna leaflet with arabic senna, dog senna. Ginger with African ginger, Japanese ginger.
- Adulteration to fortified inferior natural drugs, e.g. lemon grass oil can be adulterated by adding higher amount of citral.
- Substitution by artificially manufactured substitutes: This is observed in case of drugs which are costly, e.g. artificial invert sugar is mixed with honey.

- Many a times a synthetic chemical which constitutes one of the chemical constituents of the drug is added to the genuine drugs, e.g. benzyl benzoate to balsam of Peru and citral to oil of lemon grass and camphor oil and eucalyptus oil in oil of rosemary.

Q 2. Define drug evaluation. Give objective/importance of drug evaluation.

Definition

Evaluation of drug means confirmation of identity purity and quality of drugs.

Objectives of Drug Evaluation

- Confirmation of already existing standards as per pharmacopoeia.
- Detection of adulteration and substitution in the drug.
- To study variations in biochemical activities of drugs.
- To study deterioration of the drug due to storage of any chemical reaction.

Q 3. Enlist different methods of drug evaluation.

- Morphological/organoleptic method.
- Microscopical method.
- Physical method.
- Chemical method.
- Biological method.

Q 4. Write a note on morphological/organoleptic method of drug evaluation.

- In this method morphological characters of the drugs are studied.
- This method is also known as organoleptic method because observations are taken with sensory organs.
- It is also known as macroscopical method because in the method generally entire drugs are examined.
- In this method following morphological characters are studied.
    i. Shape: Parts of the plants such as leaves, roots, barks, flowers have specific shape. Thus change in shape can be found and useful for evaluation.

ii. Colour: The colour of the drug dependant upon state of maturity of entire plant as well as cells of specific part. Thus colour change due to storage may be find out, e.g. Beeswax in crude state is yellowish-brown and when purified and bleached appears a white in colour.

iii. Odour: It is the observation taken with nose. It plays an important role in identifying unorganised drugs and oils, e.g.

Aromatic odour: Fennel, coriander

Pungent: Clove

Pleasant: Peppermint.

iv. Taste: It is the observation taken with tongue. It is useful to identify unorganised drugs and oils, e.g. sweet—liquorice, bitter—nux vomica, sour and acid—amla.

v. Fracture: It means broken surface of the bark. The drugs are broken with hands and broken surface is observed for the type of fracture, e.g. short fracture, granular fracture, fibrous fracture, sphintary fracture, laminated fractures.

vi. Part of plant: The various parts of plant are roots, stem, leaves, flowers, fruits, seeds, bulbs, leaflets, etc. Thus by knowing the part of plant in the sample, one can get an idea about the name of drug, e.g. root—Rauwolfia, leaf—Senna, Vasaka, flower bud—Clove.

Merits/Advantages of Morphological Method

- Easy method.
- It helps in identification of drug.
- No special equipment is required.
- No special experimentation is required.
- It helps in deciding purity of drug.

Demerits/Disadvantages of Morphological Method

- Large quantity of sample is required during evaluation.
- Limitation of sensory organs of human being.
- Chances of sample to sample variation are observed.
- Applicable to entire organised crude drug.
- Time consuming method.
- Less helpful for unorganised drugs, powdered drugs and liquid drugs.

Q 5. Write a note on "microscopical evaluation" of crude drugs.

- In this method observations are taken by using microscope.
- The microscopical characters of crude drugs such as trichomes. starch grains, stomata are observed under microscope.

Objectives of Microscopical Evaluation

- To study cellular arrangement in the drugs.
- To study special structures or tissues or any modifications.
- To take numerical measurements, e.g. number of stomata.
- To locate the site of various chemical constituents.

Microscopical methods of drug evaluation are:

1. **Stomatal number:** It is the average number of stomata present per square mm of the epidermis. Stomatal no. is relatively a constant for particular species of the same age, hence used as a diagnostic character for identification of a leaf drug.

   e.g. *Datura stramonium*—87
Hyoscyamus niger—141 } Stomatal numbers

2. **Stomatal index:** It is the percentage which the number of stomata forms to the total number of epidermal cells.

$$I = \frac{S \times 100}{(E + S)}$$

   I = Stomatal index

   S = Number of stomata

   E = Epidermal cells in the same area.

3. **Vein islet number:** It is the number of vein islets per sq. mm of leaf surface

   e.g. *Digitalis purpurea* —0.2 to 5.5
Erythroxylon—8 to 12
Cassia Angustifolia—19 to 33 } Vein islet number

4. **Palisade ratio:** It is the average number of palisade cells, beneath one epidermal cell, using four continuous epidermal cells for the count.

   e.g. *Atropa belladonna* 6 to 10
Datura stramonium 4 to 7 } Palisade ratio

5. **Quantitative microscopy:** This method can be used for evaluation of powdered drugs, e.g. clove, ginger, cardamom, nutmeg and umbelliferous fruits.

   This method is used only if the powder contains:
   i. Well-defined particles
   ii. Single-layered cells or tissues
   iii. The object of uniform thickness.

Merits/Advantages

- Small quantity of sample is required.
- No person to person variation in observations.
- Standard observations and values are available in books.
- It can be applied to entire drug, powdered drug, rarely unorganised drug.
- It gives correct idea of substituents and adulterants.
- It confirms purity of drug.
- It helps in fixing location of constituents.

Demerits/Disadvantages

- Time consuming method.
- Skilled person is required for experimentation.
- Costly method.
- Does not give much more information about quality of drugs.
- Little application in unorganised drugs and oils.

Q 6. Write a note on "physical method of evaluation".

In this method physical properties of drugs are studied. The experimental observations are compared with standard information. The variations in these two indicate pure nature of the sample. The following are physical properties of drugs useful in physical evaluation.

- *Viscosity:* Viscosity can be studied for oils and semiliquids. If the oil undergoes rancidity, condensation, the viscosity increases.
- *Density:* Adulterated oils have different densities than genuine oils.
- *Optical activity:* It helps in identifying the adulterants in the drug by considering changes in optical rotation.
- *Refractive index:* It is used in identification of volatile oils, fixed oils, fats, resins. The refractive index may change as per temperature, pressure and light.

- *Melting point and boiling point:* Purity of drug is related to MP and BP. Hence BP and MP help in identification and establishing purity of drugs.
- *Moisture content:* Estimation of moisture content is the estimation of H_2O content present in the drug. In case of moisture sensitive drugs definite moisture content is necessary. Hence it should be determined and controlled. The moisture control is necessary to prevent the destruction of crude drug due to chemical change or due to microbial contamination.
- *Ash value (Ash content):* Ash is a residue left after complete ignition of drug. It is expressed as % of ash collected on complete ignition of drug and compared with standard value to observe presence of impurity.
- *Extractive value:* The drug is extracted with organic solvents like water, alcohol, ether. Extractive values are important in identifying and determination of purity of drug.

Merits/Advantages of Physical Evaluation

- Useful for organised and unorganised drugs.
- Mainly applicable to unorganised, semisolids and liquids.
- Vegetative adulteration can be examined.
- Purity of drugs can be examined.
- Standard values of physical constants are available in official books.

Demerits/Disadvantages of Physical Evaluation

- Costly method.
- Time consuming method.
- The observation changes depending upon experimental conditions.
- It does not give information about quality of drugs.
- Skilled person is required to handle analytical equipment.

Q 7. Write a note on "chemical method" of drug evaluation.

This method helps in determining chemical nature and chemical composition of drug.

- Objectives:
  i. Determination of active chemical constituents.
  ii. Determination of other chemical constituents.
  iii. Determination of % of active constituents.
  iv. Establishing quality of drug.

v. Confirmation of variety of drug.
vi. Confirmation of adulterant, if present.

- The chemical method involves three parts:
  i. *Solubility:* The solubility has more importance in the cases of unorganised drugs and oils. Solubility is important step in identification of drugs. The observations are noted in terms of freely soluble, soluble, sparingly soluble, insoluble, etc. For example, alkaloids and glycosides are soluble in alcohol. Carbohydrates and gums are completely soluble in water. Thus solubility helps in identification of drug and adulterant.
  ii. *Qualitative chemical test:* These are the simple chemical tests performed in order to identify various chemical constituents present in the drug. The drugs are powdered and treated with one or more reagents in a proper sequence and observations are noted, e.g. hydrolysable tannins give blue colour with $FeCl_3$ solution and condensed tannins give green/black colour with $FeCl_3$ solution.
  iii. *Quantitative chemical analysis method:* In this method % of active constituent is determined.
- Assay: The estimation of percentage purity of the active chemical constituent is known as assay.
- The important types of chemical assay are:
  i. Volumetric assay:
     – Acid–base titration
     – Redox titration
     – Complexometric titration
     – Precipitation titration.
  ii. Gravimetric assay.
  iii. Potentiometric assay.
  iv. Colourimetric assay.

Merits/Advantages of Chemical Method

- The experiments have a great accuracy.
- No chances of personal variation.
- Presence of chemical constituents in amounts can be determined.
- Confirmation to variety of drugs and adulterants present can be obtained.

- It determines the quality and purity of drugs.
- It helps in judging pharmacological actions of the drugs.
- This method gives guidelines for extraction of crude drugs with the help of solubility.

Demerits/Disadvantages of Chemical Method

- Requires heavy instrumentation, so costly method.
- Skilled persons are required for experimental work.
- The pharmacological action predictable should be confirmed by using biological method.

Q 8. Write a note on "biological method" of evaluation.

In this method the experimentation is carried on biological system, i.e. living organisms.

- Objectives
  i. To study quantitative action of drugs.
  ii. To study toxic effects of drugs.
  iii. To study synergistic effects or antagonist effects of drugs.

Depending upon experimental animals biological methods can be divided as follows:

i. *Bioassay:* The estimation of potency of active constituent of crude drugs by means of its effect on living organisms is called bioassay.

   The bioassay can be studied using experimental animals or isolated tissues, e.g. heart and blood vessels—frog, eye—rabbit, respiration—dog.

   The drugs are administered in the above animals in a particular dilutions with specific doses and the quantitative effects are observed.

ii. *Bacteriological assay method:* In this method the drug is evaluated by taking the actions of drugs on the growth of bacteria.

   In this method a pure strain of microorganisms is introduced in nutrient medium and system is incubated at 37°C for sufficient length of time.

   A series of solution of various dilutions are prepared. The selected dilutions are administered in the nutrient medium in a definite doses.

   The system is again incubated and effects are noted.

Merits/Advantages Biological Method of Evaluation

- It helps in determination of potency of drug.
- It also helps in determination of ED_{50} and LD_{50}.
- Effect on various systems can be studied.
- It gives idea about quality of drugs.
- Synergistic agents and antagonists can be find out.
- Toxic effects of drug can be find out.
- Used when other methods of evaluation cannot be used.

Demerits/Disadvantages Biological Method of Evaluation

- Very complicated method.
- Costly method.
- Time consuming method.
- Skilled person is required for experimentation.
- Does not given an idea about morphological, physical or chemical properties of drugs.
- Animals are required for experimentation.

Q 9. How moisture content is useful in evaluation of drugs?

- Moisture content means amount of water content present in the drug.
- Water is essential component of living organisms but some drugs are less stable in water.
- In case of the moisture sensitive drugs, definite moisture is necessary.
- The moisture control is necessary to prevent the destruction of crude drugs either due to chemical change or due to microbial contamination.
- Excessive presence of water may lead to fungal and microbial growth, affecting chemical nature of drug, stability and pharmacological action.
- Moisture content can be determined by:
  i. Heating the drug in an oven at 100°C until the weight is constant.
  ii. Karl Fisher reagent is used to determine moisture content.

Q 10. Explain "ash value" (ash content).

- Ash is a residue after complete ignition of the drug.
- In experiment a carefully weighed quantity of a drug is taken into porcelain crucible and it is burned completely.

- Ash collected is heated at 450°C to remove organic content of drug.
- Heating is continued till two constants weight of the ash are obtained, then the percentage of change in weight is calculated.
- Importance of ash value:
  i. It helps in identification of drugs.
  ii. It helps in deciding purity of drug.
  iii. It helps in detecting the adulteration and substitutions.
- Acid insoluble ash: It is the % of ash which is insoluble in diluted HCl.
- Water soluble ash: When above observation fails, the ash is treated with water and % of water soluble ash is calculated.

Q 11. How "extractive values" are helpful in drug evaluation?

Extraction of drug is done with solvents such as water, alcohol, ether. Extractive values are important in identification of drugs and determination of purity of drugs.

i. *Water soluble extractive value:* The drugs containing carbohydrates, plant acids, tannins are tested for their solubility in water.

ii. *Alcohol soluble extractive value:* The drugs containing alkaloids, resins, glycosides are tested for their solubility in 90% alcohol.

iii. *Ether soluble extractive value:* It is important for the drugs containing volatile oils, fixed oils and colouring matter.

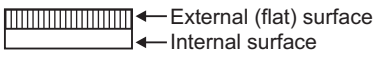
Q 12. Define bark. What are various shapes/types of barks?

Bark

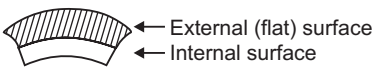
Barks are the external tissues of stems.

Types of Barks

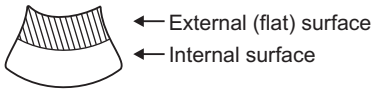
1. *Flat barks:* The barks are collected from large plants and show flat surface, e.g. Arjuna bark.



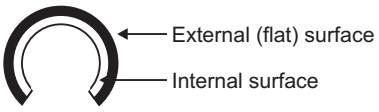
2. *Curved barks:* The barks are collected from primary branches of stems, e.g. Ashoka.



3. *Recurved barks:* The barks are collected from primary branches containing the more soft tissues. The shape can be explained as concavity on the external surface, e.g. Kurchi.



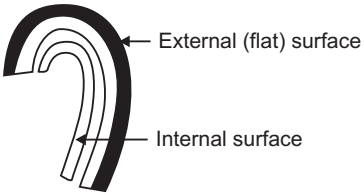
4. *Channeled barks:* The barks are collected from secondary branches of the stem. The curvature is more but the ends are not meeting each others, e.g. Cascara.



5. *Double quilled barks:* Two ends of bark are quilled, e.g. cascara in rare cases.



6. *Compound quilled barks:* One quill is inserted in other quilled, e.g. Cinnamon.



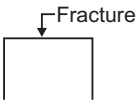
Q 13. Define fractures. Explain various types of fractures.

Fractures

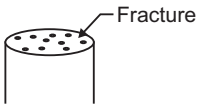
Fractures are the transverse broken surfaces of the bark.

Types of Fractures

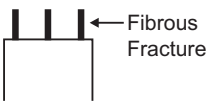
1. *Short fracture:* The surface is smooth, e.g. Kurchi bark.



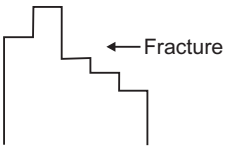
2. *Granular fracture:* The surface shows small circular elevations, e.g. wild cherry bark.



3. *Fibrous fracture:* Fibre like materials project out on breaking the drug, e.g. cinchona, ginger.



4. *Sphintary fracture:* The surface shows various levels or steps, e.g. Cinnamon bark.



5. *Laminated fracture:* The drug cannot be broken in single plane, e.g. Quassia root.

Q 14. Write the diagnostic characteristics of leaf (leaf constants) (microscopic constants)

a. Stomatal number: It is the average number of stomata present per square mm of the epidermis.

b. Stomatal index: It is the percentage which the number of stomata forms to the total number of epidermal cells.

$$I = \frac{S \times 100}{(E + S)}$$

I = Stomatal index

S = Number of stomata per unit area

E = Epidemal cell in the same area

c. Vein islet number: It is the number of vein islets per sq. mm of leaf surface.

d. Palisade ratio: It is the average number of palisade cells, beneath one epidermal cell, using four continuous epidermal cells for count.

CHAPTER 8

Pharmacological Grouping of Natural Drugs

A LAXATIVES

Q 1. Define the term laxatives. Name the four drugs used as laxative.

- Laxatives: The drugs which promote defecation are called laxatives.
- *Drugs:* Aloe, senna, castor oil, rhubarb, ispaghula.
- *Laxatives:* These are categorised as:
  i. *Laxatives:* It means elimination of soft formed stools, e.g. senna, isapgol, liquid-paraffin.
  ii. *Purgatives:* It means more evacuation of stools, e.g. castor oil, aloe, rhubarb.
  iii. *Drastics:* They act intensely by irritating the mucous membrane of the intestine, e.g. jalap, podophyllum.
  iv. *Hydrogogue:* It means the substances which produce fluid motions, e.g. cotton oil, colocynth.

Q 2. Give the synonyms, biological source, chemical constituents and uses of the following crude drugs: a. Senna, b. Aloe, c. Castor oil, d. Rhubarb, e. Ispaghula.

a. Senna

- *Synonyms:* Sonamukhi, Tinevelly senna, Indian senna.
- *Biological source:* It consists of dried leaflets of *Cassia angustifolia* vahl.
- *Family:* Leguminosae.
- *Chemical constituents:* Senna contains anthraquinone glycosides.
  i. Sennoside A
  ii. Sennoside B

iii. Sennoside C
iv. Sennoside D
v. Sennidin
vi. Rhein
vii. Emodin
viii. Aloe-emodin.

- *Uses:* Senna leaves are used as laxatives.
- *Substitutes and adulterants:*
  i. Dog senna
  ii. Arabian senna.

b. Aloe

- *Synonyms:* Korphad, musabbar, kumari.
- *Biological source:* Aloe is the dried juice of the leaves of *Aloe barbadensis* miller.
- *Family:* Liliaceae.
- *Chemical constituents:*
  i. Aloin
  ii. Barbaloin
  iii. Isobarbaloin
  iv. Aloe-emodin
  v. β-barbaloin
  vi. Resin contains aloesin.
- *Uses:*
  i. Aloe is used as purgative.
  ii. Used in cosmetics as protective.
  iii. Stimulates the growth of hairs.
  iv. Also applied for painful inflammations.

c. Castor oil

- *Synonyms:* Oleum ricini, ricinus oil.
- *Biological source:* Castor oil is a fixed oil obtained by the cold expression of the seeds of *Ricinus communis*.
- *Family:* Euphorbiaceae.
- *Chemical constituents:*
  i. Ricinoleic acid
  ii. Isoricinoleic acid
  iii. Linoleic acid

iv. Isostearic acid
v. Stearic acid.

- *Uses:*
  i. Castor oil is used as a cathartic/purgative.
  ii. As lubricant.
  iii. Used in preparations of paints, enamel, varnishes, grease, polishes, printing ink.
  iv. Used in cosmetics.

d. Rhubarb

- *Synonyms:* Radix, rhein, rheum
- *Biological source:* Rhubarb consists of dried rhizome of *Rheum emodi Wall*.
- *Family:* Polygonaceae.
- *Chemical constituents:*
  i. Rhein
  ii. Emodin
  iii. Chrysophanol
  iv. Glucorhein
  v. Palmidin A, B, C
- *Uses:*
  i. Bitter stomachic
  ii. Purgative

e. Ispaghula

- *Synonyms:* B. psyllium, Isabgol, plantago.
- *Biological source:* It consists of dried seeds of the plant known as *Plantago ovata*.
- *Family:* Plantaginaceae
- *Chemical constituents:*
  i. Mucilage, contains natural dietary fibre
  ii. Pentosan
  iii. Aldobionic acid
  iv. Fixed oil, proteins.
- *Uses:*
  i. The husk of the seeds used as demulcent, laxative, emollient and treatment of chronic constipation.
  ii. Used in amoebic and bacillary dysentery
  iii. Reduce cholesterol level

iv. Mucilage of Isapgol used as a stabilizer in the ice-cream industry.

- *Swelling factor test:* Swelling factor means quantitative swelling due to mucilage present in the drug.

  Test: Put 1 gm of drug in the measuring cylinder (25 ml capacity) in 20 ml water with occasional shaking. The volume occupied by the seeds after 24 hours of swelling is measured.
- Swelling factors for isapgol seed is 10 to 14.

B CARDIOTONICS

Q 3. Define cardiotonics. Give four examples.

- *Cardiotonics:* The drugs which increase the force of contraction of cardiac muscles and stimulate the overall activity of heart are called cardiotonics, e.g. digitalis, strophanthus, squill, Arjuna bark.

Q 4. Give the synonyms, biological source, chemical constituents and uses of: a. Digitalis, b. Arjuna.

a. Digitalis

- *Synonyms:* Fox glove leaves, digitalis leaves.
- *Biological source:* Digitalis consists of dried leaves of digitalis purpurea dried at a temperature below 60°C, immediately after collecting the leaves.
- *Family:* Scrophulariaceae.
- *Chemical constituents:* Digitalis contains cardiac glycosides:
  i. Digoxin
  ii. Digitoxin
  iii. Gitoxin
  iv. Digitoxigenin
  v. Digitonin
  vi. Gitonin
  vii. Digoxigenin
  viii. Purpurea glycosides A and B.
- *Uses:*
  i. It is used as a cardiotonic
  ii. In the treatment of congestive heart failure.

b. Arjuna

- *Synonyms:* Arjuna bark.
- *Biological source:* Arjuna consists of dried stem bark of the plant known as Terminalia arjuna Rob.
- *Family:* Combretaceae.
- *Chemical constituents:*
  i. Tannins (15%)
  ii. Arjunolic acid
  iii. Saponin
  iv. Ellagic acid
  v. Arjunic acid.
  vi. Arjunin
  vii. Arjunine
  viii. Arjunetine
- *Uses of Arjuna:*
  i. Used as a cardiotonic
  ii. It is also used as a styptic and antidysenteric
  iii. Arjuna bark is used extensively in tanneries and also as timber.
  iv. it is also used as febrifugal, diuretic.

c. Squill (Indian Squill/Urginea)

- *Synonyms:* Jangli pyaj, sea onion, scilla.
- *Biological source:* It consists of dried slices of the bulbs of *Urginea indica* Kunth.
- *Family:* Liliaceae
- *Chemical constituents:* Indian squill contains about 0.3% of cardiac glycosides.
- **The major cardiac glycosides found are:**
  i. Scillaren A
  ii. Scillaren B
  iii. Scillandin
  iv. Scilliroside
  v. Scilliphenoside

  It also contains glucoscillaren A and an enzyme scillarenase.
- **Uses:**
  i. It is used as cardiotonic, stimulant and also an expectorant.
  ii. It is diuretic in small doses.
  iii. In larger doses, it is used as emetic and cathartic.

C CARMINATIVES AND GASTROINTESTINAL REGULATORS

Q 5. What are carminatives and GIT regulators? Give examples.

- *Carminatives:* The drugs which expel the flatulence and gas from the gastrointestinal tract are called carminatives, e.g. fennel, coriander, cardamom, clove, cinnamon, caraway.
- *Gastrointestinal regulators:* The drugs which regularise the activity of gastrointestinal tract are called GI regulators, e.g. fennel, coriander, cinnamon, caraway.

The gastrointestinal regulators include stomachics, stimulants, aromatics, sialogogue, cholagogues, antiemetics, appetizers.

Q 5A. Write in brief about "Umbelliferae" family group of drug.

The plant family umbelliferae is characterized by the shape of its flowers like umbrella.

Umbrella is the Latin word means "little shade" and the flowers looks like umbrellas.

Characteristics of Umbelliferae Family

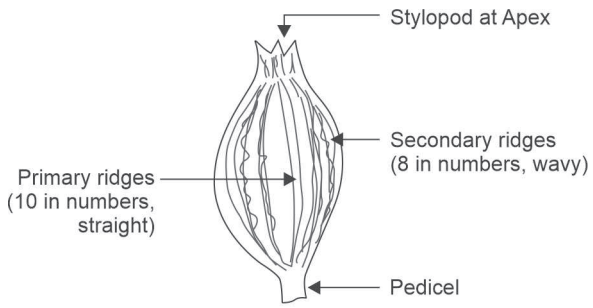
1. Umbelliferae family is easily identified by its characteristic umbel flower head.
2. The flowers are normally small and actinomorphic.
3. Umbels are always five petals and five sepals on the flower.
4. The inflorescences are usually compound or simple umbels.
5. This plant family performs cross-pollination.
6. The fruits of this family separate at maturity into two dry segments.
7. The fruit is called the schizocarp.
8. The stems of the family are hollow.
9. The leaves are alternate and pinnate.
10. The characteristics umbels on these plants attract an excessive range of flies, mosquitoes, moths, butterflies and other insects.

Examples of Umbelliferous Drugs

Fennel, coriander, ajowan, asafoetida.

Q 5B. What are umbelliferous fruits? Write the morphological characters of umbelliferous fruit along with diagram.

Umbelliferous fruits: The drugs which belong to family umbelliferae are called umbelliferous fruits, e.g. fennel, coriander, asafoetida, ajowan.



Fennel fruit

Morphological Characteristics of Umbelliferous Fruits

1. Schizocarp (splitting fruit): Dry fruits from syncarpus ovary that splits at maturity into two portions.
2. Mericarp: Each portion of schizocarp (cremocarp) is called mesocarp.
3. Two mericarps join together by a thread-like structure called carpophore.
4. Primary ridges are 5 or more runs from apex to base.
5. Each mericarp has a disc-like structure at the apex called stylopod.
6. Each mericarp has 2 surfaces, i.e.
   i. Outer dorsal or curved surface
   ii. Inner ventral or commissural surface.
7. Each mericarp contains 6 vittae. 04 on dorsal surface and 02 on commissural surface.
8. Each mericarp contains a single seed.

   The single seed contains:
   i. An apex
   ii. Endosperm
9. An umbelliferous fruit contains volatile oils.

Q 6. Give the synonyms, biological source, chemical constituents and uses of following crude drugs: a. Ginger, b. Fennel, c. Coriander, d. Clove, e. Asafoetida, f. Nutmeg, g. Black pepper, h. Ajowan, i. Cinnamon, j. Cardamom

a. Ginger

- *Synonyms:* Gingerin, zingiber, zingiberis.

- *Biological source:* Ginger consists of rhizomes of *Zingiber officinale.*
- *Family:* Zingiberaceae.
- *Chemical constituents:*
  i. Gingerol like shogaols, zingerone, gingediols
  ii. Zingiberene
  iii. Volatile oils (1–4%).
- *Uses:*
  i. Stomachic
  ii. Carminative
  iii. Stimulant
  iv. Flavouring agents.
  v. Ginger oil is used in mouthwashes, ginger-beverages and liquors.

b. Fennel

- *Synonyms:* Saunf, *Fructus foeniculum*, Badishep.
- *Biological source:* Fennel consists of dried ripe fruits of the plant known as *Foeniculum vulgare*.
- *Family:* Umbelliferae.
- *Chemical constituents:*
  i. Fenchone
  ii. Anethole
  iii. Phellandrene
  iv. Limonene
  v. Anisidic aldehyde.
- *Uses:*
  i. Carminative
  ii. Aromatic
  iii. Stimulant
  iv. Expectorant
  v. Flavouring agent.

c. Coriander

- *Synonyms:* Coriander fruits, Dhania.
- *Biological source:* It consists of fully dried ripe fruits of the plant known as *Coriandrum sativum* linn.
- *Family:* Umbelliferae.

- *Chemical constituents:*
  i. Geraniol
  ii. Pinene
  iii. L-borneol
  iv. D-linalool (coriandrol)
  v. Coriandryl acetate.
  vi. L-borneol
- *Uses:*
  i. Aromatic
  ii. Carminative
  iii. Stimulant
  iv. Flavouring agents.

d. Clove

- *Synonyms:* Clove flower, clove buds, *lavang, laung,* caryophyllum.
- *Biological source:* It consists of dried flower buds of *Eugenia caryophyllus.*
- *Family:* Myrtaceae.
- *Chemical constituents:*
  i. Eugenol
  ii. Eugenol acetate
  iii. Caryophyllenes
  iv. Volatile oil (15 to 20%)
  v. Eugenin.
- *Uses:*
  i. Dental analgesic
  ii. Carminative
  iii. Stimulant
  iv. Flavouring agent
  v. Aromatic
  vi. Antiseptic
  vii. The oil is used in perfumery and also in manufacture of vanillin

e. Asafoetida

- *Synonyms:* Devils dung, hing, gum asafoetida.
- *Biological source:* Asafoetida is the oleo-gum resin obtained by making incision from living rhizomes and roots of *Ferula foetida*.
- *Family:* Umbelliferae.

