MINISTRY OF HEALTH OF UKRAINE
ZAPORIZHZHIA STATE MEDICAL UNIVERSITY
DEPARTMENT OF PHARMACEUTICAL, ORGANIC AND BIOORGANIC CHEMISTRY

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PHARMACEUTICAL CHEMISTRY

Section 2.3

Study and methodical Guide

for 3rd year English-speaking students of the specialty "Pharmacy, Industrial Pharmacy"

Zaporizhzhia
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P56

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P56 **Pharmaceutical Chemistry. Section 2.3**: Study and methodical Guide for 3rd year English-speaking students of the specialty "Pharmacy, Industrial Pharmacy" / L. I. Kucherenko, O. O. Portna, O. V. Khromylova [et al.]. – Zaporizhzhia : ZSMU, 2023. – 141 p.

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INTRODUCTION

Pharmaceutical chemistry is studied in accordance with the "Model curriculum for the training of specialists of the second (master's) level of higher education in the field of knowledge 22 "Health Protection" in higher educational institutions of the Ministry of Health of Ukraine in specialty 226 "Pharmacy"б educational qualification "Master of Pharmacy" as of 26.07.2016.

Most of the drawings were developed by the authors of this study guide.

According to the curriculum, pharmaceutical chemistry is taught in the III, IV and V courses. In the III course (V-VI semesters), the discipline program is structured into 2 meaningful blocks:

Block 1 - "Pharmaceutical analysis"

Block 2 - "Special pharmaceutical chemistry"

Block 2 consists of three sections.

SPECIFIC GOALS:

Learn the characteristics, classification, relationship between structure and pharmacological action, mechanism of action, methods of obtaining, methods of analysis, use in medicine of anti-tuberculosis, anti-diabetic, anti-ulcer, antiseptic and disinfectant drugs, as well as sorbents, antidotes and complexons, derivatives of 8-oxyquinoline, quinoxaline and nitrofuran. To explain the peculiarities of the identification of drugs according to the requirements of the State Pharmacopoeia of Ukraine (SPhU).

To interpret the results of studies on the maximum content of impurities in accordance with the requirements of the SPhU.

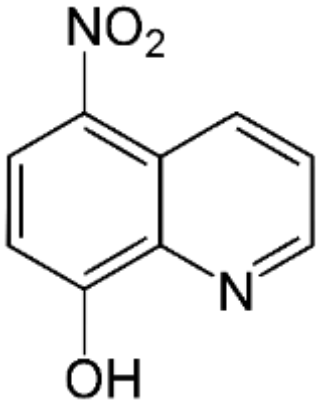
To propose and carry out a selection of physical, physico-chemical and chemical methods for determining the good quality of drugs in accordance with the requirements of the SPhU and other regulatory documentation, as well as Quality Control Methods (QCM).

PLAN OF PRACTICAL LECTURES

No.	TOPIC OF PRACTICAL LECTURES	Number of hours
1.	Derivatives of 8-oxyquinoline, quinoxaline and nitrofuran. Characteristics, classification, relationship between structure and pharmacological action. Mechanism of action, methods of extraction, methods of analysis. Application in medicine.	3
2.	Anti-tuberculosis drugs. Characteristics, classification, relationship between structure and pharmacological action. Mechanism of action, methods of extraction, methods of analysis. Application in medicine.	3
3.	Antiseptic and disinfectants. Characteristics, classification, relationship between structure and pharmacological action. Mechanism of action, methods of extraction, methods of analysis. Application in medicine.	3
4.	Antidiabetic drugs. Characteristics, classification, relationship between structure and pharmacological action. Mechanism of action, methods of extraction, methods of analysis. Application in medicine.	3
5.	Sorbents, antidotes and complexons. Anti-ulcer drugs. Characteristics, classification, relationship between structure and pharmacological action. Mechanism of action, methods of extraction, methods of analysis. Application in medicine.	3
6.	**Control lesson on the section**	3

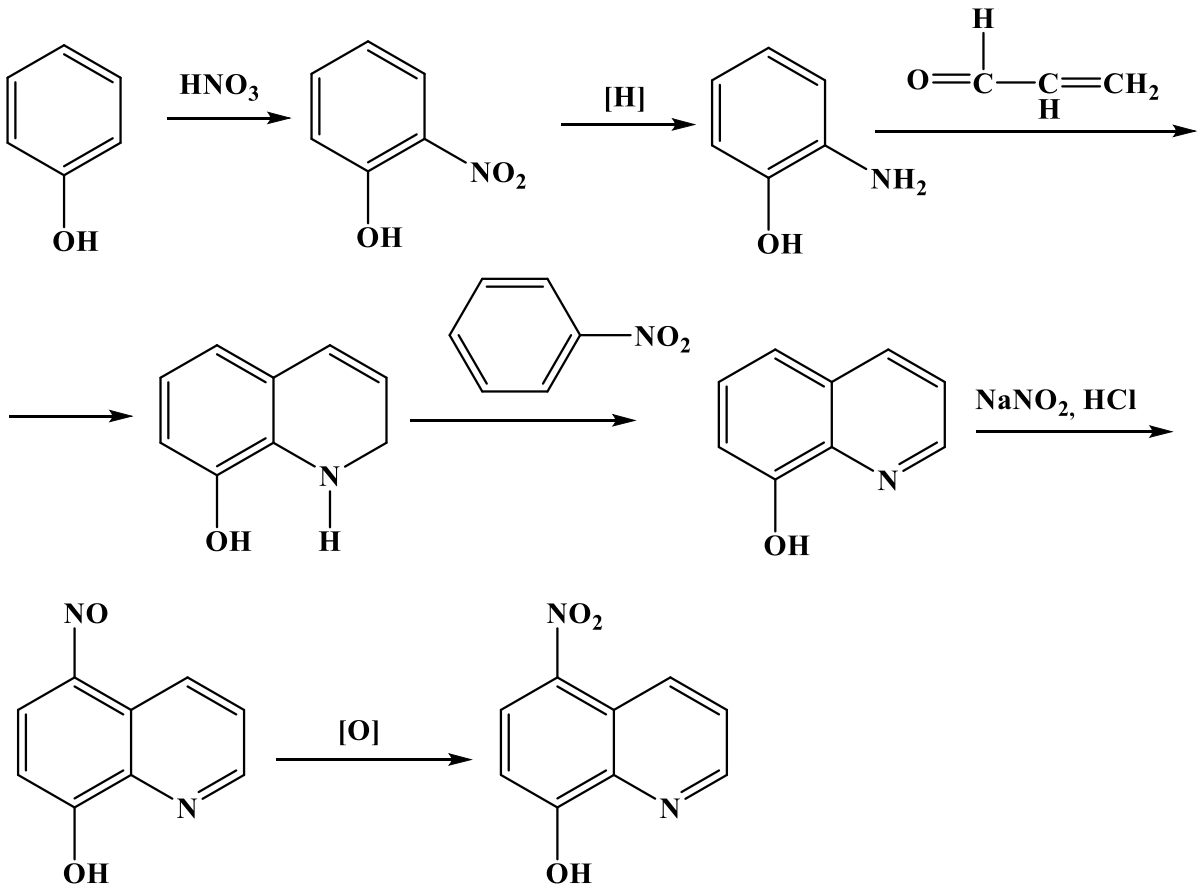
1. DERIVATIVES OF 8-OXYQUINOLINE, QUINOXALINE AND NITROFURAN

Nitroxolinum
Nitroxoline



5-Nitro-8-hydroxyquinoline

Extraction. As a starting product, phenol is used, from which o-nitrophenol, then o-aminophenol is successively obtained. The latter is condensed with acrolein according to Skraup method. The formed 8-hydroxydihydroquinoline is dehydrogenated to 8-hydroxyquinoline, which is nitrosated, and then the nitroso group is oxidized:

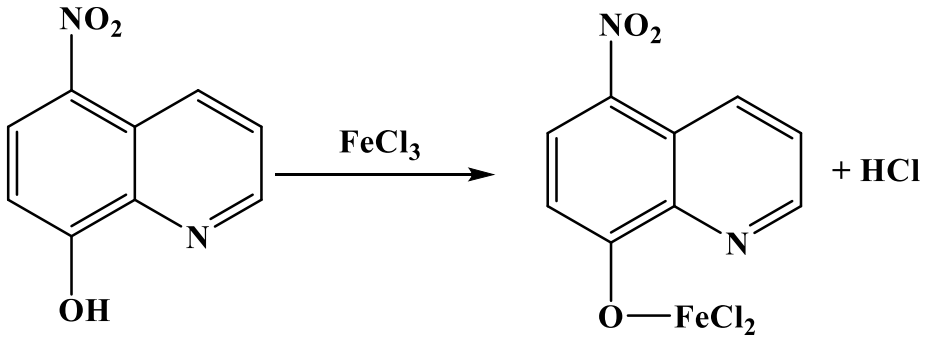


Properties. Fine-crystalline powder of yellow or grayish-yellow color, slightly greenish tint is allowed. Practically insoluble in water.

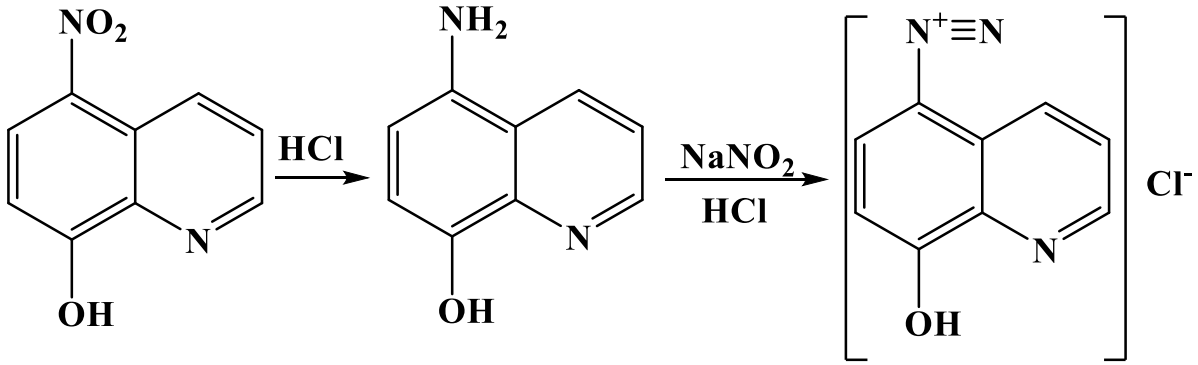
Identification:

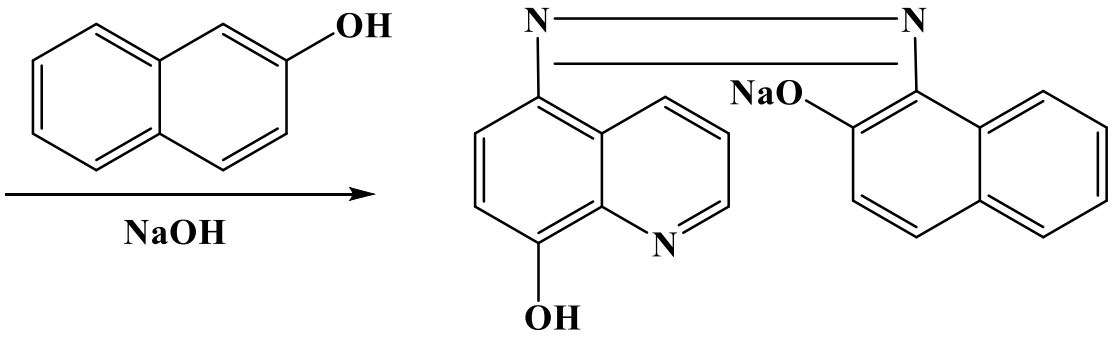
1. UV spectroscopy.

2. With a solution of ferrum (III) chloride, a black-green color is formed.

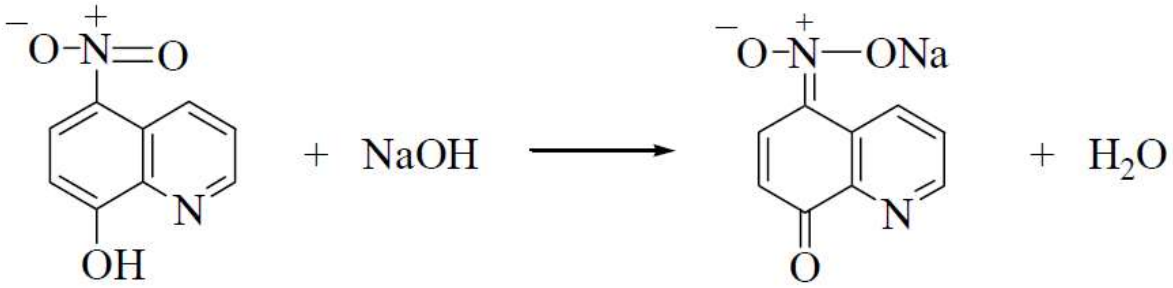


3. The nitro group is reduced to the amino group and diazotization and azo coupling reactions are carried out - an orange-red azo dye is formed:





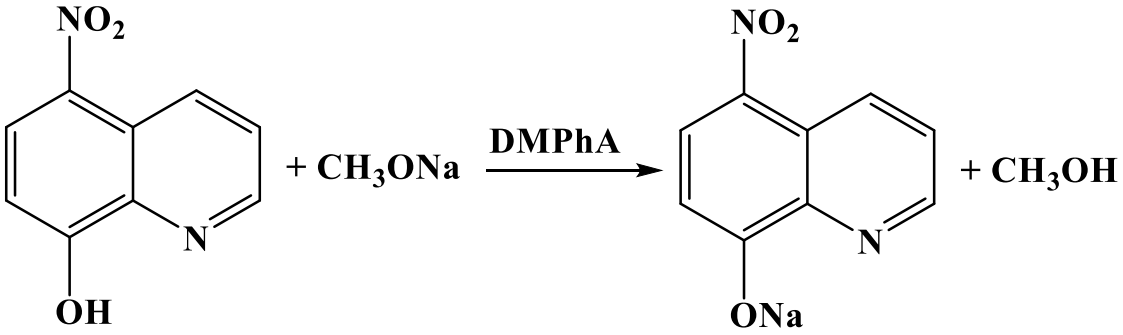
4. Nitroxoline forms a red-orange color with sodium hydroxide solution:



Purity test. 5,7-Dinitro-8-oxyquinoline and 5-nitroso-8-oxyquinoline are determined chromatographically.

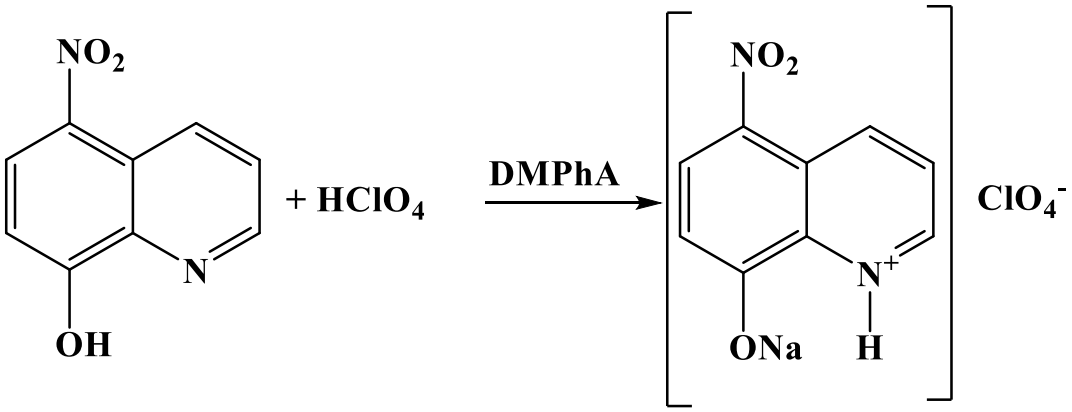
Quantitative definition.

1. Alkalimetry in a non-aqueous medium, direct titration. The weight of the substance is dissolved in dimethylformamide and titrated with sodium methylate solution from yellow to blue-green color, the indicator is a solution of thymol blue in dimethylformamide:

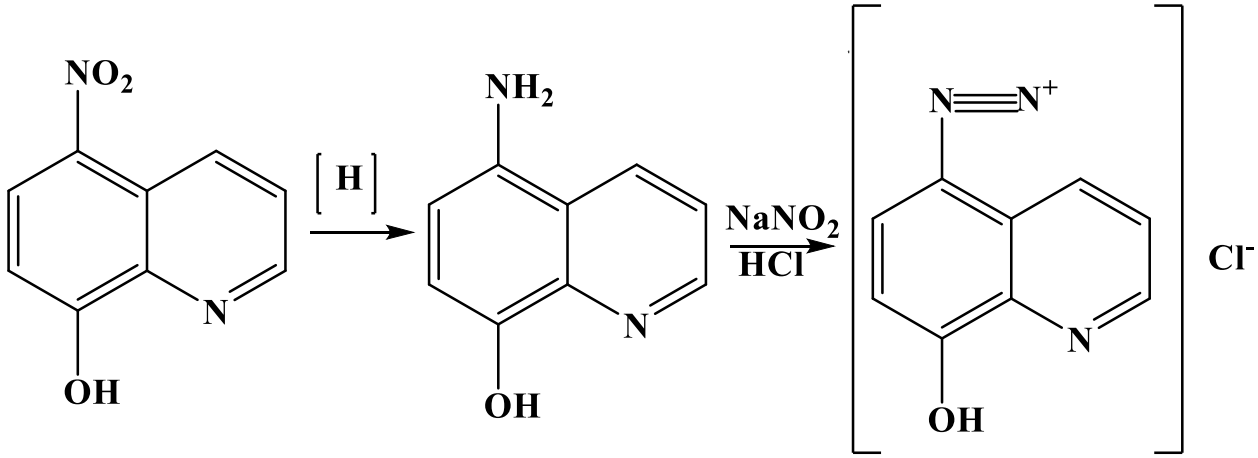


In parallel, a control experiment is conducted.

2. Acidimetry in a non-aqueous environment, direct titration. The weight of the substance is dissolved in formic acid and titrated with a solution of perchloric (chlorine) acid until it turns yellow, the indicator is malachite green:



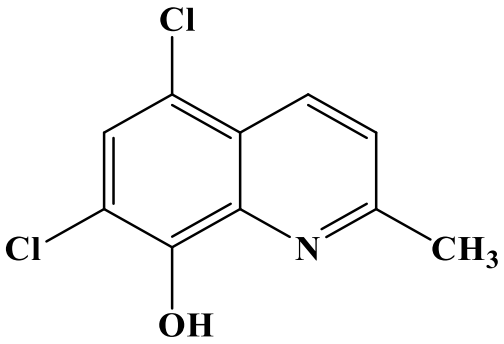
3. Nitritometry after the reduction of the nitro group to the amino group.



Storage. In a dry place protected from light.

Application. Antibacterial agent for infections of the urogenital tract (pyelonephritis, cystitis, etc.) in the form of a dragee of 0.05 g.

Chlorquinaldol

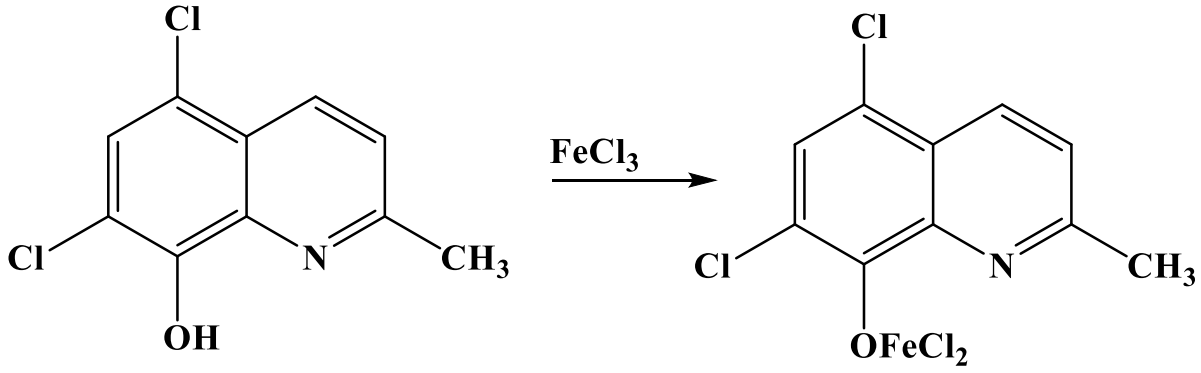


5,7-dichloro-2-methyl-8-hydroxyquinoline

Properties. Cream or orange-cream fine crystalline powder with a specific smell. Melting point – 108 – 114 °C. Practically insoluble in water, slightly soluble in ethanol, moderately soluble in acetone.

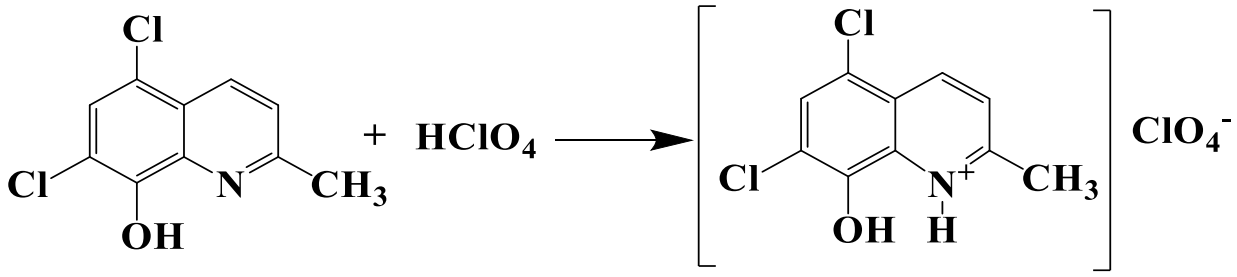
Identification:

1. UV spectroscopy.
2. With a solution of ferrum (III) chloride, a black-green color is formed.



Quantitative definition.

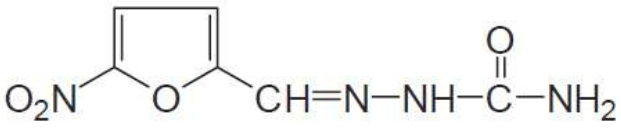
Acidimetry in a non-aqueous medium, direct titration. The weight of the substance is dissolved in acetic anhydride and titrated with a solution of perchloric (chloric) acid, the indicator is crystal violet, s = 1:



Storage. In a dry place protected from light.

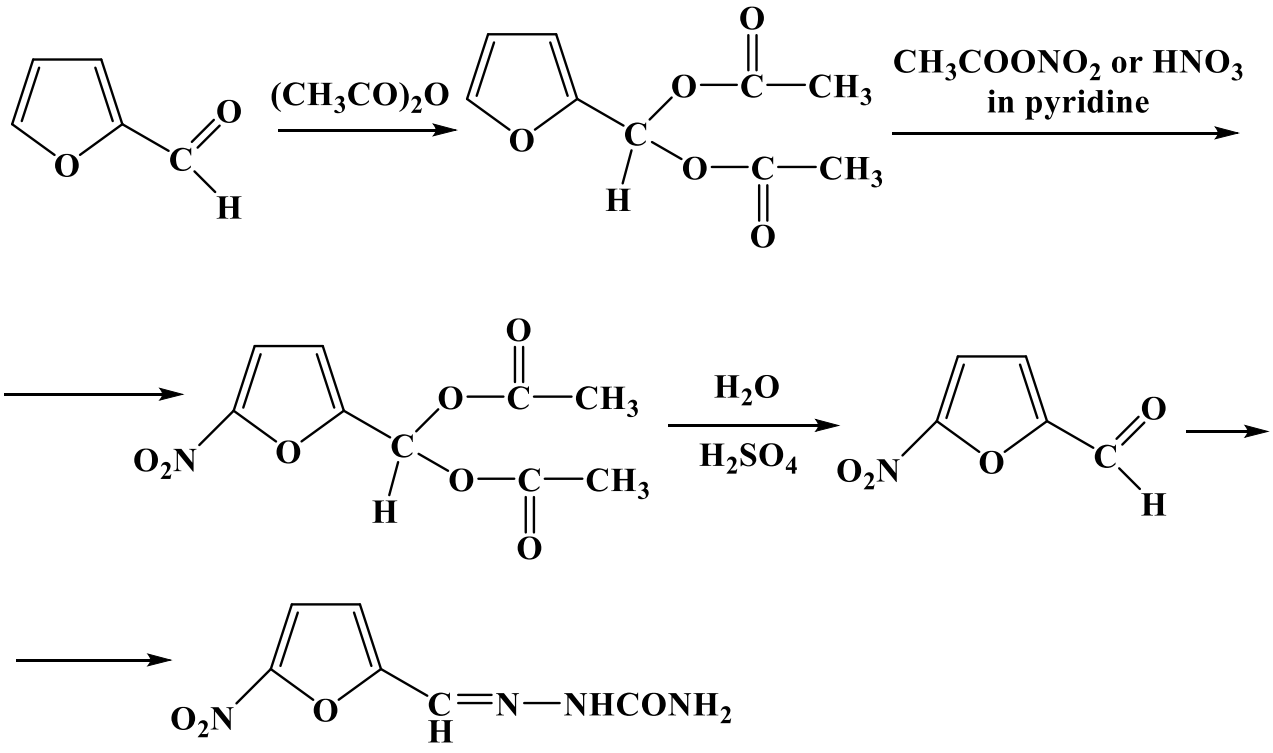
Application. Antibacterial, antifungal and antiprotozoal agent for intestinal infections in the form of 0.1 g tablets.

Nitrofuralum
Furacilinum



5-Nitro-2-furaldehyde semicarbazone

Extraction. The starting material for the synthesis of furacilin and other drugs of the 5-nitrofurfural group is furfural, which is obtained as a result of the hydrolysis of waste wood, straw, sunflower husks and other pentosan-containing raw materials. Synthesis is carried out in several stages:



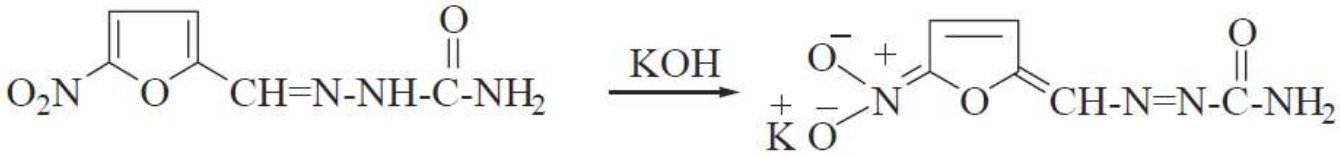
Furan derivatives are acidophobic substances, therefore, not nitric acid is used for nitration of furfural, but acetyl nitrate or a mixture of nitric acid and pyridine.

Properties. Yellow or brownish yellow crystalline powder. Very slightly soluble in water (1:4200), solubility increases in the presence of sodium chloride, slightly soluble in 96% alcohol, practically insoluble in ether, soluble in alkali solutions.

