Ministry of Health of the Russian Federation
Volgograd State Medical University

Department of Pharmaceutical and Toxicological Chemistry

GENERAL PHARMACEUTICAL CHEMISTRY

SUBJECT AND TASKS OF PHARMACEUTICAL CHEMISTRY

Lesson 1
IV term

Volgograd, 2022

Discipline

GENERAL PHARMACEUTICAL CHEMISTRY

LESSON №1 Subject and tasks of pharmaceutical chemistry	Subject and tasks of pharmaceutical chemistry. Terminology in pharmaceutical chemistry, nomenclature. Classification of medicines.

QUESTIONS FOR THE LESSON

1. What is Pharmaceutical Chemistry? What are the tasks of pharmaceutical chemistry?
2. What are the objects of pharmaceutical chemistry?
3. What are the types of drug classifications?
4. What is the pharmacological classification based on? Give examples.
5. What is the therapeutic classification based on? Give examples.
6. What is the anatomic therapeutic chemical (ATC) classification based on? Give examples.
7. How are drugs classified according to chemical classification?

BASIC CONCEPTS

Pharmaceutical chemistry is a science that studies the methods of preparation, structure, physical and chemical properties of medicinal substances, the relationship between their chemical structure, and effects on the body, quality control methods and changes that occur during storage.

Tasks of pharmaceutical chemistry:

1. Study of the chemical nature, composition and structure of medicinal substances.
2. Study of the relationship between the structure of the medicinal substance and its effect on the body.
3. Search and development of new medicinal substances.
4. Study of the physical and chemical properties of medicinal substances.
5. Development and study of drug quality control methods.
6. Determining the storage conditions for drugs.

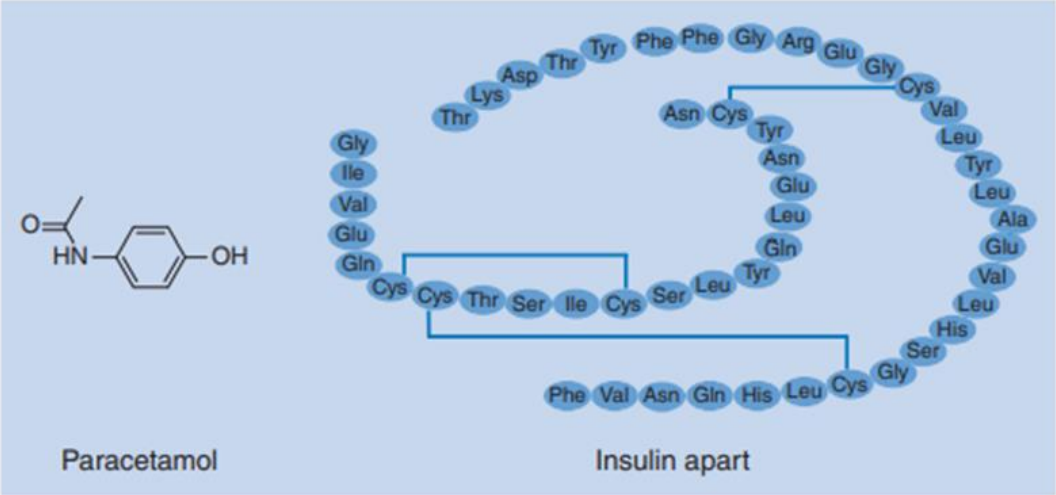
Pharmaceutical chemistry is divided into general pharmaceutical chemistry and special pharmaceutical chemistry. General Pharmaceutical Chemistry deals

with the main issues. Special pharmaceutical chemistry studies the synthesis and pharmaceutical analysis of individual drugs.

PHARMACEUTICAL CHEMISTRY OBJECTS

Medicinal substance (MS) is an individual substance of plant, animal, microbial or synthetic origin with pharmacological activity. It is also called *the active pharmaceutical ingredient* (API). Substances are intended for obtaining medicines.

A large number of APIs exists. For example, paracetamol (acetaminophen), which is used for pain, and insulin aspart, which is used in the treatment of diabetes. Paracetamol is a low molecular weight API (or small molecule drug) produced by organic synthesis and with a molecular weight of 151 Da.



Paracetamol (small molecule drug) and insulin aspart (biopharmaceutical)

Medicinal product (MP) - any substance or combination of substances used for the prevention, diagnosis and treatment of a disease, obtained from blood, blood plasma, as well as organs, tissues of a person or animal, plants, microorganisms, minerals by synthesis methods or using biological technologies.