- *Chemical constituents:*
  i. Ferulic acid
  ii. Umbelliferone
  iii. Resin (40 to 65%)
  iv. Gum (20 to 25%)
  v. Volatile oil (4 to 20%).
- *Uses:*
  i. Carminative
  ii. Nervine tonic
  iii. Flavouring agent
  iv. Intestinal antiseptic
  v. In veterinary medicine.

f. Nutmeg

- *Synonyms:* Banda soap, Jayphal, Myristica, *Nux moschata*.
- *Biological source:* Nutmeg consists of dried kernels of seeds of *Myristica fragrans.*
- *Family:* Myristicaceae.
- *Chemical constituents:*
  i. Myristicin
  ii. Elemicin
  iii. Saffrole
  iv. Myristic, palmitic, oleic, lauric acids.
- *Uses:*
  i. Aromatic
  ii. Stimulant
  iii. Carminative
  iv. Flavouring agent
  v. Used in soap industries (nutmeg butter)
  vi. In the treatment of rheumatism.

g. Black Pepper (S. 96)

- *Synonyms:* Kali mirri, Kali mirch.
- *Biological source:* It consists of dried unriped fruits of *Piper nigrum*.
- *Family:* Piperaceae.

- *Chemical constituents:*
  i. Piperine
  ii. Volatile oil (1 to 2.5%)
  iii. Resin (6%)
  iv. Piperidine
  v. Starch
  vi. Phellandrene
  vii. Caryophyllene
- *Uses:*
  i. Aromatic
  ii. Stimulant
  iii. Stomachic
  iv. Carminative
  v. As a condiment
  vi. Used as a spice due to pungent taste.

h. Ajowan

- *Synonyms:* Carum copticum hieren, Bishop's weed.
- *Biological source:* Ajowan consists of dried ripe fruits of plant, *Tachyspermum ammi*.
- *Family:* Umbelliferae.
- *Chemical constituents:*
  i. Volatile oil contains thymol (35 to 60%)
  ii. P-cymene (50 to 55%)
  iii. Terpinene
  iv. Pinene
  v. Dipentenes
  vi. Thymol.
- *Uses:*
  i. Antispasmodic
  ii. Stimulant
  iii. Carminative
  iv. In the treatment of sore throat, bronchitis
  v. Antiseptic, insecticide, antifungal and anthelmintic.

i. Cinnamon

- *Synonyms:* Kalmi-dalchini, ceylon cinnamon.
- *Biological source:* It consists of dried inner bark of shoots of coppiced tree of *Cinnamomum zeylanicum*.

- *Family:* Lauraceae
- *Chemical constituents:*
  i. Volatile oil (0.5 to 1%)
  ii. Tannins (phlobatannins) 1.2%
  iii. Cinnamaldehyde
  iv. Eugenol
  v. Benzaldehyde, cuminaldehyde
  vi. Phellandrene, pinene, cymene, caryophyllene.
- *Uses:*
  i. Carminative, stomachic, mild astringent
  ii. Flavouring agent, stimulants, aromatic, antiseptic
  iii. As a spice and condiment
  iv. Also used in preparation of candy, dentrifices, perfumes.

j. Cardamom

- Synonyms: Elaichi, cardamom fruits, velchi
- *Biological source:* It consists of dried ripe fruits of *Elettaria cardamomum*.
- *Family:* Zingiberaceae
- *Chemical constituents:*
  i. Vol. oil (2 to 8%)
  ii. Cineole
  iii. Borneol, terpene
  iv. Terpinyl acetate
- *Uses:*
  i. Aromatic
  ii. Carminative
  iii. Stimulant
  iv. Flavouring agent
  v. As a spice and condiment.

D ASTRINGENTS

Q 7. What are astringents? Give examples.

- *Astringents:* Astringents are the drugs, which cause precipitation of protein.
- They are capable of arresting haemorrhages and reducing secretions of mucous membranes of stomach or intestine by precipitating proteins.

- Astringents are used as styptic and antidiarrhoeal agents.
  Natural astringents may be of:
  i. *Vegetable:* Tannic acid, myrobalan, black catechu, pale catechu.
  ii. *Minerals:* Copper and zinc.

Q 8. Give the synonyms, biological source, chemical constituents and uses of following crude drugs: a. Black catechu, b. Pale catechu, c. Myrobalan, d. Galls.

a. Black Catechu

- *Synonyms:* Kattha, Khair
- *Biological source:* It consists of dried aqueous extracts prepared from heart wood of *Acacia catechu* wild.
- *Family:* Leguminosae.
- *Chemical constituents:*
  i. It contains about 10% of acacatechin.
  ii. Quercetin
  iii. Gum
  iv. Catechu red
  v. Quercitrin.
- *Uses:*
  i. It is used as astringents
  ii. Used in cough and diarrhoea
  iii. It has cooling and digestive properties.
  iv. Used in dying and tanning industries.

b. Pale Catechu

- *Synonyms:* Gambier, Gambir.
- *Biological source:* It is dried aqueous extracts of leaves and young shoots of *Uncaria gambir*.
- *Family:* Rubiaceae.
- *Chemical constituents:*
  i. Catechin
  ii. Catechu tannic acid
  iii. Catechu red
  iv. Gambier fluorescein.
  v. Quercetin

- *Uses:*
  i. In the treatment of diarrhoea.
  ii. Local astringent in the form of lozenges.
  iii. Mainly used in dyeing and tanning industries.

c. Myrobalan

- *Synonyms:* Chebulic myrobalan, *Harde, Haritaki*
- *Biological source:* It consists of dried ripe and fully matured fruits of *Terminalia chebula* Retzr.
- *Family:* Combretaceae.
- *Chemical constituents:*
  1. Myrobalan fruits are an important source of tannins.
  2. It contains hydrolysable tannins.
  3. It contains chebulic acid, chebulagic, chebulinic, ellagic and gallic acids.
- *Uses:*
  i. It is mainly used as an astringent, laxative, stomachic and tonic.
  ii. It is also used as anthelmintic
  iii. Fruit pulp is used to cure bleeding.
  iv. It is used as an ingredient of Ayurvedic preparation "Triphala churna".
  v. Commercially myrobalan is used in dying and tannic industry.
  vi. Myrobalan is used in the treatment of piles and external ulcers.

d. Galls

- *Synonyms:* Galla, Nutgall, Turkey galls, Aleppo galls, Blue galls.
- *Biological source:* Galls are vegetable outgrowths formed on the twigs of dyer's oak.
- *Family:* Fagaceae.

Method of Preparation of Galls

1. Dyer's oak plant is 2 m in height or shrub.
2. The "Gall-wesp" lay eggs on the twigs in early summer.
3. Larvae come out from the eggs and enter into the soft epidermis near the growing point of the twigs.
4. The larvae secrete an enzyme from its mandible which stimulates abnormal development of vegetable tissues around the larvae.
5. During this process there is a rapid conversion of starch in the surrounding tissues into sugars which stimulate the cell division.

6. Shrinkage of tissue takes place due to disappearing of starch and a central cavity is formed in which development of larvae and pupae takes place.
7. The larva remains in the galls for 5 to 6 months.
8. The mature insect bores the covering of the galls and escapes.
9. The colour of galls changes from bluish-grey to white during this process.
10. The galls are collected before escaping the insect.

Chemical Constituents

- Galls contain tannin known as gallotannic acid (50–70%).
- It also contains gallic acid, ellagic acid, β-sitosterol, nyctanthic acid, roburic acid and syringic acid.

Uses:

Galls are used as astringent, for tanning and dyeing and in the manufacture of inks and tannic acid.

E DRUGS ACTING ON CENTRAL NERVOUS SYSTEM (CNS)

i. CNS stimulants: The drugs which stimulate the brain and spinal cord are called CNS stimulants, e.g. Nux vomica, Lobelia.
ii. CNS depressants: The drugs which depress the activities of CNS are called CNS depressants, e.g. opium, ashwagandha, cannabis.

1. Opium

- *Synonym:* Raw opium.
- *Biological source:* It is the dried latex obtained by incisions from unripe capsules of *Papaver somniferum* linn.
- *Family:* Papaveraceae.
- *Chemical constituents:*
  i. Narcotine
  ii. Papaverine
  iii. Morphine
  iv. Codeine
  v. Thebaine
  vi. Noscapine.
- *Uses:*
  i. Narcotic analgesic
  ii. Hypnotic and sedative

iii. Codeine is used as antitussive.
iv. Used as diaphoretic and in diarrhoea.

2. Hyoscyamus

- Synonym: Henbane.
- *Biological source:* It consists of dried leaves and flowering tops of *Hyoscymus niger*.
- *Family:* Solanaceae.
- *Chemical constituents:*
  i. Hyoscyamine
  ii. Atropine
  iii. Hyoscine (scopolamine).
- *Uses:*
  i. It relieves spasms of urinary tract.
  ii. It is used as sedative
  iii. As expectorant, antispasmodic, antiasthmatic.

3. Belladonna

- *Synonyms:* Belladonna leaf, deadly nightshade leaf.
- *Biological source:* It consists of dried leaves of *Atropa belladonna*.
- *Family:* Solanaceae.
- *Chemical constituents:*
  i. Atropine
  ii. Hyoscyamine
  iii. Hyoscine
  iv. Homatropine.
- *Uses:*
  i. It is used as anticholinergic
  ii. It is used as antidote in opium and chloral hydrate poisoning
  iii. Antispasmodic.

4. Aconite

- *Synonyms:* Aconite root, Bachnag, Monkshood.
- *Biological source:* It is the dried root of *Aconitum napellus*.
- *Family:* Ranunculaceae.
- *Chemical constituents:*
  i. Aconitine
  ii. Hypoaconitine
  iii. Neopelline

iv. Aconitic acid.
v. Aconine
vi. Neoline

- *Uses:*
  i. Externally in the form of liniment in treatment of neuralgia, sciatica, rheumatism and inflammation.
  ii. It is also used as analgesic and cardiac depressant.

5. Ashwagandha

- *Synonyms:* Withania root, Asgandh, Indian Ginseng.
- *Biological source:* It consists of dried roots and stem bases of *Withania somnifera*.
- *Family:* Solanaceae.
- *Chemical constituents:*
  i. Withanine
  ii. Withaferine
  iii. Withanolides
  iv. Anaferine
  v. Cuscohygrine
  vi. Withasomnine
  vii. Vasamine.
- *Uses:*
  i. It has sedative and hypnotic effect.
  ii. It is hypotensive and depressant.
  iii. It is used in the treatment of gout, rheumatism and hypertension.
  iv. Antispasmodic and anthelmintic.

6. Cannabis

- *Synonyms: Cannabis indica*, Indian hemp, ganja, marijuana.
- *Biological source:* Cannabis consists of dried flowering tops of cultivated female part of *Cannabis sativa* linn.
- *Family:* Cannabinaceae (moraceae).
- *Chemical constituents:*
  i. Cannabinol
  ii. Cannabigerol
  iii. Tetrahydro cannabinol (THC)
  iv. Cannabidiol.

v. Cannabidiolic acid
vi. Cannabichromene

- *Uses:*
  i. It is used as narcotic sedative and analgesic.
  ii. Psychotropic properties.

7. Ephedra

- *Synonym:* Ma huang.
- *Biological source:* It consists of dried young stems of *Ephedra gerardina* Wall.
- *Family:* Ephedraceae.
- *Chemical constituents:* It contains alkaloids such as:
  i. Ephedrine
  ii. Norephedrine
  iii. Pseudoephedrine.
- *Uses:*
  i. As a bronchodilator in asthma.
  ii. In treatment of allergic conditions like hay fever, whooping cough.

8. Nux Vomica

- *Synonym:* Crow-fig.
- *Biological source:* It consists of dried ripe seeds of *Strychnos nux-vomica* linn.
- *Family:* Loganiaceae.
- *Chemical constituents:* It contains bitter indole alkaloids.
  i. Strychnine
  ii. Brucine
  iii. Vomicine
  iv. Pseudo-strychnine.
- *Uses*
  i. As a bitter stomachic and tonic
  ii. It is a CNS stimulant
  iii. It increases blood pressure and recommended in certain forms of cardiac failure.

9. Datura

- *Synonym:* Datura herb.
- *Biological source:* It consists of dried leaves and flowering tops of *Datura metel*.

- *Family:* Solanaceae.
- *Chemical constituents:*
  i. Hyoscine (scopolamine)
  ii. Atropine
- *Uses:*
  i. Parasympathetic depressant
  ii. In the treatment of asthma and cough.
  iii. Antispasmodic
  iv. CNS depressant
  v. Atropine and hyoscine are used in ophthalmic practice to dilate the pupil of eye.

10. Tea Leaves

- *Synonym:* Camellia thea
- *Biological source:* It contains the prepared leaves and leaf buds of *Thea sinensis* linn.
- *Family:* Theaceae
- *Chemical constituents:* It contains.
  i. Caffeine
  ii. Theophylline
  iii. Theobromine
  iv. Gallotannic acid
  v. Tea leaves also contain an enzymatic mixture called theine.
- *Uses:*
  i. Tea leaves are used as CNS stimulant in the form of beverage.
  ii. It is also used as diuretic.

11. Coffee Seeds

- *Synonyms:* Coffee, Coffee bean.
- *Biological source:* It is the dried riped seed of *Coffea arabica* Linne.
- *Family:* Rubiaceae
- *Chemical constituents:* It contains
  i. Caffeine
  ii. Tannins
  iii. Caffeotannic acid
- *Uses:*
  It is used as CNS stimulant and diuretic.

12. Coca Leaves

- *Synonym:* Coca
- *Biological source:* It consists of dried leaves of *Erythroxylon coca*.
- *Family:* Erythroxylaceae.
- *Chemical constituents:* It contains:
  i. Cocaine
  ii. Cinnamyl cocaine
  iii. Ropocaine
  iv. Benzoyltropine
  v. Dihydroxytropane
  vi. Benzoylecgonine
  vii. Ecgonine
- *Uses:*
  i. Cocaine is used as a local anaesthetic.
  ii. Coca leaves are used as a stimulant, restorative.
  iii. Coca leaves are also used in convulsions.
  iv. Due to its hallucinogenic and addictive effect, its uses are limited to ophthalmic surgery and surgery of ear, nose and throat.

F ANTIHYPERTENSIVES

Q 9. What are antihypertensives? Describe the drug rauwolfia.

Antihypertensives

Antihypertensives are the drugs, which lower elevated blood pressure to normal level, e.g. rauwolfia.

Rauwolfia

- *Synonyms:* Sarpagandha, chhota chand, snake root, serpentine root
- *Biological source:* Rauwolfia consists of dried roots of the plant known as *Rauwolfia serpentina* Benth.
- *Family:* Apocyanaceae.
- *Chemical constituents:* It contains:
  i. Reserpine is an important alkaloid
  ii. Oleoresin
  iii. Phytosterol
  iv. Other alkaloids are ajmaline, ajmalicine, rauwolfinine, rescinnamine, reserpinine, serpentine, etc.

- *Uses:*
  i. Antihypertensive
  ii. To treat mild essential hypertension
  iii. It has tranquillizing effect used in mild anxiety conditions.
  iv. In the treatment of snake-bite.

G ANTITUSSIVES

Q 10. What are antitussives? Give examples of antitussives.

Antitussives

Antitussives are the drugs used to assist in the removal of secretion or exudate from the trachea, bronchi or lungs and hence are useful in treatment of cough, e.g. Vasaka, Tolu Balsam, Tulsi.

Q 11. Give the synonyms, biological source, chemical constituents and uses of following crude drugs: a. Vasaka, b. Tolu Balsam, c. Tulsi.

a. Vasaka

- *Synonyms:* Adulsa, Adhatoda.
- *Biological source:* Vasaka consists of dried as well as fresh leaves of the plant *Adhatoda vasica* nees.
- *Family:* Acanthaceae.
- *Chemical constituents:*
  i. Vasicine
  ii. Vasicinone
  iii. 6-hydroxy vasicine
  iv. It contains volatile oil betain and vasakin.
  v. Adhatodine
- *Uses:*
  i. Antitussive
  ii. Expectorant
  iii. Bronchodilator.

b. Tolu Balsam

- *Synonym:* Balsam of tolu.
- *Biological source:* Balsam of tolu is solid or semisolid balsam obtained from the trunk of trees *Myroxilon balsamum* Linn.
- *Family:* Leguminosae.

- *Chemical constituents:*
  i. Cinnamic acid 8%
  ii. Benzoic acid 7.6%
    a. Benzyl benzoate
    b. Benzyl cinnamate.
  iii. Vanillin
  iv. Toluresinotannol.
- *Uses:*
  i. Expectorant and flavouring agent
  ii. Antiseptic
  iii. Common ingredient in cough mixtures.
  iv. Used in preparation of confectionery, chewing gums and perfumery.

c. Tulsi

- *Synonyms:* Sacred basil, Holy basil.
- *Biological source:* Tulsi consists of fresh and dried leaves of *Ocimum sanctum* Linn.
- *Family:* Labiatae.
- *Chemical constituents:*
  i. Eugenol 70%
  ii. Carvacrol 3%
  iii. Eugenol-methyl-ether 20%
  iv. Fixed oil
  v. It also contains traces of alkaloid, saponin, tannin, small amount of vitamin C, traces of maleic, oleic, tartaric acid.
  vi. Caryophylline.
- *Uses:*
  i. Oil is used as antibacterial and insecticidal
  ii. Leaves used as stimulant.

H ANTIRHEUMATICS

Q 12. What are antirheumatics? Give examples of antirheumatics.

Antirheumatics: The drugs used to relieve or used in treatment of rheumatism are known as antirheumatics.

Rheumatism is an inflammatory condition characterized by soreness, stiffness of muscles and pain in joints (arthritis), e.g. Guggul, Colchicum.

Q 13. Give the synonyms, biological source, chemical constituents and uses of following drugs: a. Guggul, b. Colchicum.

a. Guggul (Indian bdellium)

- *Synonyms:* Scented bdellium, Gum guggul.
- *Biological source:* Guggul is the oleo-gum-resin obtained by the incision of the bark of plant *Commiphora weightii*.
- *Family:* Burseraceae.
- *Chemical constituents:*
  i. Steroids
  ii. Diterpenoids
  iii. Carbohydrates and aliphatic esters
  iv. Myrecene
  v. Caryophylline
  vi. Z-guggulosterene
  vii. E-guggulo-sterone.
  viii. Guggulsterol I, II, III.
- *Uses:*
  i. Anti-inflammatory
  ii. Antirheumatic
  iii. Hypolipidemic
  iv. Hypocholesteremic.

b. Colchicum

- *Synonyms:* Colchicum seeds.
- *Biological source:* Colchicum consists of dried seeds of the plant *Colchicum luteum* Baker.
- *Family:* Liliaceae.
- *Chemical constituents:*
  i. It contains 0.2 to 1% of colchicine
  ii. Demecolcine
  iii. Colchicoresin
  iv. Starch.
- *Uses:*
  i. Gout and rheumatism
  ii. It controls the malignant tumour

iii. It is used to cause polyploidy
iv. Used in horticulture.

I ANTITUMOUR

Q 14. What are antitumour drugs? Give example.

Antitumour drugs are the drugs used in treatment of tumour/cancer. Tumour is defined as abnormal or uncontrolled cellular multiplication in neoplasm, e.g. vinca, colchicum, podophyllum.

Q 15. Give synonyms, biological source, chemical constituents and uses of (a) Vinca, (b) Podophyllum.

a. Vinca

- *Synonyms:* Vinca rosea, catharanthus, periwinkle.
- *Biological source:* It is dried whole plant of *Catharanthus roseus*.
- *Family:* Apocyanaceae.
- *Chemical constituents:* It contains indole alkaloids:
  i. Vincristine
  ii. Vinblastine
  iii. Ajmalicine
  iv. Lochnerine
  v. Serpentine
  vi. Vindoline
  vii. Vindolinine
  viii. Catharantuine
- *Uses:*
  i. It is given intravenously in treatment of acute leukaemia
  ii. It is an antineoplastic agent
  iii. It is used in the treatment of Hodgkin's disease
  iv. It also exhibits hypotensive and antidiabetic activity.

b. Podophyllum

- *Synonyms:* Indian podophyllum, *Podophyllum radix*, Himalayan May-apple.
- *Biological source:* Podophyllum consists of dried rhizomes and roots of *Podophyllum hexandrum* Royle.
- *Family:* Berberidaceae.

- *Chemical constituents:* It contains 7 to 15% of resin.
  i. Podophyllin
  ii. Podophyllotoxin
  iii. a and b peltatins
  iv. Querectin
  v. Kaemferol
  vi. Asiragalin
  vii. Etoposide
- *Uses:*
  i. It is used as anticancer (cytotoxic)
  ii. Due to its cytotoxic action, it is used in the treatment of venereal and other warts.
  iii. It is also used as purgative, cholegogue and bitter tonic.

J ANTILEPROTICS

Q 16. What are antileprotics? Give example.

Antileprotics are the drugs used in treatment of leprosy, e.g. Chaulmoogra oil, Brahmi.

Leprosy is an infectious disease caused by microorganism known as *Mycobacterium leprae*.

Q 17. Give synonyms, biological source, chemical constituents and uses of the following drugs.

Chaulmoogra Oil

- *Synonyms:* Hydnocarpus oil, Gynocardia oil.
- *Biological source:* It is the fixed oil obtained by cold expression method from ripe seeds of the plant *Hydnocarpus anthelmintica*.
- *Family:* Flacourtriaceae.
- *Chemical constituents:*
  i. Chaulmoogric acid (27%)
  ii. Hydnocarpic acid (48%)
  iii. Glycerides of palmitic acid.
- *Uses:*
  i. It is used as antileprotic (in leprosy)
  ii. In tuberculosis
  iii. Psoriasis
  iv. Rheumatism

v. It has bactericidal effect against *Mycobacterium leprae* and *Mycobacterium tuberculosis*.

K ANTIDIABETICS

Q 18. What are antidiabetics? Give examples of antidiabetic drugs.

Antidiabetics are the drugs used to reduce elevated blood sugar level to normal level, e.g. Pterocarpus, Gymnema.

Q 19. Give synonyms, biological source, chemical constituents and uses of the following drugs.

a. Pterocarpus

- *Synonyms:* Bijasal, Indian kino tree, Malabar kino, Rakta-chandan.
- *Biological source:* It consists of dried juice of plant *Pterocarpus marsupium* linn.
- *Family:* Leguminosae.
- *Chemical constituents:*
  i. Kinnotannic acid 70–80% (glucosidal tannin)
  ii. Kino red (it is anhydride of kinoin)
  iii. Catechol
  iv. Gallic acid
  v. Kinoin
- *Uses:*
  i. Antidiabetic
  ii. It is used as powerful astringent.
  iii. In treatment of diarrhoea and dysentery.
  iv. Used in dyeing, tanning and printing industries.
  v. Used in passive haemorrhage and toothache.

b. Gymnema

- *Synonyms:* Gudmar, Madhunashni.
- *Biological source:* It consists of leaves of perennial woody climber plant known as *Gymnema sylvestre*.
- *Family:* Asclepiadaoceae
- *Chemical constituents:* It contains:
  i. Pentriacontrane
  ii. Phytin
  iii. a and b chlorophylls
  iv. Gymnemic acid.

- *Uses:*
  i. It is used as antidiabetic
  ii. Stomachic
  iii. Stimulant
  iv. Laxative
  v. Diuretic

L ANTIDYSENTERICS

Q 20. What are antidysenteric drugs? Give examples.

- *Antidysenteric drugs:* These are the drugs used in treatment of dysentery, e.g. Ipecacuanha, kurchi.

  The term dysentery is a combination of two words, namely dys means bad or difficult, enteron means intestine.

  In dysenteric conditions the inflammation of the colonic mucosa occurs which leads to passage of blood and mucus.
- Depending on the type of invading parasite, dysenteric condition is grouped in various types:
  i. *Anaerobic dysentery:* It occurs due to *Entamoeba histolytica* which infects the large intestine. Parasite invades the mucosa and causes ulcers. It occurs either in acute and chronic form.
  ii. *Bacillary dysentery:* It occurs due to various forms of dysentery bacilli, viz. *Shigella*. These parasites attack the mucous membrane of large intestine causes necrosis.
  – It is severe than the amoebic dysentery.
  iii. *Balantidal dysentery:* In this type, dysentery and diarrhoea are associated with presence of a large ciliate protozoan called *Balantidium coli*.
  iv. *Schistosomal dysentery:* It occurs due to *Schistosoma mansoni* species.

Q 21. Give synonyms, biological source, chemical constituents and uses of ipecacuanha.

Ipecacuanha

- *Synonyms:* Ipecac.
- *Biological source:* It consists of dried roots of the rhizomes and roots of *Cephaelis ipecacuanha* or *Cephaelis acuminata* Karsten.
- *Family:* Rubiaceae.
- *Chemical constituents:* It contains:
  i. Emetine, cephaline
  ii. Ipecacaunhin (saponin)

iii. Psychotrine
iv. O-methyl psychotrine
v. Emetamine
vi. Ipecacuanhic acid
vii. Starch and calcium oxalate.

- *Uses:*
  i. Antidysentric
  ii. It is used as expectorant in small doses and emetic in higher doses
  iii. It is used in treatment of diarrhoea and dysentery
  iv. Used for isolation of emetine and cephaline.

M DIURETICS

Q 22. What are diuretics? Give examples.

Diuretics are the drugs which increase the rate of urine flow, e.g. Gokharu, Punarnava.

Q 23. Give synonyms, biological source, chemical constituents and uses of drugs: a. Gokharu, b. Punarnava.

a. Gokharu

- *Synonym:* Puncture vine.
- *Biological source:* It consists of dried fully ripen fruits of the plant *Tribulus terrestris* Linn.
- *Family:* Zygophyllaceae.
- *Chemical constituents:* It contains:
  i. Harmine and harman
  ii. Steroidal sapogenins like diosgenin
  iii. Gitogenin
  iv. Chlorogenin
  v. Rusogenin
  vi. Kaemferol
  vii. Tribuloside.
- *Uses:*
  i. Used as diuretic, tonic.
  ii. In treatment of calculous affections.
  iii. In treatment of painful micturition.
  iv. Used as aphrodiasic and in gout.

b. Punarnava

- *Synonyms:* Hog weed, Rakta punarnava, Lalsabuni
- *Biological source:* It consists of fresh, as well as dried herbs *Boerhaavia diffussa* Linn.
- *Family:* Nyctaginaceae.
- *Chemical constituents:*
  i. Punarnavine
  ii. Punarnavoside
  iii. Ursolic acid
- *Uses:*
  i. It is used as diuretic and expectorant
  ii. It is stomachic and is used in treatment of jaundice.

N ANTISEPTICS AND DISINFECTANTS

Q 24. What are antiseptics and disinfectants? Give examples.

Antiseptics: These are the chemical sterilizing substances which are used to kill pathogenic microbes or for prevention of their growth, e.g. Benzoin, Myrrh, Neem, Curcuma.

Q 25. Give synonyms, biological source, chemical constituents and uses of drugs. a. Benzoin, b. Myrrh, c. Neem, d. Curcuma.

a. Benzoin

- *Synonyms:* Sumatra benzoin, Gum benzoin, Loban.
- *Biological source:* Benzoin is a balsamic resin obtained from *Styrax benzoin*, or it contains balsamic resin from *Styrox tonkinesis* known as siam benzoin.
- *Family:* Styraceae.
- *Chemical constituents:* It contains:
  i. Balsamic acid and esters
  ii. Coniferyl alcohol
  iii. Coniferyl benzoate
  iv. Benzoic acid
  v. Cinnamic acid
  vi. Sumaresinolic acid.
- *Uses:*
  i. It is used as irritating expectorant, carminative and diuretic.
  ii. Externally used as an antiseptic and protective.

iii. In treatment of upper respiratory tract infection.
iv. Used in soaps, perfumes incense, cosmetic manufacturing.

b. Myrrh

- *Synonyms:* Gum myrrh, Bol myrrh.
- *Biological source:* Myrrh is an oleo-gum-resin obtained from *Commiphora molmol* Engler and from other Commiphora species.
- *Family:* Burseraceae.
- *Chemical constituents:* It contains:
  i. Resin 25 to 40%
  ii. α, β and γ camphoric acids
  iii. Terpenes
  iv. Eugenol
  v. Cuminic aldehyde
  vi. Volatile oil.
- *Uses:*
  i. It is used as an antiseptic and stimulant, protective.
  ii. It is astringent to the mucous membrane
  iii. Its tincture is used in the mouthwashes and gargles.

c. Neem

- *Synonyms:* Limb, Morgosa, Melia azadirachta, Nim.
- *Biological source:* It consists of leaves and other aerial parts of *Azadirachta indica*.
- *Family:* Meliaceae.
- *Chemical constituents:* **Bitter principle "Margosine"**.
  i. Azadirachtin
  ii. **Salannin, Nimbin, nimbidin**
  iii. Meliantriol
  iv. Nimbosterol, Nimbiol
  v. Quercetin
  vi. Nimbidinine, Nimaton, Nimbosterol.
  vii. Myrecetin
  viii. Diterpenes (sugiol, nimbiol)
- *Uses:*
  i. It is used as insect repellant, insecticide, antiseptics.
  ii. It has antifeedant and antimicrobial properties.
  iii. Seed oil has spermicidal activity.

d. Turmeric (Curcuma)

- *Synonyms:* Haldi, Indian saffron.
- *Biological source:* Turmeric consists of dried as well as fresh rhizomes of the plant known as *Curcuma longa* linn.
- *Family:* Zingiberaceae.
- *Chemical constituents:* It contains:
  i. Curcumin
  ii. Curcuminoids
  iii. Zingiberene
  iv. α and β curcumenes
  v. Comphor
  vi. Camphene
  vii. Volatile oil.
  viii. Turmerone
  ix. Borneole
  x. Turmeric oil
- *Uses:*
  i. It is used as antiseptic and expectorant
  ii. It is used as condiment, colouring agent
  iii. It is used for the detection of boric acid
  iv. It is used especially for ointment and creams.