Identification:

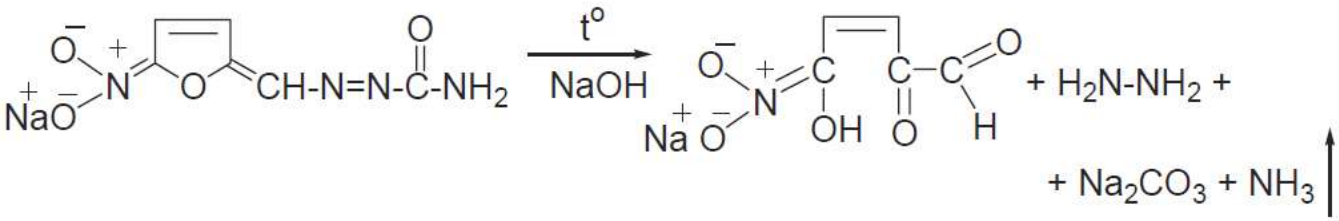
1. Physico-chemical methods: UV and IR spectroscopy, thin-layer chromatography.

2. When the substance is dissolved in dimethylformamide and the subsequent addition of an alcoholic potassium hydroxide solution, a purple-red color appears:



3. When dissolving a portion of the substance in a mixture of equal volumes of water and a solution of alkali metal hydroxides, an orange-red color appears, which can be explained by the formation of an acinitroform salt (see reaction 2).

Heating the resulting alkaline solution of nitrofural leads to the release of ammonia, which is detected by the smell or by the bluing of wet red litmus paper:



Furadonin and furazolidone also form colored products in an alkaline environment, so this reaction is group for them.

4. The literature also describes other reactions for the identification of 5-nitrofuran derivatives, which are accompanied by the formation of colored products. Nitrofural in these reactions forms the following colors:

Reagent	Observation
95% ethanol, 10% solution of $CuSO_4$ 10% solution of NaOH	Dark red color and precipitate
Perhydrol, 30% solution of NaOH	Pale yellow color
95% ethanol, 5% solution of sodium	Red color and precipitate

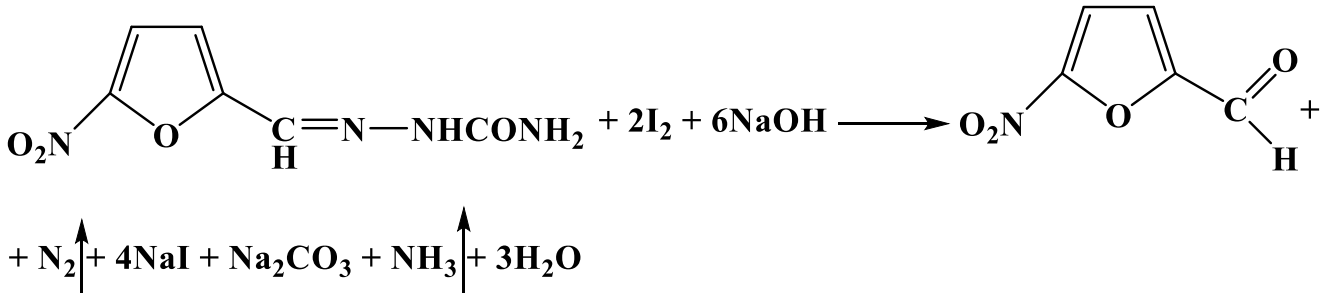
nitroprusside	
Alkaline solution of potassium tetraiodomercurate (Nessler reagent)	Reddish-brown color

5. When heated in an acidic environment with zinc dust, nitrofural slowly dissolves; the solution is decolored due to the reduction of the nitro group to the amino group and the formation of 5-aminofurfural semicarbazone.

Quantitative definition.

1. Spectrophotometry (standard method at λ = 375 nm) (SPhU).

2. Iodometry in an alkaline environment, reverse titration, the indicator is starch. The weight of the drug substance is dissolved in the presence of sodium chloride in water in a measuring flask when heated on a water heater. An excess of a titrated iodine solution and an alkali solution are added to a certain amount of the solution. An oxidation-reduction reaction takes place, which in general can be represented by a scheme:



In an alkaline medium, iodine is in the form of iodide and hypoiodide:

$$I_2 + 2NaOH \longrightarrow NaI + NaOI + H_2O$$

After acidification, the released iodine is titrated with a sodium thiosulfate solution from a microburette:

$$NaI + NaIO + H_2SO_4 \longrightarrow I_2 + Na_2SO_4 + H_2O$$

$$I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$$

In parallel, a control experiment is conducted.

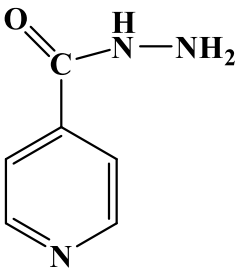
3. Photocolorimetry, which consists in determining the optical density of a colored alkaline solution of nitrofural.

Storage. In well-stoppered glasses of dark glass, in a cool place protected from light.

Application. An antibacterial agent that acts on a variety of gram-positive and gram-negative microorganisms. Externally for the treatment and prevention of purulent-inflammatory processes and internally for the treatment of bacterial dysentery.

1. ANTITUBERCULOSIS DRUGS

Isoniazid

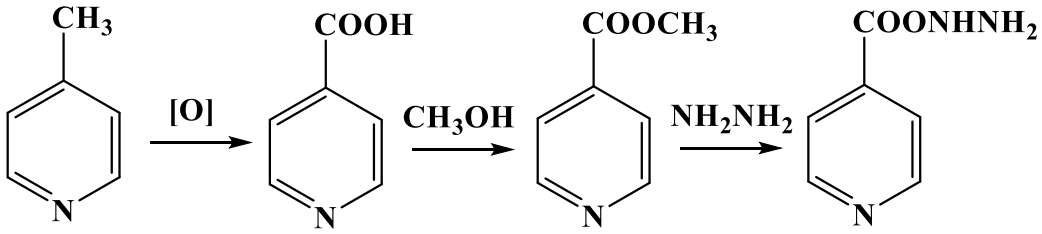


Pyridine-4-carbohydrazide

$C_6H_7N_3O$ M.m. 137,14

Contains at least 99.0% $C_6H_7N_3O$ in terms of dry matter.

Extraction. It is carried out according to the scheme:

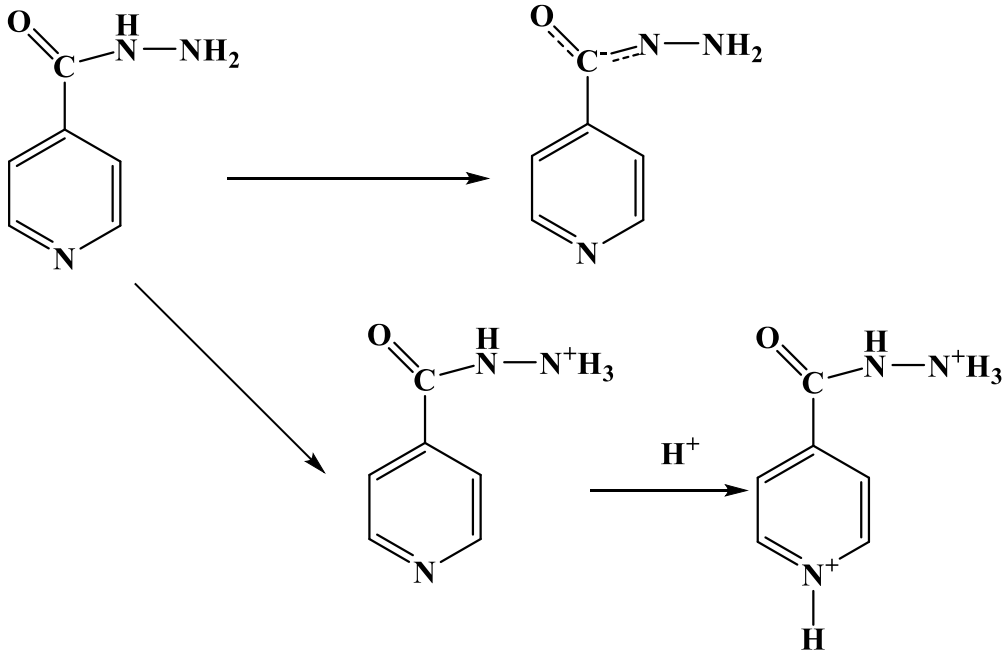


Description. White or almost white crystalline powder or colorless crystals.

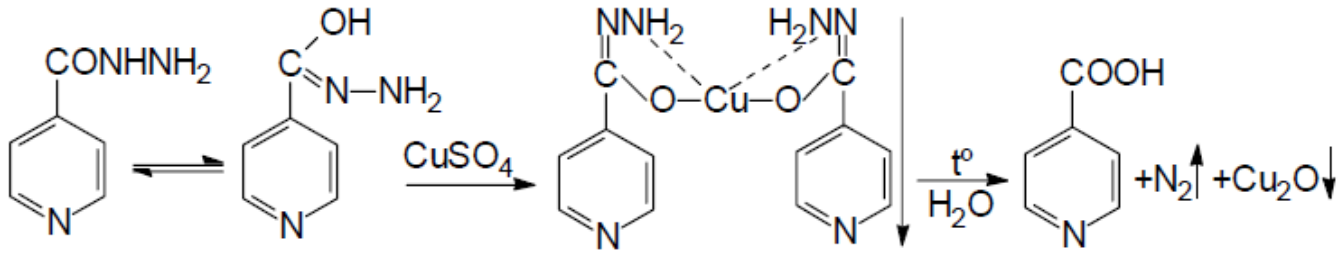
Solubility. Easily soluble in water, moderately soluble in 96% alcohol, very slightly soluble in chloroform.

Identification of isoniazid.

1. ***Isoniazid*** - is an ampholyte; the main center is a nitrogen atom with an lone pair of electrons in the pyridine ring and the amino group of the hydrazide fragment, and the acidic one is the urea group of the hydrazide fragment of isonicotinic acid hydrazide.

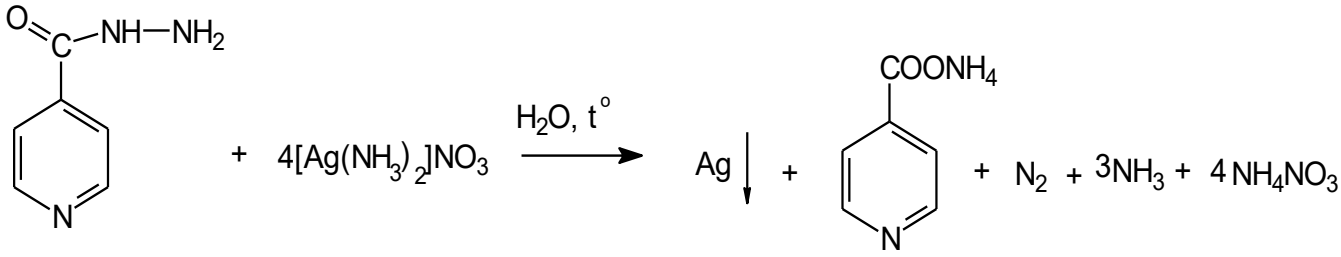


2. As a base, isoniazid enters into precipitation reactions with general alkaloid reagents, as well as salts of heavy metals. With copper sulfate, a blue precipitate is formed and a blue solution above it:



After further heating, the solution acquires a green color, gas is released:

3. When isoniazid interacts with an ammonia solution of silver nitrate, a yellow precipitate is released, and when heated, silver is deposited on the walls of the flask ("silver mirror" reaction):



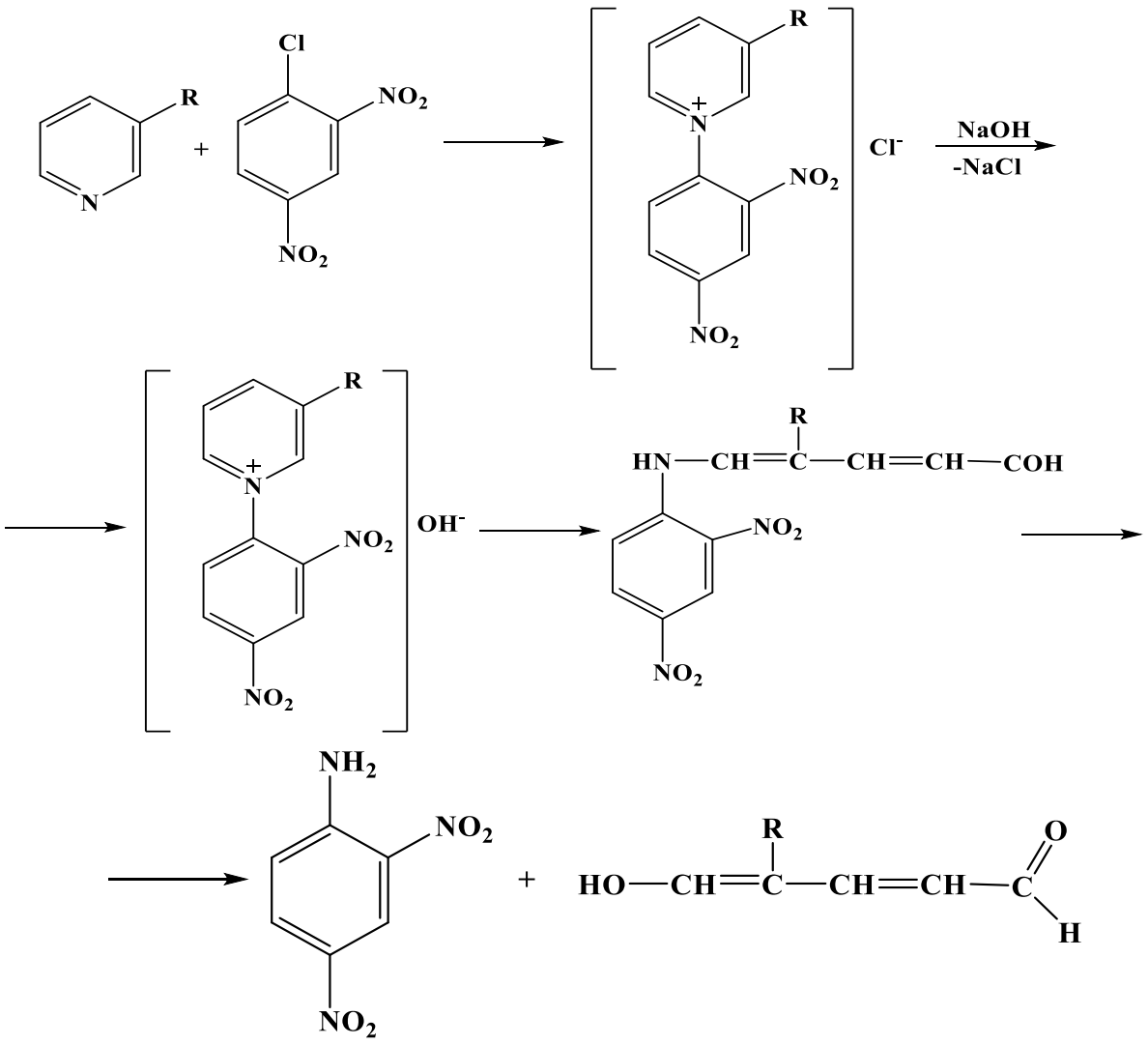
4. The substance gives reactions to the pyridine cycle:

a) Pyrolysis.

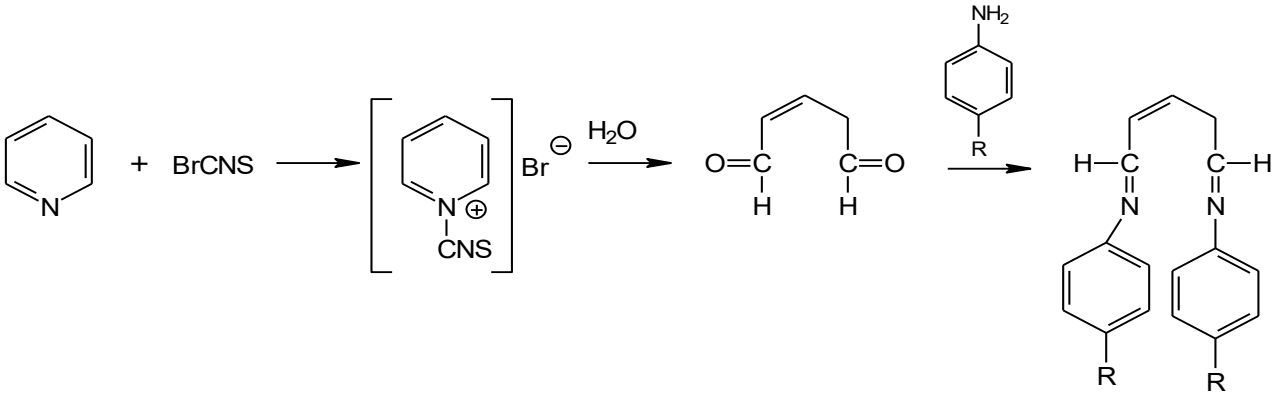
Heating the substance of a medicinal substance from the pyridine group with crystalline sodium bicarbonate in a crucible leads to the formation of free pyridine (a characteristic smell appears).

b) Zincke reaction.

When drugs containing a pyridine cycle (with free α, α'-positions) are boiled with 2,4-dinitrochlorobenzene in the presence of an alcoholic alkali solution, the pyridine cycle is opened, resulting in a yellow color, which turns purple, and then red-brown when adding an alkali solution:



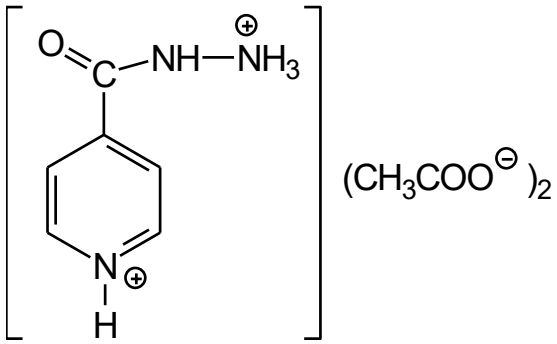
c) Opening of the pyridine ring also occurs when interacting with cyanobromide (rhodanbromide reagent). The reaction mixture is neutralized with sodium hydroxide solution. The glutaconaldehyde derivative condenses with primary aromatic amines to form Schiff bases, colored yellow, orange, or red:



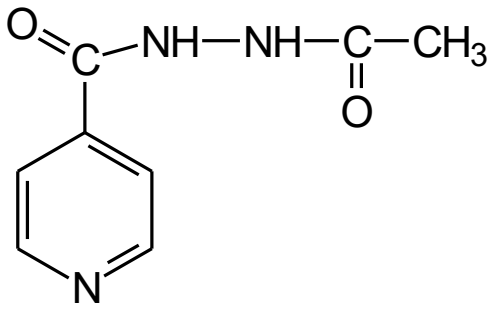
Quantitative definition:

1. Non-aqueous titration method

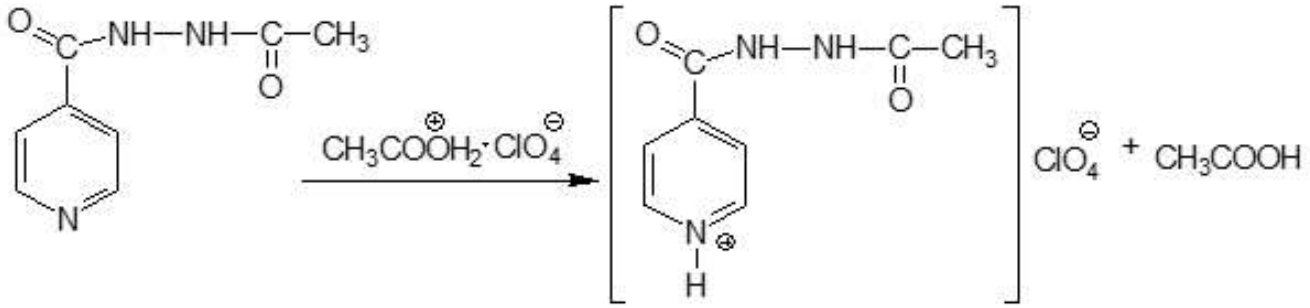
The titration is carried out in the medium of anhydrous acetic acid with the addition of a sufficient amount of acetic anhydride, while diacetate is formed at two main centers:



Part of gdrazid is acetylated, therefore, only 1 mol of perchloric acid interacts with the drug. As a result of titration, the following is formed:

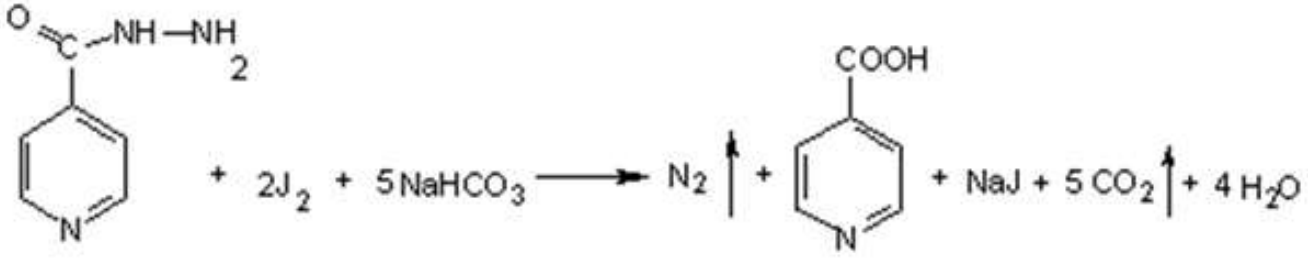


That is, they are titrated only with a heteroatom:



2. Iodometry, reverse method

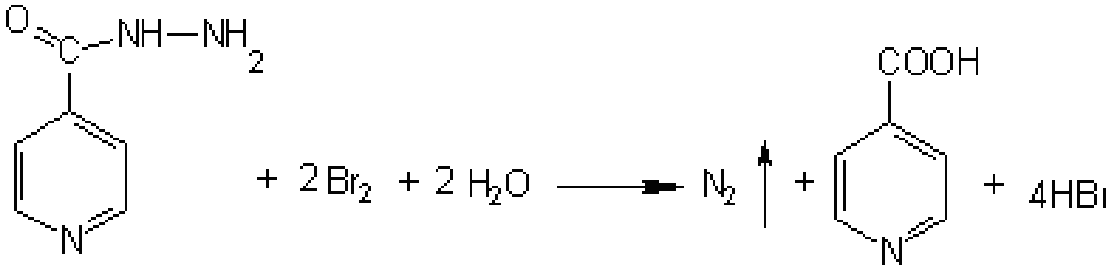
The method is carried out in the presence of sodium bicarbonate, which is necessary to neutralize the hydroiodic acid formed.



$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

3. Bromatometry, reverse method:

$$KBrO_3 + 5KBr + 6HCl \rightarrow 3Br_2 + 3H_2O + 6KCl$$



$$Br_2 + 2KI \rightarrow I_2 + 2KBr$$

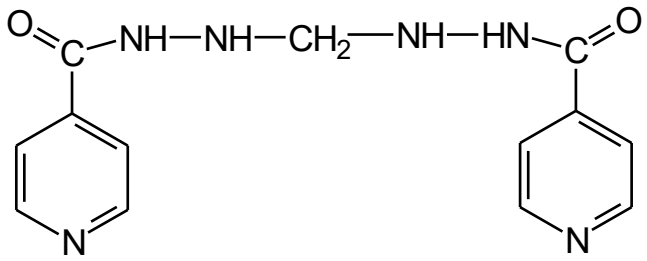
The released iodine is titrated with sodium thiosulfate solution.

$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

Storage. In a place protected from light at a temperature not higher than 25 °C.

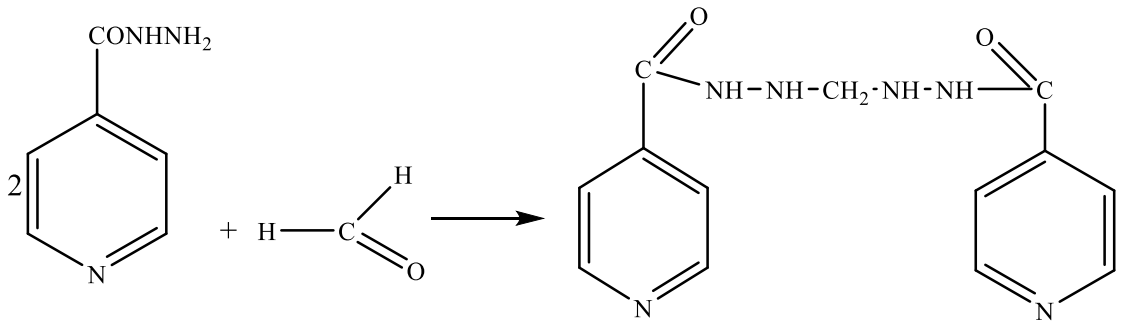
Application. Antituberculosis agent.

Metazide



1,1`- Methylene-bis-(isonicotinoylhydrazone

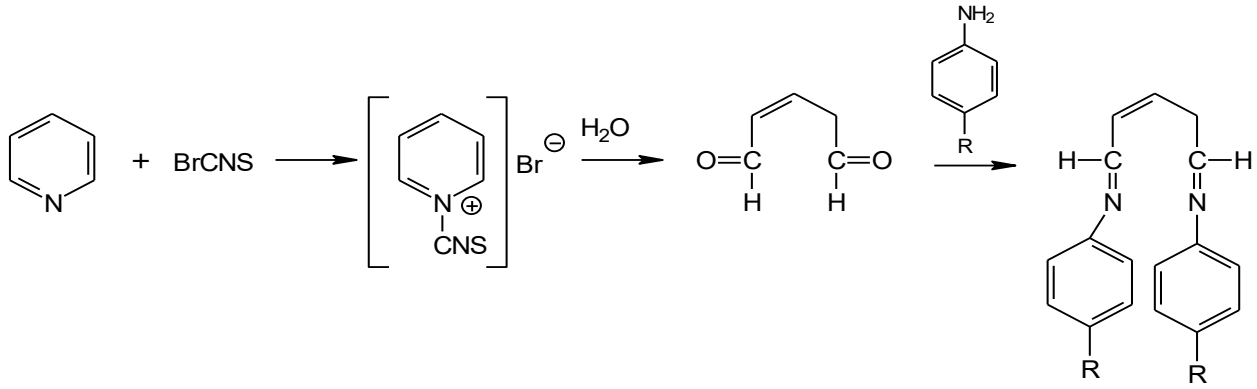
***Metazide*:** differs in properties from isoniazid - it is not soluble in water, because it is a product of condensation of isoniazid with formaldehyde (1,1'-methylene-bis-isonicotinoylhydrazone).



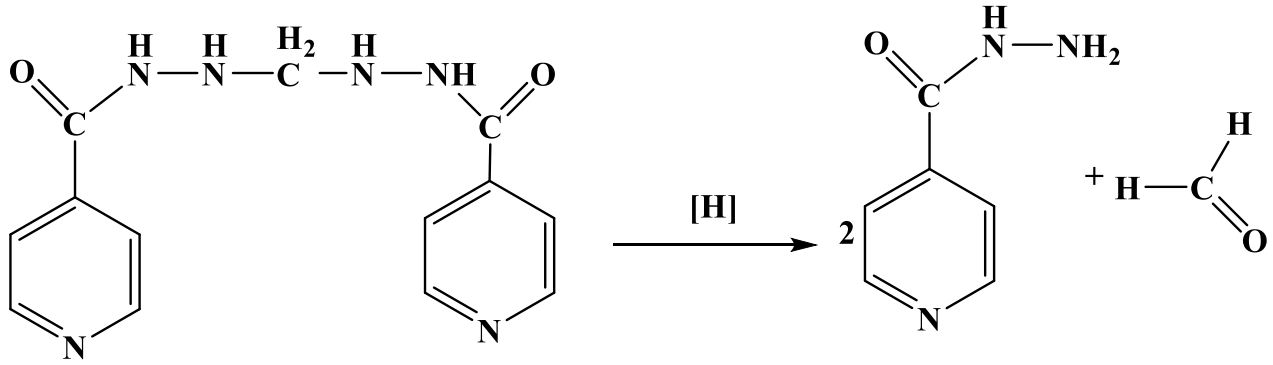
Identification method:

1. UV spectra, IR spectra;

2. Zincke reaction (similar to isoniazid); as a result of the reaction, a product colored in a red-brown precipitate is formed.