Dosage form (DF) - the physical manifestation of a product that contains the active ingredient(s) and/or excipient(s) that are intended to be delivered to the patient.

Examples: Tablets, syrups.

Pharmaceutical preparation (MP) is a dosed medicinal product in a specific dosage form and ready for use.

Another definition of the term:

Pharmaceutical preparations (PM) are medicinal products generally consisting of active substances that may be combined with excipients, formulated into a dosage form suitable for the intended use, where necessary after reconstitution, presented in a suitable and appropriately labeled container.

Example: Paracetamol tablets as received from the pharmacy

Excipient - a relatively indifferent chemically and biologically substances, approved for medical use in obtaining a dosage form, issuance or a list of properties of a medicinal substance.

Adjuvants, stabilizers, antimicrobial preservatives, diluents, antioxidants, for example, are excipients.

Excipient is included in a medicine delivery system to:

- ✓ aid in the processing of the medicine delivery system during its manufacture;
- ✓ protect, support or enhance stability, bioavailability, or patient acceptability;
- ✓ assist in product identification; or
- ✓ enhance any other attribute of the overall safety and effectiveness of the medicine during storage or use.

Example: Hydroxypropyl methyl cellulose.

Poisonous drug - a drug with a very high biological activity, prescription, dispensing, storage and accounting of which is carried out according to special rules established by the Ministry of Health of Russia.

For example, atropine sulfate.

Potent drug is a drug with high biological activity, the prescription, dispensing, storage and accounting of which is carried out according to special rules established by the Ministry of Health of Russia.

For example, adrenaline.

Narcotic drug is a poisonous or potent drug that requires limited use and is classified as a narcotic drug by the law.

For example, morphine hydrochloride.

CLASSIFICATION OF DRUGS

Drugs can be classified according to various criteria. Usually, they are classified according to

a) chemical structure,
b) pharmacological action,
c) therapeutic use,
d) anatomic therapeutic chemical structure (ATC),
e) mechanism of action at the molecular level.

The chemical classification was used extensively some years ago. Chemical classification is based on the common chemical structures, drugs are classified into various classes. As chemical structures, functional groups, etc., are responsible for their chemical properties. Mostly, drugs having similar chemical structures show similar effects on the body. For example, sulphonamide drugs, barbiturates, etc.

Unfortunately, classifying drugs according to their chemical structural type has the disadvantage that members of the same structural group often exhibit very different types of pharmacological activity. Steroids, for example, may act as hormones (testosterone), diuretics (spironolactone).

Pharmacological classification takes into consideration the mode of action of drugs. According to this criterion, WHO divided the known drugs into the following classes:

- ✓ central nervous system depressants,
- ✓ central nervous system stimulants,
- ✓ peripheral nervous system drugs,
- ✓ smooth muscle active drugs,
- ✓ drugs acting at synaptic and neuroeffector junction sites,
- ✓ histamine and anihistamines,
- ✓ cardiovascular drugs,
- ✓ gastrointestinal tract drugs and others.

Each class is subdivided. For example, central nervous system depressants include the following groups:

a) general anesthetics,
b) hypnoticssedatives,
c) central voluntary muscle tone modifying drugs,

d) analgesics,
e) antivertigo drugs.

Classification following the third criterion, ***therapeutic use***, is very similar to the pharmacological classification and in many cases, identical with it. Thus, drugs are divided into the following classes:

- ✓ central nervous system depressants,
- ✓ central nervous system stimulants,
- ✓ psychotropic drugs,
- ✓ peripheral
- ✓ nervous system drugs,
- ✓ muscle relaxants,
- ✓ spasmolytics,
- ✓ vitamins,
- ✓ anti-infectives, and other therapeutic uses.

Each class is subdivided. Thus anti-infectives comprise

a) antiprotozoal drugs,
b) fungicides,
c) sulfonamides,
d) antituberculosis drugs,
e) urinary tract chemotherapeutics,
f) systemic antibiotics, etc.

Anatomic therapeutic chemical (ATC) classification is adopted in the Nordic countries (Denmark, Finland, Iceland, Sweden). This very useful system for clinicians, divides the drugs into 14 main "anatomic groups (first level), distinguished by letters:

A, alimentary tract and metabolism;
B, blood and blood-forming organs;
C, cardiovascular system;
D, dermatologicals;
G, genitourinary system and sex hormones;
H, systemic hormonal preparations, excluding sex hormones;
J, general anti-infectives, systemic;
L, antineoplastic and immunosuppressive drugs;
M, musculoskeletal system;
N, central nervous system;
P, antiparasitic products;
R, respiratory system;
S, sensory organs;
V, various.