ANTIMALARIALS

Q 26. What are antimalarials? Give examples.

Antimalarials: These are the drugs which are used in prophylaxis or treatment of malaria, e.g. cinchona.

Malaria occurs due to infections by four species of a protozoan—*Plasmodium species, p. malariae, p. vivax, P. ovale, P. officinales*.

Q 27. Give synonyms, biological source, chemical constituents and uses of. a. Cinchona, b. Artemisia, c. Artemisia annuna

a. Cinchona

- *Synonyms:* Jesuit's bark, Peruvian bark.
- *Biological source:* It is the dried bark of cultivated trees of *Cinchona calisaya wedd, C. ledgeriana moens, Cinchona officinalis* Linn.
- *Family:* Rubiaceae.

- *Chemical constituents:* It contains:
  i. Quinine
  ii. Quinidine
  iii. Cinchonine
  iv. Cinchonidine
  v. Cinchonicine
  vi. Quinicine
  vii. Quinovin
  viii. Cinchofulvic acid
  ix. Cinchotannic acid
  x. Quinic acid
  xi. Hydrocinchonidine.
- *Uses:*
  i. It is used as an antimalarial and antipyretic.
  ii. It is employed as bitter stomachic and tonic.
  iii. Quinidine is used in prevention of atrial fibrillation.
  iv. It is used to treat arrhythmia and tachycardia.
  v. It is used in rheumatism and neuralgia.

b. Artemisia

- *Synonyms:* Santonica, worm seeds.
- *Biological source:* These are the unexpanded flower heads of *Artemisia cina Berg* and other species of Artemisia.
- *Family:* Compositae
- *Chemical constituents:* It contains.
  i. Santonin
  ii. Artemisin
  iii. Cineole
  iv. Pinene.
- *Uses:* Artemisia (santonica) is used as a strong anthelmintic, especially for roundworms.

c. Artemisia annua

- *Synonyms:* Worm seed, qinghao.
- *Biological source:* It consists of Chinese traditional herb *Artemisia annua* Linn.
- *Family:* Asteraceae
- *Chemical constituents:* It contains
  i. Artemisin
  ii. Deoxyartemisin

iii. Artemisinic acid
iv. Arteannuin A and B
v. Amyrin
vi. Luteolin
vii. β-sitosterol, stigmasterol
viii. Caryophyllene, myrecene

- *Uses:*
  i. Artemisin shows antimalarial effect by its rapid blood schizonticidal activity.
  ii. Artemisinic acid has antibacterial, cytotoxic and anti-inflammatory actions.

P OXYTOCICS

Q 28. What are oxytocics? Give examples.

Oxytocics: These are the drugs which have stimulant effect on the motility of the uterus, e.g. ergot alkaloid.

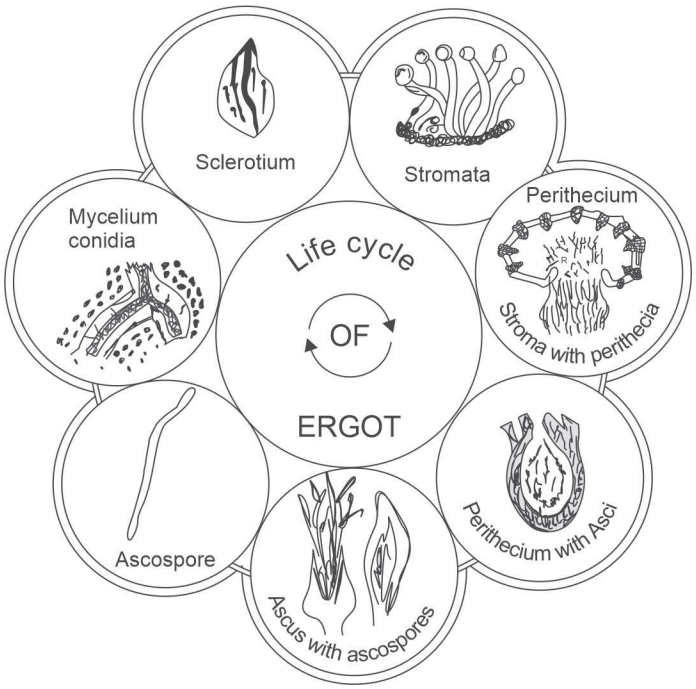
Q 29. Give synonyms, biological source, chemical constituents and uses of ergot.

Ergot

- *Synonyms:* Ergota, Ergot of Rye.
- *Biological source:* Ergot is the dried sclerotium of a fungus *Claviceps purpurea* Tulasne.
- *Family:* Hypocreaceae.
- *Chemical constituents:*
  i. Ergotamine
  ii. Ergocristine, Ergocryptine
  iii. Ergometrine
  iv. Ergotaminine
  v. Ergosinine
  vi. Ergocorninine.
- *Uses:*
  i. As oxytocic.
  ii. Ergotamine is used in treatment of migraine.
  iii. It is used in labour to assist delivery to reduce postpartum haemorrhage.

Life Cycle of Ergot

- Ergot is a fungal growth.
- Its life cycle is required to be studied so as to produce the drug commercially by artificial means.
- Ergot completes its life cycle in the following stages:
  1. Over wintering stage
  2. Stage of sexual reproduction
  3. Stage of asexual reproduction



Life cycle of ergot

Explanation

- The **sclerotica** are produced in late summer.
- These **sclerotica** fall on the ground in autumn.
- When favorable conditions for germination are available, these sclerotica germinate in the spring to produce purple coloured stalks which on further growth form flattened spherical cavities known as **perithecia**.

- Each **Perithecium** contains several **asci**.
- Each **Ascus** contains eight thread-like **Ascopores**.
- Ascopores come out and get dispersed by air.
- The dispersal of ascopores takes place at the time of flowering of **Rye plant**.
- Ascopores become entangled with the stigma of host and produce mycelia which penetrate through ovary.
- The **Mycelia** give rise to conidia, produced from the surface of ovary.
- The **Honey-dew** is sweet in taste and attracts the insects.
- Along with honey-dew conidia are carried from one place to another by insects and this stage is known as **Honey-dew stage**.
- In second stage, hyphae penetrate deeply into the ovary and develop into mass covering the entire ovary which results in formation of elongated sclerotium and is known as sclerotium stage.
- Sclerotium develops further, attains maximum size and falls on ground and the cycle begins.

Q VITAMINS

Q. 30. What are vitamins? Give examples.

Vitamins: These are the substances which are required for normal growth and maintenance of life of animals, e.g. shark liver oil, amla.

Q 31. Give synonyms, biological source, chemical constituents and uses of shark liver oil.

a. Shark Liver Oil

- *Synonyms:* Oleum selachoids.
- *Biological source:* Shark liver oil is the fixed oil obtained from the fresh and carefully preserved livers of various species of the shark, mainly *Hypoprion brevirostris*.
- *Chemical constituents:* It contains vitamin A and fatty acid.
- *Uses:*
  i. It is used as a source of vitamin A and fatty acid
  ii. It is nutritive
  iii. It is used in burn and sunburn
  iv. It is also known as antixerophthalmic factor.

b. Amla

- *Synonyms:* Emblica, Embelic myrobalan Indian gooseberry.
- *Biological source:* It consists of dried as well as fresh fruits of the plant *Emblica officinalis*.
- *Family:* Euphorbiaceae.
- *Chemical constituents:*
  i. Vitamin C (ascorbic acid)
  ii. 0.5% fat
  iii. Phyllemblin
  iv. 5% tannin
  v. Pectin.

  Other inorganic constituents are iron, calcium, phosphorus.
- *Uses:*
  i. In the treatment of scurvy.
  ii. It is used as a diuretic, laxative.
  iii. Fruits are given in diarrhoea and dysentery.
  iv. They are administered in jaundice, anaemia along with iron compound.
  v. It is given in treatment of asthma and bronchitis.
  vi. Fruits are also used in preparation of ink, hair oils and shampoo.

R ENZYMES

Q 32. What are enzymes? Give examples.

Enzymes are the protein substances, which serve a role of catalysing the biochemical reactions in living systems, e.g. diastase, yeast, papaya.

Q 33. Give synonyms, biological source, chemical constituents and uses of: a. Diastase, b. Yeast, c. Papaya, d. Pancreatin.

a. Diastase

- *Synonyms:* Amylose, malt diastase, salivary diastase.
- *Biological source:* It is one of the amylolytic enzymes present in saliva found in digestive tract of the animals (animal diastase).
- *Family:* Gramineae

- *Description:*
  i. It is yellowish white
  ii. It has faint characteristic odour
  iii. It is soluble in water forms colloidal solution.
- *Uses:*
  i. It is used as digestant.
  ii. Used as catalyse reactions in plant and animal.

b. Yeast

Yeast is a fungi which under normal conditions of growth, contains a vegetative body of simple individual cell.

- *Biological source:* It consists of unicellular fungal microorganisms, *Saccharomyces cerevisiae*.
- *Family:* Saccharomycetaceae.
- *Description:*
  i. *Colour:* Whitish powder
  ii. *Odour:* Characteristic
  iii. *Size:* Unicellular microorganism range less than 1.5 μ.
- *Chemical constituents:* It contains:
  i. Glycogen, fat and vitamins
  ii. Thiamine, riboflavin, nicotinic acid
  iii. Folic acid, biotin
  iv. Enzymes like invertase, diastase, zymase.
- *Uses:*
  i. Used in manufacture of alcohol, beer and wines.
  ii. In bread industry.
  iii. Used as source of vitamin D.
  iv. It is a good source of protein.

c. Papaya

- *Biological source:* It is cultivated fruiting tree known as *Carica papaya* linn.
- *Family:* Caricaceae.
- *Description:*
  Colour—light brown or white coloured amorphous powder
  Odour and taste is typical
  pH—5 to 6.1
- *Solubility:* Soluble in water and glycerine.

- *Chemical constituents:*
  i. Chymopapain
  ii. Polypeptides
  iii. Amides.
- *Uses:*
  i. Used in clarification of beverages
  ii. It is used as digestant and anti-inflammatory agent
  iii. It is used in textile and leather industry for dehairing of skins and hides.

d. Pancreatin: (Pancreases/pancrelipase)

- *Biological source:* It is a preparation extracted from pancrease of certain animals like hog (sus scrofa var. domesticus, family—suidae) or OX (BOS taurus, family Bovidae).
- *Description:*
  i. It is amorphous powder with white or buff colour
  ii. It does not have a taste and odour
  iii. It is water soluble, but insoluble in alcohol and ether.
- *Chemical constituents:* It contains enzymes, namely—amylase, lipase, protease.

  Each gram of pancreatin contains not less than 12000 units of amylase activity, 1000 units of protease activity and 15000 units of lipase activity.
- *Uses:*
  i. It is used to treat pancreatic deficiency like pancreatitis and also in fibrocystic disease of pancreas.
  ii. It is also used for preparing peptonized or predigested food.
  iii. Pancreatin is used as digestive aid for converting starch into dextrin and sugar proteins into proteases and derived substances, and fats into fatty acids and glycerol.

S PERFUMES AND FLAVOURING AGENTS

Q 34. What are perfumes? Give examples.

Perfumes: It is any substance which is made from natural or synthetic materials or a combination of both, employed for creating a pleasant odour, e.g. sandalwood oil, Jasmine, Rose, Citronella.

Flavouring agents: These are the substances which are used to give a flavour to the pharmaceutical formulations, e.g. lemon oil, mint, orange, clove, lavendor, rose, peppermint oil.

Q. 35. Give synonyms, biological source, chemical constituents and uses of following drugs: a. Peppermint oil, b. Sandalwood, c. Lemon oil, d. Orange oil, e. Lemon grass oil.

a. Peppermint Oil

- *Synonyms:* Oleum, *Mentha piperita.*
- *Biological source:* Peppermint oil is the volatile oil obtained by steam distillation of the fresh flowering tops of the plant known as *Mentha piperita* Linn.
- *Family:* Labiatae.
- *Chemical constituents:*
  i. L-menthol
  ii. Menthone
  iii. Methyl acetate
  iv. Terpene derivatives include L-limonene, cineole, pinene, camphene, isopulegone.
- *Uses:*
  i. It is used as carminative, aromatic.
  ii. Stimulant.
  iii. Counterirritant.
  iv. Flavouring agent.
  v. It has antiseptic property.
  vi. Used in jellies, candles, perfumes.
  vii. Used in toothpaste and powder, shaving creams.

b. Sandalwood (S. 05; W. 03, 05)

- *Synonyms:* Yellow sandalwood, lignum santali.
- *Biological source:* It is the dried heartwood of *Santalum album* Linn.
- *Family:* Santalaceae.
- *Chemical constituents:*
  i. α-santalol
  ii. β-santalol
  iii. Santalal
  iv. Santene

v. Santenone
vi. Teresantol
vii. Santalone
viii. Santalene.

- *Uses:*
  i. As a perfume in cosmetics and incense sticks.
  ii. For the treatment of dysuria.
  iii. For carvings and manufacture of boxes.

c. Lemon Oil

- *Biological source:* Lemon oil is a volatile oil obtained from the fresh peel of the ripe fruits of *Citrus limonis*.
- *Family:* Rutaceae.
- *Chemical constituents:*
  i. Lemonene
  ii. Citral
  iii. Citronellal.
- *Uses:*
  i. Flavouring agent
  ii. In perfumery.

d. Orange Oil

- *Synonyms:* Sweet orange oil, oleum auranti.
- *Biological source:* Orange is the volatile oil obtained from orange peels of sweet orange of *Citrus sinensis*.
- *Family:* Rutaceae.
- *Chemical constituents:*
  i. Limonene
  ii. Cetronellal
  iii. Citral
  iv. Decanal
- *Uses:*
  i. As flavouring agent
  ii. In perfumery
  iii. In the preparation of terpeneless orange oil.

e. Lemon Grass Oil

- *Synonyms:* East Indian lemon grass oil, Gavati chaha.
- *Biological source:* It is a volatile oil obtained from the leaves and aerial parts of the plants *Cymbopogon flexuosus*.

- *Family:* Graminae.
- *Chemical constituents:*
  i. Citral
  ii. Methylheptenol
  iii. Nerol
  iv. Geraniol.
- *Uses:*
  i. Flavouring agent
  ii. In perfumery.

T PHARMACEUTICAL AIDS

Q 36. Define and classify pharmaceutical aids with examples.

- *Pharmaceutical aids:* The substances which are of little or no therapeutic value, but are essentially used in manufacturing or compounding of various pharmaceuticals are known as pharmaceutical aids.
- *Classification:* (As per use of application)
  i. *Colour:* Caramel, saffron, indigo
  ii. *Diluent:* Cinnamon water, sesame oil
  iii. *Disintegrating agent:* Starch, CMC
  iv. *Emulsifying:* Acacia, tragacanth and suspending agent
  v. *Flavours:* Cardamom, rose, cinnamon
  vi. *Lubricants:* Talc, cocoa butter
  vii. *Ointment bases:* Beeswax, lanolin
  viii. *Solvents:* Alcohol, glycerine
  ix. *Sweetening agents:* Honey, sorbitol.

Q 37. Give synonyms, biological source, chemical constituents and uses of following drugs: a. Acacia, b. Guar gum, c. Honey, d. Starch, e. Tragacanth f. Agar, g. Arachis oil, h. Olive oil, i. Lanolin.

a. Acacia (Indian Gum)

- *Synonyms:* Gum acacia, Gum arabic.
- *Biological source:* Indian gum is the dried gummy exudation obtained from the stem and branches of *Acacia arabica* wild.
- *Family:* Leguminosae.

- *Chemical constituents:*
  i. Arabin
  ii. Arabic acid
  iii. Enzyme-oxidase.
- *Uses:*
  i. Demulcent
  ii. Suspending agent
  iii. Emulsifying agent
  iv. Binding agent
  v. As a gum of choice.

b. Guar gum

- *Synonyms:* Guar flour, Jaguar gum.
- *Biological source:* Guar gum is the powder of endosperm of seeds of *Cyamopsis tetragonolobus*.
- *Family:* Leguminosae.
- *Chemical constituents:*
  i. Guaran
  ii. 5–7% proteins.
- *Uses:*
  i. Binding and disintegrating agent
  ii. Bulk laxative
  iii. Appetite depressant
  iv. In peptic ulcer therapy
  v. In paper manufacturing, printing
  vi. In food and cosmetic industries.

c. Honey

- *Synonyms:* Madhu, honey purified, mel, madh.
- *Biological source:* Honey is a sugar secretion deposited in honey comb by the bees *Apis mellifica, Apis dorsata*.
- *Family:* Apidae
- *Chemical constituents:*
  i. Glucose, fructose and sucrose
  ii. Maltose
  iii. Gum
  iv. Traces of succinic acid
  v. Invert sugar.

- *Uses:*
  i. Demulscent
  ii. Sweetening agent
  iii. Good nutrient
  iv. Antiseptic
  v. Ingredient of common cough mixtures, cough drops
  vi. In preparation of creams, soft drinks, candies.

d. Starch

- *Synonyms:* Amylum.
- *Biological source:* Starch consists of polysaccharide granules obtained from the grains of maize, rice or wheat.
- *Family:* Gramineae.
- *Chemical constituents:*
  i. α-amylose
  ii. β-amylose
  iii. Amylopectin.
- *Uses:*
  i. Nutritive
  ii. Demulcent
  iii. Protective
  iv. Absorbent
  v. Antidote in iodine poisoning
  vi. Disintegrating agent in tablets and pills
  vii. In preparations of dusting talcum powder.

e. Tragacanth

- *Synonyms:* Tragacantha, gum tragacanth.
- *Biological source:* Tragacanth is the dried gummy exudation obtained by making incisions on stems and branches of *Astragalus gummifer*.
- *Family:* Leguminosae.
- *Chemical constituents:*
  i. Tragacanthin
  ii. Bassorin
  iii. Tragacanthic acid.
- *Uses:*
  i. Demulscent and emollient in cosmetics
  ii. Also used in confectionery

iii. Thickening, suspending and emulsifying agent
iv. Binding agent and excipient in the pills.

f. Agar

- *Synonyms:* Agar-agar, Japanese-isinglass.
- *Biological source:* It is the dried gelatinous substance obtained from *Gelidium amansii*.
- *Family:* Rhodophyceae.
- *Chemical constituents:*
  i. Agarose
  ii. Agaropectin.
- *Uses:*
  i. Emulsifying agent
  ii. Bulk laxative
  iii. In preparation of jellies, confectionery items
  iv. Used in culture medium.

g. Arachis Oil

- *Synonyms:* Groundnut oil, peanut oil, sweet oil.
- *Biological source:* It is a fixed oil expressed from the seed Kernels of the activated varieties of *Arachis hypogea*.
- *Family:* Leguminosae.
- *Chemical constituents:*
  i. Oleic acid
  ii. Linoleic acid
  iii. Stearic acid
  iv. Arachidic acid
  v. Lignoceric acid
  vi. Palmitic acid.
- *Uses:*
  i. As a solvent for intramuscular injections
  ii. In preparation of liniments and soaps
  iii. As a lubricants
  iv. As an edible oil.

h. Olive Oil

- *Synonyms:* Oleum olivae.
- *Biological source:* It is a fixed oil expressed from the ripe fruit of *Olea europoea*.

- *Family:* Oleaceae.
- *Chemical constituents:*
  i. Olein
  ii. Palmitin
  iii. Linolein.
- *Uses:*
  i. Emollient
  ii. Soothing agent
  iii. In psoriasis
  iv. As a nutritive, demulcent
  v. Mild laxative.

i. Lanolin (Hydrous Wool Fat)

- *Synonyms:* Lanolin, Adeps lanae.
- *Biological source:* Hydrous wool fat is the purified fat-like substance obtained from the wool of the sheeps *Ovis aries*.
- *Family:* Bovidae.
- *Chemical constituents:*
  i. Esters of cholesterol and isocholesterol
  ii. 50% of water.
- *Uses:*
  i. As a water absorbable ointment base
  ii. As a base for water soluble creams and cosmetic preparations.

j. Beeswax

- *Synonyms:* Yellow beeswax, cera-flava
- *Biological source:* Yellow beeswax is purified wax and obtained from honey comb of the bees *Apis mellifeca*.
- *Family:* Apidae
- *Chemical constituents:*
  i. Myricin (myricyl palmitate)
  ii. Cerotic acid
  iii. Cerolein
  iv. Melissic acid.

- *Uses:*
  i. Used in preparation of ointments, plasters and polishes.
  ii. Used in manufacture of candles, moulds, lipsticks, face creams, etc.

k. Pectin

- *Biological source:* Pectin is purified carbohydrate product obtained by acid hydrolysis from inner portion of the rind of citrus peels, i.e. *Citrus limonis*.
- *Family:* Rutaceae.
- *Chemical constituents:*
  i. D-galactouronic acid.
  ii. Galactouronic acid
- *Uses:*
  i. As an adsorbent in the treatment of diarrhoea.
  ii. As a haemostatic for haemorrhage.
  iii. As an emulsifying and gelling agent.
  iv. In food industry as a thickening agent.
  v. Used in cosmetic preparations.

l. Gelatin

- *Biological source:* Gelatin is a product obtained by partial hydrolysis of collagenous material.
- *Chemical constituents:*
  i. Glutin (protein)
  ii. 17 to 20% moisture.
- *Uses:*
  i. Used as a valuable dietary supplement.
  ii. In the preparation of ice-cream.
  iii. Used in confectionery.
  iv. Used in cosmetic preparations.
  v. Used in manufacture of suppositories, capsules.

m. Kaolin

- *Synonyms:* China clay, porcelain clay.
- *Biological source:* Kaolin is obtained by powdering purified native hydrated aluminium silicate.

- *Uses:*
  i. Used as adsorbent in poisoning.
  ii. Used in dusting powders.
  iii. As a clarifying agent
  iv. Used in cosmetics, insecticides, paints.

n. Sodium Alginate

- *Synonym:* Algin, seed-weed.
- *Biological source:* Sodium alginate is the salt of alginic acid and is obtained from the algal growth of species like *Macrocystic pyrifera*.
- *Family:* Phaeophyceae.
- *Chemical constituent:* Alginic acid.
- *Uses:*
  i. In preparation of paste, creams.
  ii. Good suspending agent and thickening agent.
  iii. As a binding and disintegrating agent.
  iv. In textile industry.

U MISCELLANEOUS NATURAL DRUGS

Q. 38. Give synonyms, biological source, chemical constituents and uses of following drugs: a. Liquorice, b. Picrorriza, c. Linseed oil, d. Shatavari, e. Shankhpushpi, f. Garlic, g. Tobacco, h. Dioscorea, i. Pyrethrum.

a. Liquorice

- *Synonyms:* Liquorice root, Glycyrrhiza, Mulethi, Jasthi-Madhu.
- *Biological source:* Liquorice consists of dried peeled or unpeeled roots and stolons of the plant known as *Glycyrrhiza glabra* linn.
- *Family:* Leguminosae.
- *Chemical constituents:* It contains:
  i. Glycyrrhizin
  ii. Glycyrrhizinic acid
  iii. Glycyrrhetinic acid
  iv. Flavone glycoside
  v. Liquiritin
  vi. Asparagine (2 to 4%) and fat.

- *Uses:*
  i. It is used as demulcent and mild expectorant
  ii. It is used as flavouring agent, antispasmodic
  iii. In treatment of Addison's disease
  iv. In treatment of peptic ulcer and anti-inflammatory agent.

b. Picrorriza

- *Synonyms:* Katki, Kadu, Indian gentian, Kutki.
- *Biological source:* It consists of dried rhizomes of the plant *Picrorrhiza kurroa*.
- *Family:* Scrophulariaceae.
- *Chemical constituents:*
  i. Picroside I
  ii. Picroside II
  iii. Kutkoside
  iv. Vanilloyl
  v. Trans-cinnamoyl.
  vi. Kutkin
- *Uses:*
  i. It is used as bitter tonic, stomachic
  ii. It is laxative, febrifuge
  iii. In treatment of jaundice
  iv. It has antibacterial effect.

c. Linseed Oil

- *Synonyms:* Flax seed, Linum, Jovas.
- *Biological source:* It consists of fixed oil obtained from the dried fully ripe seeds of the *Linum usitatassimum* linn.
- *Family:* Linaceae.
- *Chemical constituents:*
  i. Palmitic acid
  ii. Stearic acid
  iii. Oleaic acid
  iv. Linoleic and linolenic acid
  v. Tocopherol and squalene.
- *Uses:*
  i. It is mainly for external applications as lotion and liniments
  ii. It is used in treatment of scabies and skin diseases

iii. It is nutritive and emollient
iv. Used for paints and varnishes.

d. Shatavari

- *Synonyms:* Shatmuli.
- *Biological source:* It consists of dried roots and leaves of the plant known as *Asparagus racemosus* wild.
- *Family:* Liliaceae.
- *Chemical constituents:*
  i. Shatavarin-I, II, III, IV
  ii. Sarsapogenin
  iii. Rhamnose moieties.
- *Uses:*
  i. Used as galactogogue, tonic, diuretic
  ii. In treatment of rheumatism and nervine disorder
  iii. It is used in Ayurveda in threatened abortion and safe delivery.

e. Shankhpushpi

- *Synonyms:* Shankhvel, Shankhphuli.
- *Biological source:* It consists of the aerial parts of the plant known as *Canscora decussata*.
- *Family:* Gentianaceae.
- *Chemical constituents:*
  i. It contains oleo-resin
  ii. Triterpenes
  iii. Alkaloids
  iv. Xanthones.
- *Uses:*
  i. It is used as bitter, nervine tonic
  ii. In treatment of epilepsy, nervous disability.

f. Garlic

- *Synonyms:* Allium, Lasun, Lasan.
- *Biological source:* It consists of bulbs of the plant known as *Allium sativum* linn.
- *Family:* Liliaceae.

- *Chemical constituents:*
  i. Carbohydrates 29%
  ii. Allilin
  iii. Allicin
  iv. Allyl propyl disulphide
  v. Diallyl disulphide.
- *Uses:*
  i. It is used as carminative, expectorant, aphrodiasic.
  ii. Used as anthelmintic, rubefacient, disinfectant.
  iii. It is useful in high blood pressure and atherosclerosis.
  iv. It is used as condiment.
  v. It has antibacterial.
  vi. It possesses cholesterol suppressing property.

g. Tobacco

- *Synonyms:* Tambaku, Tamak, tumbakhu.
- *Biological source:* It consists of dried leaves of *Nicotiana tabacum*.
- *Family:* Solanoceae.
- *Chemical constituents:*
  i. Nicotine
  ii. Anabasine
  iii. Nornicotine.
- *Uses:*
  i. Tobacco and nicotine are used as insecticides.
  ii. It is powerful quick-acting poison.
  iii. It exerts stimulant effect on heart and nervous system.
  iv. Nicotine is used in the manufacture of nicotinic acid and nicotinamide.

h. Dioscorea

- *Synonym:* Yam, rheumatism root.
- *Biological source:* It consists of dried tubers of the plant *Dioscorea deltoidea* and other species of dioscorea.
- *Family:* Dioscoreaceae.