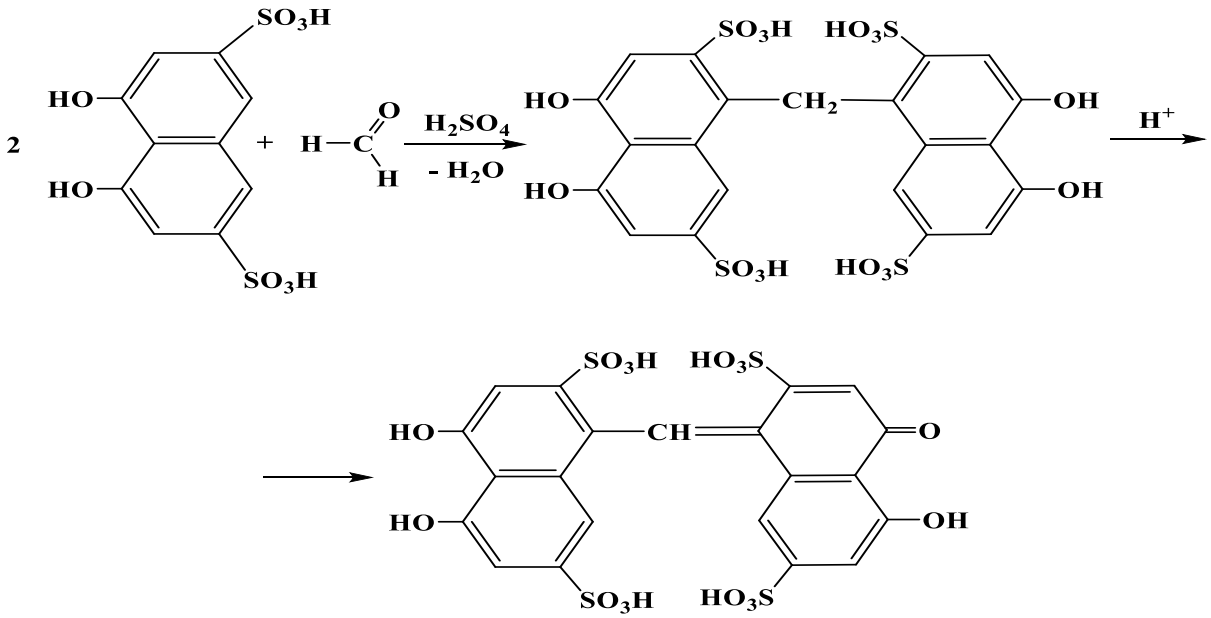


3. Hydrolysis - formation of formaldehyde and isoniazid.

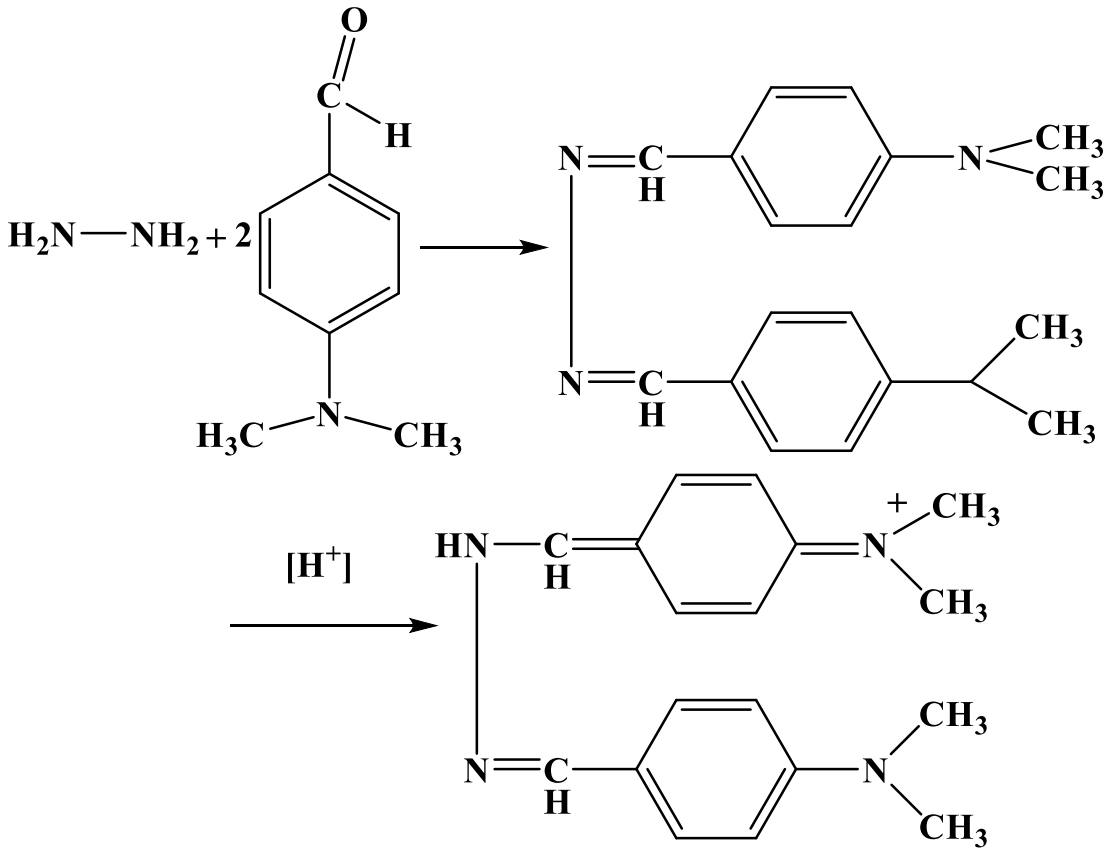


The formed reaction products are determined by the corresponding reactions.

When interacting with the sodium salt of chromotropic acid in the presence of concentrated sulfuric acid, a violet-blue or violet-red color is formed:

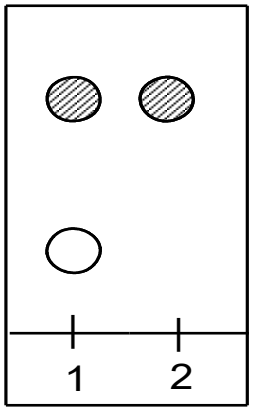


The resulting hydrazine is detected by a color reaction with *n*-dimethylaminobenzaldehyde



Specific impurities in drugs of isonicotinic acid derivatives

Degree of purity: A. In isoniazid, the admixture of free hydrazine is determined by thin-layer chromatography.

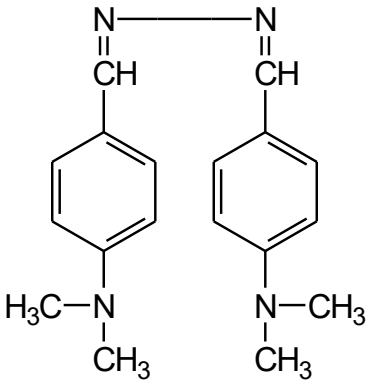


1 – isoniazid;

2 - hydrazine sulfate (developer) $(NH_3\text{-}NH_3)SO_4$

The color intensity after spraying with 4-dimethylaminobenzaldehyde should not exceed - hydrazine sulfate.

After spraying, an orange Schiff base is formed:



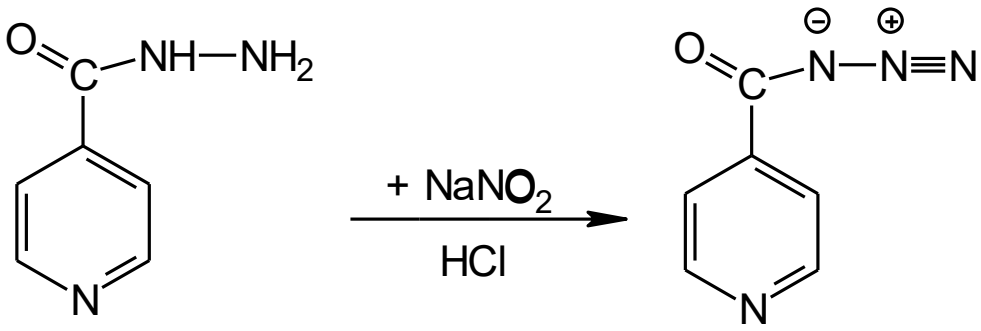
B. An admixture of hydrazide is determined in metazide. To do this, shake the substance with ice water, filter. Add 1 drop of hydrochloric acid, 1 drop of sodium nitrite to the filtrate and apply it to iodine-starch paper. In the absence of isoniazid, a blue color is observed.

$$8NaNO_2 + 3\ KIO_3 + 8HCl = I_2 + KI + 2NaNO_3 + 6HNO_3 + 2KCl + 6NaCl + H_2O$$

or

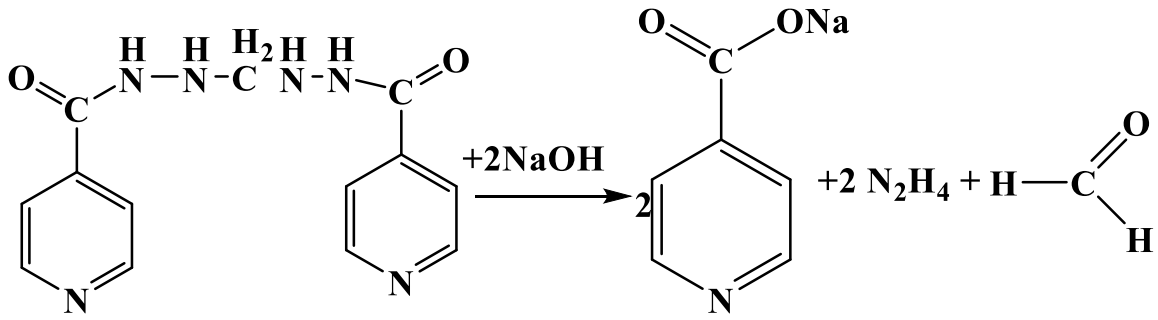
$$NaNO_2 + 2KI + 4HCl = I_2 + 2NO + 2KCl + 2NaCl + 2H_2O$$

If an admixture of isoniazid is present, then iodostarch paper is not colored, because isonicotinic acid azide is formed:



Quantitative determination of metazide is based on iodine oxidation of isonicotinic acid hydrazide and formaldehyde released during hydrolysis in an alkaline environment.

Iodometric method, the indicator is starch.

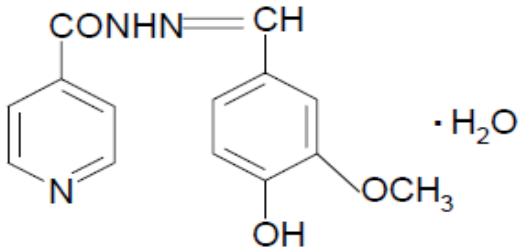


$$2NaOH + J_2 \longrightarrow NaJO + NaJ + H_2O$$

$$NaI + NaOI + H_2SO_4 \longrightarrow I_2 + Na_2SO_4 + H_2O$$

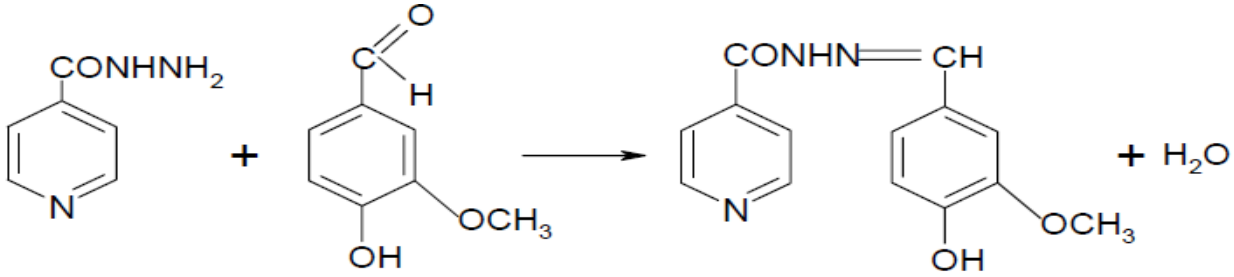
$$I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$$

Ftivazide (Phthivazidum)



3-Isonicotinic acid methoxy-4-hydroxybenzylidene hydrazide hydrate

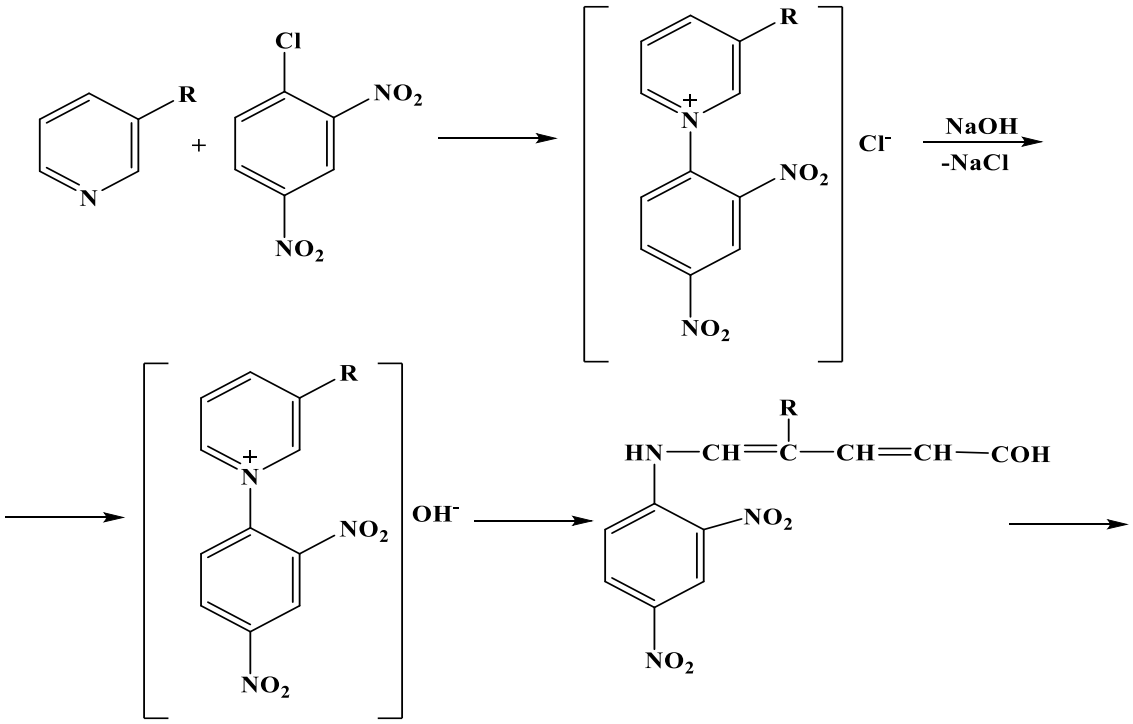
Extraction. Synthesize ftivazide by condensing isoniazid with vanillin:



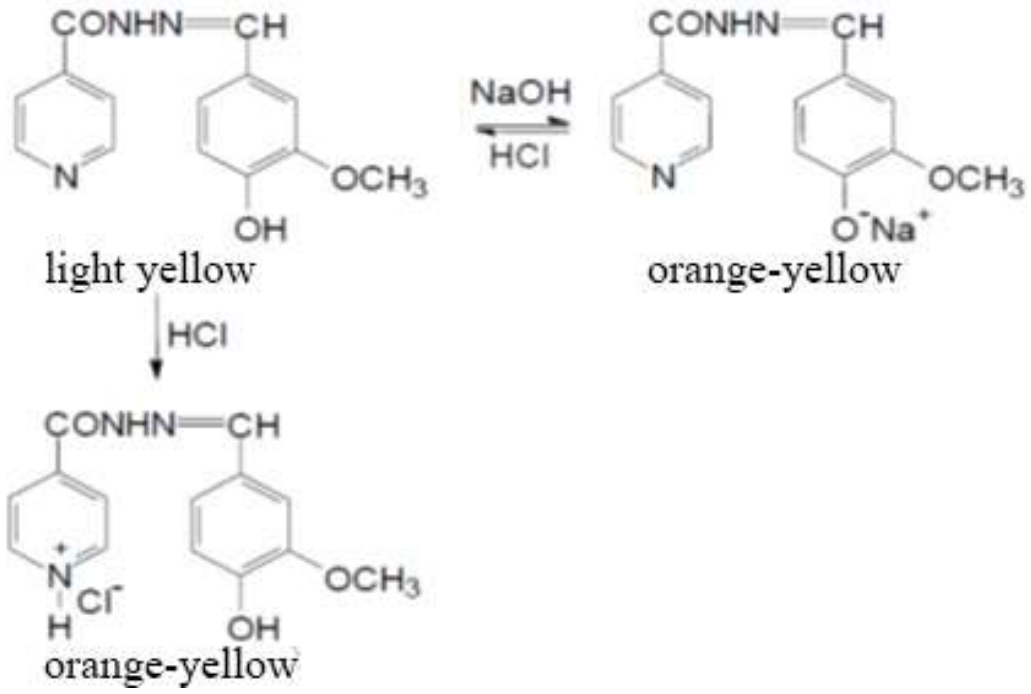
Properties. Light - yellow or yellow fine-crystalline powder with a faint smell of vanillin, tasteless. Very slightly soluble in water, slightly soluble in 96% alcohol, easily soluble in acids and alkali solutions.

Identification:

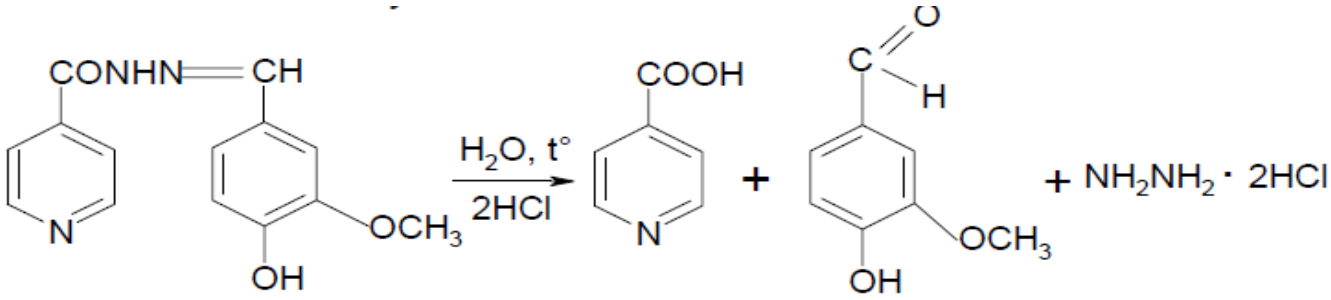
1. After heating with 2,4-dinitrochlorobenzene and adding alkali, a yellowish-brown color is formed, which intensifies over time.



2. When a solution of alkali is added to an alcoholic solution of ftivazid, the light yellow color changes to orange-yellow. With the gradual addition of hydrochloric acid, the solution turns yellow again, and then orange-yellow (the reaction confirms the amphoteric properties of ftivazide):

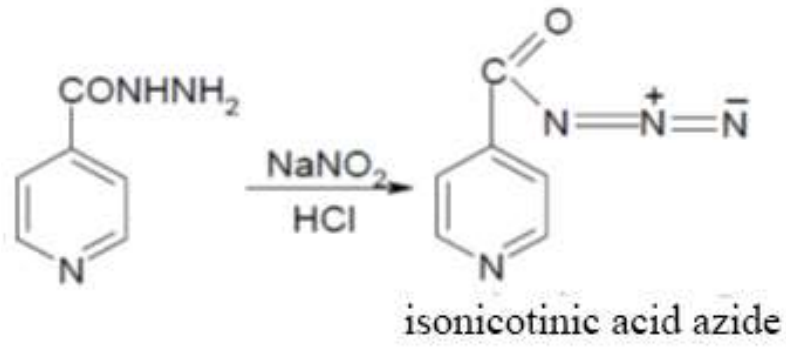


3. When ftivazide is heated with hydrochloric acid, the smell of vanillin is felt:



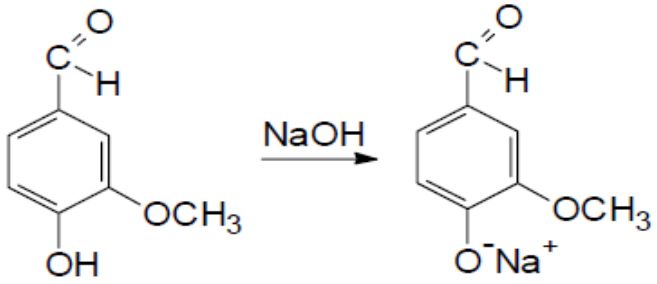
Purity test. Specific impurities are determined - isoniazid and vanillin.

To detect isoniazid, the substance is shaken with water, filtered, hydrochloric acid, sodium nitrite solution are added to the filtrate, and iodine-starch paper is moistened with this mixture. The absence of a blue spot means the presence of an impurity:



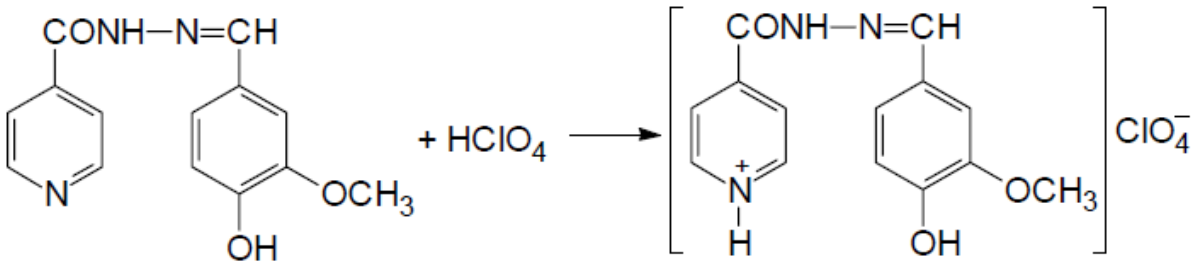
isonicotinic acid azide

Vanillin is determined in the filtrate after shaking the substance with water. The absence of color after alkalizing and adding phenolphthalein indicates the presence of an impurity:



Quantitative definition.

1. Acidimetry in a non-aqueous medium, crystal violet indicator. Titrations lead to the transition of the red-brown color to gray-green, since the salts of ftivazide have an orange-yellow color:

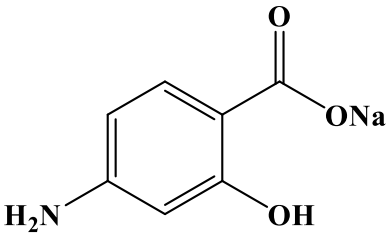


In parallel, a control experiment is carried out (color transition from purple to blue).

Storage. In a sealed container.

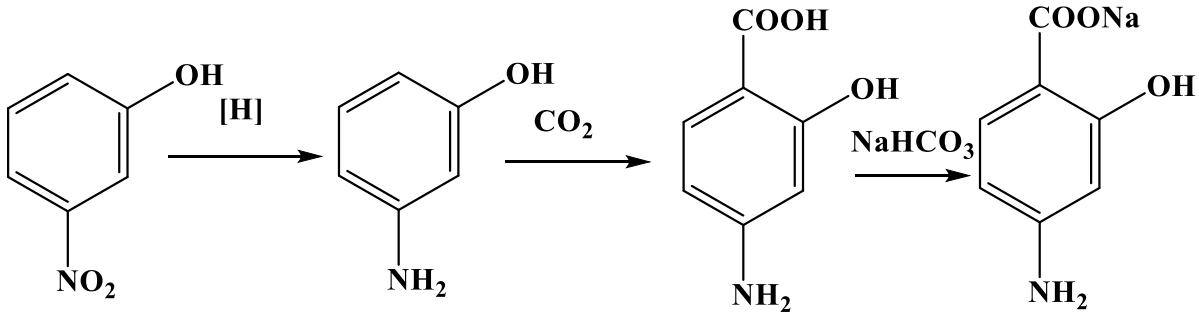
Application. Antituberculosis agent.

Sodium p-aminosalicylate (Natrii para-aminosalicylas)



Sodium salt of p-aminosalicylic acid

Extraction. *m*-Nitrophenol is reduced, carboxylated according to the Kolbe method, and then the resulting n-aminosalicylic acid is neutralized:

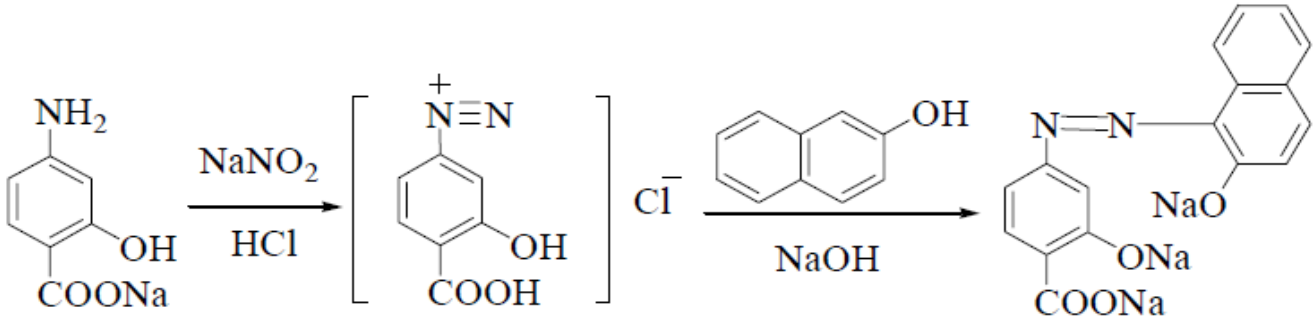


Properties. White, sometimes with a slight yellowish or pink tint, fine crystalline powder. Aqueous solutions darken on standing. Easily soluble in water, poorly soluble in alcohol. Na-PASK decomposes at a temperature of 80 C, so the solution cannot be sterilized by heating.