Each main group is further divided into four subgroups: the second level "therapeutic main group", distinguished by two digits; the third level, "therapeutic

subgroup", distinguished by a letter; the fourth level, "chemical/therapeutic subgroups", distinguished by a letter; the fifth level, "chemical subgroup", distinguished by a two-digit number specific for each substance.

CHEMICAL CLASSIFICATION OF DRUGS

The inconvenience of pharmacological classification is that in groups of the same pharmacological orientation there may be substances of different chemical structures. For example, the group of cardiac stimulants includes alkaloids (caffeine, strychnine) and synthetic heterocycles (cordiamin), representatives of terpenes (camphor), cardiac glycosides with a steroid structure. Their pharmacological action is the same, but their structure and chemical properties are different.

Chemical classification allows you to very clearly distribute all the drugs into groups and classes of compounds in accordance with their chemical structure. But in the same group there may be drugs with different pharmacological effects.

For professionals working in the field of pharmaceutical chemistry, chemical classification is more acceptable. It is important for conducting research in the field of synthesis, obtaining drugs from plant and animal raw materials, establishing a relationship between their chemical structure and pharmacological action, and developing methods for pharmaceutical analysis based on various physical and chemical properties of drugs, due to the characteristics of the chemical structure.

All drugs in accordance with the chemical classification are divided into two large groups: ***inorganic*** and ***organic.***

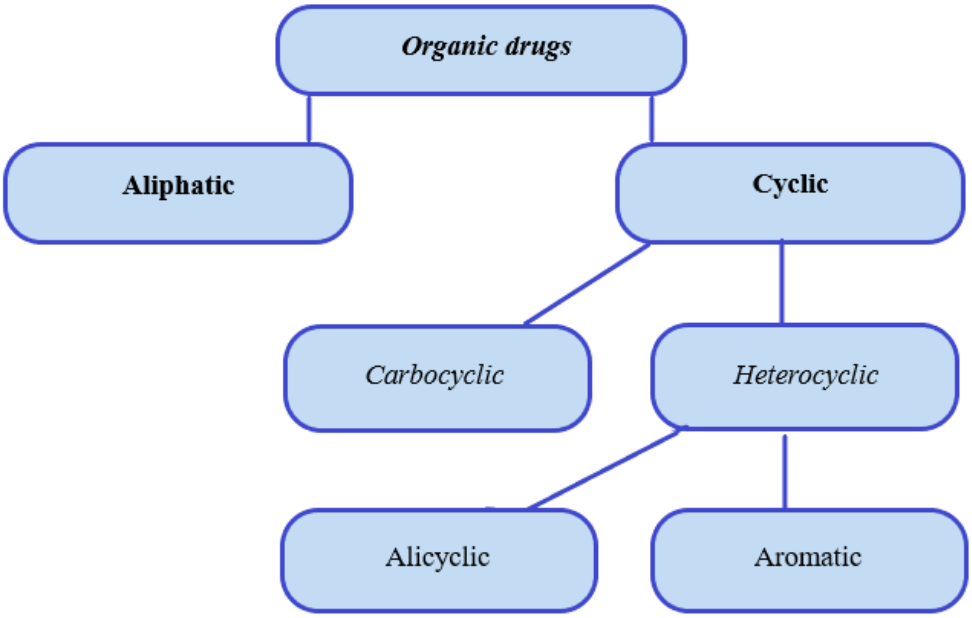
Inorganic drugs are divided into main classes:

- oxides
- acids
- hydroxides
- salts
- complex compounds.

Organic drugs are classified according to two criteria:

1. the structure of a carbon chain or cycle
2. the types of the functional groups

Classification based on the structure of the carbon chain or cycle



Heterocyclic compounds are classified according to the number of atoms forming the ring, the nature of the heteroatoms and their number, and also according to the number of heterocycles or the nature of the condensed system, including heterocycles and aromatic rings.

Classification according to the types of the functional groups

Organic medicines are divided into:

- halogen derivatives
- alcohols
- phenols
- esters
- aldehydes:
- ketones
- sulfonic acids
- carboxylic acids and their derivatives
- imines
- oximes
- hydrazones
- semicarbazones
- thiosemicarbazones.

Classification is important for planning, accounting and production of medicinal substances.