- *Chemical constituents:*
  i. Diosgenin
  ii. Sapogenin
  iii. Glycoside
  iv. Phenolic compounds.
- *Uses:*
  i. It is used as for synthesis of several corticosteroids, sex hormones
  ii. Used in oral contraceptives
  iii. In treatment of rheumatic arthritis.

i. Pyrethrum

- *Synonyms:* Natural pyrethrum, insect flowers.
- *Biological source:* It consists of dried flower-heads of *Chrysanthemum cinerariefolium* and other species of chrysanthemum.
- *Family:* Compositeae.
- *Chemical constituents:*
  i. Pyrethrin: I–II
  ii. Cinerin: I–II
  iii. Jasmolin: I–II
  iv. Chrysanthenic acid
  v. Pyrethric acid
  vi. Cinerolone
  vii. Jasmoline.
- *Uses:*
  i. It is used as contact insecticide
  ii. Used in preparation of mosquito coils and insect repellent formulations.

CHAPTER 9

Basic Principles Involved in the Alternative Systems of Medicines
(Ayurveda, Siddha, Unani and Homeopathy)

INTRODUCTION

- 'An alternative system of medicines' means systems of medicines other than allopathic systems.
- The principle and philosophy of these systems differ from each other but these systems have served the humanity for the treatment and management of diseases and also maintaining good health of the person.
- About 80% of population rely on traditional systems of medicines.
- India has a rich heritage of large number of medicinal plants.
- These medicinal plants have been used for various medicinal purposes from many centuries.
- The different indigenous systems/traditional Indian systems of medicine/ancient system of medicines existing in India are:
  i. Ayurveda
  ii. Siddha
  iii. Unani
  iv. Naturopathy
  v. Yoga
- Homeopathy system of medicine was discovered by a German chemist, physician and pharmacist Dr. Samuel Hahnemann (1755–1843).

Q 1. What is Ayurveda? Explain basic principles involved in Ayurvedic system of medicine. Write a note on Ayurveda.

Ayurveda

- Ayurveda is one of the oldest systems of medicine originating from India.
- Ayurveda is made up of two parts: (Ayu + Veda).

- Ayu means life and Veda means knowledge or science.
- Thus Ayurveda means "science of life".
- Ayurveda is prepared from two basic Vedas, namely 'Rigveda' and 'Atharvaveda'.
- Ayurveda deals both physical and mental health and also converts art of living.

Theory and Basic Principles of Ayurveda

- Ayurveda is based on three fundamental principles:
  a. Panchamahabhuta, i.e. space, air, energy, liquid and solid.
  b. Tridosha, i.e. Vata, Pitta, Kapha.
  c. Guna, Rasa, Virya, Vipaka, Prabhava
- The principle of Ayurveda is based on the concept of five basic elements and 'Tridoshas'.
- These elements exist in the human body in a combined form like:
  i. Vata (space and air)
  ii. Pitta (energy and liquid)
  iii. Kapha (liquid and solids)
- Vata, Pitta, Kapha are together called 'Tridosha' (three pillars of life).
- These three doshas are the regulators of cell function and help in maintaining health.
- Tridoshas are the three basic governing factors of pathophysiology of a body. When there is an imbalance in these three factors, a disease develops in the body.
- **Vata:** Vata dosha is constituted from vayu and akash which is characterized by lightness and mobility. Balanced vata brings about respiration and equilibrium of tissues and the coordination of senses. Vata is located in the colon, thighs, hips, ears, etc.
- **Pitta:** Pitta dosha originates from Agni and has a hot bright and acidic character. Balanced pitta condition helps in digestion, metabolism and energy production. Imbalance in this dosha is brought about by hot weather, hot and spicy food, etc. Pitta in excess causes yellow colour of stools, urine, eyes and skin, hunger, thirst, burning sensations and difficulty in sleeping. Pitta is located in stomach, small intestine, sebaceous glands, blood and lymph.
- **Kapha:** Kapha is a watery and heavy in character. Increased Kapha affects lubrication of joints and stability of the body. Kapha is caused by cold weather, spring, and heavy meal and by taking too much

rest. Excessive Kapha causes depression of the digestive function, nausea, lethargy, heaviness, white colour, chills, looseness of limbs, cough, difficulty in breathing and excessive sleeping.

- There are eight branches of Ayurveda:
  i. *Kayachikitsa:* Internal medicine
  ii. *Tarkchikitsa:* Psychological medicine
  iii. *Kumarbhritya:* Pediatric medicine
  iv. *Shalya Tantra:* Surgery
  v. *Shalakya Tantra:* Old age patients (Geriatrics)
  vi. *Rasayana Tantra:* ENT/Eye.
  vii. *Agadha Tantra:* Toxicology (study of poisons)
  viii. *Vajikaran Tantra:* Aphrodisiac
- Ayurvedic dosage forms are available in the forms like churna, avleha, arista, asava ghrita swarasa, kalka, kwath, etc.

Q 2. Write a note on Siddha system of medicine. Give the basic principles of Siddha system of medicine.

Siddha System of Medicine

- Siddha means achievements and practitioners of the method are known as 'Siddhars'.
- Siddha system is originated in South India.
- The material of Siddha is mostly in Tamil language.
- 'Siddhars' are saintly personalities who have studied medicines through a practice of Bhakti and Yoga.
- Siddha is the system of pre-Vedic period identified with Dravidian culture and it is largely therapeutic in nature.
- Siddha is one of the most ancient recorded herbal systems of medicine.
- Siddha system uses minerals and metals mainly but some products of vegetable and animal origin are also used.
- Thousands of herbs and minerals were included in Siddha system which are effective in managing chronic, degenerative diseases, viral diseases, etc.

The basic principles involved in Siddha system of medicine:

- Siddha system is essentially a psychosomatic system of medicine.
- Siddhars adopted principle of Shiva Siddhantham.

- Like Ayurveda this system believes that all objects of universe are made up of five basic elements, namely earth, water, sky, fire and air.
- Siddha system of medicine is based on three principles of body, i.e. vata, pitta, kapha collectively called TRIGUNA.
- **Vata:** Increase in vata develops flatulence, acidity, dysentery, obesity, etc. Individual with increased vata shows arrogant behavior, partial paralysis, heart attacks, and neck and chest pains, body smells.
- **Pitta:** Increase in pitta shows graying of hairs, reddish eyes, burning in chest, anemia, etc.
- **Kapha:** Increased kapha causes jaundice, heart attacks, high fever, anemia, etc.
- In Siddha system of medicine the identification of diseases is done through:
  i. Pulse reading
  ii. Colour of the body
  iii. Study of voice
  iv. Urine examination
  v. Status of digestive system
  vi. Examination of tongue
  vii. Colour changes in eye

Treatment of Siddha system of medicines:

i. It includes the drugs of vegetables, animals and minerals.
ii. It includes drugs from metal and non-metal. Gold, silver, zinc borax, asbestos, arsenic, etc.
iii. Drugs from animal secretions, shells and bones of aquatic animals.

Drugs used in Siddha system of medicine:

i. Abini (Papaver somniferum)
ii. Alari (Nerium indicum)
iii. Ethi (Strychonus Nux-vomica)
iv. Gomathai (Datura stramonium)
v. Ratha polam (Aloe-barbedensis)

Q 3. What is the Unani system of medicine? Explain the theory and principle of Unani system of medicines.

Unani System of Medicine (Greek)

- The Unani system of medicine was introduced in India in 10th century AD.

- It aims at treating the cause of disease and not its treatment.
- In Unani system history of the patient is recorded in addition to his pulse, urine and stool examination.
- The drugs used in Unani system are polyherbal formulations and their collective effect is considered.
- The Unani system is called by various names in different parts of world such as Arab medicine, Greco-Arab medicine, Islamic medicine and also Oriental medicine.
- The Unani systems of medicines are: Madar, fulfal, Glio, Kabab, Chini, Karanj, Kulthi, Lodh, Zeera.
- A large number of Indian drugs from indigenous Ayurvedic system of medicine were taken by the Unani system.

Theory and basic principles of Unani system:

- The Unani system of medicine is based on the Hippocratic theory of four humours and Pythagorean theory of four approximate qualities.
- The Hippocrates theory of four humours include blood, phlegm, yellow bile and black bile which are the first products of the digestion.
- According to the Unani system these four qualities are inherent in elements and their interaction with each other gives rise to the quality of the person known as temperament.
- The Hakeem's and physicians, who follow the Unani system of medicine, diagnose their patients by reading pulse and by examination of sputum, urine and stools. Some other aspects such as the patient's psychology, age, general habits, family history, hobbies, occupation, working conditions are also taken into account while diagnosing a disease.
- The material medica of the Unani system consists of drugs of vegetable, animal and mineral origin.
- The Unani system of medicine is supposed to be a holistic system of medicine.
- According to principles of Unani, body is made up of the following proximal qualities:
    i. Four basic elements of human body
    ii. Qualities or states of human body
    iii. Four humours of human body

- Principles and concepts of Unani medicines are:
  i. Arkan (Elements) ii. Mizas (Temperament)
  iii. Akhlat (Humours) iv. Aaza (Organs)
  v. Arwah (Spirit) vi. Quwa (Faculties)

Treatment of Unani system of medicine includes:

i. Treatment of root causes of the ailment, not the symptoms.
ii. It is considered that disease is due to imbalance of humours and is the products of digestion. Hence the aim of treatment is to regulate diet to get rid of accumulated toxins and restore equilibrium of humours.
iii. Physical, mental and emotional exercises and proper massage should be given.
iv. Improving natural defense power of the body.

Q 4. Give the theory and basic principles of Homeopathy system of medicine.

Homeopathy System of Medicine

- Homeopathy system was discovered by physician and chemist of Germany, Dr. Samuel Hahnemann.
- The term homeopathy is made up of two words:
  Homeo: Means similar, Pathos: Means sufferings
- Thus homeopathy can be considered as the system of 'similar sufferings'.
- He found that there is a law in medicine which is called "Law of Similars" indicating the similarity between the drugs and diseases.

Theory and Basic Principles of Homeopathy System of Medicine

- Dr Hahnemaan introduced his new principle that like diseases are cured by like medicines (Like cures Like). With this principle he proved that Cinchona can produce the symptoms of malaria.
- The doctrine of "*Similia Similibus Curantur*" (like cures like) is the basic foundation of homeopathic medicine.
- The unique features of homeopathic medicines are its small dose and methodology of serial dilution by which all the energy of the drug is liberated and transferred to the medium used as base sugar or alcohol.
- During the treatment the drug extracts are extremely diluted which is believed to cause potentiation and enhancement of curative effect.
- The drugs are extracted in the form of mother tincture, which is further diluted in terms of decimal or centesimal potencies.

- **Homeopathy is based on seven principles:**
  i. Individualization
  ii. Principle of similia
  iii. Principle of simplex
  iv. Principle of minimum dose
  v. Law of proving
  vi. Law of dynamisation
  vii. Law of vital force
- **Diagnosis of diseases in homeopathic system:**
  Detail patient history, current symptoms, patient's mood, behavior, likes and dislikes, responses to stress conditions, food reactions and personality, etc. was considered during diagnosis of diseases. From the history symptoms, a picture is created which is matched with drug picture in Materia Medica and treatment is started.
- **Treatments in homeopathic system:**
  i. Practitioners identify single medicine as per the symptoms.
  ii. Treatment contains one or more doses or daily dose of 2–6 weeks.
  iii. Progress of the patient is checked from time to time and alterations in therapy are made.
  iv. In case of recurrence, treatment is repeated with same or higher potency.

Q 5. Write in brief about 'Naturopathy as a system of Medicine".

Naturopathy

- The term naturopathy was coined by Dr. John Scheel in 1895.
- Naturopathy means use of components of nature in the treatment of diseases.
- Naturopathy is a system of healthcare which promotes the body's own self-healing mechanism.
- Naturopathy is based on laws of nature.
- Naturopathy gives importance to cleaning of physiological systems.
- It states that the disease can be completely treated by removing the imbalance in internal and external atmosphere.
- In naturopathy the attention is given particularly to eating and living habits, purification measures, mud packs, baths, massages, etc. and maximum importance is given to digestive system.
- Naturopathy medicine is dedicated to the study and celebration of natures healing powers.
- Naturopathy uses natural therapies such as nutrition, herbal medicines, acupuncture, homeopathy, fasting, exercise and such other ways, in accordance with naturopathic principles.

- **Six basic principles of naturopathic medicines are:**
  i. First do no harm.
  ii. The healing power of nature (the body heals itself)
  iii. Identify and treat the causes.
  iv. Naturopathic doctor as a teacher.
  v. Treat the whole person.
  vi. Prevention.

Q 6. Write a note on 'Yoga as a traditional Indian system of medicine'.

Yoga

- Yoga system was practicised in routine in the history of India.
- Yoga is based on positive thinking and meditation.
- Yoga system gives importance to calmness to the brain and body.
- Yoga gives physical and mental strength.
- Yoga saves physical energy.
- Yoga focuses on internal environment than external environment.
- Yoga system gives importance to cardiovascular system and central nervous system.
- The main objectives of yoga are:
  a. Blood purification
  b. Blood circulation
  c. Tranquility.
- *Eight components of yoga are:* Restraint, observance of austerity (discipline), physical posture, restraining of sense organs, breathing exercises, contemplation (thoughtful observation), meditation and Samadhi.
- **Ten principles of yoga are:**
  i. Non-violence (No killing of other beings. Be peaceful).
  ii. Truthfulness (Satya): Live in truth.
  iii. Righteousness (asatya): No cheating
  iv. Wisdom: Live in spiritual focus
  v. Simplicity
  vi. Worship of the spiritual goal
  vii. Sacrifice the ego
  viii. Self-discipline
  ix. Reading
  x. Contentment (Santosha).

CHAPTER 10

Methods of Preparations of Ayurvedic Formulations
(Arista, Asava, Gutika, Taila, Churna, Lehya, Bhasma)

Q 1. Define Ayurvedic dosage forms. Classify Ayurvedic dosage forms with examples.

Ayurvedic Dosage Forms

It means all medicines intended for internal or external use or, in the diagnosis, treatment, mitigation or prevention of disease or disorder in human being or animals and are manufactured in accordance with the formulae described in authoritative books of Ayurveda specified in the First Schedule of the D and C Act, 1940.

Classification of Ayurvedic Dosage Forms

A. Solid dosage forms: For example, pills, gutika, vatika,

B. Semisolid doasage forms: For example, Avaleha, paka, Lepa, Ghrita, malamas, kalkas,

C. Liquid dosage forms: For example, Aristas, Asavas, Arkas, Tailas, Dravakas, Netrabindu, kwaths, swarasas

D. Powder dosage forms: For example, Bhasma, Churna, anjan, Satva, Lavana, Kshara, pisti, parpati.

Q 2. Explain methods of preparations of following Ayurvedic Formulations: a. Aristas, b. Asavas, c. Gutika, d. Tailas, e. Churnas, f. Lehya, g. Bhasmas

a. Aristas

These are weak alcoholic preparations prepared by making a decoction of the drug and then allowing them to undergo fermentation by the help of raw sugar or honey.

e.g. Dashmularista, Ashokarista.

Method of Preparation of Arista

- The drug mentioned in the formula is coarsely powdered and decoction (kasaya) is prepared, filtered and transferred to wooden vats.
- Sugar, honey or jaggery is added to it, dissolved and boiled.
- Other finely powdered ingredients and Dhataki pushpa (Woodfordia fruticosa) are added to it.
- The vessel is closed with lid and edges are sealed with clay smeared cloth wrapped in seven consecutive layers.
- The vessels are kept in basement for a specific period in order to facilitate fermentation (Sadhana)
- The contents are examined for completion of fermentation and arista is filtered and bottled.

b. Asavas

These are medicated alcoholic liquors prepared by the fermentation of raw vegetables juices with honey or jaggery.

e.g. Kumariasava, Chandanasava, Madhukasava

- The various parts of the plant such as roots, leaves and barks, etc. are cut into pieces and infusion is prepared in water in airtight earthen jars.
- Honey is mixed in it and fermentation is done for at least six months.
- Asavas are used as stomachics, stimulants, tonics and astringents.

Method of Preparation of Asavas

- Required quantity of water and jaggery or sugar is taken, boiled, cooled and transferred to fermentation vessel or barrels.
- Finely powdered crude drug and other ingredients as mentioned in the formula are then added to it.
- The container is covered with the lid and edges are sealed with clay smeared cloth wrapped in seven consecutive layers.
- The vessels are kept in basement for a specific period of at least six months to facilitate fermentation.
- The contents are examined for the completion of fermentation and the asavas are filled and bottled.

c. Gutika

Gutikas are large tablets or pills prepared by converting the decoction of vegetable substances into thick consistency and then mixed with powdered medicine, raw sugar and honey.

e.g. Bilavdi Gutika, Lasunadi Gutika, Marma Gutika

Method of Preparation of Gutika

- The drugs from plant origin are dried and finely powdered separately.
- The minerals are made into bhasmas or sinduras.
- Kajjali is made first the other drugs are added one by one according to the formula.
- It is then put into khalva (mortar) and ground to soft paste with the prescribed fluids.
- When the mass is properly ground, sugandhi dravyas are added and ground again.
- The final pill mass should not stick to the fingers when rolled.
- Pills are prepared and may be dried in shade or in sun.

d. Tailas (Medicated oils)

- Tailas are medicated oils which are prepared by boiling drugs in water, milk or other liquid substances mixed with oil until water content is evaporated.

  The oils thus prepared are generally meant for local application. e.g. Bhringraja tailas, Mahanarayan tailas, Dhanvantra tailas, Anu tailas, Jyotismati tailas.

Method of Preparation of Tailas

- These are prepared by cooking oils with the juice or the decoction and paste of drugs.
- The fine paste of drug, liquid and oil together are cooked, stirred constantly to the paste at the bottom and prevented it from getting charred.
- When medicated tailas gets properly cooked, large amount of foam appears at the surface of the oil. Therefore, formulation should be strained prior to packing.
- Tailas can be used internally or topically. They retain potency of about sixteen months.
- Tailas are taken internally with warm water or milk.

e. Churna

These are powdered mixtures prepared by mixing dry, mineral, animal or vegetable substances in pastle mortar.

- The fine powder of drug or drugs is also known as Churna.
- Churnas are taken with milk, hot water and cows urine
  e.g. Triphala churna, Sudarshan churna, Ashwgandhadi churna, Drakshadi churna

Method of Preparation of Churna

- The drugs mentioned in formula are cleaned properly, dried thoroughly, pulverized and then sieved.
- All the ingredients are weighed and mixed together.
- The churna is free flowing and retains potency for one year, if preserved in airtight containers.

f. Lehya/Avleha/Leha

These are thick extracts of drugs in which decoction of drug is prepared, strained and then boiled with sugar or honey to soft consistency.

For example, kutajavaleha, drkasavaleha, vasavaleha.

Avlehas are used for digestive troubles, respiratory problems and as a general tonic.

Method of Preparation of Lehya/Avleha

- Jaggery or sugar candy is dissolved in liquid, boiled and strained.
- Solution is boiled over moderate fire till paka becomes thread.
- The fine powered drug in small quantities are added and stirred continuously to form the homogenous mass.
- Ghee or oil is added while preparation is hot.
- Honey is added after cooling and mixed well.

g. Bhasma

These are ashes prepared from vegetable, mineral substances and also from animal products.

Bhasma are powdered form of substances obtained by calcinations of metals, minerals or animal products by special process in closed crucibles or in pit covered with cow dung cake (puta).

For example, Tamra bhaasma, Godanti Bhasma, Pravala Bhasma, Shankha Bhasma, Suvarna Bhasma.

Method of Preparation of Bhasma

The preparation of bhasma consists of two steps:

1. **Sodhana:** It means purification.
2. **Marana:**
   - The purified drug is placed in mortar and pastle, ground with juices or kasaya of drugs.
   - Small cakes are made. Cakes are dried under sunlight and placed in single layer in shallow earthen plate and closed with another plate.

- The edge is sealed with clay smeared cloth in seven consecutive layers and dried.
- A pit is dug in open space.
- Half pit is filled with cow dung cakes.
- The sealed earthen container is placed in it and the remaining space is filled with more cow dung cakes.
- Fire is put in all four sides and middle of pit.
- After completion of burning it is allowed to cool.
- Earthen container is removed, seal is opened, and contents are taken out.
- The material from the container is ground into fine powder in khalva repeatedly till proper fineness and quality is obtained.

Q 3. Define the terms.

1. **Anjan:** These are medicated fine powders intended to use in the eyes for their local effects.
2. **Netrabindu:** These are liquid preparations made by dissolving the specified form of drug in water or honey and used as eye drops.
3. **Vati/Vatika:** The medicaments in the form of small tablet or pills are known as vati or vatika.
4. **Rasayna/kupipakva:** These are preparations of metals containing mercury and are in the form of pills or tablets.
5. **Sattva:** A water extractable solid substance obtained from a drug is known as sattva.
6. **Lepa:** These are semisolid preparations in the form of paste used for external application on the body.
7. **Dravakas:** These are the liquid preparations obtained from lavana and kshara.
8. **Pakas:** These are semisolid preparations of drugs prepared by addition of sugar, raw sugar and boiled with prescribed drug juice.
9. **Araks:** These are distilled essences or liquors made by soaking drugs in water for 24–48 hours and then distilled the same.
10. **Kanjika:** It is sour liquid produced from the fermentation of powdered paddy (*Brassica juncea*) and other grains.
11. **Murambas:** These are preparations of drug or fruits made by soaking them in syrup or honey.
12. **Swarasas:** These are fresh expressed juices prepared by crushing green fresh medicinal plants in a mortar and expressed.

CHAPTER 11

Role of Medicinal and Aromatic Plants in National Economy

INTRODUCTION

- Medicinal and Aromatic Plants (MAPs) are botanical raw materials, also known as herbal drugs that are primarily used for therapeutic, aromatic and culinary purposes as a component of cosmetics, medicinal products, health foods and other natural health products.
- Aromatic plants are the special kinds of plants used for their aroma and flavor. Many of them are also used for medicinal purposes.
- Aromatic compounds are found in the parts of plants like roots, wood, bark, leaves, fruit, seeds, etc.
- Examples of medicinal and aromatic plants: Isapgula, Senna, Opium, Vinca, Cinchona, Sandalwood oil, Jasmine, etc.

Q 1. Explain the role of Medicinal and Aromatic Plants (MAPs) in National Economy.

Role of Medicinal and Aromatic Plants (MAPs) in National Economy:

- Medicinal and Aromatic Plants (MAPs) contribute to the local and national economy and become the source of cash for the rural livelihood.
- Aromatic plants are those plants which produce a certain type of aroma (smell/odor).
- Medicinal and Aromatic Plants (MAPs) have many parts/ingredients that can be used to treat various types of ailments, infections and other disorders.
- Ayurvedic, Naturopathy and aromatherapy systems of medicines heavily depend on Medicinal and Aromatic Plants (MAPs).
- A Medicinal and Aromatic Plants (MAPs) also serve as raw material for condiments, soaps, fragrances, hair oils and more.

- The demand of these MAPs is ever increasing rapidly; they exported abroad to countries like Canada, France, the US, the UK and Turkey. This contributes to major Indian export.
- Domestic and foreign markets for medicinal and aromatic plants are growing rapidly.
- India possesses all types of climatic conditions and topography has been considered as "Botanical Garden of the world". This botanical wealth constitutes more than 2200 species of medicinal and essential oil containing plants.
- The rapid growth of phytopharmaceuticals, perfumery and allied industries in India showing a great role in improving national economy.

Q 2. Give the scope and importance of medicinal and aromatic plants.

Scope and Importance of Medicinal and Aromatic Plants

- India is one of the few countries where almost all the known medicinal plants can be cultivated in some parts of the country.
- The plants of great demand in the country as well as abroad are opium poppy, Senna, cinchona and ipecac has more scope for cultivation and earning profits.
- The Indian system of medicine (ISM) is a plant-based material medica making the use of most of our native plants.
- India has about 2000 species of medicinal plants and a vast geographical area with high production potential in various agricultural climatic conditions.
- India is a major exporter of raw material and drugs from medicinal and aromatic plants.
- There are more than 1500 known aromatic plant species act as a source of raw material for the perfumery and cosmetic industries in India.
- Many numbers of aromatic plants have found commercial source of essential oils and aroma chemicals.
- Aromatic plants are used in the formulations of cosmetics, pharmaceutical preparations, perfumery, confectionery ice-cream, aerated waters, disinfectants, Agarbatti, etc.

Q 3. Write in brief about 'export potential of medicinal and aromatic plants'.

Export Potential of Medicinal and Aromatic Plants

- India has been the major supplier of medicinal plants in the world market till 1976. Later on with increasing demand in abroad major drugs are exported from India.
- The plants of export value from India were opium, psyllium husk and seeds, Vinca rosea, Senna leaves and pods, etc.
- The export of these drugs is permitted by firms obtaining certificates from the chief conservator of the forest or officer authorized by him that the material is of plantation or nursery origin.
- Huge amount of foreign exchange can be earned by exporting medicinal plants to other countries.
- Examples of medicinal and aromatic plants and their photochemicals exported from India:
  1. Opium alkaloids (*Papaver somniferum*)
  2. Seed husk and seeds of Isabgol (*Plantago ovate*)
  3. Root and root alkaloids of Vinca (*Catharanthus roeus*)
  4. Leaves, pods and total sennoside concentrate of senna (*Cassia angustifolia*)
  5. Quinine and quinidine alkaloids (*Cinchona officinalis*)
  6. The essential oils are also exported regularly such as sandalwood oil (*Santalum album*), Jasmine otto and absolute (*Jasminum grandi floure*).

CHAPTER 12

Herbs as Health Food

Herb is a plant that has leaves and stems that die down at the end of the growing season to the soil level. Herb plants may be annuals, binneals or perennials. Herbs have variety of uses including culinary, medicinal and in some cases spiritual usage.

Examples of herbs: Garlic, alfalfa, ginkgo, ginseng, onion, etc.

Q 1. What is Nutraceutical? Classify Nutraceuticals with suitable examples.

Nutraceutical

Nutraceutical is a substance which can be considered as a food or its part which provides medicinal or health benefits including the prevention and treatment of diseases.

Nutraceuticals are biologically active phytochemicals that possess health benefits.

Classification of Nutraceuticals

Nutraceuticals are Classified as:

1. As per natural source:

i. Plants: Garlic (*Allium sativum*), Tomato (*Solanun lycopersicum*)
ii. Animals: Shark liver oil, Cod liver oil
iii. Mineral: Calcium, boron, magnesium, manganese, copper, zinc, phosphorus.
iv. Microorganisms: Bifidobacteria, Lactobacilli.

2. As per pharmacological basis:

i. Allergic relief: *Ginkgo biloba*
ii. Cardiac disease: Garlic
iii. Cancer prevention: Flex seeds, green tea

iv. Cholesterol lowering: Garlic
v. Digestive support: Digestive enzymes

3. As per chemical constitution

i. Inorganic supplements: Minerals
ii. Vitamin supplements: Vitamins
iii. Digestive enzymes: Enzymes
iv. Probiotics: Helpful bacteria
v. Prebiotics: Digestive enzymes
vi. Dietary fibres: Fibres (oats and dried beans)
vii. Antioxidants: Natural antioxidants
viii. Phytochemicals: Omega 3-fatty acids, carotenoids, vitamins.

Q 2. Give the importance/therapeutic applications of nutraceuticals.

- Nutraceuticals may increase the health value of our diet and help us live longer.
- Nutraceuticals playing significant role in modifying and maintaining healthy human being.
- Nutraceuticals help to prevent some of the health problems like obesity, sleeping disorders, digestive problems, CVS disorders, cancer, arthritis, blood pressure, osteoporosis, etc.
- Nutraceuticals may have some psychological benefits from doing something for oneself.
- The food products used as nutraceuticals can be categorized as dietary fibres, prebiotics, probiotics and other types of herbal or natural foods.
- Due to nutraceuticals, food industry has becoming progressive sector.

Q 3. Write a note on the following nutraceuticals: a. Antioxidants, b. Prebiotics, c. Probiotics, d. Dietary fibres, e. Omega-3-fatty acids, f. Spirulina, g. Carotenoids, h. Soya, i. Garlic

A. Antioxidants

- Antioxidants are the compounds which retard or prevent the oxidation and prolong the life of the oxidizable matter.
- Antioxidant nutraceuticals are those which contain vitamin C, vitamin E, vitamin A and beta-carotene.