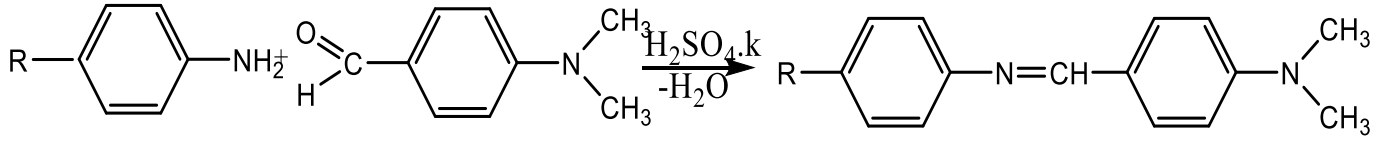
Identification:

1. Reaction to the primary aromatic amino group:

a) Azo dye formation reaction. The diazotization reaction proceeds under the action of sodium nitrite in an acidic medium. As a result, unstable diazonium salts are formed. Upon further addition of an alkaline solution of any phenol (β-naphthol, resorcinol, etc.), a cherry, red, or orange-red azo dye is formed:



b) As a result of the interaction of amines with aldehydes, Schiff's bases are formed - compounds colored yellow or orange-yellow:



2. The substance reacts to the sodium ion:

According to the requirements of the SPhU, the sodium cation is determined using a solution of potassium pyroantimonate (potassium hexahydroxystibiate), resulting in the formation of a white precipitate.

$$Na^+ + K[Sb(OH)_6] \rightarrow Na[Sb(OH)_6]\downarrow + K^+.$$

When heating the investigated solution with potassium pyroantimonate, a supersaturated solution can be obtained, therefore, to create a crystallization center, the solution is cooled in ice water and the walls of the test tube are rubbed with a glass rod.

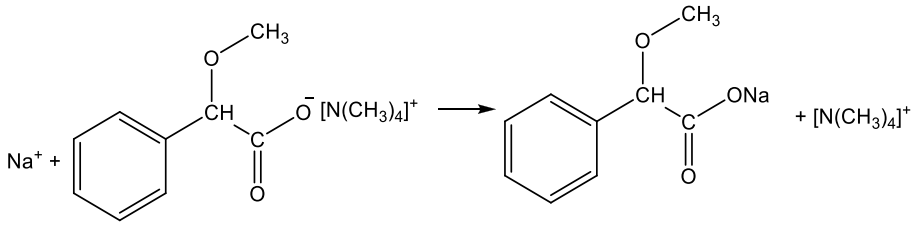
The reaction should be carried out in a slightly alkaline environment, since in an acidic environment potassium pyroantimonate decomposes with the formation of a white amorphous precipitate of metaantimonic (metaantimony) $HSbO_3$ acid:

$$K[Sb(OH)_6] + HCl \rightarrow HSbO_3 \cdot 3H_2O\downarrow + KCl$$

To remove NH_4^+ ions, which interfere with the determination, the test solution is preheated with a potassium carbonate solution to boiling (at the same time, an alkaline reaction of the medium is created):

$$2NH_4^+ + K_2CO_3 \rightarrow 2K^+ + (NH_4)_2CO_3\downarrow$$

Sodium salts with the reagent of methoxyphenylacetic acid in chilled ice water form a white crystalline precipitate that does not disappear at room temperature:



Confirmation of the formation of a precipitate of the sodium salt of methoxyphenylacetic acid is its ability to dissolve in a diluted ammonia solution.

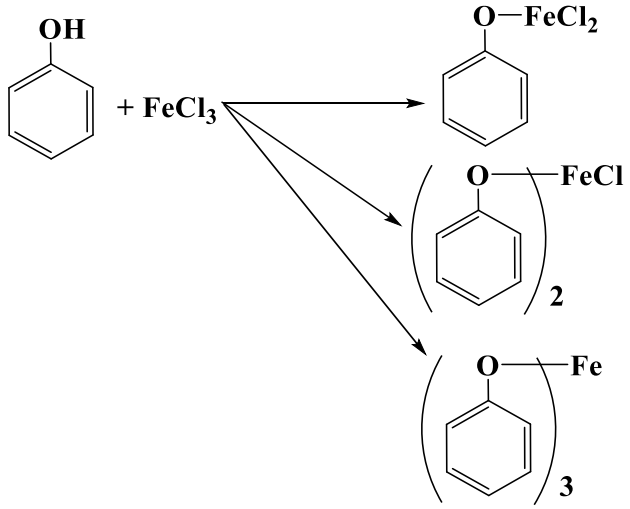
Sodium salt is wetted with concentrated hydrochloric acid to form volatile sodium salts, which color the colorless flame of the burner yellow:

In addition, there is a non-pharmacopoeial reaction with zincuranyl acetate $Zn(UO_2)_3(C_2H_3O_2)_8$ - a greenish-yellow crystalline precipitate is observed that has the shape of tetrahedra or octahedra.

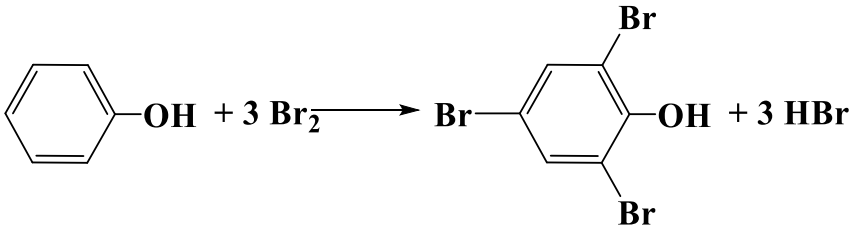
$$Na^+ + Zn(UO_2)_3(C_2H_3O_2)_8 + CH_3COO^- + 9H_2O = NaZn(UO_2)_3(C_2H_3O_2)_9 \cdot 9H_2O$$

3. The substance reacts to phenolic hydroxyl:

a) Complexation reaction with iron (III) salts. As a result, compounds are formed, most often colored in blue. The color depends on the number and location of phenolic hydroxyls.

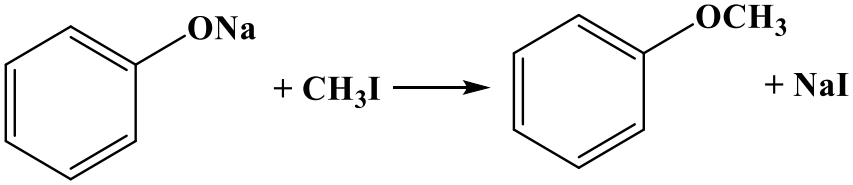


b) Reactions of electrophilic substitution. Phenols undergo nitration and sulfonation reactions, but the halogenation reaction (bromination, iodination) is the most widespread.

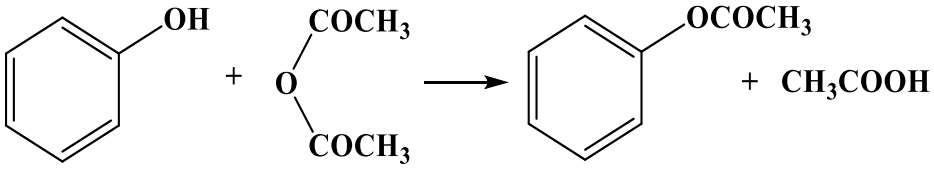


A white precipitate of tribromophenol is released and bromine water becomes discolored. Phenols, like alcohols, form simple and complex esters:

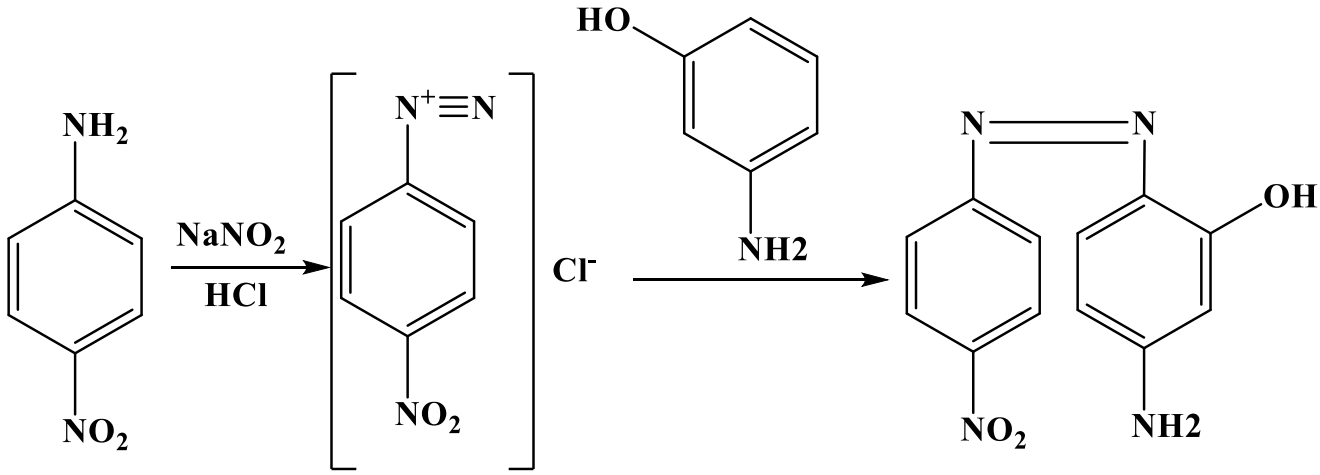
• formation of simple ethers:



• formation of complex esters:

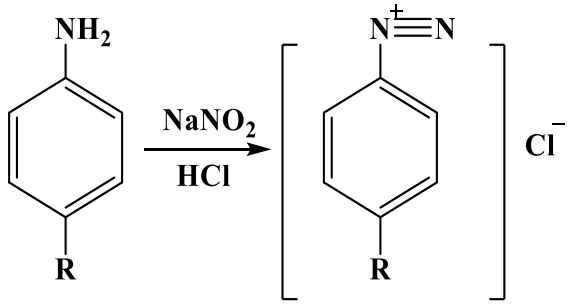


Purity test. As an impurity in the drug, there can be m-aminophenol (an intermediate product of synthesis), which is extracted with diethyl ether and a reaction of azo dye formation is carried out with diazotized n-nitroaniline. The color intensity should not exceed the standard:



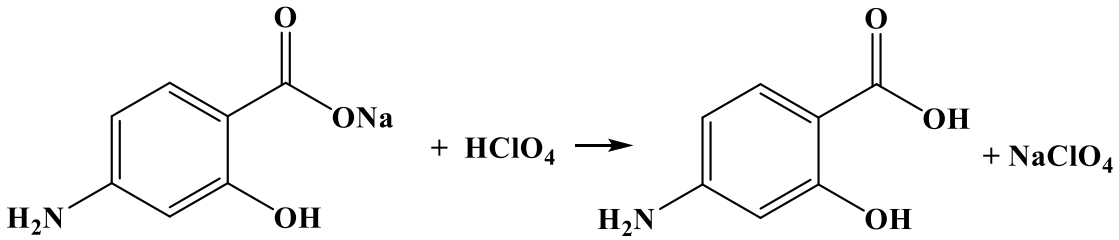
Quantitative definition:

1. Nitritometry with an external indicator (iodostarch paper):

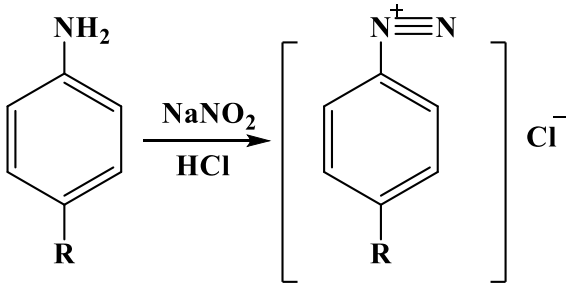


$$2KIO_3 + 5NaNO_2 + 2HCl \rightarrow I_2 + 5NaNO_3 + 2KCl + H_2O$$

2. Acidimetry, direct titration.



3. Iodochlorometry.



$$\mathbf{ICl + KI \longrightarrow I_2 + KCl}$$

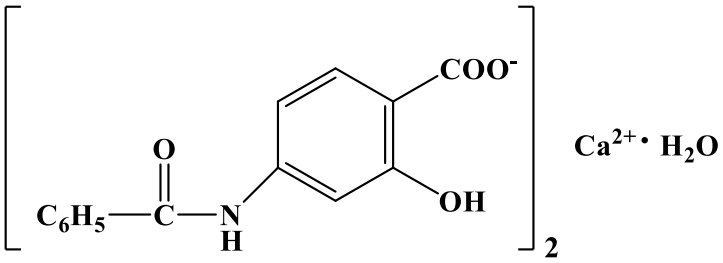
$$\mathbf{I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6}$$

Storage. In a sealed container that protects from light.

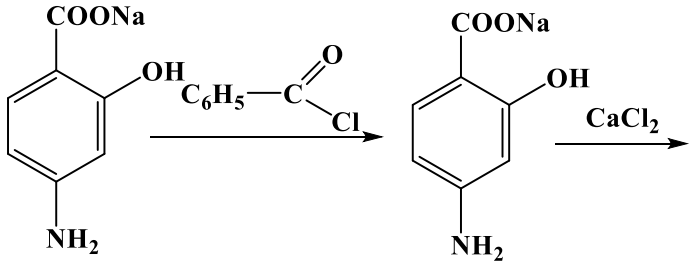
Application. Antituberculosis agent. It has an antithyroid effect, with long-term use a side effect may be observed.

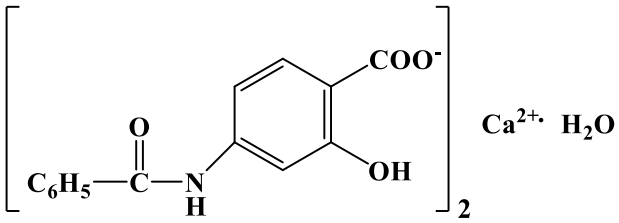
Bepascum

Calcii Benzamidosalicylas



Extraction. It is carried out according to the following scheme:





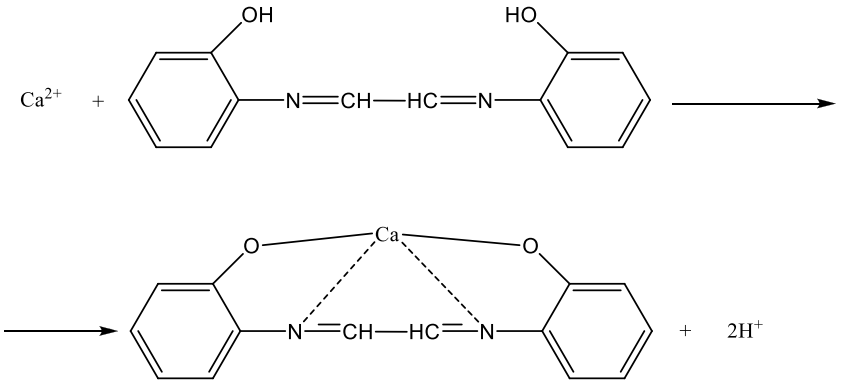
Properties. White powder, sometimes with a yellowish tint. Practically insoluble in water, difficult and slow to dissolve in 96% ethyl alcohol, soluble in methyl alcohol with the formation of slightly cloudy solutions.

Identification:

1. Reactions to the calcium cation after preliminary heating of the drug substance with dilute hydrochloric acid.

A) With a solution of glyoxalhydroxyanil.

The reaction is carried out in the presence of a mixture of sodium hydroxide and sodium carbonate, which prevents the formation of complex compounds with other alkaline earth metals, the presence of which prevents this reaction - a red coloration of the chloroform layer is observed:



B) With potassium ferrocyanide solution.

The reaction is carried out at pH ≈ 9:

$$CaCI_2 + K_4[Fe(CN)_6] + NH_4Cl \rightarrow CaNH_4K[Fe(CN)_6]\downarrow + 3KCl$$

NB! The formed white crystalline precipitate of potassium-calcium-ammonium hexacyanoferrate (II) does not dissolve in acetic acid.

C) With ammonium oxalate solution.

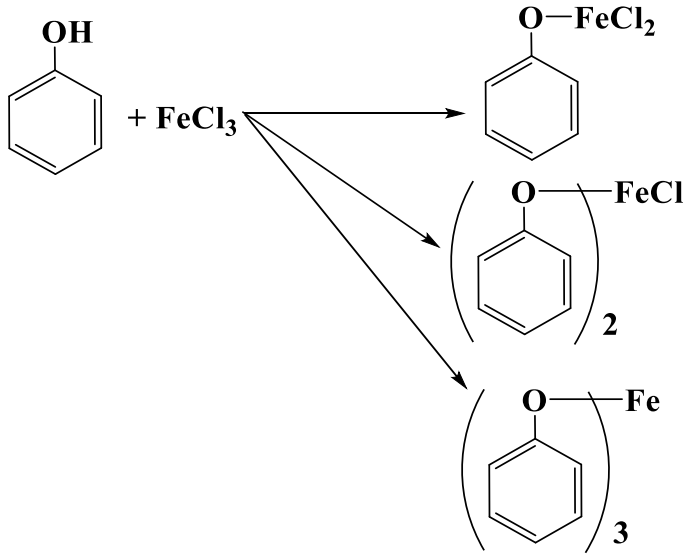
$$Ca^{2+} + C_2O_4^{2-} \rightarrow CaC_2O_4\downarrow$$

$$CaC_2O_4\downarrow + 2HCl \rightarrow CaCl_2 + H_2C_2O_4.$$

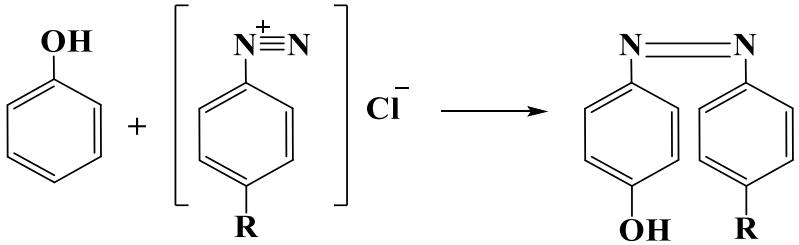
The reaction is carried out in an acetic acid environment, a white crystalline precipitate is formed, soluble in mineral acids, but not soluble in acetic acid and ammonia solution:

2. Reactions to phenolic hydroxyl:

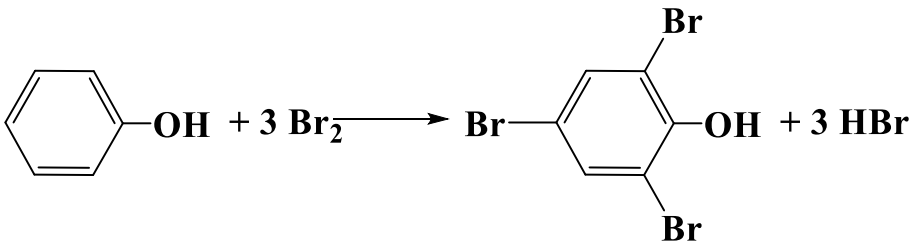
a) Complexation reaction with iron (III) salts. As a result, compounds are formed, most often colored in blue. The color depends on the number and location of phenolic hydroxyls.



b) Azo coupling reaction. As a result of the interaction of phenol with a diazo reagent, an azo dye of cherry, red or orange-red color is formed:



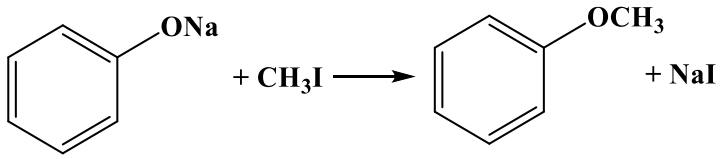
d) Reactions of electrophilic substitution. Phenols undergo nitration and sulfonation reactions, but the halogenation reaction (bromination, iodination) is the most widespread.



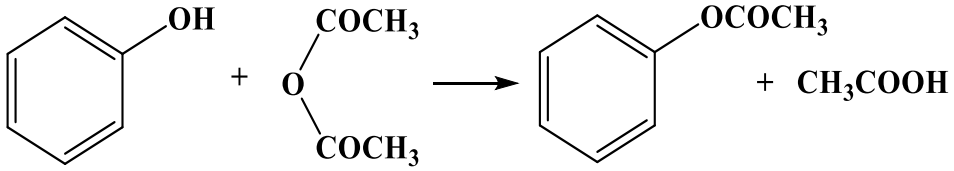
A white precipitate of tribromophenol is released and bromine water becomes discolored.

d) Phenols, like alcohols, form simple and complex esters:

• formation of simple esters:



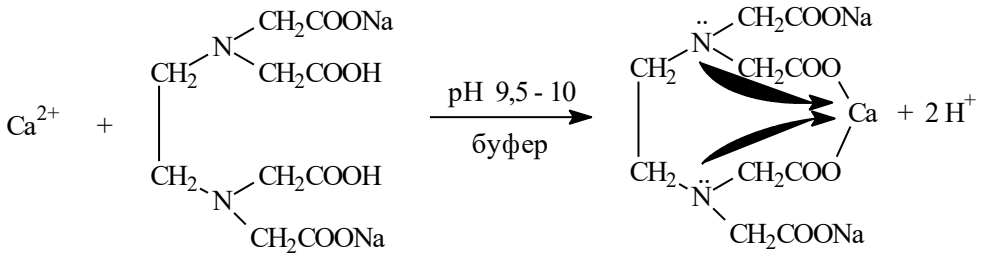
• formation of complex esters:



Quantitative definition.

1. Complexonometry. The substance is pre-burned and calcined in a muffle, the residue is dissolved in hydrochloric acid and titrated with sodium edetate solution. At the end of the titration, sodium hydroxide solution and the indicator – murexide are added.

$$Ca^{2+} + H_2Ind \rightarrow CaInd + 2\,H^+$$



at the equivalence point:

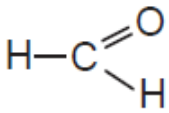
$$CaInd + Na_2H_2TrБ \rightarrow CaNa_2TrБ + H_2Ind$$

Storage. In a sealed container that protects from light.

Application. Antituberculosis agent.

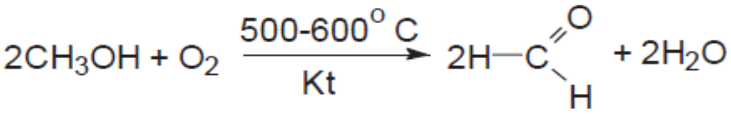
3. ANTISEPTIC AND DISINFECTANT AGENTS

Формальдегіду розчин (35%)
Formaldehydi solutio (35 per centum)

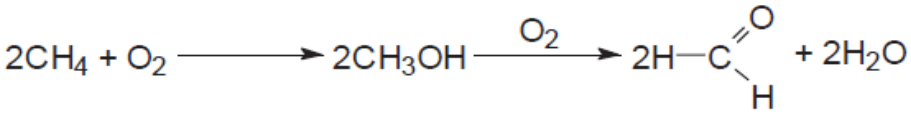


Extraction:

1. Oxidation of methanol:



2. Oxidation of methane according to the Medvedev method:

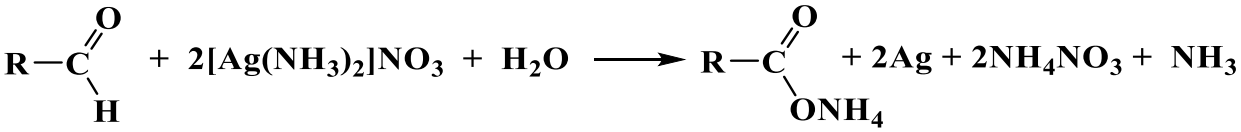


Properties. Transparent colorless liquid. Miscible with water and 96% alcohol. During storage, it may become cloudy due to polymerization with the formation of paraform. To prevent polymerization, a stabilizer is added - methyl alcohol (up to 15%).

Identification:

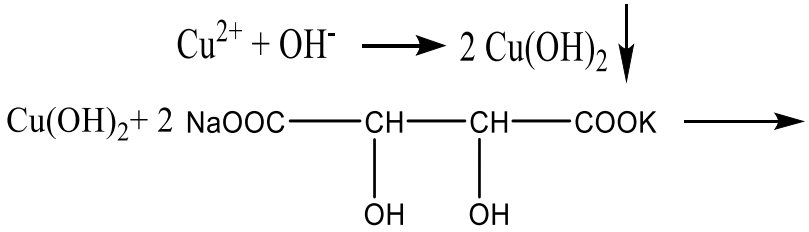
1. Oxidation reactions. For the qualitative determination of aldehydes, Tollens reagent (ammonia solution of silver nitrate), Fehling's reagent (a solution of copper (II) sulfate with a potassium-sodium tartrate solution), Nessler's reagent (potassium tetraiodomercurate (II)) is used:

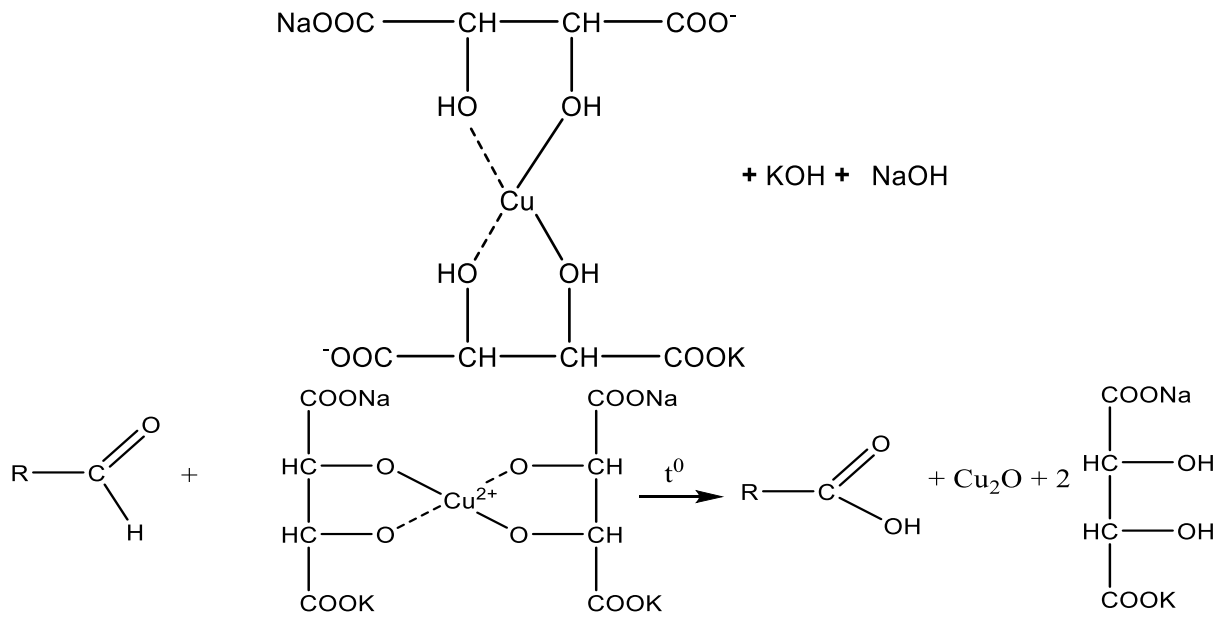
• reaction of the "Silver Mirror":



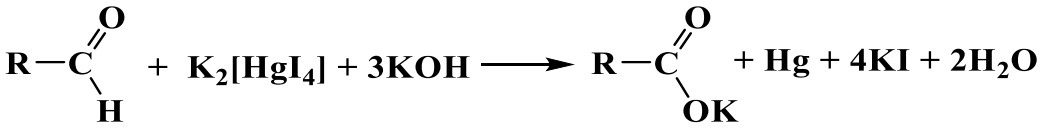
Aldehydes reduce silver from Tollens' reagent, which is deposited on walls of the test tube in the form of a mirror layer, or forms gray precipitate.