- Antioxidants are also present in some fixed oils, fruits, vegetables and fishes.
- These antioxidants either prevent the formation of oxygen-free radical or trap them (Scavenging effect).
- Antioxidants play a vital role in the life of a living being.
- S-allyl cysteines sulphoxide from garlic may act by scavenging effect and also shown hypolipidaemic action.
- Vitamin E (Tocopherol) is a major radical trapper in lipid membrane is clinically useful in cardiac damage and carcinogenicity.
- Selenium is an important dietary anticarcinogen.
- Various plant materials like amla, myrobalan, and lemon contain ascorbic acid (vitamin C) which prevents both the formation and scavenging of oxygen free radical.
- Beta-carotene and vitamin A have shown to cause antioxidant effect and immune enhancement.
- Deficiency of antioxidants causes diseases like cancer, rheumatoid arthritis, Alzheimer's disease, cardiovascular disorders.
- Antioxidants are of three categories:
  i. True antioxidants
  ii. Reducing agents
  iii. Antioxidant synergists

B. Prebiotics

- Prebiotics are food substances which reach to colon in intact form, without getting depleted by gastric pH and digestive acids.
- Prebiotics also selectively promote the growth of colonic bacteria.
- Prebiotics are non-digestible substances that provide a beneficial physiological effect for the host by selectively stimulating the favorable growth of a limited number of indigenous bacteria.
- Commonly known prebiotics are:
  i. Inulin
  ii. Oligo fructose
  iii. Galacto-oligosaccharides
  iv. Lactulose
- At present the best known prebiotics is inulin.
- Lactobacilli and Bifidobacteria digest inulin and feed themselves on it. Hence, prebiotics acts as fertilizers for these bacteria.
- Inulin also serves as the role of dietary fibre.

C. Probiotics

- Probiotics are living micro-organisms which when taken with or without food, may improve the intestinal microbial balance and functioning of the large intestine.
- These micro-organisms show their effect by producing substances and conditions which inhibit the growth of harmful bacteria in the large intestine.
- Probiotics includes:
  i. Bifidobacterium
  ii. Lactobacilli species (e.g. *Lactobacillius acidophilus*)
  iii. Yeast *Saccharomyces cerevisiae*
  iv. Some *E. coli* and Bacillus species.
  v. Dairy products like sour milk.
- Benefits of probiotics:
  i. To treat diarrhea
  ii. To improve symptoms of irritable bowel syndrome
  iii. Shortens the duration of intestinal infections
  iv. Manages lactose intolerance
  v. Reduces bladder and urinary tract infections

D. Dietary Fibres

- Dietary fibres are the parts of plant such as stem, leaves and seeds which human body cannot digest and absorb.
- Dietary fibres are generally categorised into two groups:
  i. *Water soluble fibres:* These are present in oats, dried beans, legumes, chicory, etc.
  ii. *Water insoluble fibres:* These are present in brown rice, bananas, vegetables and whole grain cereals like wheat, barley, etc.
- Insoluble fibres mainly help in bulking of stool and their quick passage through digestive canal.
- Soluble fibres dissolve in water and form a gel that binds the stools.
- Uses of dietary fibres:
  i. Soluble fibre lowers serum cholesterol level and also regulates blood sugar level.
  ii. Insoluble fibres promote regular elimination, increase stool weight and speed up digestion and elimination time.
  iii. Increased dietary fibre intake may reduce the risk of gastro-intestinal diseases, hypertension, diabetes, heart diseases, colon cancers, etc.

E. Omega-3-Fatty Acids

- Omega-3-fatty acids are polyunsaturated essential fatty acids mainly of marine origin.
- They are called omega-3 fatty acids because the first double bond counting from the methyl end of the fatty acid which is located at third carbon atom.
- Omega-3-fatty acids are Eicosapentaenoic acid (EPA) and Dpcosahexanoic acid (DHA).
- Omega-3-fatty acids are found in cold water fishes like cod, salmon, tuna, sardines, blue fish, etc.
- Fish oil is the reliable source of omega-3-fatty acids.
- Walnut, soyabean, freshly ground wheat germ, flax seed, canola are valuable sources of omega-3-fatty acids.
- Omega-3-fatty acids are important components of cell membrane. Their presence in the cell membrane increases the physicochemical stability and functional integrity of cell.
- Omega-3-fatty acids are essential for normal growth and development at all stages of life.
- Omega-3-fatty acids make the cells less susceptible to oxidative damages as well as they decrease the formation of lipid peroxides.

Significance/Importance/Uses of Omega-3-Fatty Acids:

1. They have significant role in Arteriosclerosis.
2. They reduce the risk of cardiovascular diseases.
3. They can fight against depression and anxiety.
4. They are used to treat mental disorders.
5. They help to prevent cancer.
6. They can reduce asthma in children.
7. They are used in arthritis.

F. Spirulina

- *Biological source:* It is blue green algae *Spirulina plantensis* or *Spirulina maxima*.
- *Family:* Oscillatoriaceae
- *Chemical constituents:* It contains:
  - i. Gamma linoleic acid
  - ii. Oleic acid
  - iii. Glycolipids and sulpholipids

iv. Rich in vitamin B
v. Beta carotenes
vi. Phycocyanin
vii. Phycobiliprotein
viii. Phycocyanobilin

- *Uses:*
  i. It has immunostimulant activity.
  ii. It is helpful in management of HIV and other viral infections such as herpes, influenza, mumps.
  iii. It is also used to treat arthritis, arteriosclerosis, diabetes, and aging process.
  iv. Spirulina is a concentrated source of food containing nutraceuticals and contains antioxidants, probiotics and phytonutrients.

G. Carotenoids

- Carotenoids are group of natural occurring matters producing purple, red, yellow or orange colours.
- Carotenoids are present both in plants and animals.
- Carotenoids act as photosynthetic access pigments in plants and in animals as a source of vitamin A and also as antioxidants.
- Examples of carotenoids: Annatto, crocus, beta-carotene, lutein, lycopene, zeaxanthin.

a. Annatto

- *Synonyms:* Arnotta, Annotta
- *Biological source:* It consists of dried seeds of the plant *Bixa orellana* Linn.
- *Family:* Bixaceae
- *Chemical constituents:* It contains:
  i. 12% of annatto oleoresin
  ii. Bixin
- *Uses:* Annatto is used as colouring agent for foods, cosmetics, alcoholic and non-alcoholic beverages, dairy desserts, fats and oils and in margarines.

b. *Crocus (Saffron)*

- *Synonyms:* Saffron, Hay Saffron, Kesar
- *Biological source:* Crocus consists of dried stigmas and upper parts of styles of plant known as *Crocus sativus* Linn.
- *Family:* Iridaceae

- *Chemical constituents:* It contains red colouring matters.
  i. Crocin
  ii. Crocetin
  iii. Picrocrocin (bitter principle)
  iv. Protocrocin
- *Uses:*
  i. Crocus (Saffron) is used as a colouring (food dye) and flavouring agent.
  ii. It is also used as antispasmodic, emmenagogue and a stimulant.

H. Soya (Soya bean)

- *Synonyms:* Soy, soya bean, soja, soja bean, glycine-max.
- *Biological source:* It consists of dried seeds of the plant *Glycine max*.
- *Family:* Leguminaceae
- *Chemical constituents:*
  i. It consists of high content of high quality of proteins.
  ii. It is rich source of carbohydrates, fats, vitamins and minerals.
  iii. It also contains calcium, iron, magnesium and potassium.
  iv. It also contains isoflavones like genistein and daidzein.
- *Uses:*
  i. It has major role in reducing risk of coronary heart disease.
  ii. It also helps to reduce blood cholesterol level.
  iii. It helps to prevent estrogen-dependent cancer.
  iv. It also helps to prevent osteoporosis.
  v. It is healthier cooking oil.
  vi. It is a rich source of omega-3-fatty acids.

I. Garlic

- *Synonym:* Allium, Lasun, Lasan
- *Biological source:* It consists of bulbs of the plant known as *Allium sativum* Linn.
- *Family:* Liliaceae
- *Chemical constituents:*
  i. Carbohydrates 29%
  ii. Allilin
  iii. Allicin
  iv. Allyl propyl disulphide
  v. Diallyl disulphide

- *Uses:*
  i. Garlic is used to reduce serum cholesterol and also in treatment of atherosclerosis.
  ii. Garlic has also been found to reduce platelet aggregation.
  iii. Garlic has antibacterial activity.
  iv. Garlic is useful in amoebic dysentery.
  v. It is used as carminative, expectorant aphrodisiac.
  vi. It is also used as anthelmintic.
  vii. It is used as condiment.

Q 4. Write in brief about following drugs: a. Ginseng, b. Flax seed, c. Gingko (*Gingko biloba*)

a. Ginseng

- *Synonyms:* Ninjin, Pannag, Panax.
- *Biological source:* It is dried root of various species of *Panax ginseng*.
- *Family:* Araliaceae
- *Chemical constituents:*
  i. Ginsenosides
  ii. Panaxosides
  iii. Chikusetsusaponin
  iv. Panaxatriol
  v. It also contains choline, vitamins B_1, B_2, B_{12}, pantothenic acid, biotin.
- *Uses:*
  i. It helps to reduce stress and fatigue.
  ii. It is used in the treatment of hypertension and hypoglycemia.
  iii. It is an important immunomodulator.
  iv. It is used as aphrodisiac.
  v. Ginseng extracts are also used externally in cosmetics.

b. Flax seed (Linseed)

- *Synonyms:* Flax seed, Linum.
- *Biological source:* It consists of dried ripe seeds of the plant known as *Linum usitatissium* Linn.
- *Family:* Linaceae.
- *Chemical constituents:*
  i. It contains about 20 to 40% of fixed oil and 20% of protein.
  ii. Mucilage 2 to 7%.

iii. Cyanogenetic glycoside: Linamarin
iv. Enzyme: Linase

- *Uses:*
  i. It is used as a source of fixed oil.
  ii. It is also used as a demulcent.
  iii. Linseed meal is used as poultice.
  iv. Linseed oil is a drying oil.
  v. It prevents mammary, colon and rectal cancers.
  vi. It reduces blood pressure in hypertensive patients.
  vii. It reduces diabetes and coronary heart diseases.

c. Gingko (*Gingko biloba*)

- *Synonyms:* Maiden hair tree, Kew tree.
- *Biological source:* It consists of dried leaves of *Gingko biloba* Linn.
- *Family:* Gingkoaceae
- *History:* Gingko occurs as a street and park tree. The leaves of gingko have an appearance of maiden hair fern, hence called maiden hair tree. Gingko is known to be resistant to insects, bacteria and pollution.
- *Chemical constituents:* It mainly contains flavonol glycosides.
  i. Bilobelin
  ii. Ginkgetin
  iii. Isoginkgetin
  iv. Gingkolic acid
  v. Bilobetin
  vi. Gingkolides—A, B, C
  vii. Schikimic acid.
- *Uses:*
  i. Gingko is traditionally used in the treatment of asthma.
  ii. Gingkoside B is used in the treatment of severe sepsis.
  iii. Gingko is used in the impairment of memory.

CHAPTER 13

Herbal Cosmetics
(Aloe Vera Gel, Almond Oil, Lavender Oil, Olive Oil, Rosemary Oil, Sandalwood Oil)

Q 1. Give the sources, chemical constituents, commercial preparations, therapeutic uses and cosmetic uses of the following: 1. Aloe vera gel, 2. Almond oil, 3. Lavender oil, 4. Olive oil, 5. Rosemary oil, 6. Sandalwood oil.

1. Aloe Vera Gel

Aloe Vera Gel is prepared from the plant Aloe, i.e. Korphad.

Aloe

- *Synonyms:* Korphad, Mussabar, Burn plant, First aid plant.
- *Biological source:* It is obtained from the dried juice of the leaves of *Aloe barbedensis* miller.
- *Family:* Liliaceae
- *Chemical constituents:* It contains chemical constituents such as amino acids, anthraquinone, sugars, enzymes, vitamins, hormones, saponins and steroids.

  Aloin, barbaloin, isobarbaloin, aloe-emodin, beta-barbaloin are the main chemical constituents.

Commercial Preparations

a. Aloe vera gel
b. Aloe vera juice
c. Aloe vera paste
d. Kumariasava
e. Rajparvanti vati
f. Regene care
g. Aloertin A
h. Regene care HA
i. Aloe vera hair oil
j. Aloe vera face wash
k. Aloe vera tea

Therapeutic Uses of Aloe Vera Gel

- It is useful in treatment of indigestion and constipation.
- It helps to reduce burns, psoriasis, warts, and eczema and reduce ageing.

- It improves joint flexibility and helps in regeneration of the body cells, reducing inflammation.
- It also helps in the treatment of rashes, sores, herpes, urticaria, fungal infections, vaginal infections, conjunctivitis.
- It is useful as a purgative and laxative and also relieves anal fissure.

Cosmetic Uses of Aloe Vera Gel

- In cosmetics it is used as protective
- It stimulates the growth of hairs
- It is used as a skin moisturizer
- It helps to sooth sunburn
- It has cooling properties
- It fights against skin ageing
- It reduces infection and acne
- It helps to lighten blemishes on the face
- It can help to remove dandruff
- It acts as a conditioner to hair and scalp.

2. Almond Oil

- *Synonyms:* Almond milk, amygdale, amara, king of nuts, amygdalin, bitter almond.
- *Biological source:* Almond oil is fixed obtained by expression from the seeds of *Prunus amygdalus* Var.
- *Chemical constituents:* It contains:
  - Amygdalin, oleic acid (77%), linoleic acid (17%), palmitic acid (5%), myrsitic acid (1%).
  - It is rich in vitamins A and E.

Commercial Preparations of Almond Oil

- Almond oil
- Almond hair oil
- Almond skin cream

Therapeutic Uses of Almond Oil

- It is used as an anti-inflammatory and boosts immunity
- It may lower the risk of cancer and heart
- It is a good source of antioxidants
- It has mild laxative action
- It is used as a vehicle for oily injections.

Cosmetic Uses of Almond Oil

- It improves complexion and skin tone
- It is used to treat dry skin

- It is used as an emollient
- It is used as a makeup remover
- It is used to prevent stretch mark
- It is used as moisturizer and massage oil
- It is used in many toilet articles
- It can help to restore natural complexion and remove all signs of skin darkening.

3. Lavender Oil

- *Synonym:* Lavender, lavendula, French lavender, English lavender, Spike lavender.
- *Family:* Laminaceae (Mint.)
- *Biological source:* Lavender oil is an essential oil obtained by distillation from the spikes of *Lavendula angustifolia* and other species of lavender.
- *Chemical constituents:* Lavender oil is one of the most well-known essential oils used in aromatherapy.

  It contains:

  Lavendulyl acetate, linalyl acetate, terpene alcohol, linalool, terpin-4-ol, camphor, *cis*-ocimene, 8-cineole, limonene and geraniol.

Commercial Preparations of Lavender Oil

Commercial preparations of lavender oil are made from dried flowers, dried herb and essential oil.

Lavender is available in the following forms:

- Lavender oil
- Bath gels
- Tea
- Tinctures
- Extracts
- Lotions
- Soaps

Therapeutic Uses of Lavender Oil

- It is used in indigestion
- It is used to treat anxiety, tension, and headache.
- It is used as local pain killer
- It is used as an antiseptic

- It increases urine flow
- It is used in the treatment of migraine, stress, depression, reduce pain of tense muscle.
- It is used in aromatherapy.

Cosmetic Uses of Lavender Oil

- It has antidandruff action
- It is useful in sunburn
- It is used to prevent hair fall
- It is helpful to build immune system of the body

4. Olive Oil

- *Synonym:* Vegetable oil, olive, oleic acid
- *Family:* Oleaceae
- *Biological source:* It is a fixed oil obtained from expression of the ripe fruits of *Olea europea* Linn. Or Indian olive (*O. ferrugia*)
- *Chemical constituents:* It contains oleic acid, linoleic acid, palmitic acid and other fatty acids, beta-sitosterols.

Commercial Preparations of Olive Oil

- Oleev Health olive oil
- Disano olive oil
- Del Monte olive pomace oil
- Olive oil
- Used as an ingredient in soaps, creams, lotions shampoos, etc.

Therapeutic Uses of Olive Oil

- It is used to treat constipation
- It is used to treat pains associated with ear infections, arthritis, gall bladder diseases
- It is used to treat jaundice and swelling of abdomen due to gases
- It is home consuming oil.

Cosmetic Uses of Olive Oil

- It is used as moisturizer and fights against bacteria
- It helps to prevent skin ageing
- It is useful for makeup removal
- It is useful to remove stretch marks
- It is used in dry skin and chapped lips, beautify hairs.

- Due to its antioxidant properties it helps to prevent or reverse damage from cancer causing ultraviolet radiation.

5. Rosemary Oil

- *Synonym:* Rosemary coronarium
- *Family:* Lamiacece (Mint.)
- *Biological source:* Oil of rosemary is an essential oil distilled from the flowering tops of leafy twigs of *Rosmarinus officinalis*.

Chemical Constituents

- It contains volatile and aromatic components.
- It contains 0.5 to 45% of volatile oil
- Alpha and beta pinene, camphene, limonene, camphor, borneole, cineole, linalool, verbinol.
- It also contains flavonids like diosmetin, diosmin, genkwanin, luteolin, hispidulin, apigenin.
- It contains rosmarinic acid and carnosic acid.

Commercial Preparations of Rosemary Oil

- Patanjali Rosemary oil
- Anti-hair fall oil
- Mama Earth Root Restore Hair Oil
- Rosemary essential oil
- Aromatique Rosemary essential oil for hair
- Rosemary tea (for its flavor, aroma and health benefits)

Therapeutic Uses of Rosemary Oil

- It is used as anti-inflammatory and antispasmodic
- It has antifungal and antibacterial properties
- It is used to reduce joint inflammation
- It helps to improve brain function (memory)
- It is useful in indigestion (dysphagia)
- It has antibacterial properties due to which it helps to treat respiratory problems such as bronchial asthma, bronchitis, sinusitis, nasal congestion, cold and flu, etc.

Cosmetic Uses of Rosemary Oil

- It is used to treat acne
- It is used to lighten stretch marks
- It gives glowing of skins

- It soothes irritation caused by dermatitis and eczema
- It helps to stimulate growth of hairs
- It is used as moisturizer and helps to reduce ageing of skin

6. Sandalwood Oil

- *Synonym:* Chandan oil, sandal oil, yellow sandalwood oil, liginum
- *Biological source:* Sandalwood oil is an essential oil obtained by distillation of dried heart wood of the plant *Santalum album* Linn.
- *Family:* Santalaceae
- *Chemical constituents:* It contains alpha-santalol, beta-santalol, santene, santenone, tersantol, santalone, santalene.

Commercial Preparation of Sandalwood Oil

- Sandalwood essential oil microcapsules
- Sandalwood oil
- Indian sandalwood oil
- Sandalwood powder

Therapeutic Uses of Sandalwood Oil

- It is used in the treatment of dysuria
- It is used in common cold
- It is used to treat urinary tract infections
- It helps to treat various digestive problems
- It is used to treat liver and gall bladder problems
- It is used as relaxant and sedative, antiseptic.
- It is used to treat mental disorders, scabies and hemorrhoids.

Cosmetic Uses of Sandalwood Oil

- It is used as perfume in cosmetics and incense sticks
- It has anti-acne, anti-ageing, anti-tanning and antidandruff properties
- It is used as a cleanser for all types of skin
- It is used to treat dry skin, crackling, wrinkles, massage oil, perfume.
- It is useful for healing of wounds, sores, scars, pimples, removal of black heads, burns.

CHAPTER 14

Phytochemical Investigation of Drugs

Q 1. Define the terms.

1. Phytochemicals

Phytochemicals are the chemicals produced by plants through primary metabolism and secondary metabolism.

Examples: Carotenoids, polyphenols, flavonoids, isothiocyanates, phenolic acids, tannins, antioxidants.

2. Phytochemistry

Phytochemistry is the study of phytochemicals which are derived from plants.

3. Phytochemical Investigation

It refers to the extraction, screening and identification of the medicinally active substances found in the plants.

Q 2. Give the importance/significance of phytochemical investigation (Phytochemical Screening).

Importance of phytochemical investigation

- It is carried out for establishing chemical profile of crude drug.
- To identify new sources of therapeutically and industrially important compounds like flavonoids, phenolic compounds, saponins, steroids, tannins, terpenoids, etc.
- It is helpful for the manufacture of new drugs.
- It helps to determine the identity of two substances.
- It is helpful to monitor the progress of a reaction.
- It is helpful to determine the effectiveness of purification.

Q 3. Enlist/state/give/mention various stages involved in phytochemical investigation.

Different stages involved in phytochemical investigation

1. The procurement of raw material and quality control.
2. Extraction, purification and characterization of the constituents of pharmaceutical interest and in-process quality control.
3. Investigations of biosynthetic pathways of particular compounds.
4. Quantitative evaluation.

Q 4. What is Extraction? Name the solvent used in extraction of crude drugs. Explain the role of solvents in extraction of crude drugs.

Extraction

The technique used for separation of active principles from the crude drug is called extraction.

Solvents Used in Extraction of Crude Drugs

Water, alcohol, chloroform, ether, light petroleum, ethyl acetate, etc.

Role of Solvent Used in Extraction

- The plant material used for extraction should be properly authenticated or identified.
- The choice of plant material for extraction depends on its nature and the components required to be isolated.
- The dried powdered material is commonly used for extraction.
- When fresh plants are used, they are macerated or homogenized with a solvent such as alcohol.
- Water immiscible solvents such as light petrolatum are used for extraction of fixed oil and essential oils, steroids and aglycones.
- Chloroform and ether are used for the separation of alkaloids and quinines.
- The glycosides are soluble in water and alcohol but are insoluble in non-polar solvents.

- Tannins are phenolic matter soluble in water, alcohol and ethyl acetate.
- Extraction itself may be performed by repeated maceration with agitation, percolation or by continuous extraction using soxhlet extractor.

Q 5. Write a note on "Preliminary Phytochemical Screening" of crude drugs.

Preliminary Phytochemical Screening

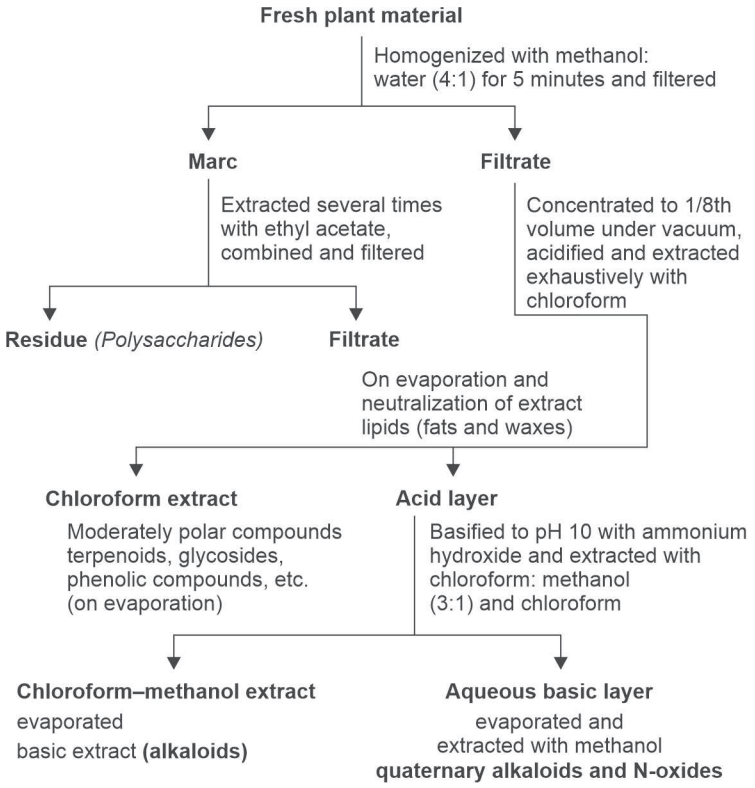
Preliminary phytochemical screening means detection of bioactive principles present in the medicinal plants.

Preliminary Phytochemical Screening Involves

A. Successive Solvent Extraction

- The air-dried powdered plant material is extracted in soxhlet extractor successively with petroleum ether, benzene, solvent ether, chloroform, acetone, ethanol and methanol.
- Finally drug is macerated with chloroform water.
- Each time before extracting with new solvent the powdered drug material is dried in hot air oven below 50°C.
- Each extract is concentrated by distilling off the solvent and then evaporating to dryness on water bath.
- The extract obtained with each solvent is weighed.
- Its percentage is calculated in terms of air-dried weight of the plant material.
- The colour and consistency of the extract is noted.
- The extracts with different solvents can also be prepared by successive macerating (cold extraction) the powdered drug in order of increasing polarity.

Schematic presentation of extraction of different constituents from fresh plant



B. Purification of Extract

- Extract may contain some impurities such as chlorophyll, pigments, inorganic and organic acids, resins, fatty acids, etc.
- Therefore, purification of the extract is necessary.
- Purification of extract is done by various methods like sublimation, distillation, fractional distillation, fractional liberation, chromatography, etc.
- Sublimation is used for purification of materials present in a crude extract.
- Fractional distillation is used for separation of components of volatile oils.
- Steam distillation is used for extraction of volatile oils and hydrocyanic acid from the plant material.

Q 6. Explain qualitative chemical examination of drugs in phytochemical investigation.

Qualitative chemical examination of drugs

The extracts obtained in preliminary phytochemical screening are then subjected to qualitative tests (chemical tests) for the identification of various plant constituents which are as follows:

1. TESTS FOR ALKALOIDS

a. **Dragendorff's test:** To 2–3 ml extract added a few drops of Dragendroff's reagent observed for orange brown precipitate.
b. **Mayer's test:** 2–3 ml extract with a few drops Mayer's reagent observed for precipitate.
c. **Hager's test:** 2–3 ml extract with Hager's reagent observed for yellow precipitate.
d. **Wagner's test:** 2–3 ml with extract a few drops of Wagner's reagent observed reddish brown precipitate.

2. TESTS FOR GLYCOSIDES

a. Tests for Cardiac Glycosides

i. **Baljet's test:** A test solution observed for yellow to orange colour with sodium picrate.
ii. **Bromine water test:** Test solution dissolved in bromine water giving yellow precipitate.
iii. **Legal's test (for cardenolides):** To aqueous or alcoholic test solution, added 1 ml pyridine and 1 ml sodium nitroprusside observed for pink to red colour.
iv. **Test for deoxy sugars (Keller-Kiliani test):** To 2 ml extract added glacial acetic acid, one drop of 5% $FeCl_3$ and concentrated H_2SO_4 observed for reddish brown colour at junction of the two liquids and upper layers bluish green.
v. **Libermann's test (for bufadenolids):** Mixed 3 ml extract with 3 ml acetic anhydride. Heated and cooled. Added a few drops concentrated H_2SO_4 observed for blue colour.

b. Test for Anthraquinone Glycosides

i. **Modified Borntrager's test:** C-glycosides of anthraquinones require more drastic conditions for hydrolysis. Hydrolysis of the drug was carried out with 5 ml of dilute HCl and 5 ml of 5% solution of $FeCl_3$. For hydrolyzed extract procedure was carried out as described under Borntrager's test.

ii. **Borntrager's test:** Boil powdered drug with 5 ml of 10% Sulphuric acid for 5 mins. Filtered while hot, cooled the filtrate shaken gently with equal volume of benzene. Benzene layer was separated and then treated with half of its volume solution of ammonia (10%). Allow to separate it. The ammoniacal layer acquired rose pink colour due to the presence of anthraquinones.

c. Cyanogenetic Glycosides

Grignard's test: Strips of sodium picrate filter paper were inserted between split cork stopper which was fitted into the neck of the test tube containing a small amount of powdered drug in water. Care was exercised that the paper did not touch the inner side of the test tube. The content was warmed for half an hour. The red colour of the strips indicated the presence of cyanogenetic glycosides.

d. Tests for Saponin Glycosides

i. **Foam test:** The drug extract or dry powder was shaken vigorously with water. Persistent foam was observed.

ii. **Foaming index:** Weigh 1 gm of finely powdered drug accurately and transfer to a 500 ml conical flask containing 100 ml of boiling water. Maintain at moderate boiling for 30 min. Cool and filter into a 100 ml volumetric flask and add sufficient water to make the volume to 100 ml.

Place the above decoction into 10 stoppered, graduated test-tubes in a series of successive portions of 1, 2, 3 up to 10 ml and adjust the volume of the liquid in each test tube water to 10 ml. Stopper the tubes and shake them vertically for 15 seconds, 2 frequencies/sec. Allow to stand for 15 min and measure the height of the foam.

The results are assessed as follows:

i. If the height of the foam in every tube is less than 1 cm, the foaming index is less than 100.
ii. If a height of foam of 1 cm is measured in any tube, the volume of the plant material decoction in this tube is used to determine the index. If this tube is the first or second tube in the series, prepare an intermediate dilution in a similar manner to obtain a more precise result.
iii. If the height of the foam is more than 1 cm in every tube, the foaming index is over 1000. In this case repeat the

determination using a new series of dilution of the decoction in order to obtain a result.

$$\text{Foaming index} = \frac{100}{a}$$

a = volume in ml of the decoction used for preparing dilution in the tube where foaming to a height of 1 cm is observed.

iii. **Haemolytic test:** Added test solution to one drop of blood placed on glass slide. Haemolytic zone whether appeared was observed.

E. Tests for Coumarin Glycosides

Test solution when made alkaline, observed for blue or green fluorescence.

3. TANNINS AND PHENOL COMPOUNDS

The extract treated with following reagents produces different colours.

a. **5% $FeCl_3$ solution:** Deep blue-black colour.
b. **Lead acetate solution:** White precipitate.
c. **Bromine water:** Discoloration of bromine water.
d. **Acetic acid solution:** Red colour solution.
e. **Dilute iodine solution:** Transient red colour.
f. One drop NH_4OH, excess 10% $AgNO_3$ solution. Heated for 20 min in boiling water bath. White precipitate was observed, then dark silver mirror deposited on wall of test tube.

4. TESTS FOR CARBOHYDRATES

a. **Molish's test (general test):** To 2–3 ml aqueous extract, added a few drops of a-naphthol solution in alcohol, shaken and added concentrated H_2SO_4 from sides of the test tube was observed for violet ring at the junction of two liquids.
b. **Fehling's test:** 1 ml Fehling's A and 1 ml Fehling's B solutions were mixed and boiled for one minute. Equal volume of test solution was added. Heated in boiling water bath for 5–10 min was observed for yellow, then brick red precipitate.
c. **Benedict's test:** Equal volume of Benedict's reagent and test solution in test tube were mixed. Heated in boiling water bath for 5 min. Solution may appear green, yellow or red depending on amount of reducing sugar present in test solution.

d. **Barfoed's test:** Equal volume of Barfoed's reagent and test solution were added. Heated for 1–2 min, in boiling water bath and cooled. It is observed for red precipitate.
e. **Cobalt-chloride test:** 3 ml of test solution was mixed with 2 ml cobalt chloride, boiled and cooled. Added $FeCl_3$ drops on NaOH solution. Solution observed for greenish blue (glucose), purplish (fructose) or upper layer greenish blue and lower layer purplish (mixture of glucose and fructose).
f. **Tests for non-reducing sugars:** Test solution does not give response to Fehling's and Benedict's test.
g. **Tannic acid test for starch:** With 20% tannic acid, test solution was observed for precipitate.

5. TESTS FOR PROTEINS

a. **Biuret test (general test):** To 3 ml test solution added 4% NaOH and a few drops of 1% $CuSO_4$ solution observed for violet or pink colour.
b. **Million's test (for proteins):** Mixed 3 ml test solution with 5 ml Million's reagent, white precipitate obtained. Precipitate warmed turns brick red or precipitate dissolves giving red colour was observed.
c. **Xanthoprotein test (for protein containing tyrosine or tryptophan):** Mixed 3 ml test solution with 1 ml concentrated H_2SO_4 observed for white precipitate.
d. **Precipitation test:** The test solution gave white colloidal precipitate with following reagents: Absolute alcohol, 5% $HgCl_2$ solution, 5% $CuSO_4$ solution, 5% lead acetate, 5% ammonium sulphate.

6. TESTS FOR SAPONIN GLYCOSIDES

a. **Foam test:** The drug extract or dry powder was shaken vigorously with water. Persistent foam was observed.
b. **Foaming index:** Weigh 1 gm of finely powdered drug accurately and transfer to a 500 ml conical flask containing 100 ml of boiling water. Maintain at moderate boiling for 30 min. Cool and filter into a 100 ml volumetric flask and add sufficient water to make the volume to 100 ml.

   Place the above decoction into 10 stoppered, graduated test-tubes in a series of successive portions of 1, 2, 3 up to 10 ml

and adjust the volume of the liquid in each test tube water to 10 ml. Stopper the tubes and shake them vertically for 15 seconds, 2 frequencies/sec. Allow to stand for 15 min and measure the height of the foam.

The results are assessed as follows:

i. If the height of the foam in every tube is less than 1 cm, the foaming index is less than 100.
ii. If a height of foam of 1 cm is measured in any tube, the volume of the plant material decoction in this tube is used to determine the index. If this tube is the first or second tube in the series, prepare an intermediate dilution in a similar manner to obtain a more precise result.
iii. If the height of the foam is more than 1 cm in every tube, the foaming index is over 1000. In this case repeat the determination using a new series of dilution of the decoction in order to obtain a result.

$$\text{Foaming index} = \frac{100}{a}$$

a = volume in ml of the decoction used for preparing dilution in the tube where foaming to a height of 1 cm is observed.

c. Haemolytic test: Added test solution to one drop of blood placed on glass slide. Haemolytic zone whether appeared was observed.

7. TESTS FOR FLAVONOIDS

a. Shinoda test: To dried powder or extract, added 5 ml 95% ethanol, a few drops concentrated HCl and 0.5 g magnesium turnings. Pink colour was observed.

To small quantity of residue, added lead acetate solution observed for yellow coloured precipitate. Addition of increasing amount of sodium hydroxide to the residue showed yellow colouration, which was decolourised after addition of acid was observed.

b. Ferric chloride test: Test solution, added a few drops of ferric chloride solution observed for intense green colour.

8. TEST FOR VITAMINS

a. Test for vitamin A: Dissolve a quantity equivalent to 10–15 units in 1 ml chloroform and add 5 ml of antimony trichloride solution, a transient blue colour is produced immediately.

b. Test for vitamin C (ascorbic acid): Dilute 1 ml of 2% w/v solution with 5 ml of water and added 1 drop of freshly prepared 5% w/v solution of sodium nitroprusside and 2 ml dilute NaOH solution. Added 0.6 ml of hydrochloric acid drop wise and stir the yellow colour turns blue.

c. Test for vitamin D: Dissolved a quantity equivalent to about 100 units of vitamin D, activating in chloroform and added 10 ml of antimony trichloride solution, a pinkish-red colour appeared at once.

9. TESTS FOR STEROIDS

a. Salkowski reaction: To 2 ml of extract, 2 ml chloroform and 2 ml concentrated H_2SO_4 was added. Shook well, whether chloroform layer appeared red and acid layer showed greenish yellow fluorescence was observed.

b. Libermann-Burchard test: Mixed 2 ml extract with chloroform. Added 1–2 ml acetic anhydride and 2 drops concentration H_2SO_4 from the side of test tube observed for first red, then blue and finally green colour.

c. Lieberman's test: Mixed 3 ml extract with 3 ml acetic anhydride. Heated and cooled. Added a few drops concentrated H_2SO_4 observed for blue colour.

10. TESTS FOR AMINO ACIDS

a. Ninhydrin test (general test): 3 ml extract and 3 drops 5% Ninhydrin solution were heated in boiling water bath for 10 min. Observed for purple or bluish colour.

b. Test for tyrosine: Heated 3 ml extract and 3 drops Million's reagent. Solution is observed for dark red colour.

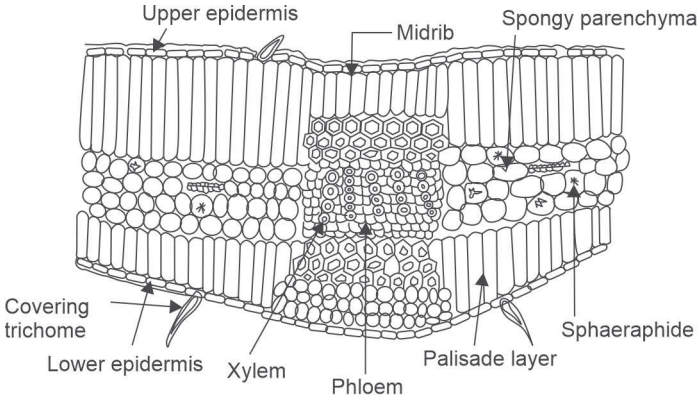
c. Test for tryptophan: To 3 ml extract added a few drops glycoloxalic acid and concentrated H_2SO_4 observed for reddish-violet ring at junction of the two layers.

CHAPTER 15

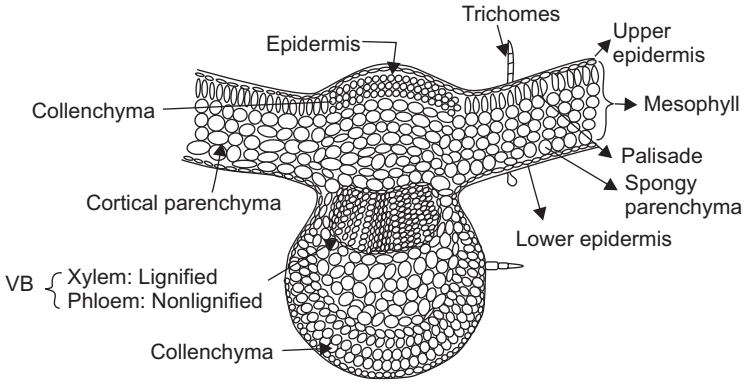
Gross Anatomical Studies of Some Crude Drugs

Q 1. Draw a well-labelled diagrammatic TS of the following crude drugs.

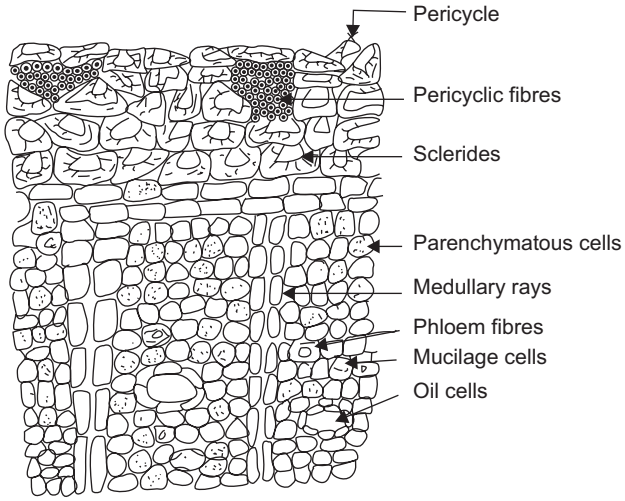
1. T.S. of Senna Leaflet



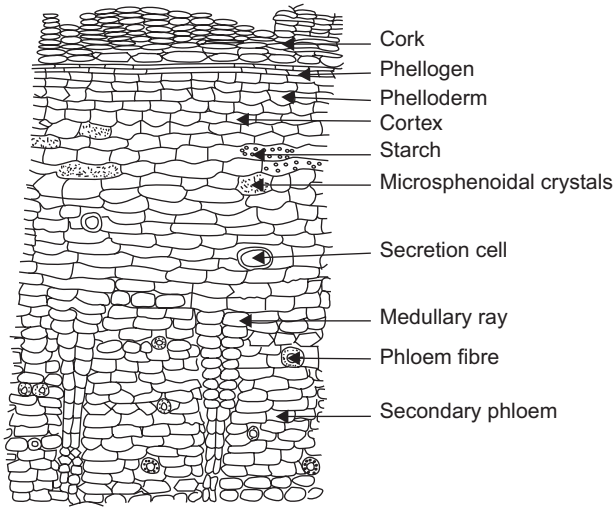
2. T.S. of Datura



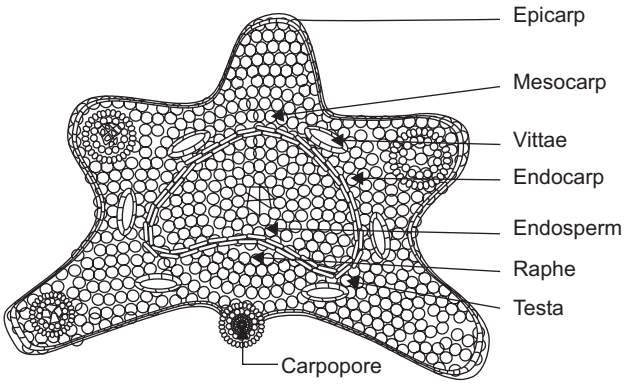
3. T.S. of Cinnamon Bark



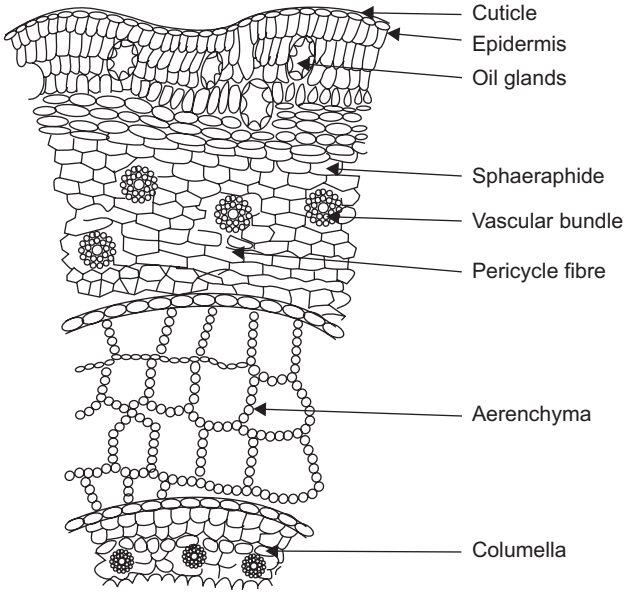
4. T.S. of Cinchona Bark



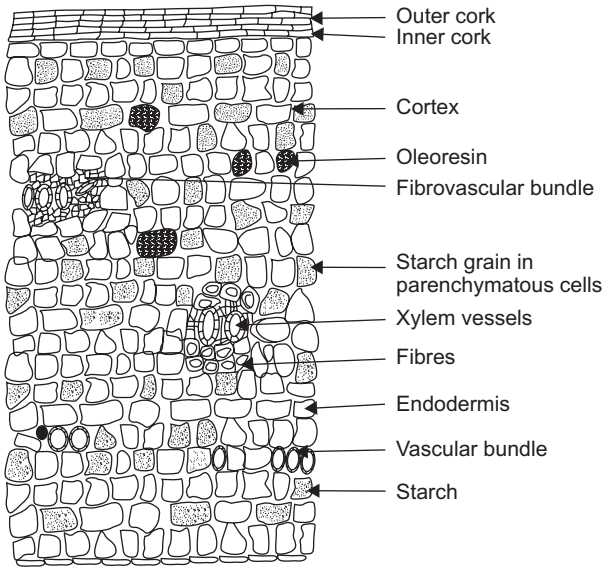
5. T.S. of Fennel



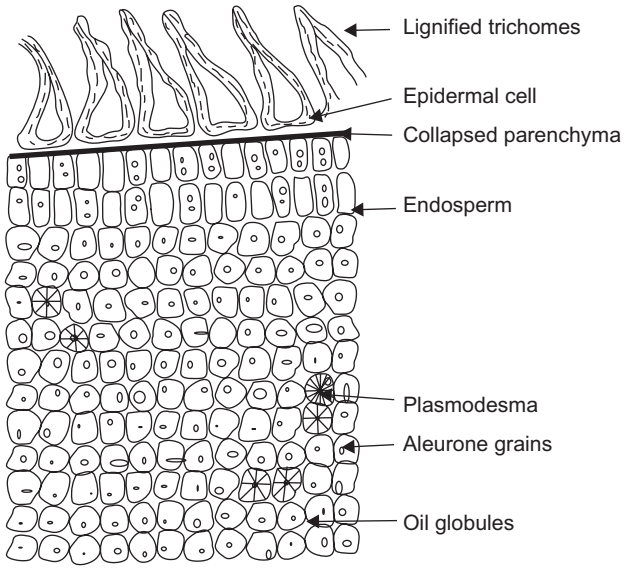
6. T.S. of Clove



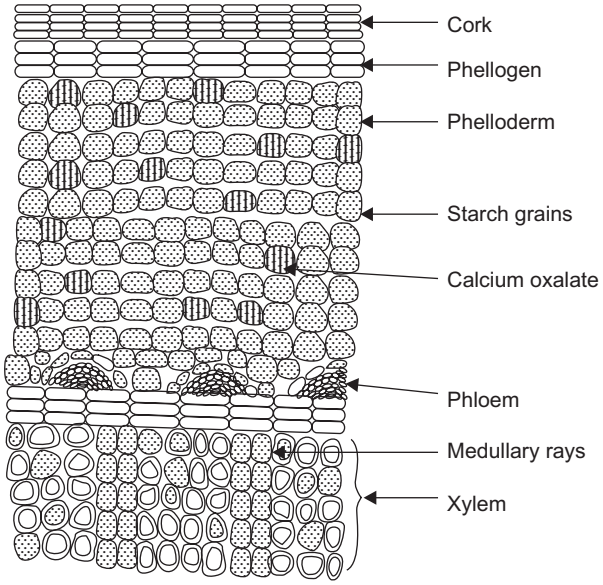
7. T.S. of Ginger



8. T.S. of Nux-vomica Seed



9. T.S. of Ipecacuanha



Appendix A

Distinguish/Difference Between

1. Organized drug	Unorganized drug
1. They are made up of cells.	1. These are made up of particles
2. They have definite size and shape.	2. They do not show definite shape and size.
3. Chemical constituents are present in the cell.	3. Chemical constituents are present in the particles.
4. Cellular arrangement is uniform in all the samples.	4. Particle arrangement is changed from sample to sample.
5. Morphological study helps in identification of the drugs.	5. Morphological studies have less importance in identification of the drugs.
6. Microscopical observations confirm the identification.	6. Chemical tests confirm the identification.
7. All the parts of the plant are organized.	7. Plant exudates and plant extracts are unorganized in nature
8. The chemical constituents are formed during metabolism.	8. The drugs are obtained by artificial process like injuries.
9. The constituents are known as metabolic products	9. They are known as pathological products.
10. Examples: Fennel, ginger	10. Examples: Catechu, acacia.

2. Leaf	Leaflet
1. In case of leaf, bud or branch is present in the axil.	1. It is absent in leaflets.
2. Leaves are arranged spirally.	2. Leaflets are arranged in pairs.
3. Leaves lie in different planes.	3. Leaflets lie in the same plane.
4. Leaves are generally symmetrical at the base.	4. Leaflets are asymmetrical at the bases
5. Examples: Digitalis, vasaka.	5. Examples: Senna, neem.

3. Roots	Rhizomes
1. Roots are characterized by their downward growth into the soil.	1. The rhizomes are characterized by their horizontal growth under the soil.
2. They do not have nodes and internodes.	2. They have nodes and internodes.
3. Root cap is present at the tip of the root.	3. Root cap is absent.
4. Examples: Rauwolfia, aconite	4. Examples: Ginger, dioscorea, rhubarb, turmeric.

4. Gums	Mucilages
1. Gums are produced outside the cells of plant by process "Gummosis".	1. Mucilages are produced inside the cells of the plant.
2. Gums are plant hydrocolloids.	2. Mucilages are esters of sulphuric acids.
3. Gums form viscous solution with water.	3. Mucilages form slimy masses with water.
4. Examples: Acacia, tragacanth, guar gum.	4. Examples: Isapgula.

5. Resins	Oleo-gum-resin
1. These are amorphous solids or semisolids obtained by exudates from plant.	1. These are resin combinations.
2. Chemically they are mixtures of resins acids, resin alcohols.	2. Chemically they consist of volatile oil, gum and resin
3. They are insoluble in water.	3. They are partly soluble in water and alcohol and partly soluble in oil and look oily
4. They are end products of metabolism.	4. These are prepared by combination of volatile oil, gum and resin.
5. Examples: Storax, colophony	5. Examples: Asafoetida, guggul, myrrh.

6. Gums	Resins
1. Gums are abnormal products of plant when it is injured.	1. Resins are either normal metabolic products of plant or occur as a result of pathological process.
2. Chemically gums consist of polyuronides combined with calcium, potassium and magnesium.	2. The complex mixtures of resin acid, resin alcohol, resinotanin, resin esters, glycoresins.
3. Gums are insoluble in alcohol but soluble in water.	3. Resins are insoluble in water but mostly soluble in alcohol and other organic solvents.
4. Examples: Tragacanth, acacia.	4. Examples: Colophony, benzoin, asafoetida, myrrh.

7. Acacia	Tragacanth
1. Colour is cream brown to red.	1. Colour is white or pale yellowish white.
2. Taste is bland and mucilaginous.	2. It is tasteless.
3. Solution lead subacetate gelatinizes aqueous solution of acacia.	3. It gives negative test with lead subacetate.
4. It does not give test with NaOH.	4. When warmed with NaOH solution gives canary yellow colour.
5. It does not give test with iodine solution.	5. With iodine solution gives green colour.

8. Volatile oil	Fixed oil
1. Evaporated at room temperature.	1. Not evaporated at room temperature.
2. These do not produce stain on paper.	2. Do not produce stain on paper.
3. Chemically these are terpenes and their oxygenated products.	3. Chemically they are fatty acids with glycerols.
4. They are not saponified by alkali.	4. They are saponified by alkali.
5. Volatile oils do not have food value.	5. Fixed oils have food value.
6. Volatile oils have pleasant odour that is why used in perfumery.	6. Fixed oils do not have pleasant odour.
7. They do not turn rancid on storage.	7. They turn rancid on storage due to free acids.
8. Examples: Orange oil, lemon oil.	8. Examples: Arachis oil, castor oil.

9. Fat	Oil
1. Fats are the substances which remain solid at temperature 15–16°C.	1. Oils are substances which remain liquid at temperature 15–16°C.
2. Fats contain more % of saturated fatty acids.	2. Oils contain less % saturated fatty acids.
3. Fats have no subclasses.	3. Oils can be subclassified as drying oils, semidrying oils and nondrying oils.
4. Example: Cocoa butter.	4. Examples: Linseed oil, castor oil, almond oil.
5. They mainly originate from animal sources.	5. They mainly originate from plant sources.

10. Fats	Waxes
1. Fats are solid or semisolid in nature above temperature 15–16°C.	1. Waxes are fusible viscous solid substances.
2. Fats are chemically glycerides of higher fatty acids.	2. These are esters of fatty acids with higher high weight monocyclic alcohol such as cholesterol, cetyl alcohol, etc.
3. Fats may be saponified by either aqueous or alcoholic alkali.	3. Waxes are saponified only by alcoholic alkali.
4. Fats are suitable for internal consumption.	4. Waxes are not suitable for internal consumption.
5. Examples: Coconut oil, cocoa butter	5. Examples: Beeswax

11. Plant fibre	Animal fibre
1. Obtained from plant source.	1. Obtained from animal source.
2. Burns without foul odour.	2. Burns slowly with foul smell.
3. With picric acid does not give deep yellow colour.	3. With picric acid gives deep yellow colour.
4. With Millon's reagent on boiling does not produce red colour.	4. With Millon's reagent on boiling produces red colour.
5. Used to produce surgical dressings.	5. Used to produce bandages and dressings.
6. Examples: Cotton, jute.	6. Examples: Silk, wool.

12. Perfumes	Flavouring agents
1. Perfumes are made from natural or synthetic materials.	1. Flavouring agents are made from natural sources like lemon, orange, etc.
2. Perfumes are used for creating a pleasant odour.	2. Flavouring agents are used to mask the unpleasant odour and taste of the preparations.
3. Perfume has a sweet and pleasant smell.	3. Flavouring agents have a distinct taste.
4. Perfume felt by nose.	4. Flavouring agent is felt by taste.
5. Perfumes are used to improve personal appearance in the society.	5. Flavouring agents are used to improve psychological effect of the preparation.
6. Perfumes are used in cosmetics and in toilet preparations.	6. Flavouring agents are used in pharmaceutical and food industries.
7. Examples: Rose, jasmine, sandal.	7. Examples: Lemon, mint, orange, clove, lavender.

13. Silk fibre	Wool fibre
1. It is obtained from silkworm *Bombyx mori*. Family: Bombycidae.	1. It is obtained from the fleece of sheep ovis aries. Family: Bovidae.
2. It contains protein known as Fibroin.	2. Wool contains protein known as keratin.
3. Fibroin is made up of amino acids glycine and alanine.	3. Keratin is rich in sulphur containing amino acid cystine.
4. When warm with 5% KOH silk fibres are insoluble.	4. When warm with 5%KOH wool fibres are soluble.
5. With conc. HCl silk fibres are soluble.	5. Wool fibres are insoluble with conc. HCl.
6. Dissolve fibre in warm 20% NaOH and add a few drops of 10% lead acetate, silk fibres do not give black precipitate.	6. Dissolve fibres in warm 20% NaOH and add a few drops of 10% lead acetate solution, wool fibres give black precipitate.
7. Special types of sutures, sieves, and ligatures are prepared from silk.	7. Wool fibres are used as filtering and straining medium, also used in manufacturing of crape bandages.

14. Sumatra Benzoin		Siam Benzoin	
1.	Grayish brown to grey in colour.	1.	Yellowish brown to rusty brown.
2.	Aromatic and characteristic odour.	2.	Agreeable and vanilla like odour.
3.	It occurs in the form of lumps of varying sizes.	3.	It occurs as hard and brittle masses.
4.	When heated fumes of benzoic acid and cinnamic acid are produced.	4.	When heated it is softened and becomes plastic.
5.	On heating in a test tube with 10 ml solution of $KMnO_4$ develops a strong odour of benzaldehyde in case of Sumatra Benzoin.	5.	No odour of benzaldehyde in case of Siam Benzoin.

Contd...

6. Heat benzoin in dry test tube covering with glass slide, observe the same slide under microscope. Cinnamic acid crystals are observed in case of Sumatra Benzoin.	6. Cinnamic acid crystals are not observed in case of Siam Benzoin.

15. Hydrolysable Tannins	**Condensed Tannins**
1. They undergo hydrolysis with the help of mineral acids like HCl, HNO_3, and H_2SO_4.	1. They cannot be hydrolysed. If they are subjected for hydrolysis, the molecules breakdown and the decomposition product "Phlobapene" is obtained.
2. With ferric chloride solution they produce blue colour.	2. With ferric chloride solution they produce brownish green colour.
3. On dry distillation gallic acid and other compounds get converted into pyrogalol.	3. On dry distillation they yield catechol tannin.
4. These are of two types: Galli Tannins, Ellagi Tannins.	4. No subtypes.
5. Examples: Rhubarb, Behda, Myrobalan.	5. Examples: Catechu, Cinchona.

16. Antiseptic	**Disinfectant**
1. Stops the growth of micro-organisms.	1. Kills microbes and spores.
2. Can be applied on living tissue or on wounds.	2. Can be applied on non-living surfaces.
3. Used to prevent sepsis.	3. Used to clean non-living surfaces and sterilize glass apparatus, drainage systems.
4. Is not as strong as disinfectant.	4. Is stronger and more toxic than antiseptic.
5. Is commonly found in the items such as mouthwash, eye wash, and antiseptic cream.	5. Is commonly used in household items to protect germs.
6. Examples: Turmeric, neem.	6. Example: Phenyl.

17. Black catechu	Pale catechu
1. It consists of dried Aq. extract of plant *Acacia catechu* belongs to family Leguminaceae.	1. It is obtained from Aq. extract from leaves and twigs of *Uncaria gambier* belongs to family Rubiaece
2. It is light brown to black in colour.	2. It is cinnamon brown in colour.
3. It does not contain chlorophyll.	3. It contains chlorophyll. Hence the chloroform extract of drug in white porcelain dish shows greenish yellow colour.
4. With ferric chloride solution it gives bluish-black colour.	4. It does not give positive test with ferric chloride solution.
5. Aq. solution of black catechu gives brown colour with lime water.	5. It gives negative test.
6. It contains 30% of catechu tannic acid which is an oxidized product of acacatechin.	6. It contains 22.50% catechu tannic acid which decomposes into catechu red.

18. Adulterant/adulteration	Substitute/substitution
1. These are somewhat similar to the genuine drug in respect of morphological appearance.	1. It relates with the other source of drug for genuine variety.
2. They may show similarity of colour, size, shape, smell, etc. but do not have therapeutic value.	2. Generally substituents are the drugs with some active constituents as found in genuine drug but less % of active constituents.
3. Adulteration is a practice of substituting original drug partially with other similar looking substance.	3. Substitution involves unwanted parts of the plant present in original drug like leaf or roots of the same plant and sometimes other variety of drugs are mixed in the original drug.

Contd..

4. Examples: (i) *Strychnos nux-vomica* seeds are adulterated with *strychonus blanda* which does not contain strychnine at all. (ii) Ginger is adulterated with exhausted ginger.	4. (i) Senna is substituted with inferior varieties like Dog senna, Arabian senna. (ii) Digitalis leaf is substituted with other parts of digitalis plant looking similar to leaf.