• Reaction with Fehling's reagent resulting in the formation of a brick-red precipitate of copper oxide (I)



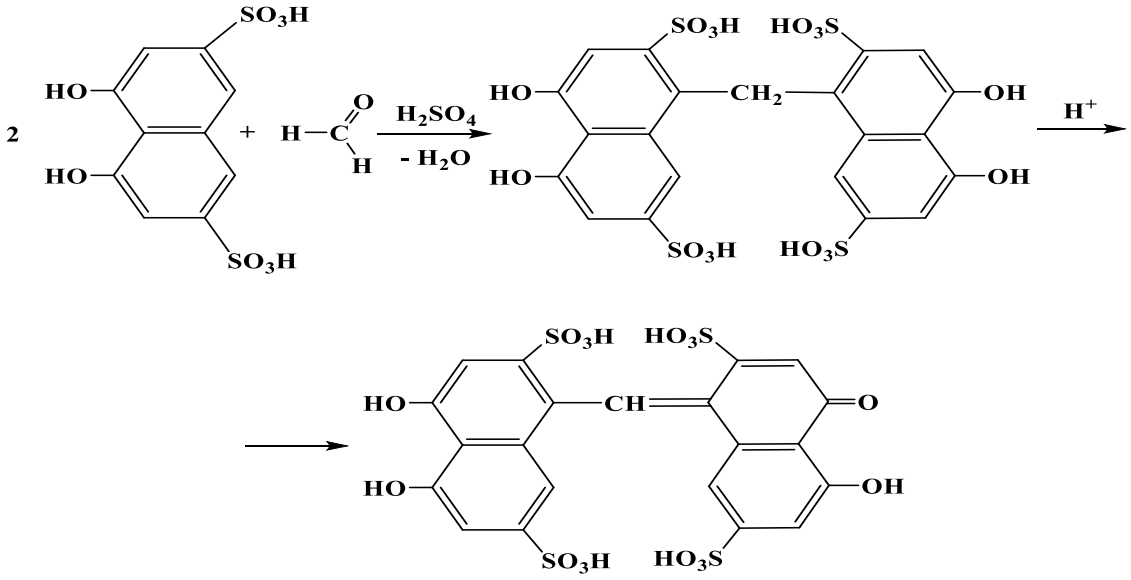


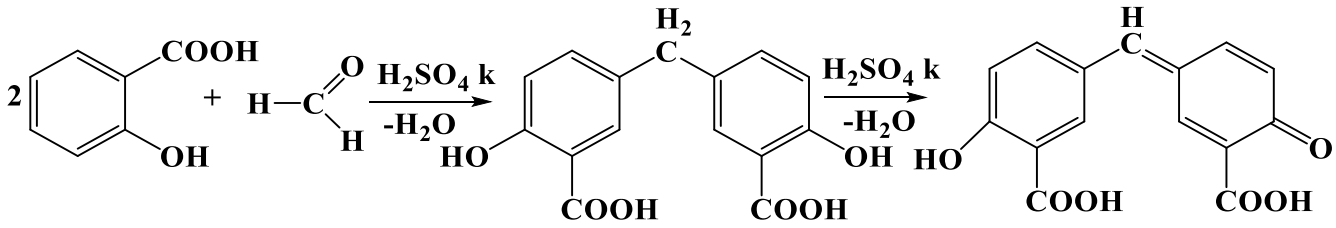
• With Nessler's reagent, as a result of the reduction of the reagent, a black precipitate of metallic mercury is released:



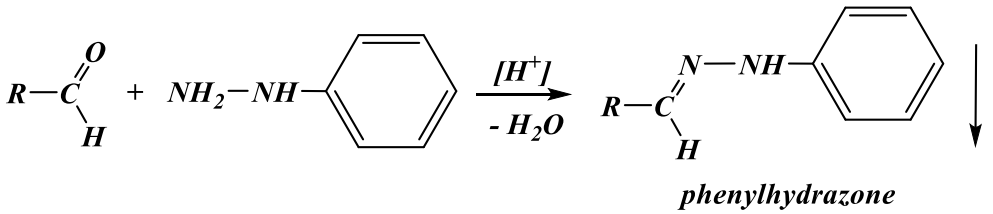
2. Aldehydes enter into a condensation reaction with phenols (salicylic acid, chromotropic acid, resorcinol, thymol, phenol, and others), forming colored compounds aurin dyes.

When interacting with the sodium salt of chromotropic acid in the presence of concentrated sulfuric acid, a violet-blue or violet-red color is formed:

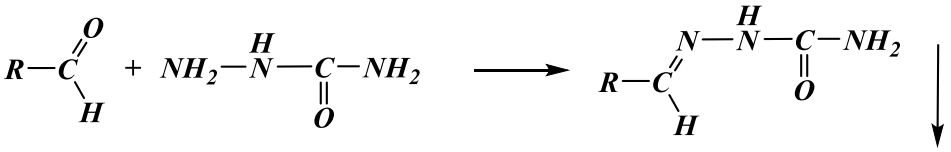




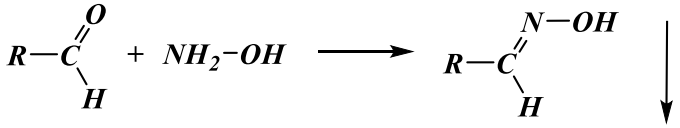
3. Substitution reaction with amines (aliphatic, aromatic, heterocyclic). Substituted hydrazine is most often used, while hydrazones, semicarbazide and oxime appear. All the listed compounds have a certain melting point:



phenylhydrazone

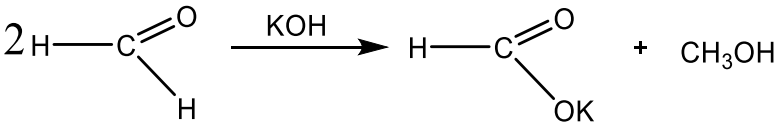


semicarbazone

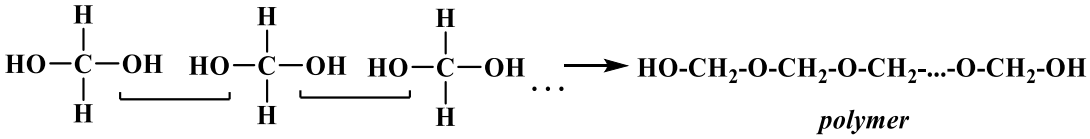


oxime

4. The Cannizzaro-Tishchenko reaction in the presence of a concentrated alkali leads to the simultaneous formation of an acid and an alcohol. It is characteristic of aldehydes that do not have a hydrogen atom in the alpha position relative to the carboxyl group:



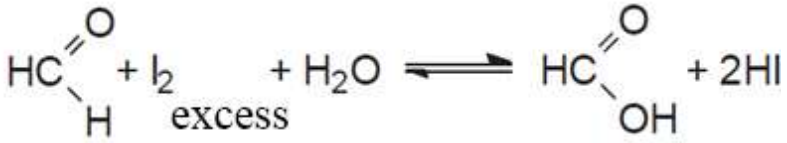
5. The ability of aldehydes to polymerize, which can occur in an aqueous solution through the hydrated form, is taken into account when storing aldehyde solutions. The formed polymer is an impurity that reduces the pharmacological effect of the drug. For example, an admixture of paraform in a formaldehyde solution:



polymer

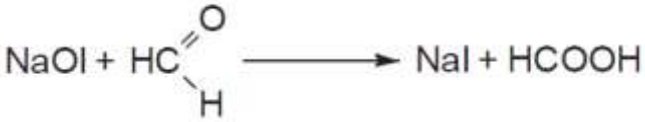
Quantitative definition.

1. Iodometry in an alkaline environment, reverse titration, the indicator is starch.



Hydroiodic acid, which is formed as a result of the reaction, can reduce formic acid to formaldehyde, so the oxidation of formaldehyde with iodine solution is carried out in an alkaline environment:

$$I_2 + 2NaOH \rightarrow NaI + NaIO + H_2O$$



A disproportionation reaction can occur in parallel:

$$3NaIO \rightarrow 2NaI + NaIO_3$$

After completion of the oxidation reaction, sulfuric acid is added to the reaction mixture:

$$NaI + NaIO + H_2SO_4 \rightarrow I_2 + Na_2SO_4 + H_2O$$

$$5NaI + NaIO_3 + 3H_2SO_4 \rightarrow 3I_2 + 3Na_2SO_4 + 3H_2O$$

Excess iodine is titrated with sodium thiosulfate:

$$I_2 + 2Na_2S_2O_3 \rightarrow 3NaI + Na_2S_4O_4$$

2. Acidimetry, direct titration by substitution after interaction with sodium sulfite:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

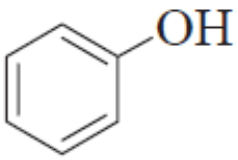
3. Reverse alkalimetry after oxidation of the substance with hydrogen peroxide in an alkaline environment, the indicator is phenolphthalein. The excess of sodium hydroxide is titrated with hydrochloric acid until discoloration:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Storage. In well-stoppered glasses, with a place protected from light, at a temperature from 15 to 25 C.

Application. Antiseptic, disinfectant and deodorizing agent, preservative for biological material.

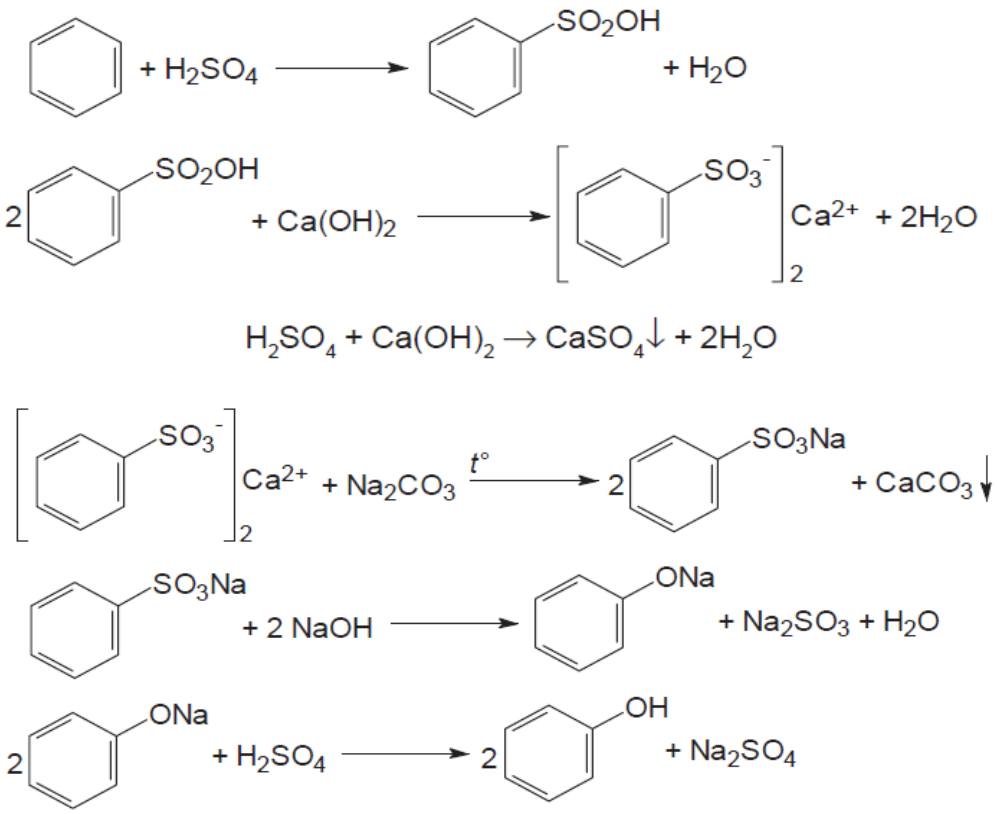
Phenol (Phenolum)



Extraction:

1. Synthetic method.

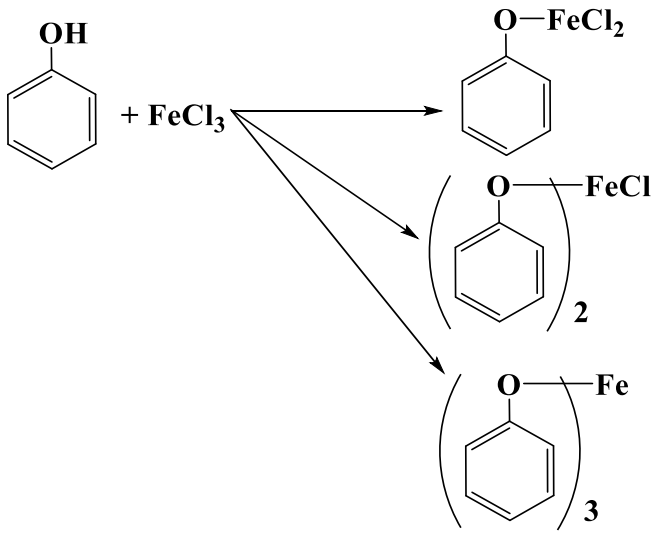
Benzene is treated with concentrated sulfuric acid to obtain benzenesulfonic acid, the reaction mass is neutralized with calcium hydroxide, and filtered. The filtrate is treated with sodium carbonate, filtered again, evaporated and sodium benzene sulfonate is fused with sodium hydroxide. The obtained sodium phenolate is treated with sulfuric acid:



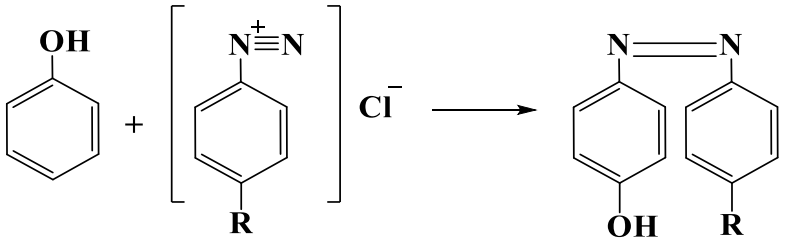
Properties. Colorless, pale pink or pale yellowish crystals or crystalline mass floating in the air, with a peculiar smell. Soluble in water, very easily soluble in 96% alcohol, glycerin and oils. It easily dissolves in alkali and ammonia solutions with the formation of phenolates.

Identification:

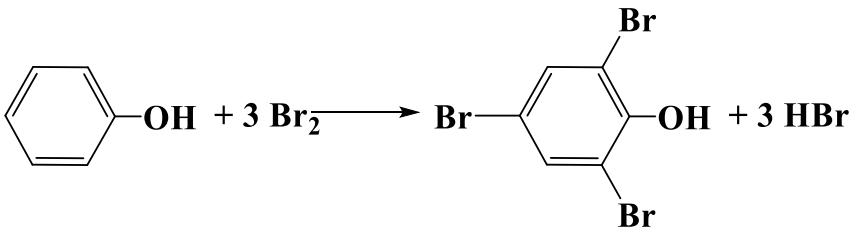
1. Complexation reaction with iron (III) salts. As a result, compounds are formed, most often colored in blue. The color depends on the number and location of phenolic hydroxyls.



2. Azo-compound reaction. As a result of the interaction of phenol with a diazo reagent, an azo dye of cherry, red or orange-red color is formed:

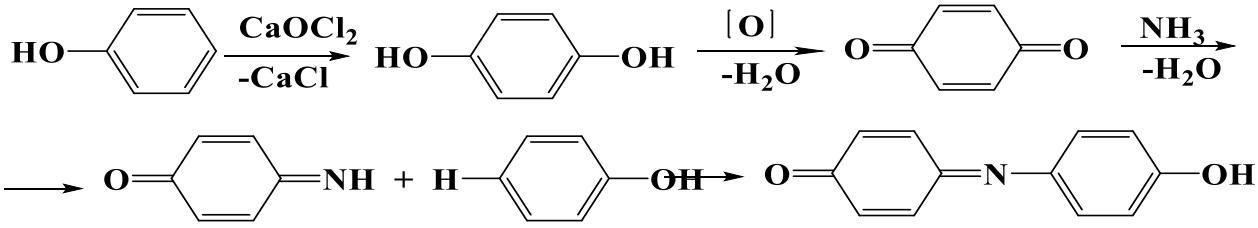


3. Reactions of electrophilic substitution. Phenols undergo nitration and sulfonation reactions, but the halogenation reaction (bromination, iodination) is the most widespread.



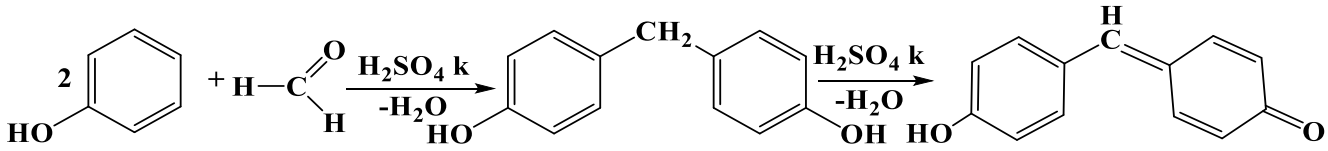
A white precipitate of tribromophenol is released and bromine water becomes discolored.

4. Oxidation reactions. Phenols are easily oxidized, which is accompanied by a change in the color of the drugs. Hypochlorites, bromine water in the presence of ammonia and others can be used as oxidants:

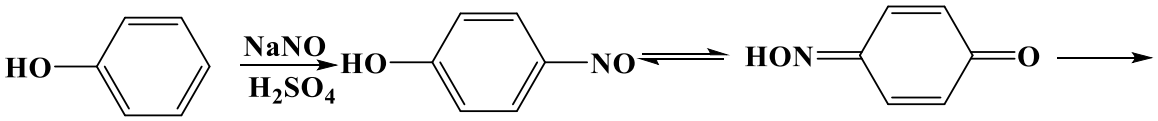


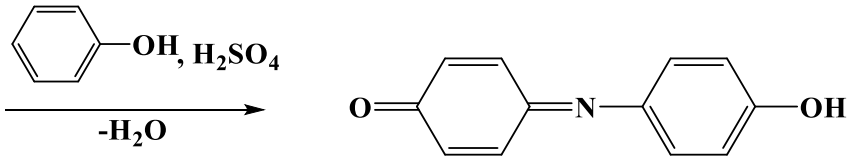
5. Condensation reaction. Phenols undergo condensation reactions with alcohols, aldehydes, organic acids, acid anhydrides, etc. Characteristic for phenols is the

condensation reaction with Marquis reagent (a mixture of formaldehyde and concentrated sulfuric acid). As a result, aurine dye of dark cherry color is formed.

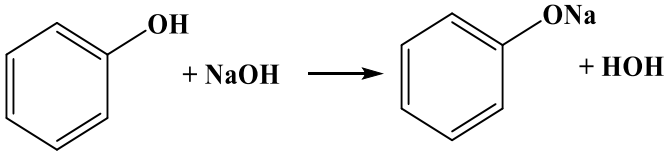


Another type of condensation reaction is the Liebermann reaction, which is based on the interaction of phenols with nitro compounds, which are obtained by the action of nitric acid on phenols:





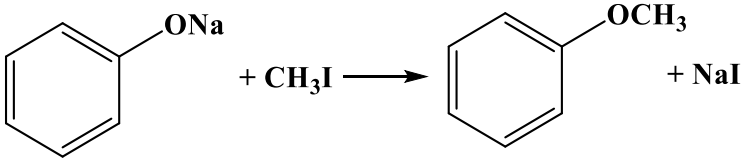
6. Unlike aliphatic alcohols, phenols show, albeit to a weak degree, a clearly expressed acidic character and therefore have the ability to dissolve in alkalis with the formation of phenolates:



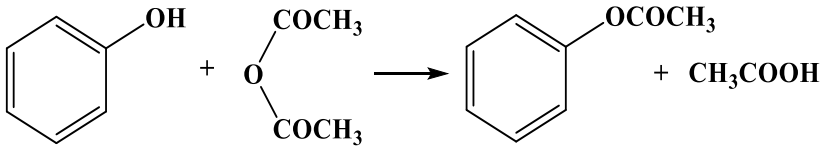
Since the acidic nature of phenols is weakly expressed, phenolates in aqueous solutions are strongly hydrolyzed, and even such a weak acid as carbonic acid displaces phenols from their salts.

7. Phenols, like alcohols, form simple and complex esters:

• formation of simple esters:

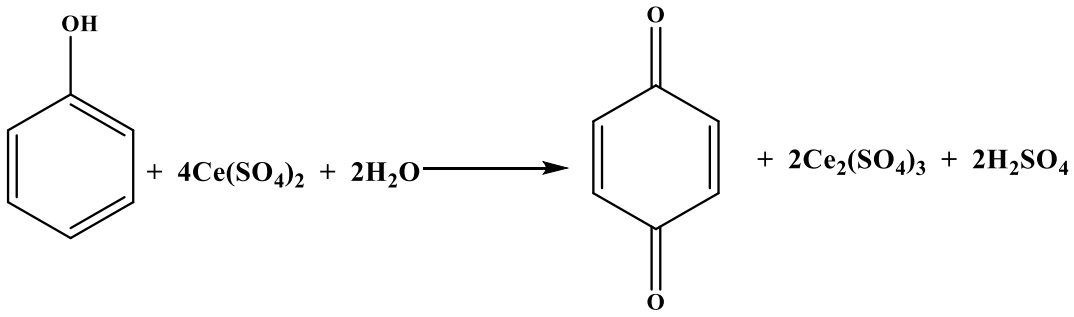


• formation of complex esters:



Quantitative definition.

1. Cerimetric method can be used for quantitative determination of phenol. It is based on the oxidation of phenol with an excess of 0.1 M solution of cerium sulfate (IV) in an acidic environment when heated to 70-80 °C:

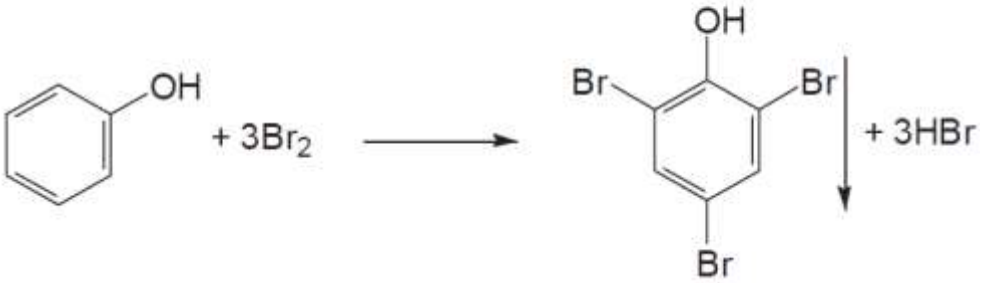


$$2Ce_2(SO_4)_2 + 2KI \longrightarrow I_2 + Ce_2(SO_4)_3 + K_2SO_4$$

$$I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$$

2. Bromatometry, reverse titration. An excess of a titrated solution of bromide-bromate is added to a beaker with a ground cork in the measuring solution, acidified with hydrochloric acid, mixed and left for some time:

$$KBrO_3 + 5KBr + 6HCl \rightarrow 6KCl + 3Br_2 + 3H_2O$$



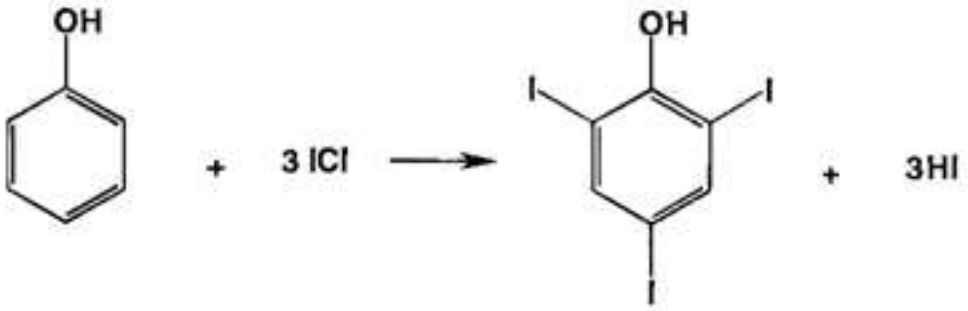
The excess of potassium bromate is determined iodometrically, the indicator is starch, chloroform is added at the end of the titration:

$$Br_2 + 2KI \rightarrow I_2 + 2KBr$$

$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

In parallel, a control experiment is conducted.

3. Phenols can be determined by the reverse iodochlormetric method. Its essence is similar to bromide bromatometry:



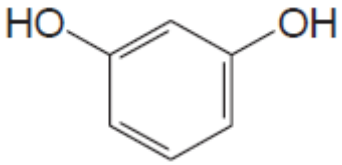
$$ICl + KI \longrightarrow I_2 + KCl$$

$$I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$$

Storage. In a sealed container that protects from light.

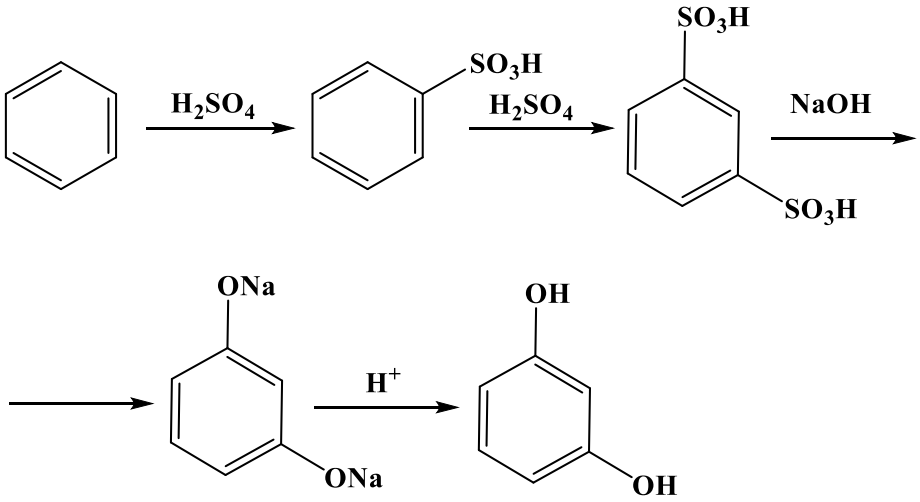
Application. Antiseptic.