19. Raw cotton	**Surgical cotton**
1. It contains 90% of cellulose, 7.8% of moisture, wax, fat and remains of protoplasm.	1. It contains entirely cellulose and 6.7% moisture.
2. It does not absorb water. It repels water.	2. It absorbs exudates (blood, pus, mucus).
3. It is a waste cotton fibre.	3. It is used for preparation of surgical dressings.

Appendix B

Chemical Tests of the Crude Drugs

Important Specific Chemical Tests

Sr. No.	Chemical Test	For Drug
1.	Borntrager's test	Senna
2.	Modified Borntrager's test	Aloe
3.	Keller-Kiliani test	Digitalis
4.	Klunge's test	Aloe
5.	Vitali Morin test	Datura
6.	Fiehe's test	Honey
7.	Gold Beater skin test	Tannins
8.	Gambier fluorescin test	Pale catechu
9.	Match stick test	Pale/black catechu
10.	Guignard test	Linseed/arachis oil
11.	Halaphene's test	Cotton
12.	Catechin test	Condensed tannins
13.	Meconic acid test	Opium
14.	Swelling factor test	Isapgula

Note: All above tests were described under the chemical tests of the given drugs.

Chemical Tests of the Crude Drugs

1. Nux vomica:

a. T.S. of Nux vomica is stained with ammonium vanadate and sulphuric acid. The endospermic cells become purple due to the presence of Strychnine.
b. T.S. of Nux vomica is stained with potassium dichromate and sulphuric acid. The endospermic cells become violet in colour due to the presence of Strychnine.
c. T.S. of Nux vomica is stained with concentrated nitric acid. The endospermic cells take yellow colour due to the presence of Brucine.
d. T.S. of Nux vomica is stained with the test solution of Thionine, wait for 10 minutes, wash with alcohol. The lignified cells turn bluish-violet.

2. Honey:

a. **Fiehe's test:** Stir 10 ml of honey with 5 ml of solvent ether for 5–10 minutes, allow it separate and draw off 2 ml of ethereal layer into a small petridish. Allow ethereal layer to evaporate, to the residue add 1 drop of resorcinol in hydrochloric acid, pure honey should not give cherry red colour. As artificial honey contains furfural it gives red colour.
b. **Fehling's test:** Take 2 ml of aqueous solution of honey and to it add Fehling's solution A and B. The reaction mixture is heated on a steam bath for 5–10 minutes. A brick red colour is produced due to presence of reducing sugars.
c. **Benedict's test:** To 1 ml of aqueous solution of honey add 2 ml (10 drops) of Benedict's reagent ($CuSO_4$). The solution is then heated in a boiling water bath for 3–5 minutes. Reddish precipitate is observed.
d. **Molisch's test:** To 2 ml of aqueous solution of honey add 5 drops of Molisch's reagent mix well and add 2 ml of conc. H_2SO_4 from the sides of the tube. Violet/purple ring is observed at the junction of two liquids.
e. **Tommer's test:** To 2 ml of aqueous solution of honey add Tommer's reagent ($NaOH + CuSO_4$), boil for 2 minutes and cool. Red colour is observed.

f. **Barfoed's test:** To 2 ml of aqueous solution of honey add Barfoed's reagent, boil for 2 minutes and cool. Brick red precipitate is observed.

3. Aloe:

Preparation of test solution: 1% solution of aloe is prepared by boiling with water and add 0.5% Kiesulgur to it and filter. The filtrate is used for the following tests.

a. **Borax test (Schoeteten test):** 0.5 gm of borax is added to a 5 ml test solution and heated; this solution when diluted with water gives fluorescence due to aloe-emodin.
b. **Bromine test:** Add equal quantity of test solution and bromine water (freshly prepared) gives yellow colour precipitate of tetra-barbaloin (tetra bromide).
c. **Nitrous acid test:** 2 ml of nitric acid is added to 5 ml of test solution. Different colours are produced as given below:
    i. Cape aloe—yellowish brown to green.
    ii. Curacao aloe—reddish orange.
    iii. Zanziber (socotrine) aloe—pale brownish yellow.
d. **Klunge's test:** To an aq. solution of aloe add a drop of saturated copper sulphate solution (buffer solution) followed by NaCl 0.5 gm and 2 ml of 90% alcohol.
    i. Cape aloe: Faint colouration
    ii. Curacao aloe: Wine red
    iii. Zanziber (socotrine) aloe: Do not respond.
e. **Modified Born Trager's test:**
    To the 0.1 gm of drug add 2 ml of 5% ferric chloride solution and 2 ml of dil. HCl.

    Heats on a boiling water bath for 5 minutes cool and shake with benzene.

    Separate the benzene layer and add equal volume of dil. ammonia. Pinkish red colour is produced with all varieties of aloe.

4. Myrrh:

a. When triturated with water it forms a yellowish emulsion.
b. Extract small quantity of powdered myrrh with ether and evaporate the solvent in such a way that a thin film of the resin is left in the dish. Pass the vapours of bromine or fumes of nitric acid over the film. A deep violet colour is produced.

5. Pale Catechu:

a. **Gambier fluorescence test:** Boil a little powdered drug with alcohol, filter and add sodium hydroxide solution to the filtrate, stir and add a few ml of light petroleum. Petroleum layer shows green fluorescence
b. **Matchstick test:** Dip the wooden matchstick in the solution of drug and dry it over a flame. Moisten the stick with hydrochloric acid and warm. Purple colour appears on the matchstick due to conversion of catechu into Phloroglucinol.
c. **Vanillin hydrochloric acid test:** Make solution containing vanillin 1 ml, alcohol 10 ml and dil. hydrochloric acid 10 ml, it gives pink or red colour due to the formation of Phloroglucinol.
d. Heat about 0.5 gm of powdered drug with 5 ml of chloroform in a dish and evaporate the filtrate on a water bath. A greenish yellow residue is left due to the presence of chlorophyll in the drug.
e. With ferric chloride solution, it gives bluish black colour.
f. With lime water, pale catechu gives brown colour.

6. Black Catechu:

a. With ferric chloride it gives bluish black colour.
b. Black catechu gives pink or red colour with vanillin hydrochloric acid solution.
c. Lime water gives brown colour with aqueous solution of black catechu.
d. **Matchstick test:** Dip the wooden matchstick in the solution of drug and dry it over a flame. Moisten the stick with hydrochloric acid and warm. Purple colour appears on the matchstick due to conversion of catechu into Phloroglucinol.

7. Starch:

a. 1 gm of starch is boiled with 15 ml of water and cooled; a translucent viscous jelly is produced.
b. Above jelly turns deep blue by addition of iodine solution. This blue colour disappears on warming and reappears on cooling.
c. Hydrolyse the starch solution with acid and then add Fehling's solution A and B in equal quantity and heat it in water bath which gives brick red precipitate.

8. Agar:

a. Boil 1% solution of agar. On cooling it forms a stiff jelly.
b. When mounted in solution of ruthenium red and examine under microscope, the mounted particles acquire pink colour.
c. To 0.2% solution of agar in water, add solution of tannic acid no precipitate is produced.
d. When N/50 iodine solution is added to the powder, it produces crimson to brown colour.
e. Agar is incinerated to ash; dilute hydrochloric acid is added and observed under microscope. Skeletons and sponge spicules of diatoms are seen.
f. On warming a little agar in solution of KOH, canary yellow colour is produced.
g. Hydrolyse 1% aq. solution of agar with 0.5 ml of concentrated HCl. Divide this hydrolyse solution into two parts:
    i. Part A: To this part add 1 ml of Fehling's solution A and B and warm on water bath, colour of the Fehling's solution is reduced.
    ii. Part B: To this part add solution of barium chloride, white precipitate of barium sulphate is produced.

9. Tragacanth:

a. When warm with NaOH solution gives a canary yellow colour.
b. With iodine solution gives green colour.
c. With ruthenium red particles do not acquire pink colour.
d. Aqueous solution of tragacanth produces a white precipitate with lead acetate.
e. Hydrolyse the aqueous solution of tragacanth with dil. HCl by boiling in ware bath. Cool it, adds equal quantity of Fehling's solution A and B, heat again, red precipitate is observed.

10. Gelatin:

a. Aqueous solution of gelatin gives precipitate with solution of trinitrophenol.
b. On heating gelatin solution with soda lime, ammonia gas is evolved.
c. Aqueous solution of gelatin precipitates mercuric nitrate solution (Millon's reagent), forming white colour, which turns red on heating.

d. Formaldehyde makes gelatin hard and insoluble after drying.
e. To aqueous solution of gelatin, add drop of picric acid or tannic acid solution, precipitate is produced.

11. Acacia:

a. Solution of lead subacetate gelatinizes aqueous solution of Indian gum.
b. Mount a small quantity of acacia powder in ruthenium red solution and examine under microscope. The particles do not get red colour.
c. To 0.1 gm powder, add 1 ml of N/50 iodine. The mixture does not acquire crimson colour.
d. Hydrolyse the aqueous solution of gum acacia in the presence of dilute hydrochloric acid by boiling. To it add Fehling's A and B and heat again. Red precipitate is observed, which confirms the presence of reducing sugar.
e. To the aqueous solution of gum acacia, add 0.5 ml solution of hydrogen peroxide and 0.5 ml solution of benzidine in alcohol (1% solution), shake it well. A blue colour is produced (due to oxidase enzyme).
f. Aqueous solution of drug is treated with dilute hydrochloric acid and heated. To it barium chloride solution is added. No precipitate is formed.

12. Benzoin:

a. To a solution of benzoin in alcohol add water. Solution becomes milky and acidic to litmus.
b. To the drug add solvent ether, decant ether layer and to it add 2/3 drops of H_2SO_4. A deep purplish-red colour in case of Sumatra Benzoin.
c. Heat benzoin in a test tube with solution of $KMnO_4$, it develops strong odour of benzaldehyde.
d. To the alcoholic solution of Benzoin, add $FeCl_3$, green colour develops in case of Sumatra Benzoin.
e. Heat small quantity of benzoin in dry test tube, cover the opening of test with clean dry glass slide, cool it and observe slide under microscope, cinnamic acid crystals are observed.

13. Guar Gum:

a. It does not acquire olive green colour with weak solution of iodine.
b. With solution of ruthenium red, the gummy solution does not acquire pink colour.
c. About 2% solution of lead acetate gives precipitate with the solution of guar gum.
d. Dissolve 0.5 gm of guar gum in 20 ml of water by shaking. To it add 0.5 ml of hydrogen peroxide and 0.5 ml of 1% solution of benzidine in alcohol. No blue colour is produced.

14. Wool:

a. Wool is insoluble in 66% sulphuric acid, concentrated hydrochloric acid and cuoxam reagent.
b. When lead acetate is added to a solution of wool in caustic soda, a black precipitate is formed due to high sulphur content.
c. Wool hairs are soluble in 1.25 sodium hydroxide solution.
d. Wool hairs are stained with ammoniacal copper oxide solution.
e. Moistened the wool fibres with N/50 iodine solution followed by a drop of 80% w/w sulphuric acid, a yellow colour is produced.
f. Warm/boil wool fibres with picric acid. Then rinse with water, permanent yellow stain is produced.
g. Warm with Millon's reagent, red stain is produced.

15. Cotton:

a. Soak cotton fibres in iodine water and dry. Add a few ml of 80% sulphuric acid, trichomes assume purplish-blue or bluish-green colour.
b. Ammoniacal copper oxide solution (cuoxam reagent) dissolves raw cotton fibres with the formation of balloons', while absorbent cotton dissolves completely with uniform swelling.
c. Cotton is insoluble in dilute sodium hydroxide solution and hydrochloric acid. It is soluble in 66% of sulphuric acid.
d. With iodinated zinc chloride solution, it becomes violet coloured.
e. To 0.1 gm add 10 ml of zinc chloride solution, heat to 40°C, fibres do not dissolve.

f. **Halaphene's Test:** Cotton plugged test tube containing 2.5 ml of sample (cotton seed oil). Add equal volume of amyl alcohol. Add 2.5 ml of 1% solution of sulphur in carbon bisulphide, boil the test tube in water bath for 30 minutes, positive crimson red colour is produced which shows purity of cotton seed oil.

16. Asafoetida:

a. Fractured surface of the drug, if treated with sulphuric acid forms red or reddish brown colour.
b. When treated with 50% of nitric acid, the drug gives colour.
c. When triturated with water, it forms yellowish orange emulsion.
d. Umbelliferone test: Triturate about 0.5 gm of drug with sand and 5 ml of hydrochloric acid, to it add a little quantity of water, filter and to the filtrate add equal volume of ammonia. A blue florescence is produced due to presence of umbelliferone.

17. Senna:

Borntrager's test: Boil the powdered leaves with dilute sulphuric acid. Filter immediately, separate the filtrate and cool. Mix the filtrate with double volume of any one of the water insoluble organic solvents like benzene, chloroform or carbon tetrachloride. Shake it well and separate the organic solvent layer. To the layer of organic solvent add equal quantity of dilute ammonia. The ammoniacal layer becomes pink and finally red indicating the presence of anthraquinone derivatives.

18. Digitalis:

a. Keller-Kiliani test:
   - Boil 1 gm of powder drug with 10 ml of 70% alcohol for 3 minutes and filter it.
   - To the filtrate add 5 ml of water and 0.5 ml of strong solution of lead acetate.
   - Filter it and the filtrate is treated with equal volume of chloroform and shake.
   - Chloroform layer is separated and evaporated to obtain residue.
   - Then the extract which is obtained is dissolved in glacial acetic acid and cooled.
   - Add 2 drops of ferric chloride solution to it.

- Transfer the above contents to a test tube containing 2 ml of concentrated sulphuric acid, a reddish brown layer acquires bluish green colour after standing due to digitoxose

b. **Baljet test:** A thick section of leaves with sodium picrate solution shows yellow orange colour.

c. **Regal's test:** Dissolve the drug in 20 ml of pridine, add 2 ml of sodium nitroprusside solution, and make alkaline with sodium hydroxide solution. It gives pink red colour.

19. Turmeric:

a. Powdered drug with sulphuric acid gives crimson colour.

b. The aqueous solution of turmeric with boric acid gives reddish brown colour which on addition of alkali changes to greenish blue.

c. With acetic anhydride and concentrated sulphuric acid, it gives violet colour. When this test is observed under UV light, red fluorescence is seen.

d. Prepare a tincture of turmeric and impregnate a filter paper with it. Treat the impregnate paper with borax solution, a green colour is produced.

e. Take powdered turmeric in a test tube or on slide and add a solution of sodium hydroxide or potassium hydroxide, the powder gives red to violet colour.

20. Ergot:

a. To defatted ergot powder add 50% potassium hydroxide solution and heat at 170°C 1 hr, cool, wash thoroughly with alcohol and to it add first iodine solution and then 20% sulphuric acid, violet colour is produced.

b. Extract about gm of powdered ergot with 10 ml of solvent ether along with 0.5 ml of dilute sulphuric acid. Filter the extract and to the filtrate add 5 ml of cold saturated solution of sodium bicarbonate. The aqueous layer becomes red or violet.

c. In UV light, Ergot powder shows red fluorescence.

d. Extract ergot with chloroform and sodium carbonate and to extract add paradimethylaminobenzaldehye, 35% sulphuric acid and 0.5% ferric chloride solution. A blue colour is produced (Ergotoxin test).

21. Rhubarb:

a. By addition of ammonia, it acquires pink colour.
b. With 5% potassium hydroxide, blood red colouration is produced.
c. Under UV radiations *Rheum emodi* gives brown colouration.
d. Borntrager's test for anthraquinone is positive with rhubarb.

22. Balsam of Tolu:

a. When heated and pressed in between two glass slides and examined under microscope, it exhibits crystals of cinnamic acid.
b. To alcoholic solution of balsam of tolu, add solution of ferric chloride, green colour is produced.
c. Warm gently about 1 gm of the drug with 5 ml of potassium permanganate solution, odour of benzaldehyde is produced.

23. Isapgula:

a. **Swelling factor test (Swelling Index):** Put 1 gm of isapgula in the measuring cylinder (25 ml capacity) in 20 ml water with occasional shaking. The volume occupied by the seeds after 24 hours of swelling is measured. This is known as swelling factor or swelling index.

   Swelling factor for isapgula seeds is 10 to 14 ml.
b. To dry seeds of isapgula add one drop of test solution of Chinese-ink, mucilage shows transparent and spherically dilated fragments on black background.
c. Being mucilage chemically, isapgula gives pink colour with the solution of ruthenium red.
d. To dry seeds add a drop of Thionine test solution, wait for 10 minutes, wash with alcohol, mucilage turns violet-red.

24. Datura:

a. **Vitali-Morin Reaction:** The tropane alkaloids are treated with fuming nitric acid, followed by evaporation to dryness and addition of methanolic potassium hydroxide solution to an acetone solution of nitrated residue. Violet colouration takes place due to tropane derivatives.

b. On addition of silver nitrate solution of hyoscine hydrobromide, yellowish white precipitate is formed, which is insoluble in nitric acid but soluble in dilute ammonia.

25. Castor oil:

a. It mixes with half its volume of light petroleum ether (40–60°C) and partly soluble in its 2 volumes. Add to the oil an equal volume of alcohol, clear liquid is obtained. On cooling at 0°C and on storage for three hours, the liquid remains clear.

26. Cinchona:

a. Heat the powdered bark in a dry test tube with little glacial acetic acid. It yields purple vapours. If treated with dilute sulphuric acid, it gives blue fluorescence.
b. To the powdered drug, add bromine water and ammonia and heat. Emrald green colour due to formation of thalleoquin, is produced.

27. Ipecacaunha:

a. To about 2.5 gm powered drug, add 20 ml of hydrochloric acid and 5 ml of water. Shake it well and filter. To the filtrate, add 0.5 gm of potassium chlorate. The presence of yellow colour gradually changing to red, after standing, confirms the presence of emetine.
b. Ultra-violet radiation shows orange fluorescence with emetine.

28. Opium:

Meconic acid test: 1 gm of opium dissolved in 5 ml of water, heat it and filter. To the filtrate add ferric chloride solution. Deep reddish purple colour is produced, which shows presence of opium alkaloids in the form of salt of meconic acid.

29. Linseed:

a. Test for mucilage: T.S. of linseed treated with ruthenium red, the epidermis shows red stain.
b. **Guignard's Paper Test (Sodium Picrate Test):** Powder of linseed moistened with water placed in a conical flask. Sodium picrate paper (Guignard Paper) is suspended in the neck of the flask by using cork in it. Brick red colour is produced shows presence of linseed.

30. Kaolin:

a. Heat the kaolin on charcoal block with cobalt nitrate. It results in a blue mass due to alumina.
b. Fuse 1 gm of kaolin with 2 gm anhydrous sodium carbonate, warm with water and filter. Acidify the filtrate with hydrochloric acid, dilute and warm. Residue of silica is obtained, the solution after neutralizing gives reactions characteristic to aluminium.

31. Pectin:

a. 10% aqueous solution forms stiff gel on cooling.
b. To 5 ml of 1% solution, add 1 ml of 2% solution of potassium hydroxide and set aside at room temperature for 15 minutes. A transparent gel or semi-gel is formed. Acidify gel with dilute hydrochloric acid and shake well. A voluminous, colourless, gelatinous precipitate is formed which when boiled becomes white and flocculent.

32. Shark Liver Oil:

a. Dissolve 1 gm of shark liver oil in 1 ml of chloroform and treat with 0.5 ml of H_2SO_4. It acquires light violet colour changing to purple and finally to brown due to vitamin A.
b. Dissolve the drug in 10 ml of chloroform and treat with saturated solution of antimony trichloride in chloroform, shake well, a blue colour is developed due to vitamin A.

33. Liquorice:

When moistened with 80% sulphuric acid, liquorice develops a deep yellow colour due to change of flavone glycoside liquiritin to chalcone glycoside.

34. Clove:

If transverse section of clove is treated with strong potassium hydroxide solution, the needle-shaped crystals of potassium eugenate are observed.

35. Alkaloids:

a. **Mayer's test:** Alkaloids gives cream or pale yellow precipitate with Mayer's reagent (potassium mercuric iodide solution)

b. **Dragendorff's test:** Alkaloids gives brown or reddish brown coloured precipitate with Dragendorff's reagent (potassium bismuth iodide solution)
c. **Wagner's test:** Alkaloids give brown or reddish brown coloured precipitate with Wagner's reagent (iodine and potassium iodide solution)
d. **Hager's test:** Alkaloids with Hager's reagent give yellow precipitate (saturated solution of picric acid).

36. Tannins:

a. **Gold beater skin test:** A piece of gold beaters skin (membrane of intestine of ox) + 2% dilute HCl, with distilled water. Add tannin solution. Allow it to react for 5 minutes. Add 1% ferrous sulphate solution.

   Observation: Brown to black colour shows positive test for tannins.

b. **Phenazone test:** 5 ml of aqueous drug extract + 0.9 gm sodium acid phosphate ($NaHPO_4$), warm, cool, filter to get filtrate. Add 2% phenazone solution.

   Observation: Coloured precipitate is observed.

c. **Catechin test:** Take drug extract of tannin solution and boil a dip matchstick in it. Dry in air. Add a drop of concentrated solution of HCl.

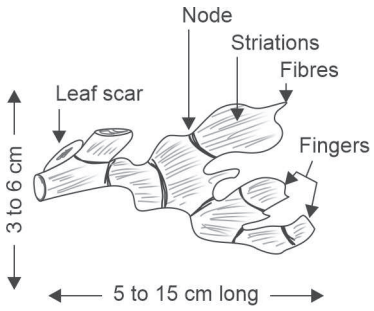
   Observation: Purple or violet colour is observed (condensed tannin)

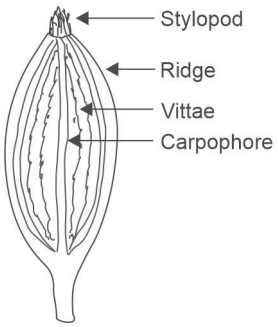
d. Tannin with aqueous $FeCl_3$ solution gives blue, black or green colour.
e. Tannins, when treated with 1% gelatin solution and 10% NaCl solution, a precipitate is observed.

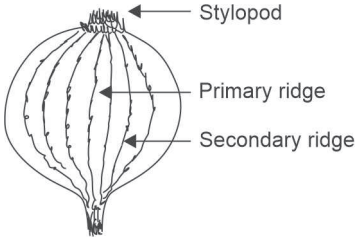
Appendix C

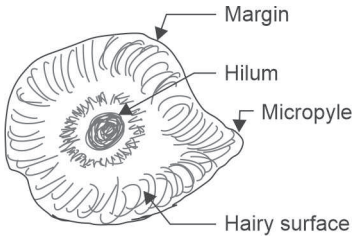
Morphological Characters of the Crude Drugs

Question: Give the morphological/external characters/macroscopy of the drugs along with diagram.

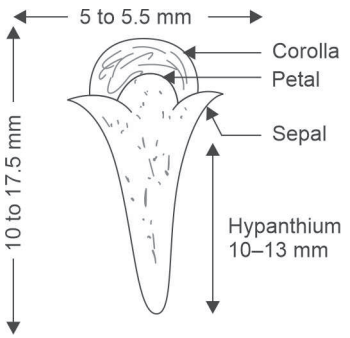
1. Ginger	**Morphological characters:**
	• Colour: Externally it is buff coloured. • Odour: Agreeable and aromatic • Taste: Agreeable and pungent • Size: 5 to 15 cm in length, 3 to 6 cm in width **Extra features:** • Rhizomes are laterally compressed bearing short flat, ovate and obligate branches on the upper side, with bud at the apex. • Striations are present on the surface. • Ends show finger-like projections. • Rhizomes have small fibres on the surface.

2. Fennel	**Morphological characters:**
	• Colour: Green to yellowish brown • Odour: Sweet aromatic • Taste: Strongly aromatic and mucilaginous • Size: 5 to 10 mm × 2 to 4 mm • Shape: Straight or slightly curved **Extra features:** • Bifid stylopod at the top • Five-sided fruit in the form of cremocarp with pedicels. • Fruits are glabrous with 5 primary ridges. • Shows 2 commissural vittae.

3. Coriander	**Morphological characters:**
	• Colour: Yellowish brown • Odour: Aromatic • Taste: Spicy and aromatic • Size: 2 to 4 mm in length **Extra features:** • Cremocarpus fruit with 10 primary and 8 secondary ridges. • Stylopod is present at the apex.

4. Nux vomica	**Morphological characters:**
	• Colour: Greenish brown • Odour: Odourless • Taste: Extremely bitter • Size: 10 to 30 mm in diameter and 4 to 6 mm in thickness • Shape: Disc-shaped, flat, concavo-convex and margin of the seed is rounded. **Extra features:** • Surface is silky, radially arranged densely covered with unicellular coverings of trichomes. • Seeds are extremely hard.

5. Clove



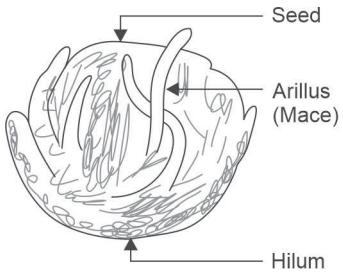
Morphological characters:

- Colour: Crimson to dark brown
- Odour: Slightly aromatic
- Taste: Pungent followed by numbness
- Size: 10 to 17.5 mm in length

Extra features:

- Dome-shaped corolla.
- Hypantheum surrounded by sepals.
- The corolla consists of unexpanded membranes of petals.

6. **Nutmeg**



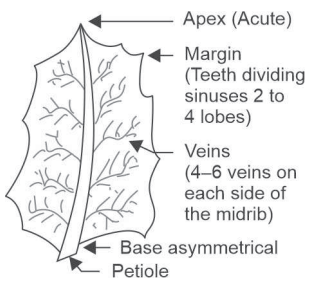
Morphological characters:

- Colour: Greenish brown or brown
- Odour: Strongly aromatic
- Taste: Pungent and aromatic
- Size: Kernels about 20 to 30 mm in length and 20 mm broad.

Extra features:

- Kernels are externally covered with small irregular patches or lines (wrinkled)

7. Datura Leaf



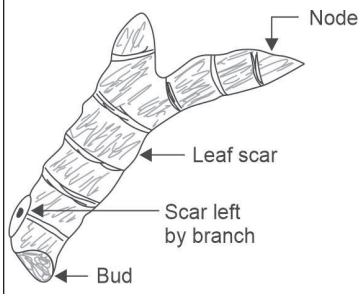
Morphological characters:

- Colour: Pale green
- Odour: Characteristic
- Taste: Bitter

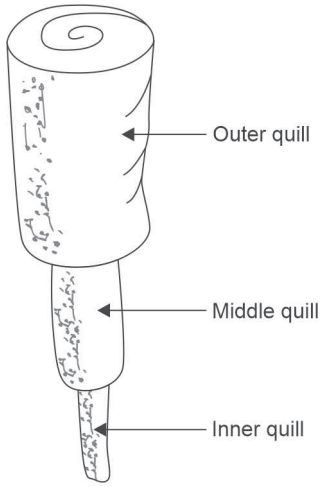
Extra features:

- Leaves are unequal at the base with acute apex
- Each leaf has 4 to 6 coarse veins on each side.
- Margin has teeth which divides the sinuses.
- Base is asymmetrical.
- Petiole is short.

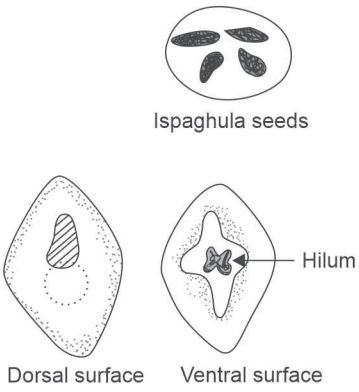
8. Turmeric	**Morphological characters:** • Colour: Yellow to yellowish brown • Odour: Characteristic • Taste: Slightly bitter • Size: 2 to 5 cm in length, 1 to 2 cm in thickness. • Shape: Round, ovate, oblong cylindrical and short. **Extra features:** • Root scars and annulations are present. • Nodes and bud are present. • Fracture is horny.



9. Cinnamon	**Morphological characters:**
	• Colour:
	  • Outer surface: Dull yellow brown
	  • Inner surface: Dark yellow brown
	• Odour: Aromatic
	• Taste: Sweet followed by worm sensation.
	• Size: 1 meter in length and 1 cm in diameter
	• Shape: Compound quill.
	Extra features:
	• Splintery fracture.
	• Bark is free of cork.