Resorcinol (Resorcinum)



Benzene-1,3-diol

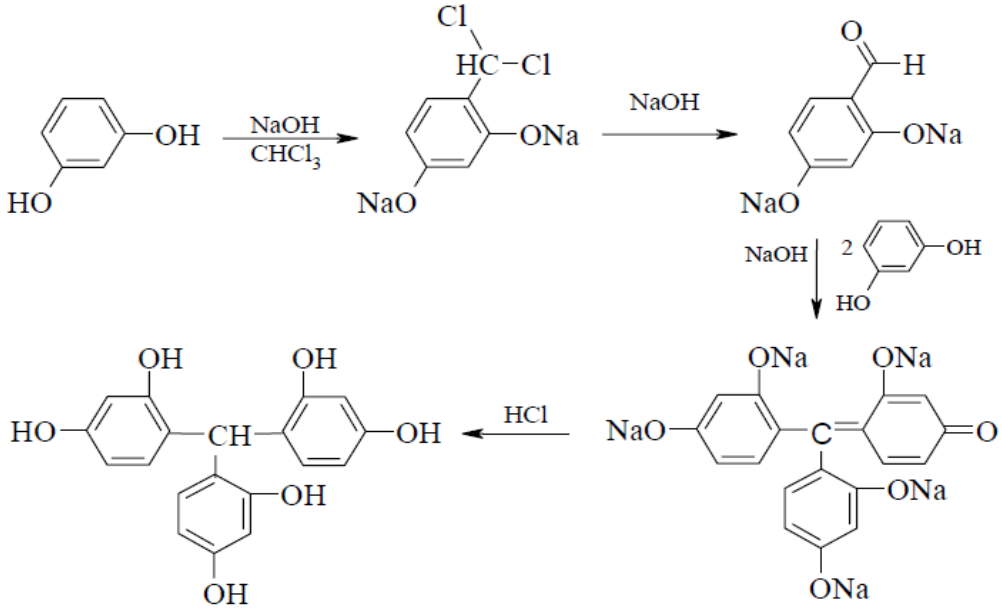
Extraction. Similarly to phenol - by sulfonation and subsequent fusion with sodium hydroxide:



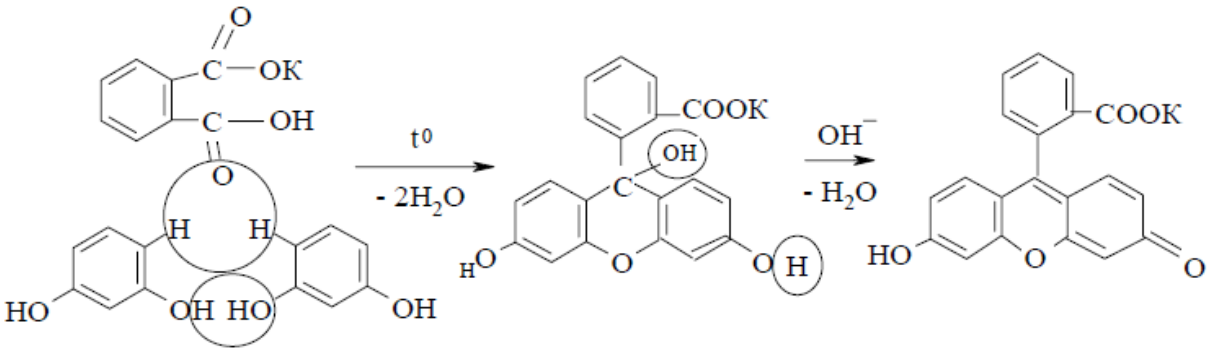
Properties. Crystalline powder or crystals, colorless or pale pinkish-gray. Redden under the influence of light and air. Very easily soluble in water, 96% alcohol, easily soluble in ether, soluble in fats and glycerin. When heated, it completely evaporates.

Identification:

1. Obtaining an auric dye when heating a substance with chloroform in the presence of a concentrated sodium hydroxide solution, a dark red color appears, which changes to pale yellow when a small excess of hydrochloric acid is added:

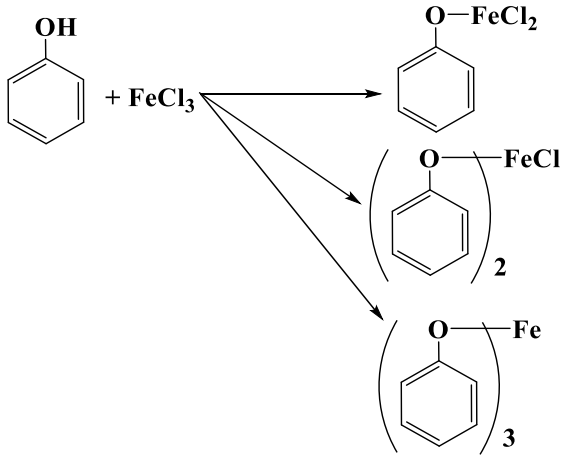


2. A specific reaction is its fusion with potassium hydrophthalate to form fluorescein, which has an intense green fluorescence in an alkaline medium:

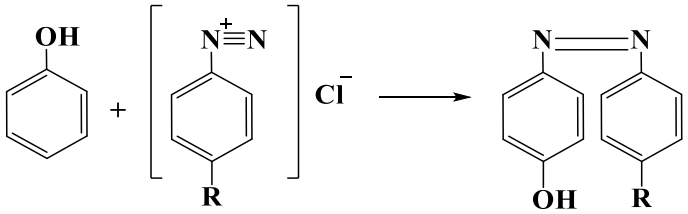


3. Also gives all reactions to phenolic hydroxyl:

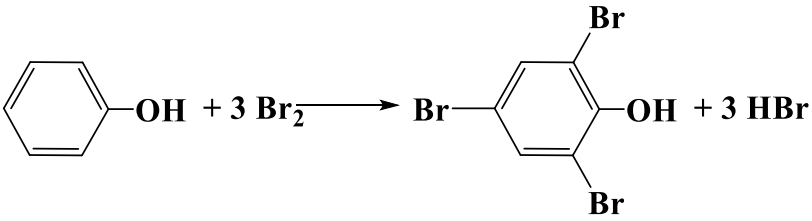
A) Complexation reaction with iron (III) salts. As a result, compounds are formed, most often colored in blue. The color depends on the number and location of phenolic hydroxyls.



B) Azo-compound reaction. As a result of the interaction of phenol with a diazo reagent, an azo dye of cherry, red or orange-red color is formed:

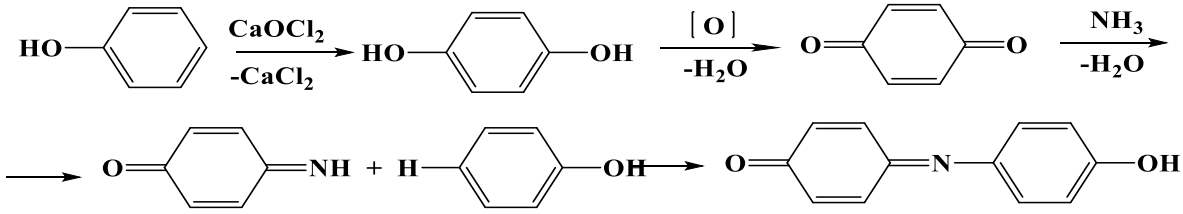


C) Reactions of electrophilic substitution. Phenols undergo nitration and sulfonation reactions, but the halogenation reaction (bromination, iodination) is the most widespread.

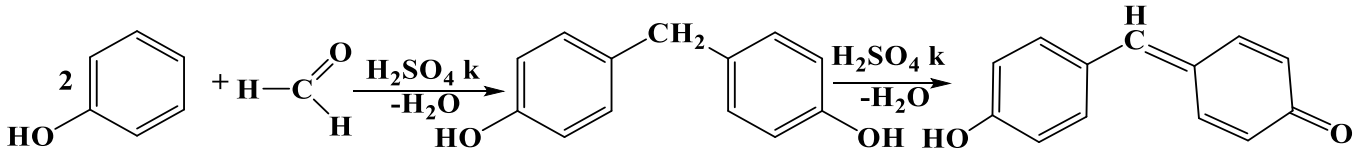


A white precipitate of tribromophenol is released and bromine water becomes discolored.

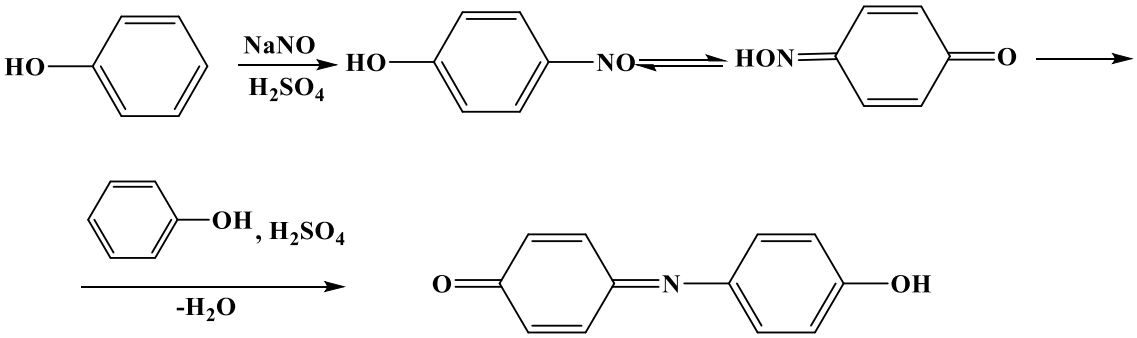
D) Oxidation reactions. Phenols are easily oxidized, which is accompanied by a change in the color of the drugs. Hypochlorites, bromine water in the presence of ammonia and others can be used as oxidants:



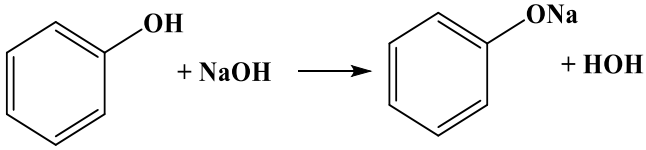
E) Condensation reaction. Phenols undergo condensation reactions with alcohols, aldehydes, organic acids, acid anhydrides, etc. Characteristic for phenols is the condensation reaction with Marquis reagent (a mixture of formaldehyde and concentrated sulfuric acid). As a result, aurine dye of dark cherry color is formed.



Another type of condensation reaction is the Liebermann reaction, which is based on the interaction of phenols with nitro compounds, which are obtained by the action of nitric acid on phenols:



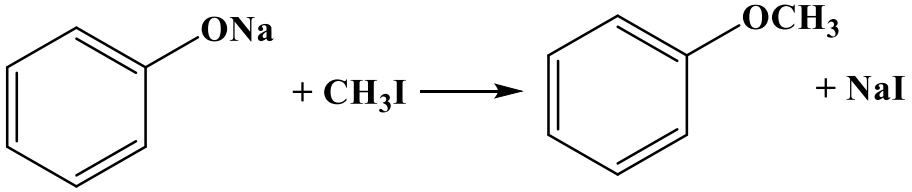
F) Unlike aliphatic alcohols, phenols show, albeit to a weak degree, a clearly expressed acidic character and therefore have the ability to dissolve in alkalis with the formation of phenolates:



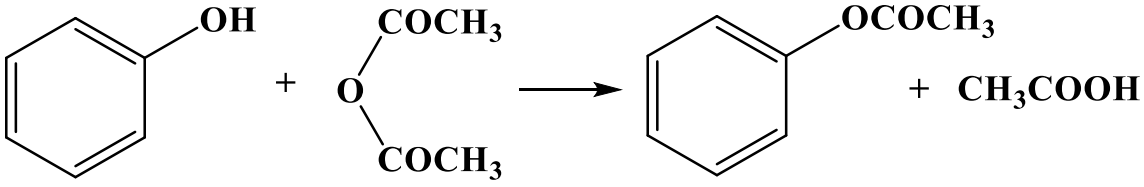
Since the acidic nature of phenols is weakly expressed, phenolates in aqueous solutions are strongly hydrolyzed, and even such a weak acid as carbonic acid displaces phenols from their salts.

G) Phenols, like alcohols, form simple and complex esters:

• formation of simple esters:



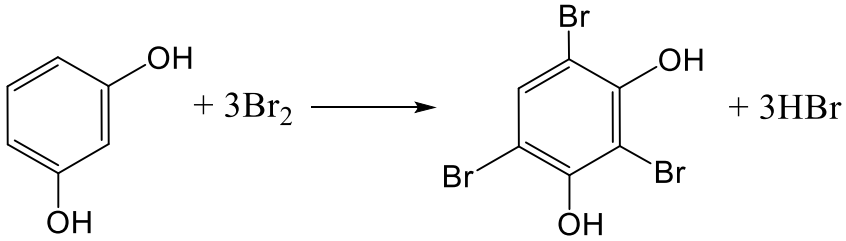
• formation of complex esters:



Quantitative definition.

Method bromatometry, back titration method, indicator the starch.

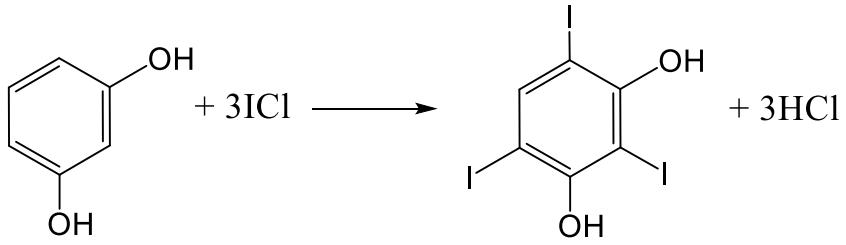
$$KBrO_3 + 5KBr + 3H_2S0_4 \longrightarrow 3Br_2 + 3H_20 + 3K_2S0_4$$



$$Br_2 + 2KI \longrightarrow I_2 + 2KBr$$

$$I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$$

Iodochlormetry method, back titration method, indicator the starch**.**



$$ICl + KI \longrightarrow I_2 + KCl$$

$$I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$$

Storage. In closed jars made of dark glass, in a place protected from light.

Application. Antiseptic.

Zinc sulfate heptahydrate (Zinci sulfas heptahydricus)

$ZnSO_4\ 7H_2O$

Extraction. The action of diluted sulfuric acid on metallic zinc or zinc oxide:

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2\uparrow$$

$$ZnO + H_2SO_4 \rightarrow ZnSO_4 + H_2O$$

Properties. White crystalline powder or colorless transparent crystals. Weathering in the air. Very easily soluble in water, practically insoluble in 96% alcohol. The aqueous solution has an acidic reaction of the environment.

Identification.

1. Gives a reaction to zinc:

A) A white flaky precipitate of zinc sulfide is formed with a solution of sodium sulfide, for this a solution of sodium hydroxide is previously added to the tested solution (to prove the amphoteric properties of zinc ions) with the subsequent formation of a white precipitate of zinc hydroxide, which in turn dissolves in an excess of the reagent with the formation of zincate-ion (ZnO_2^{2-}) and when adding sodium sulfide solution:

$$Zn^{2+} + 2OH^- \rightarrow Zn(OH)_2\downarrow.$$

$$Zn(OH)_2\downarrow + 2OH^- \rightarrow [Zn(OH)_4]^{2-};$$

$$[Zn(OH)_4]^{2-} \rightarrow ZnO_2^{2-} + 2H_2O$$

$$Zn^{2+} + S^{2-} = ZnS\downarrow$$

or

$$Na_2ZnO_2 + 2Na_2S + 2H_2O \rightarrow ZnS\downarrow + 4NaOH$$

B) Potassium ferrocyanide $K_4[Fe(CN)_6]$ reacts with zinc ions, resulting in the formation of a white precipitate of zinc-potassium ferrocyanide, insoluble in acids, but soluble in alkalis:

$$3Zn^{2+} + 2K_4[Fe(CN)_6] \rightarrow Zn_3K_2[Fe(CN)_6]_2\downarrow + 6K^+;$$

$$Zn_3K_2[Fe(CN)_6]_2\downarrow + 12OH^- \rightarrow 2K^+ + 2[Fe(CN)_6]^{4-} + 3ZnO_2^{2-} + 6H_2O.$$

2. Gives a reaction to sulfates:

A) Barium chloride from sulfate solutions produces a white precipitate of barium sulfate, which is insoluble neither in water, nor in mineral acids, nor in alkalis (even when heated).

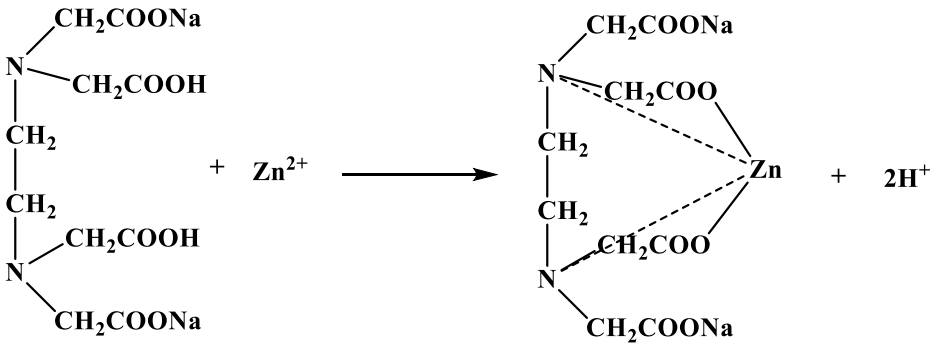
Some other anions (carbonates, sulfites) with a solution of barium chloride also form insoluble salts, which, unlike barium sulfate, dissolve in hydrochloric acid. Therefore, during the reaction of the sulfate ion with a solution of barium chloride, it is necessary to add a solution of hydrochloric acid:

$$SO_4^{2-} + BaCl_2 \rightarrow BaSO_4\downarrow + 2Cl^-.$$

Quantitative definition.

1. Complexonometry, direct titration after dissolving the substance in diluted acetic acid in the presence of hexamethylenetetramine, the indicator is xylenol orange.

$$Zn^{2+} + H_2Ind \rightarrow ZnInd + 2H^+$$



at the equivalence point:

$$ZnInd + Na_2H_2TrБ \rightarrow ZnNa_2TrБ + H_2Ind$$

Storage. In a stoppered container.

Application. Antiseptic and astringent.

Boric acid (Acidum boricum)

H_3BO_3

Extraction. Boric acid is obtained by decomposing borax or borocalcite with a hot solution of hydrochloric acid:

$$Na_2B_4O_7\ 10\ H_2O + 2HCl \rightarrow 4H_3BO_3 + NaCl + 5H_2O$$

$$Na_2B_4O_7\ 4\ H_2O + 2HCl + H_2O \rightarrow 4H_3BO_3 + CaCl_2$$

Properties. Crystalline powder or crystals of white color or colorless, shiny, greasy to the touch plate. Soluble in water, 96% alcohol, easily soluble in boiling water and glycerin (85%). When heated for a long time (up to 100 °C), it loses part of its water, turning into metaboric acid HBO2, then a vitreous fused mass is formed, which, upon further heating, swells and, having lost all the water, forms boric anhydride B_2O_3.

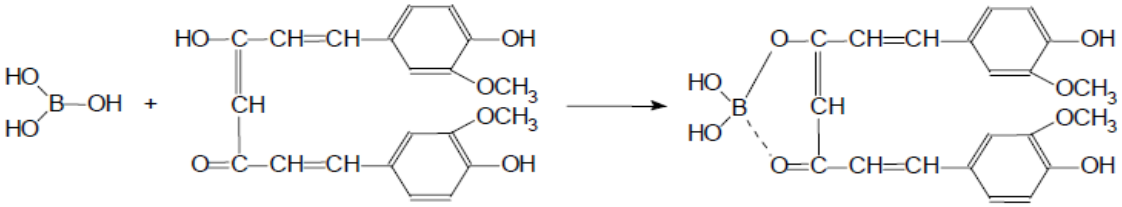
Identification:

1. A mixture of boric acid with methanol and concentrated sulfuric acid burns with a flame with a green border:

2. An aqueous solution of the substance has an acidic reaction.

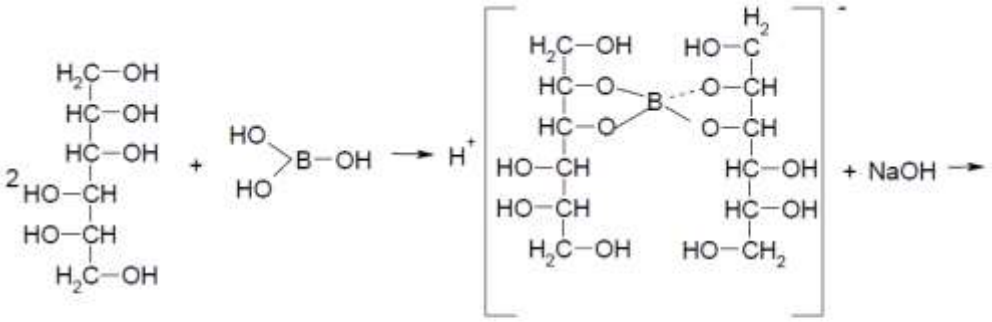
3. Turmeric paper turns pink or brownish-red:

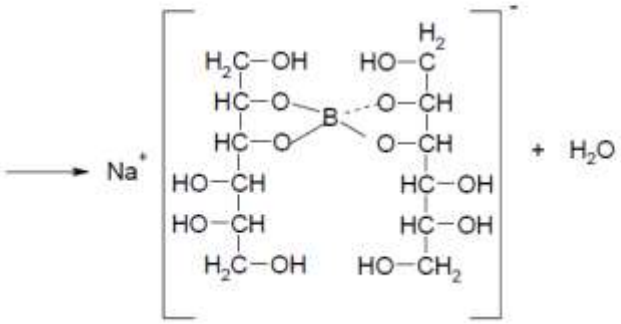
After wetting with an ammonia solution, the color turns greenish-black.



Quantitative definition.

1. Alkalimetry, direct titration in the presence of mannitol (DFU) or in the presence of other polyatomic alcohols, the indicator is phenolphthalein:





When titrating aqueous solutions of boric acid with sodium hydroxide solution without the addition of polyhydric alcohols, sodium metaborate (NaBO2) is formed, which is strongly hydrolyzed. As a result, the medium becomes alkaline before the equivalence point is reached.

Storage. In a stoppered container.

Application. Antiseptic agent.

Hydrogenii peroxidum 3%

Розчин водню пероксиду 3%

Hydrogen peroxide solution 3%

H_2O_2

Extraction. Electrolysis of sulfuric acid solutions:

$$H_2SO_4 + HOH \rightarrow H_3O^+ + HSO_4^-$$

cathode

$2H_3O^+ + 2\bar{e} \longrightarrow 2H_3O$

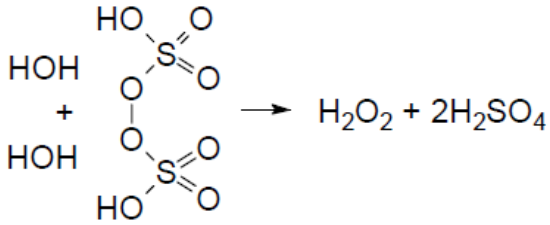
$2H_3O \longrightarrow 2H_2O + H_2\uparrow$

anode

$2HSO_4^- - 2\bar{e} \longrightarrow 2HSO_4$

$2HSO_4 \longrightarrow H_2S_2O_8$

When the solution is heated in a vacuum to 70-75 ºC, persulfate acid decomposes with the formation of hydrogen peroxide:



Properties. A colorless transparent liquid with a slightly acidic reaction. Decomposes in the light when heated, interacts with oxidants, alkalis, heavy metals with the formation of oxygen. Miscible in all proportions with water.

Identification:

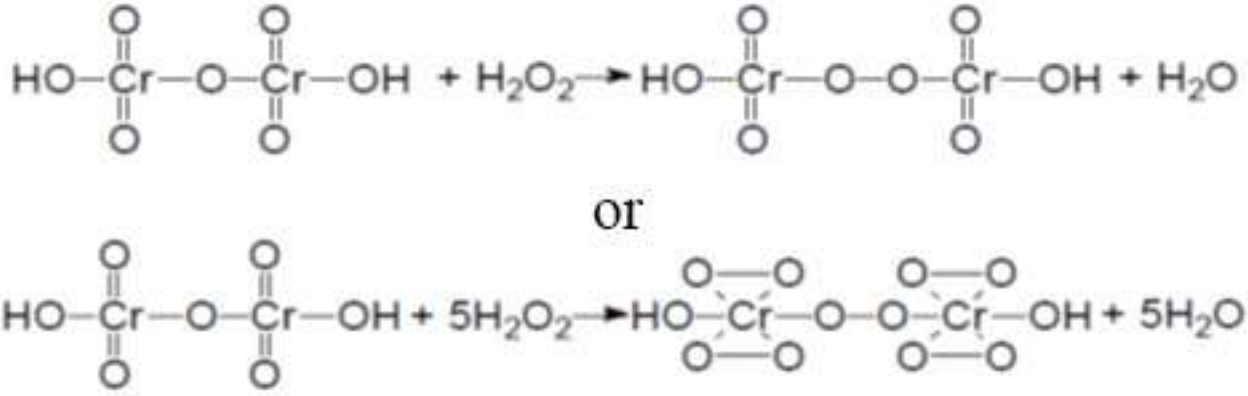
1. In an acidic environment, it decolorizes the potassium permanganate solution:

$$\mathbf{5H_2O_2 + 2KMnO_4 + 3H_2SO_4 \rightarrow 2MnSO_4 + K_2SO_4 + 8H_2O + 5O_2 \uparrow}$$

2. The reaction of the formation of perchromic acids during interaction with potassium chromate in an acidic environment in the presence of diethyl ether. Ether is added to remove peroxide compounds of chromium, as they decompose in an acidic environment with the formation of green colored Cr3+:

$$2K_2CrO_4 + H_2SO_4 \rightarrow K_2Cr_2O_7 + K_2SO_4 + H_2O$$

3. $K_2Cr_2O_7 + H_2SO_4 \rightarrow H_2Cr_2O_7 + K_2SO_4$



Quantitative definition.

1. Permanganatometry without indicator, direct titration:

$$\mathbf{5H_2O_2 + 2KMnO_4 + 3H_2SO_4 \rightarrow 2MnSO_4 + K_2SO_4 + 8H_2O + 5O_2 \uparrow}$$

Storage. In a place protected from light; if the substance does not contain a stabilizer, it is stored at a temperature below 15ºC.

Application. An antiseptic, also has a hemostatic effect.

Potassium permanganate (Kalii permanganas)

$KMnO_4$

Extraction.

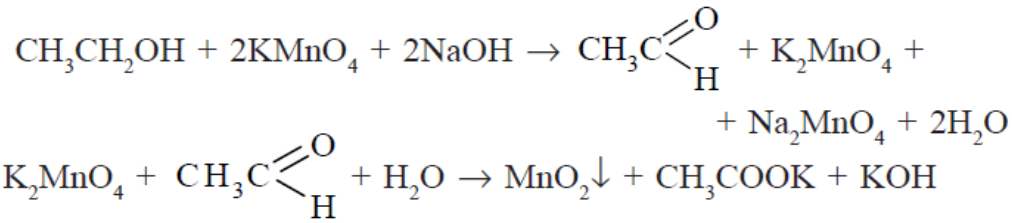
$$2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2\ H_2O$$

$$2K_2MnO_4 + Cl_2 \rightarrow 2KMnO_4 + 2KCl$$

Properties. Granular powder of dark purple color or brownish-black color. Soluble in cold water, easily soluble in boiling water. Decomposes when interacting with certain organic substances. When interacting with some organic or easily oxidizable substances, an explosion may occur.

Identification:

1. When adding alcohol and sodium hydroxide to an aqueous solution, a green color is formed - upon further boiling of the mixture, a dark brown precipitate falls out:



2. The mixture obtained in the first test is filtered. The resulting filtrate gives the reaction (b) for potassium:

Reaction with sodium cobaltinitrite.

The reaction is carried out in a weakly acidic environment, since Co(OH)2 may precipitate in an alkaline environment. In a strongly acidic environment, the precipitate does not fall out, as the reagent decomposes. An orange-yellow precipitate is formed:

$$2KCl + Na_3[Co(NO_2)_6] \rightarrow K_2Na[Co(NO_2)_6]\downarrow + 2NaCl.$$

3.Non-pharmacopoeial reaction. When hydrogen peroxide and diluted sulfuric acid are added to the medicinal substance, the solution becomes discolored:

$$2KMnO_4 + 5H_2O_2 + 3H_2SO_4 \rightarrow 2MnSO_4 + K_2SO_4 + 8H_2O + 5O_2\uparrow$$

Quantitative definition. Iodometry, substitution titration, starch indicator:

$$2KMnO_4 + 10KI + 8H_2SO_4 \rightarrow 5I_2 + 6K_2SO_4 + 2MnSO_4 + 8H_2O$$

$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

Storage. In a stoppered container.

Application. Antiseptic agent.

Iodine (Iodum)

I_2

Extraction. The sources of iodine extraction are drilling water and seaweed (0.5%).

The process of obtaining iodine from oil drilling water consists of several stages:

1. Cleaning of drilling water from impurities of oil and naphthenic acids.

2. Oxidation of iodide ions to free sodium iodine by nitrite in the presence of sulfuric acid:

$$2NaI + 2NaNO_2 + 2\ H_2SO_4 \rightarrow I_2 + 2NO\uparrow + 2Na_2SO_4 + 2H_2O$$

3. Iodine is adsorbed with activated carbon.

4. The process of iodine desorption with sodium hydroxide or sodium sulfite solutions:

$$3I_2 + 6NaOH \rightarrow 5NaI + NaIO_3 + 3H_2O$$

5. Oxidation of iodides to free iodine with active chlorine:

$$2NaI + Cl_2 \rightarrow I_2 + 2NaCl$$

6. Purification of iodine by sublimation.

Properties. Fragile plates or small crystals of grayish-purple color with a metallic sheen. Volatile at room temperature, when heated, sublimes with the formation of purple vapor. Very slightly soluble in water, very easily soluble in aqueous solutions of iodides, soluble in 96% alcohol, ether and chloroform, slightly soluble in glycerol. Solutions in chloroform have a purple color.

Identification.

1. Heat the crystalline substance in a test tube; a purple vapor is released and a blue-black crystalline sublimate is formed.

2. The aqueous solution of the medicinal substance turns blue from the addition of the starch solution. When heated, the solution becomes colorless, when cooled, the color reappears.

3. Formation of iodoform, a yellow precipitate with a characteristic smell:

$$C_2H_5OH + 4I_2 + 6NaOH \rightarrow CHI_3\downarrow + 5NaI + HCOONa + 5H_2O$$

Quantitative definition. The iodine solution is titrated with sodium thiosulfate solution, the indicator is starch.

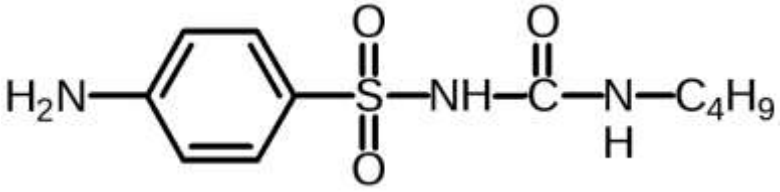
$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

Storage. In glass jars with rubbed corks, in a cool place protected from light.

Application. Antiseptic agent.

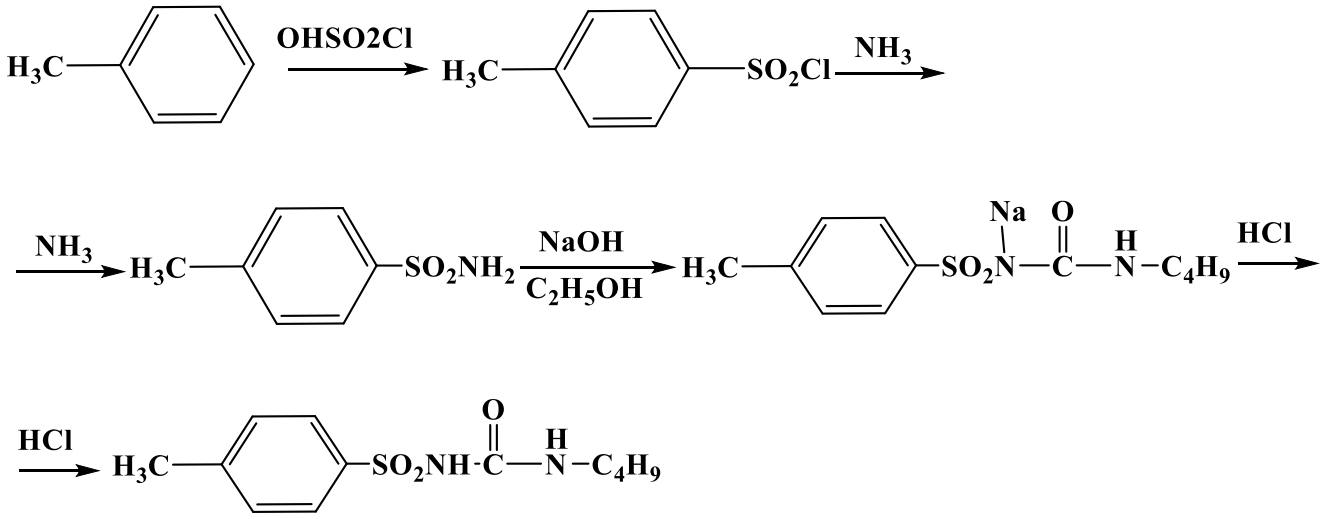
4. ANTIDIABETIC DRUGS

Butamidum
Tolbutamide



N-(p-methylbenzene sulfonyl)-N′-methylurea

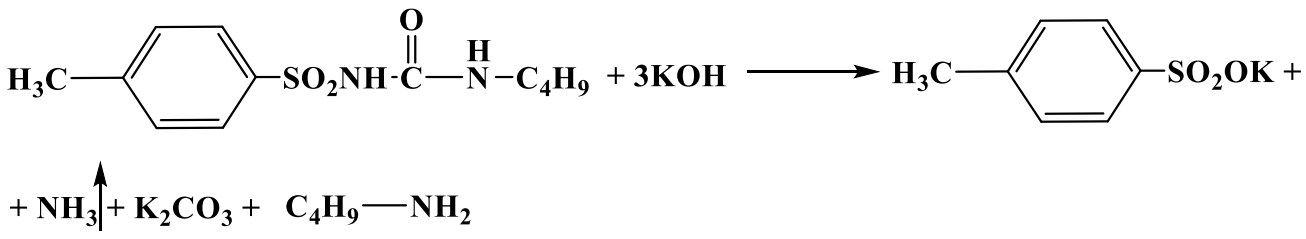
Extraction. It is carried out according to the following scheme:



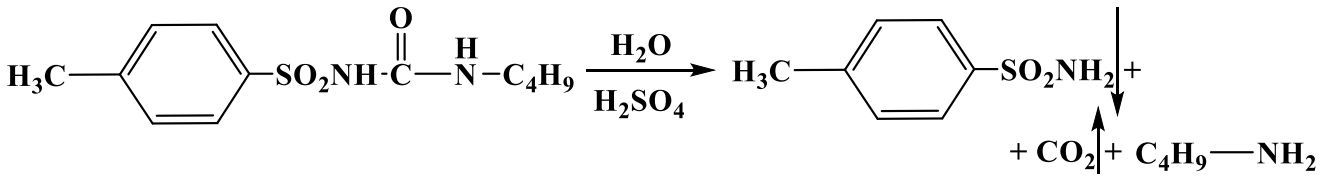
Properties. White crystalline powder without odor or with a slight odor, bitter in taste. Practically insoluble in water, soluble in 96% alcohol, slightly soluble in acetone and chloroform, sparingly soluble in ether.

Identification:

1. When butamide is heated with a 30% solution of potassium hydroxide, hydrolysis occurs with the formation of ammonia, which can be detected by the smell or by the blue color of red litmus paper. Oily drops form on the surface and the smell of butylamine appears:



2. Prolonged heating of butamide in the presence of 50% sulfuric acid (with reflux) produces a precipitate of p-toluenesulfamide with a melting point of 135–138 °C.



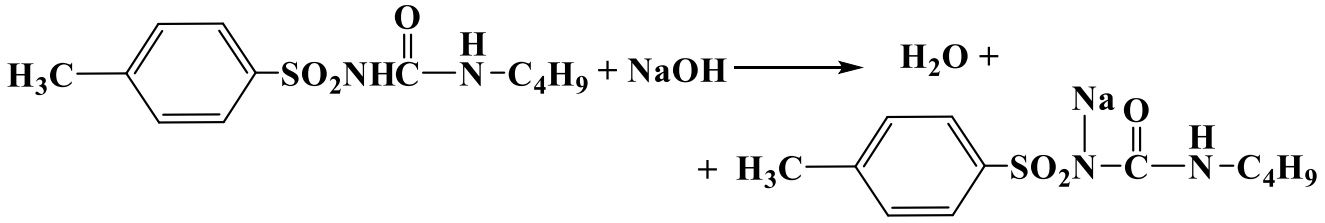
3. The presence of a sulfo group in drug is established after mineralization by fusion with a mixture of potassium carbonate and potassium nitrate. The melt is dissolved in hydrochloric acid and sulfate ions are discovered in the filtrate.

Reaction with barium chloride a white precipitate of barium sulfate, insoluble in water, mineral acids or alkalis is formed:

$$SO_4^{2-} + BaCl_2 \rightarrow BaSO_4\downarrow + 2Cl^-.$$

4. Butamide can be identified by the UV spectrophotometry method based on the characteristic maximum and the specific absorption index. A 0.001% solution of butamide in a 0.01 M sodium hydroxide solution has an absorption maximum at 227 nm with a specific index in the range of 405–435.

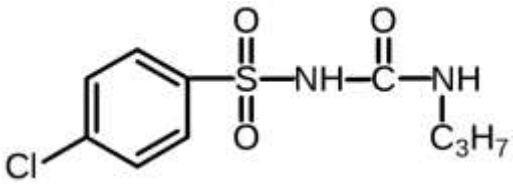
Quantitative definition. Alkalimetry, direct titration, the indicator is thymolphthalein. The acidic properties of the drug substance due to the presence of a sulfamide group are used. Solvent - ethyl alcohol neutralized with thymolphthalein:



Storage. In a dry place protected from light.

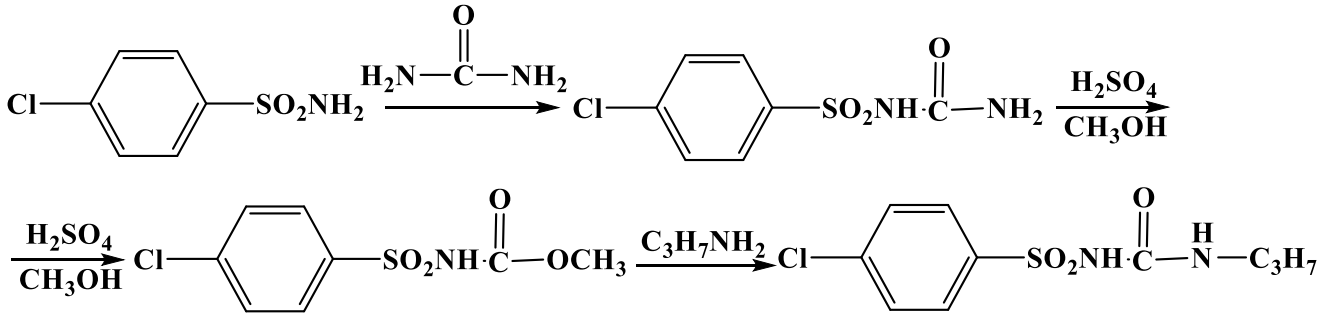
Application. Antidiabetic agent.

Chlorpropamide –Chlorpropamidum



N-(*n*-chlorobenzenesulfonyl)-*N*′-propyl urea

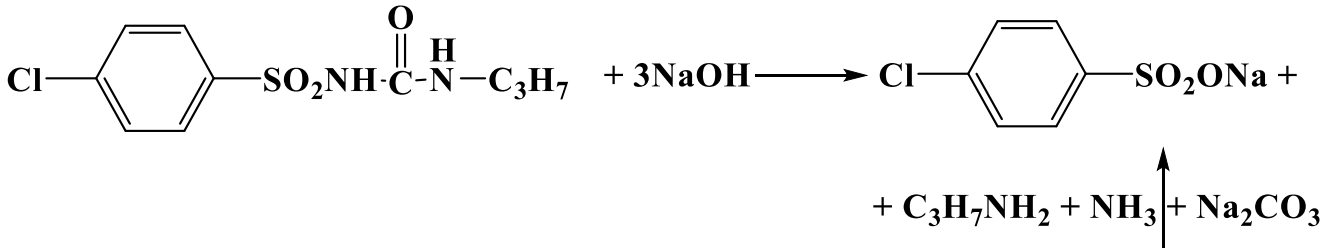
Extraction. It is carried out according to the following scheme:



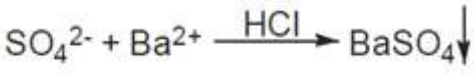
Properties. White crystalline powder without odor and taste. Practically insoluble in water, soluble in alcohol, acetone, benzene, chloroform and alkali solutions, slightly soluble in ether.

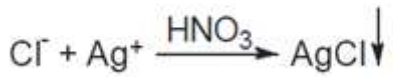
Identification:

1. When heated with sodium hydroxide solution, ammonia and propylamine are released, which turn wet red litmus paper blue:

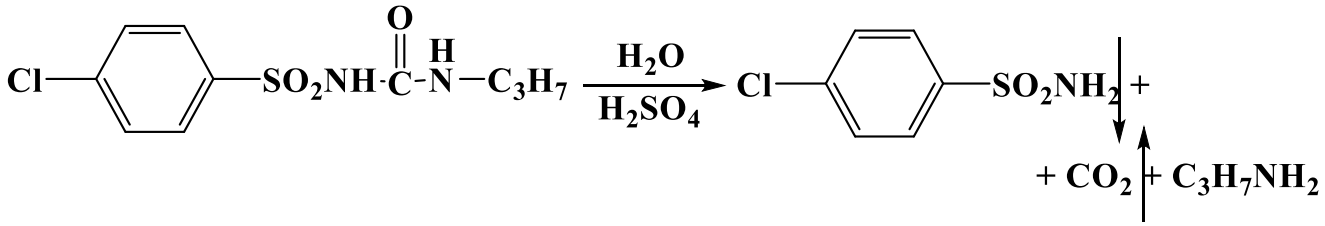


2. The presence of sulfur and chlorine in chlorpropamide is established after mineralization by fusion with a mixture of potassium carbonate and potassium nitrate. Sulfates and chlorides are determined in the filtrate:

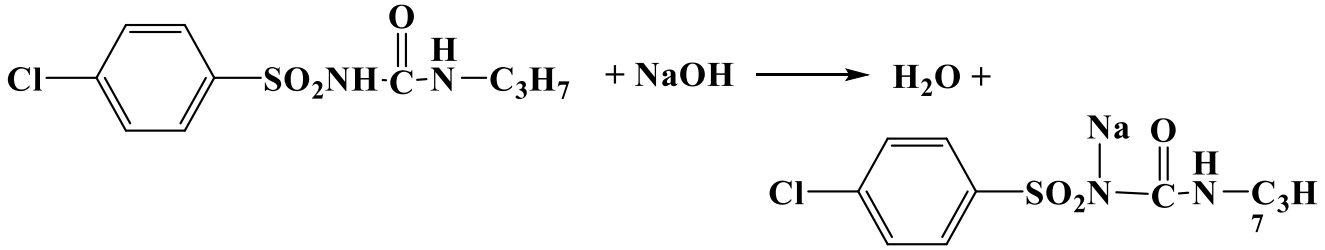




3. Chlorpropamide is heated under reflux with a 50% solution of sulfuric acid. After cooling, a precipitate of p-chlorobenzenesulfamide with a melting point of 143–144 °C is formed:



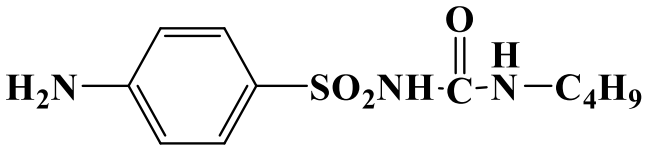
Quantitative definition. Alkalimetry, direct titration in alcohol neutralized with thymolphthalein, which is the quantification indicator:



Storage. In a sealed container.

Application. Antidiabetic agent.

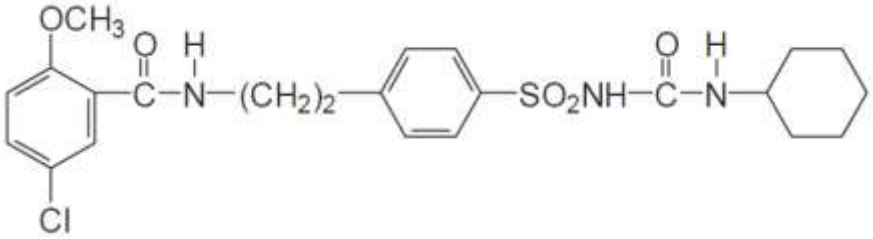
Bucarban- Bucarbanum
Carbutamide



N-(*n*-aminobenzenesulfonyl)-*N*′-butylurea

Application. Antidiabetic agent.

Glibenclamide - Glibenclamidum (SPhU)
Maninil, Daonil



1-[[4-[2-[(5- chloro -2- methoxybenzoyl) amino] ethyl] phenyl] sulfonyl] -3-cyclohexylurea

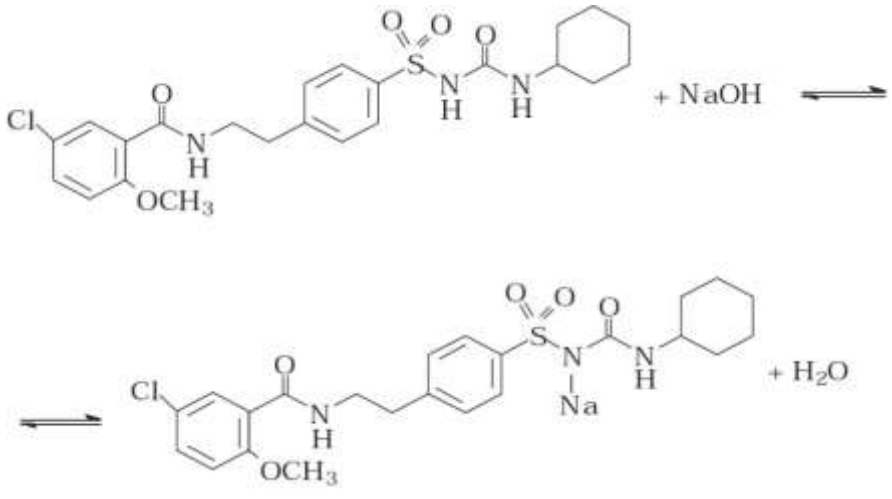
Properties. Crystalline powder of white or almost white color. Practically insoluble in water, moderately soluble in methylene chloride, sparingly soluble in 96% alcohol and methanol.

Identification:

1. Physico-chemical methods: melting point, UV and IR spectroscopy, thin-layer chromatography.

2. The solution of the substance in sulfuric acid should be colorless and show blue fluorescence in UV light. With further addition of chloral hydrate, the color of the solution should change to dark yellow with a brownish tint.

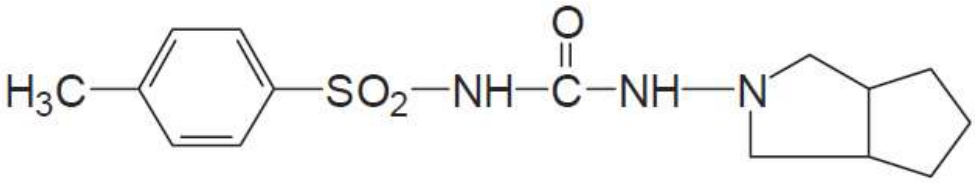
Quantitative definition. Alkalimetry in an alcoholic medium, direct titration, indicator – phenolphthalein:



Storage. In a sealed container.

Application. Unlike the previous means, it has a higher hypoglycemic activity (the effect is achieved in much smaller doses), is quickly absorbed and is relatively well tolerated.

Predian – Predianum



1-(3- Azabicyclo[3,3,0]-oct-3-yl)-3-(p-tolylsulfonyl)-urea

Application. Antidiabetic agent; prescribed to diabetics who suffer from obesity.

5. SORBENTS, ANTIDOTES, COMPLEXONS

Sodium thiosulfate (Natrii thiosulfas)

$Na_2S_2O_3 * 5H_2O$

Extraction. Oxidation of polysulfides:

$$2CaS_2 + 3O_2 \rightarrow 2CaS_2O_3$$

$$CaS_2O_3 + Na_2SO_4 \rightarrow Na_2S_2O_3 + CaSO_4$$

Properties. Crystals are colorless, transparent. In dry air, it weathers, in wet air, it blurs a little. Very easily soluble in water, practically insoluble in 96% alcohol.

Identification:

1. The substance decolorizes the iodized potassium iodide solution:

$$K[I_3] + 2Na_2S_2O_3 \rightarrow KI + 2NaI + Na_2S_4O_6$$

2. When an excess of argentum nitrate is added to the drug substance, a white precipitate is formed, which quickly turns yellowish, then black:

$$Na_2S_2O_3 + 2AgNO_3 \rightarrow Ag_2S_2O_3\downarrow + 2NaNO_3$$

$$\downarrow 2Ag_2S_2O_3 \rightarrow Ag_2SO_3\downarrow + S\downarrow$$

$$Ag_2SO_3 + S + H_2O \rightarrow Ag_2S\downarrow + H_2SO_4$$

3. When hydrochloric acid is added to the substance, a sulfur precipitate is formed and a gas is released, which turns the iodine-starch paper blue:

$$Na_2S_2O_3 + 2HCl \rightarrow 2NaCl + SO_2\uparrow + S\downarrow + H_2O$$

$$5SO_2 + 2KIO_3 \rightarrow I_2 + 4SO_3 + K_2SO_4$$

4. The substance gives characteristic reactions to the sodium cation:

A) According to the requirements of the SPhU, the sodium cation is determined using a solution of potassium pyroantimonate (potassium hexahydroxystibiate), resulting in the formation of a white precipitate.

$$Na^+ + K[Sb(OH)_6] \rightarrow Na[Sb(OH)_6]\downarrow + K^+.$$

When heating the investigated solution with potassium pyroantimonate, a supersaturated solution can be obtained, therefore, to create a crystallization center, the solution is cooled in ice water and the walls of the test tube are rubbed with a glass rod.

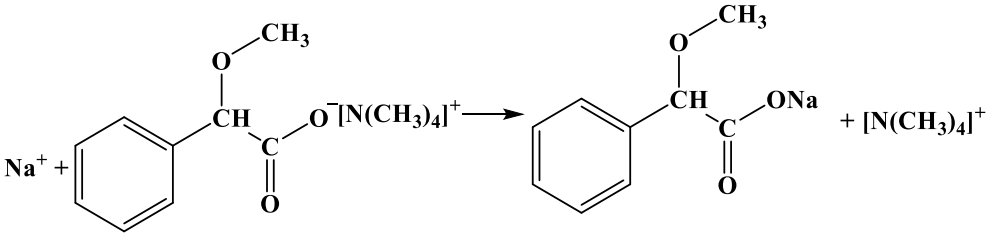
The reaction should be carried out in a slightly alkaline environment, since in an acidic environment potassium pyroantimonate decomposes with the formation of a white amorphous precipitate of metaantimonic (metaantimony) $HSbO_3$ acid:

$$K[Sb(OH)_6] + HCl \rightarrow HSbO_3 \cdot 3H_2O\downarrow + KCl$$

To remove NH4+ ions, which interfere with the determination, the test solution is preheated with a potassium carbonate solution to boiling (at the same time, an alkaline reaction of the medium is created):

$$2NH_4^+ + K_2CO_3 \rightarrow 2K^+ + (NH_4)_2CO_3\downarrow$$

B) Sodium salts with the reagent of methoxyphenylacetic acid in chilled ice water form a white crystalline precipitate that does not disappear at room temperature:



Confirmation of the formation of a precipitate of the sodium salt of methoxyphenylacetic acid is its ability to dissolve in a diluted ammonia solution.

C) Sodium salt is wetted with concentrated hydrochloric acid to form volatile sodium salts, which color the colorless flame of the burner yellow:

B) In addition, there is a non-pharmacopoeial reaction with zincuranyl acetate $Zn(UO_2)_3(C_2H_3O_2)_8$ - a greenish-yellow crystalline precipitate is observed that has the shape of tetrahedra or octahedra.

$Na^+ + Zn(UO_2)_3(C_2H_3O_2)_8 + CH_3COO^- + 9H_2O = NaZn(UO_2)_3(C_2H_3O_2)_9 \cdot 9H_2O$

Quantitative definition.

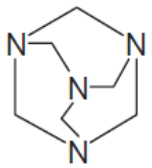
1. Iodometry, direct titration, indicator - starch:

$$\mathbf{Na_2S_2O_3 + I_2 \rightarrow 2NaI + Na_2S_4O_6}$$

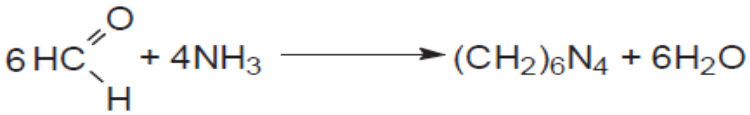
Storage. In a sealed container.

Application. Detoxifying, desensitizing agent.

Hexamethylenetetramine (Hexamethylentetraminum)
Urotropin (Urotropinum)
Methenaminum



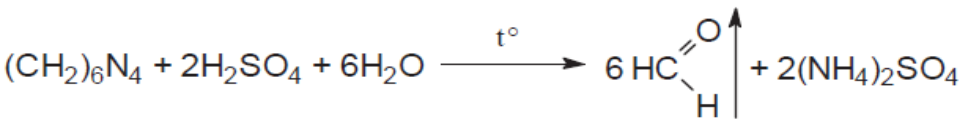
Extraction. The interaction of formaldehyde solution with ammonia:



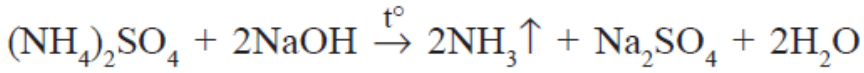
Properties. Colorless crystals or white crystalline powder without odor, burning and sweet, and then bitter taste. Easily soluble in water and alcohol, soluble in chloroform.