10. Ispaghula



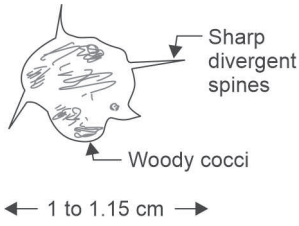
Morphological Characters:

- Colour: Pinkish green or brown
- Odour: Odourless
- Taste: Mucilaginous
- Size: 10 to 35 mm in length and 1 to 1.75 mm in width
- Shape: Ovate.

Extra features:

- Seeds are hard and smooth.
- Grey or reddish brown oval spot in the centre of convex surface
- Concave surface contains the hilum covered with thin membrane having two perforations.

11. Gokharu



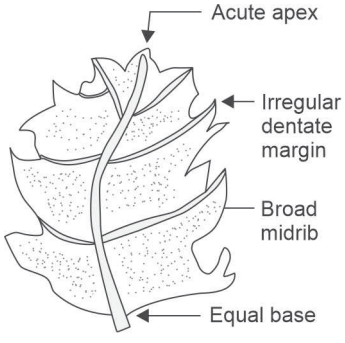
Morphological characters:

- Colour: Fruits are greenish or grey
- Odour: odourless
- Taste: Bitter
- Size: 1 to 1.5 cm in length
- Shape: Fruits are globose, oval, rounded.

Extra feature:

- Consist of 5 to 10 woody cocci each with two pairs of hard sharp divergent spines.

12. Hyoscymus leaf



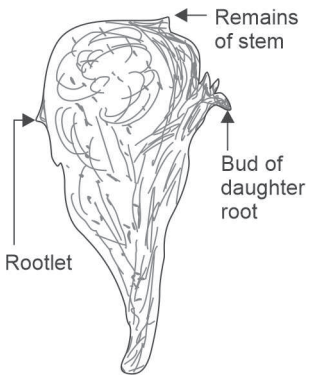
Morphological characters:

- Colour: Leaves are grayish green to pale green
- Odour: Odourless
- Taste: Bitter
- Size: 20 to 30 cm in length and 4 to 10 cm in width.

Extra features:

- Leaves are petiolate with acute apex.
- Base is asymmetrical.
- Leaf margin is irregular with dentate.
- Venation is reticulate with prominent midribs.

13. Aconite



Morphological characters:

- Colour: Dark brown
- Odour: Slight
- Taste: Slight, causing tingling sensation followed by numbness of tongue.
- Size: 4 to 10 cm in length and 1 to 3.5 cm in width
- Shape: Conical.

Extra features:

- Roots are slightly twisted and deeply wrinkled.
- Fracture is short and horny.
- The border end of root shows numerous rootlets and scars.

Appendix D

Summary Chart of Crude Drugs

Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
1	Aloe	Korphad, Musabbar	Leaves	*Aloe barb-adensis* Miller	Liliaceae	Aloin, Barbaloin, Aloe-emodin	Purga-tive, laxa-tive.
2	Rhubarb	Radix, Rheum, Rhizomerhei	Rhizomes	*Rheum emodi* Wall	Polygo-naceae	Rhein, Chryso-phanol, Physicon, Aloeemodin.	Purgative, laxative.
3	Castor oil	Oleum ricini, Ricinus oil	Seeds	*Ricinus communis*	Euphor-biaceae	Ricinoleic acid	Purgative, laxative.
4	Isapgula	Indian psyllium, Isabgol, Plantago, Sabja.	Seeds	*Plantago ovate* Forscal	Plantag-inaceace	Pentosan, Aldobionic acid	Purgative, laxative.
5	Senna	Sonamukhi, Tinnevelly senna, Indian senna.	Dried leaflets	*Cassia angusti-folia* Vahl	Legumi-noceae	Sennoside-A, B, C, D., Sennidin, Rhein, Kaemferol, Aloe-emodin	Purgative, laxative.

Contd...

Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
6	Digitalis	Foxglove leaves, Digitalis leaves	Leaves	*Digitalis purpurea*	Scrophul-ariaceae	Digoxin, Digitoxin, Digoxigenin, Digitoxigenin, Purpurea glycosides-A&B	Cardiotoinc
7	Arjuna	Arjuna bark	Bark	*Terminalia arjuna* Rob	Combretaceae	Arjunolic acid, Arjunic acid, Arjungenin, Arjunine, Arjunetine	Cardiotoinc
8	Cardamom	Cardamom fruits, Cardamom seeds, Elaichi.	Fruits	*Elettaria cardamom* Matonavar	Zingiberaceae	Cineole, Borneol, Terpinene	Aromatic, stimulant, carminative, flavouring agents, stomachic.
9	Black Pepper	Kali mirri, Kali mirch	Fruits	*Piper nigrum* Linn	Piparaceae	Piperine, Piperidine, Phellandrene, Caryophyllene.	Aromatic, stimulant, carminative, flavouring agents, stomachic.

Contd...

Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
10	Coriander	Dhania, coriandar fruits, dhane.	Fruits	*Coriandrum sativum* Linn	Umbelliferae	D-linalol (Coriandrol), L-borneol, Geraniol, Pinene.	Aromatic, stimulant, carminative, vlavouring agents, stomachic.
11	Fennel	Badishep, Saunf, Fructus foeniculum, Fennel fruits	Fruits	*Foeniculum vulgare* Miller	Umbelliferae	Fenchone, Anethole, Limonene, Phellandrine	Aromatic, stimulant, carminative, flavouring agents, stomachic.
12	Ginger	Zingiber, Ale, Adrak, Gingerin.	Fruits	*Zingiber officinale* Roscoe	Zingiberaceae	Gingerol, Zingiberene, Shagol, Zingerone	Aromatic, stimulant, carminative, flavouring agents, stomachic.
13	Asafoetida	Devils-Dung, Hing, Gum Asafoetida.	Rhizomes and roots	*Ferula foetida* Regel	Umbelliferae	Ferulic acid, Umbelliferone, Asaresino-tannol.	Carminative, nervine tonic, flavouring agent, intestinal antiseptic.
14	Cinnamon	Kalmi-Dalchini, Dalchini, Cinnamon bark, Ceylon cinnamon	Bark	*Cinnamomum zeylenicum* Nees	Lauraceae	Cinnamadle-hyde, Eugenol, Phellandrine, Pinene, Cymeme, Caryophyal-lene.	Aromatic, stimulant, carminative, flavouring agents, stomachic

Contd...

Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
15	Nutmeg	Jaiphal, Nux Moschata, Banda soap, Myristica.	seeds	*Myristica fragran*s Houtt	Myristicaceae	Myristicin, Elemicin, Saffrole, Geraniol, Terpineol, Camphene.	Aromatic, stimulant, carminative, flavouring agents, stomachic, soap industries
16	Clove	Laung, Clove bud, Caryophyllum, Clove flower.	Flower Bud	*Eugenia caryophyllus*	Myrtaceae	Eugenol, Caryophyllenes, Eugenin	Aromatic, stimulant, carminative, flavouring agents, stomachic, dental analgesics, antiseptic.
17	Ajowan	Bishop's Weed, Ova, Trychyspermum copticum, Carum copticum hieren	Dried ripe fruits	*Trychyspermum ammi* Sprague	Umbelliferae	P-cymene, Terpene, Pinene.	Antispasmodic, stimulant, carminative, antiseptic, insecticide, antifungal, anthelmintic.
18	Black Catechu	Kattha, Khair, Cutch, Khadir.	Dried aq. extract	*Acacia catechu* Wild	Leguminoceae	Quercetin, Acacatechin, Catechu red, Quercitrin, Catechin.	Astringent, used in cough and diarrohea, used in dying and tanning industries.

Contd...

Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
19	Pale Catechu	Gambier, Gambir	Dried aq. extract	*Uncaria gambier* Roxburg	Rubiaceae	Catechutannic acid, Catechin, Catechu red, Quercetin, Gambir-fluorecin.	Used in diarrhea, local astringent, used in dying and tanning industries
20	Hyoscymus	Henbane, Hyoscymus herb, Hyoscymus leaves.	Dried leaves and flowering tops.	*Hyosymus niger* Linn	Solanaceae	Hyoscyamine, Hyoscine (Scopolamine), Atropine.	Antispasmodic, anti-asthmatic, sedative, expectorant, to relieve spasms of urinary tract.
21	Datura	Thorn apple leaves, Datura herb	Dried leaves and flowering tops	*Datura metel*	Solanaceae	Hyoscine, Atropine	In asthma and cough, antispasmodic, CNS depressant.
22	Belladonna	Deadly night shade leaf, Belladona leaf	Leaves	*Atropa belladonna* Linn	Solanaceae	Hyoscyamine, Aesculetin (Scopolamine), Belladonine, Hyoscine, Atropine	Parasympathetic depressant, antispasmodic, as antidote.

Contd...

Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
23	Aconite	Monk shood, Bechnag, Visha, Aconite root.	Dried roots	*Aconitum napellus* Linn	Ranunculaceae	Aconitine, Hypoaconitine, Aconitic acid, Neopelline, Aconine, Neoline.	In rheumatism, inflammation also used as analgesic and cardiac depressant.
24	Ashwagandha	Indian Ginseng, Withania roots, Asgand.	Dried roots	*Withania somnifera*	Solanaceae	Withanine, Withanolide, Withaferine, Withasomnine, Anaferine, Cuscohygrine, Vasamine.	As a sedative and hypnotic, in the treatment of gout, rheumatism and hypertension.
25	Ephedra	Ma-Hung,	Dried young stems	*Ephedra gerardiana*	Ephedraceae	Ephedrine, Nor-ephedrine, Pseudoephe-drine	Antiasthamatic, in high fever and whooping cough.
26	Opium	Raw opium, Afim.	Dried latex from unripe capsule	*Papaver somniferum* Linn	Papaveraceae	Morphine, Papaverine, Narcotine, Codeine, Thebaine, Noscapine.	Narcotic analgesic, hypnotic, codeine as antitussive, opium is used as diaphoretic and in diarrhoea.

Contd...

Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
27	Cannabis	Indian Hemp, Marijuana, Ganja, Bhang.	Dried Flowering tops	*Cannabis sativa* Linn	Cannabinaceae	Cannabinol, Cannabidiol, Cannabigerol, Cannabidiolic acid, Cannbi-chromeme.	Used as narcotic, sedative and analgesic.
28	Nux vomica	Crow-fig, Semen strychni, Nux vomica seeds	Dried ripe Seeds	*Strychonus nux vomica* Linn	Loganiaceae	Strychnine, Brucine, Vomicine, Pseudo-strychnine.	As a bitter stomachic and tonic, CNS stimulant, stimulates respiratory and CVS systems.
29	Rauwolfia	Chhotachand, Sarpgandha, Snakeroot, Rauwolfia root	Roots	*Rauwolfia serpentine* Benth	Apocyanaceae	Reserpine, Serpentine, Rauwolfinine, Reserpinene, Resinnamine, Ajmaline, Ajmalicine.	Antihyper-tensive, tranqullizer, in snakebite.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
30	Vasaka	Adhatoda, Adulsa	Fresh leaves	*Adhatoda vasica* Nees	Acanthaceae	Vasicine, Vasicinone. Vasakin, Adhatodine, Betain.	Expectorant, bronchodilator, antitussive.
31	Tulsi	Sacred basil, Holy basil	Fresh and dried leaves	*Ocimum sanctum* Linn.	Labiateae	Eugenol, carvacrol, Caryophylline.	Antibacterial, insecticidal, stimulant.
32	Tolu balsam	Balsam of Tolu	Solid or semisolid balsam	*Myroxylon Balsamum* Linn.	Leguminaceae	Vanillin, Cinnamic acid, Benzoic acid, Cinnamein, Toluresino-tannol.	Expectorant, flavouring agent, antiseptic, in perfumery.
33	Guggul	Scented bdellium, Indian bdellium, Gum guggul.	Oleo-gum-resin from bark	*Commiphora weightii* Bhand.	Burseraceae	Gugguloster-one-Z, Guggu-losterol-I, E-guggulo-sterone, Myrecene, Caryophylline	Anti-Rheu-matic, antiinflam-matory, Hypoli-pedemic, hypocholes-teremic.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
34	Colchicum	Meadow saffron, Colchicum seeds	Seeds	*Colchicum luteum* Baker.	Liliaceae	Colchicine, Demecolicine, Colchicoresin.	In gout and rheumatism, to control malignant tumour
35	Chaulmoogra oil	Hydnocarpus oil, Gynocardia oil	Fixed oil from seeds	*Hydnocarpus anthelminitica* Piere	Flacourtiaceae	Choulmoogric acid, Hydno-carpic acid	Antileprotic, antitubercular drug.
36	Vinca	Periwinkle, Sadaphuli, Vinca rosea, Catharanthus	Whole plant	*Catheranthus roseus* G.	Apocyanaceae	Vinblastin, Vincristin, Vindoline, Vindolinine, Catharan-thine, Ajmalicine, Serpentine, Lochnerine.	Anticancer, in leukaemia, hodgkins disease, also exhibits hypotensive and antidiabetic activity
37	Gymnema	Gudmar, Madhu nashini.	Leaves	*Gymnema sylvestre* R.	Asclepiadaceae	Gymnemic acid, Phytin.	Antidiabetic, stomachic, stimulant, laxative, diuretic.
38	Pterocarpus	Malabarkino, Bijasal, Indian kino tree, Rakta-chandan, Asana	Dried juice	*Pterocarpus marsupium* Linn	Leguminaceae	Kino red, Kinnotanic acid, Kinoin, Pyrocatechin	Antidiabetic, astringent, in diarrhea and dysentery.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
39	Gokharu	Puncture vine	Fruits	*Tribulus terrestris* Linn	Zygophyllaceae	Harmine, Harman, Diosgenin, Gitogenin, Chlorogenin, Rusogenin, Kaemferol, Tribuloside.	Diuretic, as a tonic, in painful menstruation, as aphrodisiac and in gout.
40	Punarnava	Hog weed, Rakta Punarnava	Fresh as well as dried herb	*Boerhaavia diffussa* Linn	Nyctaginaceae	Punarnavine, Punarnavoside, Ursolic acid	Diuretic, expectorant, stomachic, in jaundice.
41	Ipecacaunha	Ipecac	Dried roots and rhizomes	*Cephaelis ipecacaunha* A.	Rubiaceae	Emetine, Cephaline, Ipecacauhin, Psychotrine, Emetamine, Ipecacaunhic acid.	Antidysentric, expectorant.
42	Turmeric	Indian Saffron, Haldi, Haridra.	Dried as well as fresh rhizomes	*Curcuma longa* Linn.	Zingiberaceae	Curcumin, Curcuminoids, Zingiberine, Camphene, Turmerone, Borneole.	Antiseptic, expectorant, as a condiment or spice, colouring agent.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
43	Benzoin	Sumatra Benzoin, Gum Benzoin, Loban.	Balsamic resin	*Styrax benzoin*	—	Benzoic acid, Cinnamic acid, Sumaresinolic acid, Coniferyl alcohol, Coniferyl benzoate.	Antiseptic and protective, expectorant, carminative, diuretic.
44	Myrrh	Gum Myrrh, Bol, Myrrha	Oleo-gumresin	*Commiohora molmol* Engler.	Burseraceae	Commiphoric acid, Herbomyrrholic acid, Terpenes, Eugenol.Cuminical-dehyde	Antiseptic, stimulant, protective, in mouthwashes and gargles.
45	Neem	Margosa, Nim, Limb, Meliazadirachta	Leaves and aerial parts	*Azadirachta indica* Linn.	Meliaceae	Margosine, Azadirachtin, Nimbin, Nimbidin, Nimbidinine, Nimbiol, Nimaton, Nimbosterol, Salanin.	Antiseptic, insecticidal, insect repellent, antifeedent, antimicrobial. seeds have spermicidal activity

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
46	Cinchona	Jesuits Bark, Peruvian Bark	Bark	*Cinchona calisaya* Wedd.	Rubiaceae	Quinine, Quinidine, Cinchonine, Cinchonidine, Quinovin, Cinchonicine, Cinchofulvic acid, Quinic acid.	Antimalarial, antipyretic, bitter Tonic, stomachic, cardiac depressant.
47	Ergot	Ergot of Rye, Ergota	Dried Scleroticum of fungus	*Claviceps pupurea* Tulasne.	Hypocreaceae	Ergometrine, Ergotamine, Ergocrystine, Ergocryptine, Ergotaminine, Ergosine, Ergosinine.	Oxytocic, in migraine, used in labour to assist delivery and to reduce postpartum haemorrhage.
48	Shark liver oil	Oleum Selachoid	Fixed oil from Shark fish	*Hypoprion brevirostris*	—	Vitamin A	In night blindness, antixeropthalmic factor, nutritive, in burns and sunburns.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
49	Amla	Indian Goose berry, Emblica, Embelic Myrobalan, Awala	Fruit	*Emblica officinales* Gaerth.	Euphorbiaceae	Vitamin C (ascorbic acid), Phyllemblin, Pectin.	In scurvy, diuretic, laxative, In diarrhea and dysentery, in jaundice, dyspepsia and anemia.
50	Diastase	Amylose, salivary diastase, malt diastase	Amyloytic enzyme	—	Graminae	Amyloytic enzymes	As a digestant.
51	Yeast	Baker's yeast	Fungus	*Saccharomyces cerevisiae*	Saccharo-mycetaceae	Vitamins like thiamine, riboflavin, nicotinic acid, pantothenic acid, folic acid, and biotin. Enzymes like invertase, diastase, zymase, and maltase.	In bread industry, in manufacture of alcohol, beer, and wines, as a source of vitamin D.
52	Papaya	—	Fruiting tree	*Carica papaya*	Cariaceae	Proteolytic enzymes like papain and chymopapain	Digestant, antiinflammatory, in clarification of beverages.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
53	Peppermint oil	Oleum Mentha Piperita	Vol-oil from fresh flowering tops	*Mentha piperita* Linn.	Labiateae	L-Menthol, Pulegone, Menthone, L-limonene, Cineole, Pinene, Camphene, Isopulegone.	Flavouring agent, carminative, aromatic, stimulant, counter irritant, antiseptic.
54	Sandalwood	Lignum Santali, chandan, Yellow Sandalwood.	Dried Heart wood	*Santalum album* Linn.	Santalaceae	Alpha and Beta Santalol, Santalal, Santene, Santenone, Santalone, Santalene, Teresantol.	As a perfume in cosmetics and incense sticks.
55	Lemon oil	Citrus oil	Vol.oil from fresh peels of ripe fruit	*Citrus limonis* (L)	Rutaceae	Lemonene, Citral, Citronellal.	Flavouring agent, perfume.
56	Lemon grass oil	East Indian Lemon Grass Oil, Gavati Chaha.	Vol.oil from leaves and aerial parts	*Cymbopogon flexuousus*	Graminae	Citral, Geraniol, Nerol.	Flavouring agent, perfume.
57	Orange oil	Sweet Orange Oil, Oleum Auranti	Vol.oil from fresh orange peels	*Citrus sinensis* (L)	Rutaceae	Limonene, Cetronellal, Citral, Decanal.	Flavouring agent, perfume.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
58	Acacia (Indian gum)	Gum Acacia, Gum Arabic, Babul, Indian Gum.	Dried gum from stem	*Acacia arabica* Wild.	Leguminaceae	Arabin, Arabic acid.	As a demulscent, suspending agent, emulsifying agent, binding agent.
59	Guar Gum	Guar Flour, Jaguar Gum	Powder of endosperm of seed	*Cyamopsis tetragonolobus* Linn.	Leguminaceae	Guaran	Bulk laxative, appetite supressant, and binding and disintegrating agent, in peptic ulcer.
60	Honey	Madhu, Mel, Madh, honey purified.	Sugar secretion from honey comb by the bees	*Apis mellifica*	Apidae	Invert Sugar	Demulscent, sweetening agent, good nutirent, antiseptic, in cough mixtures.
61	Starch	Amylum	Polysaccharide granules	Grains of Maize and Wheat, *Zea mays* Linn.	Graminae	Alpha and Beta Amylose, Amylopectin.	Nutritive, demulscent, protective, absorbent, in dusting powders, as a disintegrating agent.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
63	Tragacanth	Tragacantha, Gum Tragacanth	Dried Gum Exudate from stems	*Astragalus gummifer* Labill.	Leguminaceae	Bassorin, Tragacanthin, Tragacanthic acid.	Demulscent, emollient, in confectionary, as a thickening agent, sus-pend- ing agent, emulsifying agent, binding agent.
64	Agar	Japanese-Isinglass, Agar-Agar	Dried Gelatinous substance	*Gelidium amansii*	Rhodophyceae	Agarose, Agaropectin.	Bulk laxative, emulsifying agent, in pre-paration of jellies and confectionery items
65	Arachis oil	Groundnut oil, Peanut oil, Sweet oil	Fixed oil from seed kernels	*Arachis hypogeal* Linn.	Leguminaceae	Arachidic acid, Oleic acid, Linoleic acid, Stearic acid, Lignoseric acid, Palmitic acid.	As a solvent for intramuscular injections, in preparation of liniment and soaps, as a lubricant, as an edible oil.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
66	Olive oil	Oleum olivae	Fixed oil from ripe fruits	*Olea europea* Linn.	Oleaceae	Olein, Linolein, Palmitin.	Emollient and soothing agent, in eczema and psoriasis, as a nutritive, demulscent, mild laxative.
67	Lanolin	Adeps Lanae, Hydrous wool fat.	From wool of the sheeps	*Ovis aries* Linn.	Bovidae	Cholesterol, Isocholesterol.	As an ointment base, in creams and cosmetic preparations
68	Yellow Beeswax	Cera-flava, Beeswax	Purified wax from honey comb of the bees	*Apis mellifica*	Apidae	Myricin, Cerotic acid, Cerolein.	In preparation of ointment, plasters, polishes, candles, moulds, lipsticks.
69	Pectin	—	Carbohy-drate product from Citrus peels	*Citrus limonis*	Rutaceae	D-galactouronic acid, Galacto-uronic acid, Arabinose, Galactose.	As absorbent in diarrhoea, as a haemostatic, as emulsifying agent, thickening agent, in cosmetic preparations.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
70	Gelatin	—	Collagenous material	Animal tissues	—	Glutin (protien)	Dietary supplement, in preparation of ice-cream, in confectionery, in cosmetics.
71	Kaolin	China clay, porcelain clay	Powder	From native hydrated aluminium silicate	—	Kaolin	As an adsorbent, in dusting powders, as a clarifying agent, in cosmetics.
72	Liquorice	Glycyrrhiza, Jasthi-Madhu, Mulethi, Liquorice roots	Dried roots and stolons	*Glycyrrhiza glabra* Linn.	Leguminaceae	Glycyrrhizin, Glycyrrhizenic acid, Glycyrrhetinic acid, Liquiritin, Aspargine.	Demulscent. expectorant, flavouring agent, antispasmodic, in Addison's disease, in peptic ulcer, as anti-inflammatory.
73	Picrorrhiza	Indian Gentian, Kutki, Katki, Kadu.	Dried rhizomes	*Picrorrhiza kurroa*	Scrophulariaceae	Kutkin, Picroside-I, Picroside-II, Kutkoside.	Bitter tonic, febri-fuge, laxative, anti-bacterial, in jaundice

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
74	Linseed	Flax seeds, Linum, Jovas.	Fixed oil from dried ripe seeds	*Linum usitatissimum* Linn.	Linaceae	Linmarine, Linoleic acid, Squalene, Tocopherol,	Used in liniment and lotions, in scabies and skin disorders, as a nutritive and emollient, in paints and varnishes.
75	Shankhpushpi	Shankh Vel, Shankh Phuli,	Aerial parts	*Canscora decussta*	Gentionaceae	Oleo-resin, Tri-trepenes, Xanthones.	Nervine tonic, in epilepsy, nervous disability.
76	Garlic	Allium, Lahsun, Lasan	Bulbs	*Allium sativum* Linn.	Liliaceae	Allicin, Allilin,	Carminative, expectorant, aphrodiasic, anthelmintic, rubefacient, disinfectant, and reduce blood pressure, anti-bacterial, as a condiment.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
77	Dioscorea	Yam, Rheumatism root	Dried tubers	*Dioscorea deltoidea*	Dioscoreaceae	Diosogenin, Sapogenin.	In synthesis of corticosteroids, sex hormones, in contraceptives, in rheumatic arthritis.
79	Shatavari	Shatmuli	Dried roots and leaves	*Asparagus racemosus* Wild.	Liliaceae	Shataverin- I, II, III, IV. Sarspogenin	Galactogogue, tonic, diuretic, in rheumatism, in nervine disorders, for safe delivery,
80	Tobacco	Tambaku, Tamak, Tumbakhu	Dried leaves	*Nicotinia tabacum*	Solanaceae	Nicotine, Nornicotine, Anabasine	Insecticide, CNS stimulant.
81	Pyrethrum	Insect flowers, natural pyrethrum.	Dried flower heads	*Chrysanthemum cinerariefolium*	Compositeae	Pyrethin-I, II. Cinerin-I, II. Jasmolin-I, II. Chrysanthenic acid, Cinerolone, Jasmoline.	Contact insecticide, used in mosquito coils and insect repellents.

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Sr. No.	Crude drug	Synonyms	Part of plant	Biological source	Family	Chemical constituents	Uses
82	Cotton	Gossypol, cotton wool, absorbent cotton, surgical cotton.	Trichomes or hairs of the seeds	*Gossypium barbadense*	Malvaceae	Cellulose	Surgical dressing, as a filter media, as insulator.
83	Wool	—	Fibres from the fleece of sheep	*Ovis aries*	Bovidae	Keratin, Cystine.	Surgical dressing, ligature, suture, filter medium, in crepe bandages.
84	Silk	—	Fibres from the cocoons	*Bombyx mori*	Bombycidae	Fibroin	Surgical dressing, ligature, suture, manufacturing of sieves, in textile industries.
85	Jute	Gunny	Phloem fibres of stem bark	*Corchorus capsularis* Linn.	Tiliaceae	True cellulose, hemicellulose, Lignin.	In manufacture of tows, padding splints, filtering media, preparation of coarse bags.

Appendix E

Families of Crude Drugs

1.	Umbelliferae	:	Fennel, Coriander, Asafoetida, Ajowan
2.	Leguminaceae	:	Acacia, Catechu, Liquorice, Senna, Pterocarpus, Tragacanth, Arachis oil
3.	Solanaceae	:	Belladona, Ashwagandha, Datura Starch, Hyoscymus, Tobacco
4.	Liliaceae	:	Aloe, Garlic, Colchicum, Shatavari
5.	Zingiberaceae	:	Ginger, Cardamom, Turmeric
6.	Apocyanaceae	:	Rauwolfia, Vinca
7.	Schophulariacece	:	Digitalis, Picrorrhiza
8.	Rutaceae	:	Lemon, Orange, Pectin
9.	Rubiaceae	:	Cinchona , Ipecacaunha
10.	Labiate	:	Mentha, Tulsi
11.	Euphorbiaceae	:	Digitalis, Picrorrhiza
12.	Apidae	:	Honey, Beeswax
13.	Burseraceae	:	Guggul, Myrrh
14.	Graminae	:	Ergot, Lemon grass oil
15.	Polygonaceae	:	Rhubarb
16.	Zygophyllaceae	:	Gokharu
17.	Combrataceae	:	Arjuna
18.	Hypocraceae	:	Ergot
19.	Acanthaceae	:	Vasaka
20.	Ranunculaceae	:	Aconite
21.	Gentionaceae	:	Shankhpushpi
22.	Lauraceae	:	Cinnamon
23.	Malvaceae	:	Cotton

24.	Myristicaceae	:	Nutmeg
25.	Caricaceae	:	Papaya
26.	Styraceae	:	Benzoin
27.	Papaveraceae	:	Opium
28.	Plantaginaceae	:	Isapgula
29.	Piperaceae	:	Black Pepper
30.	Myritaceae	:	Clove
31.	Ephedriaceae	:	Ephedra
32.	Cannabinaceae	:	Cannabis/Hemp
33.	Loganiaceae	:	Nuxvomica
34.	Flacourtiaceae	:	Chaulmoogra oil
35.	Asclepidaceae	:	Gymnema
36.	Meliaceae	:	Neem
37.	Santalaceae	:	Sandalwood
38.	Rhodophyaceae	:	Agar
39.	Oleaceae	:	Olive oil
40.	Bovidae	:	Lanolin, Wool
41.	Dioscoreaceae	:	Dioscorea
42.	Linaceae	:	Linseed
43.	Compositeae	:	Pyrethrum
44.	Tiliaceae	:	Jute
45.	Bombycidae	:	Silk

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