Identification:

1. The smell of formaldehyde after acid hydrolysis:



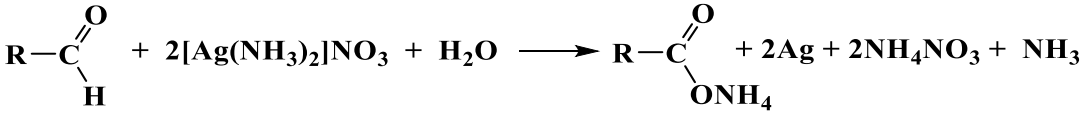
With the subsequent addition of sodium hydroxide, ammonia is released:



Reactions to formaldehyde:

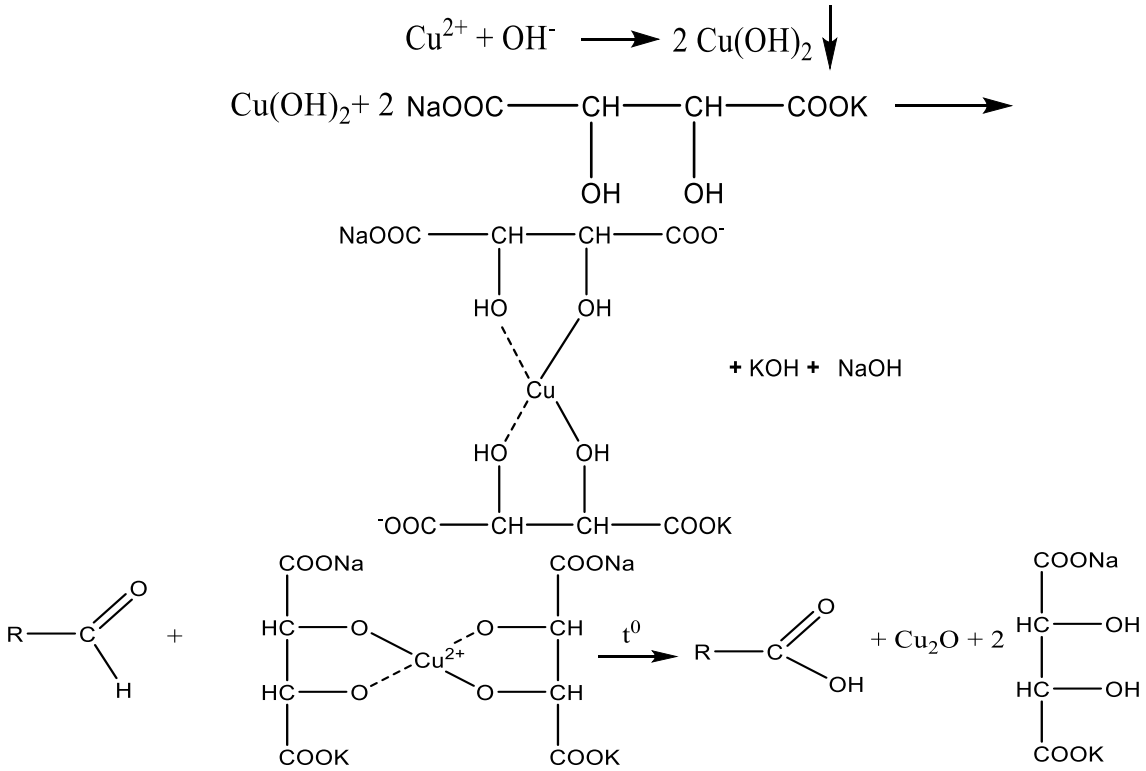
1. Oxidation reactions. For the qualitative determination of aldehydes, Tollens reagent (ammonia solution of silver nitrate), Fehling's reagent (a solution of copper (II) sulfate with a potassium-sodium tartrate solution), Nessler's reagent (potassium tetraiodomercurate (II)) is used:

• reaction of the "Silver Mirror":

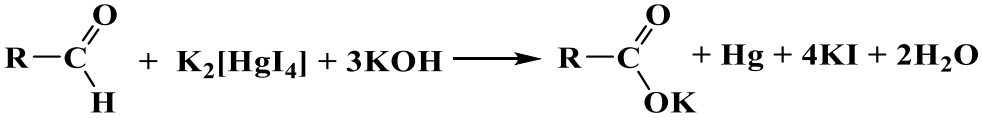


Aldehydes reduce silver from Tollens' reagent, which is deposited on walls of the test tube in the form of a mirror layer, or forms gray precipitate.

• Reaction with Fehling's reagent resulting in the formation of a brick-red precipitate of copper oxide (I)

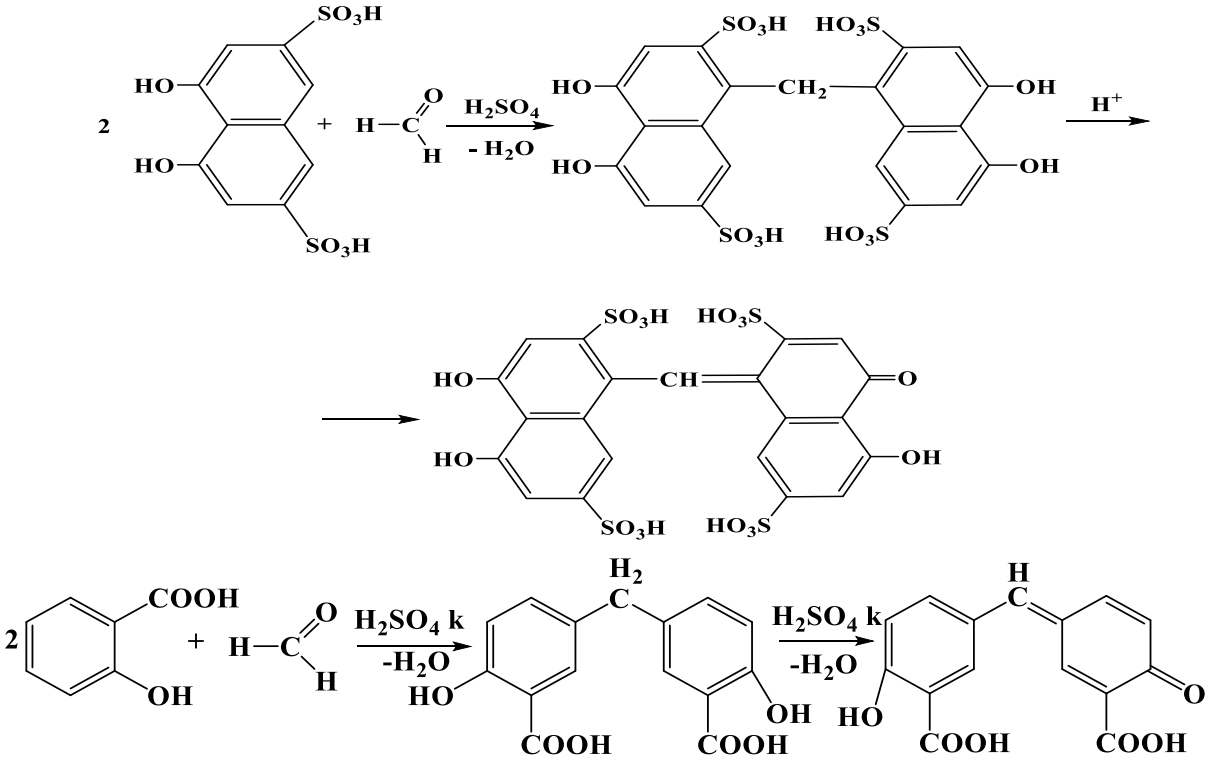


• With Nessler's reagent, as a result of the reduction of the reagent, a black precipitate of metallic mercury is released:

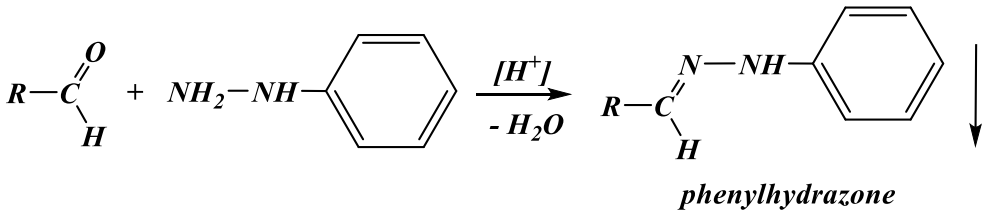


2. Aldehydes enter into a condensation reaction with phenols (salicylic acid, chromotropic acid, resorcinol, thymol, phenol, and others), forming colored compounds aurin dyes.

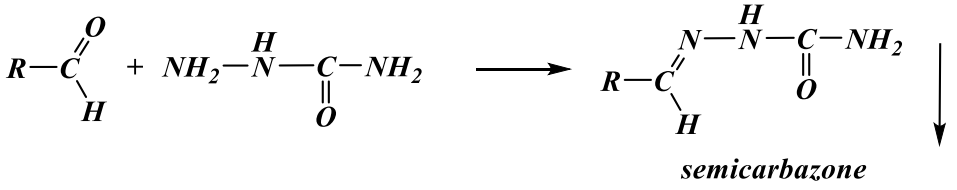
When interacting with the sodium salt of chromotropic acid in the presence of concentrated sulfuric acid, a violet-blue or violet-red color is formed:



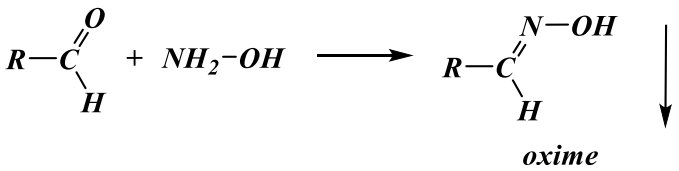
3. Substitution reaction with amines (aliphatic, aromatic, heterocyclic). Substituted hydrazine is most often used, while hydrazones, semicarbazide and oxime appear. All the listed compounds have a certain melting point:



phenylhydrazone

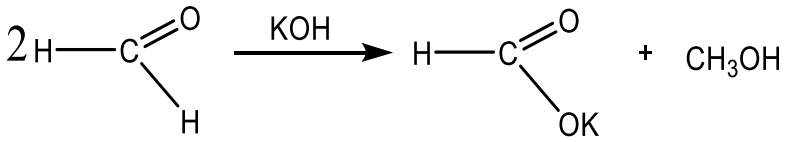


semicarbazone

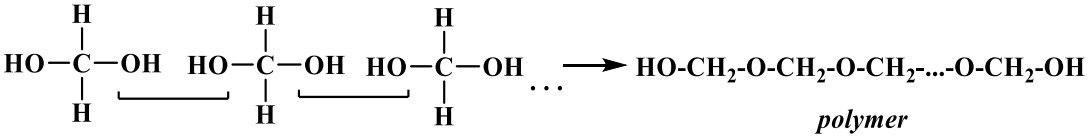


oxime

4. The Cannizzaro-Tishchenko reaction in the presence of a concentrated alkali leads to the simultaneous formation of an acid and an alcohol. It is characteristic of aldehydes that do not have a hydrogen atom in the alpha position relative to the carboxyl group:

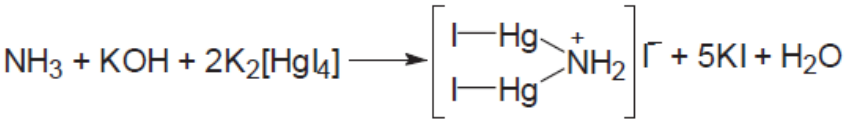


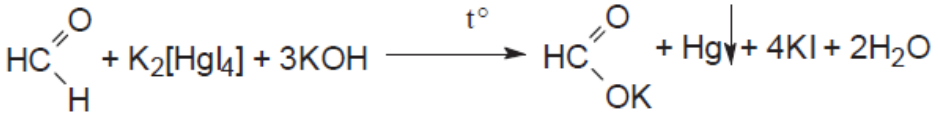
5. The ability of aldehydes to polymerize, which can occur in an aqueous solution through the hydrated form, is taken into account when storing aldehyde solutions. The formed polymer is an impurity that reduces the pharmacological effect of the drug. For example, an admixture of paraform in a formaldehyde solution:



Purity test.

Paraform and ammonium salts are determined by heating with an alkaline solution of potassium tetraiodomercurate (Nessler's reagent) - no yellow color or turbidity should appear:

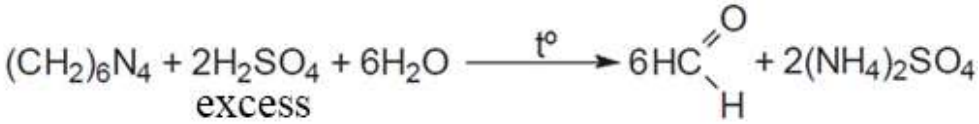




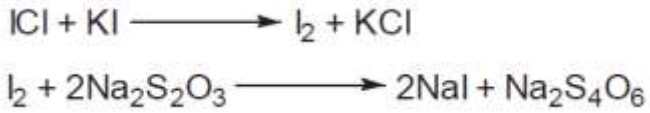
Quantitative definition.

1. Acidimetry, direct titration, mixed indicator - methylene orange and methylene blue:

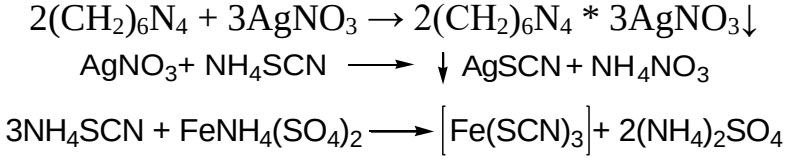
2. Reverse acidimetry, indicator - methyl red:



3. Iodine chlorometry, reverse titration, starch indicator.



4. Argentometry, reverse titration according to the Volhard method, iron (III) ammonium sulfate indicator.



LESSON No. 1

TOPIC: Derivatives of 8-oxyquinoline, quinoxaline and nitrofuran. Characteristics, classification, relationship between structure and pharmacological action. Mechanism of action, methods of extraction, methods of analysis. Application in medicine.

PURPOSE: To study the classification, mechanism of action, as well as methods of standardization of drugs, derivatives of 8-oxyquinoline, quinoxaline and nitrofuran.

3. TARGETS:

3.1. To know the classification of drugs derived from 8-oxyquinoline, quinoxaline and nitrofuran and be able to give an example for each section of the classification;

3.2. To know the Latin name, synonyms, structure, chemical name, physical and chemical properties of drugs of this group;

3.3. To study all possible identification reactions and methods of quantitative determination of drugs related to derivatives of 8-oxyquinoline, quinoxaline and nitrofuran;

3.4. To explain the conditions of storage and use in medical practice of antihistamines.

4. TASKS FOR STUDENTS' SELF-PREPARATION:

4.1. Repeat the theoretical material from the course of inorganic, organic and analytical chemistry, regarding all possible methods of identification and quantification of drugs, derivatives of 8-oxyquinoline, quinoxaline and nitrofuran;

4.2. Prepare for the lesson according to the questions listed below.

EDUCATIONAL QUESTIONS FOR STUDENTS' SELF-PREPARATION:

1. Study the classification of drugs, derivatives of 8-oxyquinoline, quinoxaline and nitrofuran.

2. Study the mechanism of action of drugs, derivatives of 8-oxyquinoline, quinoxaline and nitrofuran.

3. Be able to analyze drugs of this group (Latin, Ukrainian, chemical name; chemical formula; description; extraction methods; all possible methods of identification; all possible methods of quantitative determination) on the example of nitroxoline, furacilin, furadonin, furazolidone.

TEST TASKS

1. According to the chemical structure, the antiseptic drug furatsilin belongs to:

A. Nitrofuran derivatives

B. Derivatives of 8-oxyquinoline

C. Derivatives of polyatomic alcohols

D. Chlorine-containing compounds

E. Isonicotinic acid derivatives

2. The general reagent for the identification of drugs - derivatives of 5-nitrofuran, when heated with which an intense color is observed, is:

A. Sodium sulfide

B. Sodium nitroprusside

C. Sodium hydroxide

D. Sodium chloride

E. Sodium sulfate

3. Which of the drugs contains a residue of semicarbazid in its structure?

A. Furadonin

B. Furacilin

C. Furazolidone

D. Furagin

E. Furosemide

4. The pharmacist determines the quantitative content of nitrofural. What titrimetric method of quantification does he use?

A. Iodometry

B. Permanganatometry

C. Alkalimetry

D. Argentometry

E. Nitritometry

5. A substance with the chemical name 5-nitro-8-hydroxyquinoline was obtained for analysis. What drug substance does this name correspond to?

A. Nitroxoline

B. Nitrazepam

C. Hinocid

D. Nitrofurantoin

E. Hingamin

6. A broad-spectrum antibacterial drug, the active ingredient of which chemically belongs to 8-oxyquinoline derivatives, was released from the hospital pharmacy to the urology department. What drug was released from the pharmacy?

A. Potassium permanganate

B. Oxylidine

C. Oxaphenamide

D. Nitroxoline

E. Chinocidum

7. During the identification of nitroxolin, a reaction was carried out, as a result of which a black-green color appears. What reagent was used?

A. Iron(III) chloride solution

B. Sodium hydroxide solution

C. Copper(II) sulfate solution

D. Nessler's reagent

E. Rhodanbromide reagent

8. The nitroxoline substance is analyzed for the quantitative content of the active substance by the method of alkalimetry in a non-aqueous medium. What titrant and indicator are used in this case?

A. Perchloric acid solution, crystalline violet

B. Sodium methylate solution, thymol blue

C. Sulfuric acid solution, naphtholbenzene

D. Sodium hydroxide solution, crystal violet

E. Potassium hydroxide solution, fluorescein

9. The presence of phenolic hydroxyl in the quinosol structure can be confirmed by the reaction with:

A. Diazo reagent or with diazotized primary aromatic amines

B. Concentrated sulfuric acid

C. Chloroacetic acid

D. p-dimethylaminobenzaldehyde

E. Sodium edetate

10. To confirm the presence of sulfate ion in the drug substance "Quinozol", the pharmacist of the pharmacy uses the following reagents:

A. Barium chloride solution and hydrochloric acid

B. A solution of ammonium chloride and ammonia

C. A solution of silver nitrate and nitric acid

D. Benzene sulfonic acid solution

E. Diphenylamine solution

11. The pharmacist identifies the substance quinozole sulfate. With the help of which reagent does he confirm the presence of sulfate ion in the substance under study?

A. Potassium permanganate

B. Sodium hydroxide

C. Barium chloride

D. Ammonium bromide

E. Zinc oxide

12. The presence of sulfate ion in drugs is detected by a solution of barium chloride in the presence of:

A. Dilute hydrochloric acid

B. Concentrated hydrochloric acid

C. Concentrated nitric acid

D. Dilute phosphoric acid

E. Dilute nitric acid

13. The presence of phenolic hydroxyl in the structure of nitroxolin can be confirmed using a solution of:

A. Sodium nitrite

B. Potassium permanganate

C. Sodium sulfate

D. Silver nitrate

E. Iron(III) chloride

14. Nitroxoline substance was received for analysis. When it interacts with a solution of ferrum(III) chloride, a blue-violet color is formed, which indicates the presence in its structure of:

A. Phenolic hydroxyl

B. Complex ether group

C. Keto groups

D. Aldehyde group

E. Alcoholic hydroxyl

15. When conducting a pharmaceutical analysis of nitroxoline, it is identified by its reaction with:

A. Potassium ferrocyanide

B. Silver nitrate

C. Barium chloride

D. Iron(III) chloride

E. Ammonium oxalate

16. Choose a reagent that can be used to confirm the presence of an aromatic nitro group in the structure of the drug substance:

A. Sodium hydroxide

B. Magnesium sulfate

C. Bromine water

D. Calcium chloride

E. Iron(III) chloride

17. What reagent should a pharmacist use to confirm the presence of an aromatic nitro group in the structure of drug substances (furacilin, furadonin, etc.)?

A. Hydrochloric acid

B. Copper(II) sulfate solution

C. Sodium hydroxide solution

D. Antipyrine

E. Hydrogen peroxide solution

18. What are the starting compounds in the synthesis of nitrofuran (furacilin)?

A. 5 nitrofurfural, semicarbazide
B. 5-nitrofurfurolacrolein diacetanil
C. 5-nitrofurfurol, thiosemicarbazide
D. 1-aminohydantoin
E. thiosemicarbazide

19. Nitrofural (furacilin), furazolidone, furadonin - drugs of the nitrofuran series. With which solution is the reaction of the formation of colored products used for their identification?

A. sodium chloride
B. acetic acid
C. sodium hydroxide
D. ammonium rhodanide
E. chromotropic acid

20. The pharmacist in the pharmacy conducts an express analysis of nitrofuran (furacilin) solution. Furacilin belongs to medicinal substances of the nitrofuran series. With which solution is the reaction of the formation of colored products used to identify these compounds?

A. sodium hydroxide
B. acetic acid
C. ammonium thiocyanate (rhodanide)
D. sodium chloride
E. chromotropic acid

21. Nitrofuran solution was taken to the control and analytical laboratory for analysis. It is necessary to choose the simplest and fastest method of quantitative determination of this dosage form. A method of quantitative determination of nitrofuran was chosen, according to which a solution of sodium hydroxide is added to its solution, which leads to the formation of a product colored in orange-red color. Such a procedure is necessary as a preliminary when determining by the method:

A. nitritometry
B. photocolorimetry
C. gravimetry
D. refractometry
E. polarimetry

22. Derivatives of 5-nitrofurfural (nitrofuran, furadonin, furazolidone) have a pharmacological effect:

A. antimicrobial
B. choleretic

C. antispasmodic
D. diuretic
E. hemostatic

23. The pharmacist of the control and analytical laboratory determines the quantitative content of nitrofuran. What titrimetric method of quantitative determination can he use?

A. alkalimetry
B. argentometry
C. nitritometry
D. permanganatometry
E. iodometry

24. Quantitative determination of the nitrofuran (furacilin) substance is carried out by the spectrophotometric method. The pharmacist can calculate its quantitative content by measuring:

A. optical density
B. melting point
C. rotation angle
D. refractive index
E. pH of the solution

25. The analyst determines the quantitative content of nitrofuran. What titrimetric method of quantitative determination can he use?

A. permanganatometry
B. iodometry
C. alkalimetry
D. argentometry
E. nitritometry

26. According to the chemical structure, the antiseptic drug furatsilin belongs to:

A. nitrofuran derivatives
B. 8-oxyquinoline derivatives
C. derivatives of polyatomic alcohols
D. chlorine-containing compounds
E. a derivative of isonicotinic acid

TASKS

1. Calculate the percentage content of nitrofural (furacilin) (M.m. 198.14) in the preparation, if 2.84 ml of 0.01 M sodium thiosulfate solution (Kp = 0.9700) was used for titration of an excess of 0.005 M iodine solution. The weight of the sample is 0.0986 g, and the titrant volume in the control experiment is 4.85 ml; taking into account the dilution, the volume of the measuring flask is 500 ml; the volume of the pipette is 5 ml.

2. Calculate the concentration of nitrofural (furacilin) (M.m. 198.14) in the preparation, if 3.15 ml of 0.01 M sodium thiosulfate solution (Kp = 1.0100) was spent on titration of an excess of 0.005 M iodine solution. The percentage content of the active substance is 100%, and the volume of the titrant in the control experiment is 5.05 ml; taking into account the dilution, the volume of the measuring flask is 500 ml; the volume of the pipette is 5 ml.

LABORATORY WORK

When performing laboratory work, it is necessary to strictly observe the safety rules of work in a chemical laboratory.

Each student individually conducts an analysis of the dosage form, which will include drugs derived from 8-oxyquinoline, quinoxaline, and nitrofuran, and also prepares a protocol according to the requirements.

Nitrofural

Nitrofuralum

Furacilin

M.m. 198.1

$C_6H_{6N4}0_4$

Nitrofural contains not less than 97.0% and not more than 103.0% of semicarbazone 5-nitro-2-furaldehyde, in terms of dry matter.

Properties

Description. Yellow or brownish-yellow crystalline powder.

Solubility. Very slightly soluble in water, slightly soluble in 96% alcohol, practically insoluble in ether.

Identification

First identification: B.

Second identification: A. C, D.

A. Tests are conducted in a place protected from bright light.

The ultraviolet absorption spectrum (2.2.25) of the solution prepared as specified in the "Quantitative determination" section in the region from 220 nm to 400 nm should have two maxima at wavelengths of 260 nm and 375 nm. The ratio of the optical density at the maximum at the wavelength of 375 nm to the optical density at the maximum at the wavelength of 260 nm should be from 1.15 to 1.30.

B. The infrared absorption spectrum (2.2.24) of the substance obtained in the disks must correspond to the spectrum of the Pharmacopoeia standard sample of nitrofural.

C. The determination is carried out by the method of thin-layer chromatography (2.27), using silica gel q as a thin layer.

Test solution. 10 mg of the substance is dissolved in methanol and the volume of the solution is brought up to 10 ml with the same solvent.

Comparison solution. 10 mg of a pharmaceutical standard sample of nitrofural is dissolved in methanol and the volume of the solution is brought up to 10 ml with the same solvent.

5 μl (5 μg) of the tested solution and 5 μl (5 μg) of the comparison solution are applied to the starting line of the chromatographic plate. The plate is placed in a chamber with a mixture of methanol R - nitromethane R (10:90) solvents. When the solvent front passes 15 cm from the starting line, the plate is removed from the chamber, dried in air and sprayed with a solution of phenyl hydrazine hydrochloride.

The chromatogram of the test solution should show a main spot at the level of the main spot on the chromatogram of the comparison solution, which corresponds to it in size and color.

Dissolve about 1 mg of the substance in 1 ml of dimethylformamide P and add 0.1 ml of alcoholic potassium hydroxide solution P; a purple-red color appears.

Purity test

pH (2.2.3). From 5.0 to 7.0.

100 ml of carbon dioxide-free water, P, is added to 1.0 g of the substance, shaken and filtered.

Concomitant impurities. Determination is carried out by the method of liquid chromatography (2.2.29).

Test solution. 0.10 g of the substance is dissolved in the mobile phase and the volume of the solution is brought up to 100.0 ml with the mobile phase.

Comparison solution (a). 10.0 mg of (5-nitro-2-furyl)methylene diacetate is dissolved in the mobile phase and the volume of the solution is brought up to 20.0 ml with the mobile phase. 1.0 ml of the obtained solution is brought to a volume of 100.0 ml with the mobile phase.

Comparison solution (b). 10 mg of a pharmaceutical standard sample of nitrofural and 10 mg of nitrofurantoin are dissolved in the mobile phase and the volume of the solution is brought up to 100 ml with the mobile phase. 5 ml of the resulting solution is brought to a volume of 100 ml with the mobile phase.

Chromatography is carried out on a liquid chromatograph with a UV detector under the following conditions: a stainless steel column measuring 0.25 m x 4.6 mm, filled with octadecylsilyl silica gel for P chromatography with a particle size of 5 μm;

mobile phase: acetonitrile R - water R (40:60);

speed of mobile phase 1 ml/min;

detection at a wavelength of 310 nm.

Chromatograph 20 μl of the comparison solution (a). The sensitivity of the recording device is adjusted so that the height of the main peak is at least 50% of the scale of the recording device.

Chromatograph 20 μl of the comparison solution (b).

The chromatographic system is considered suitable if the separation factor of nitrofurantoin and nitrofural peaks is at least 2.0.

20 μl of the tested solution and 20 μl of the comparison solution (a) are alternately chromatographed. The time of chromatography should be 10 times longer than the retention time of nitrofural, which is about 3 minutes.

On the chromatogram of the tested solution, the area of any peak, except the main one, should not exceed the area of the main peak on the chromatogram of the comparison solution (a) (0.5%); the sum of the areas of all peaks, except the main one, should not exceed 2 areas of the main peak on the chromatogram of the reference solution (a) (1.0%). Peaks whose area is less than 0.05 of the area of the main peak on the chromatogram of the comparison solution (a) are not taken into account.

Loss in mass during drying (2.2.32). No more than 0.5%. 1,000 g of substance is dried at a temperature from 100°C to 105°C

Sulfated ash (2.4.14). No more than 0.1%. The determination is carried out with 1.0 g of the substance.

Quantitative definition

Tests are carried out in a place protected from bright light. 60.0 mg of the substance is dissolved in 20 ml of dimethiformamide and the volume of the solution is brought to 500.0 ml with water. 5.0 ml of the obtained solution is made up to a volume of 100.0 ml with water. Similarly, a comparison solution is prepared using 60.0 mg of a pharmaceutical standard sample of nitrofural.

The optical density (2.2.25) of the obtained solutions is measured at a maximum at a wavelength of 375 nm.

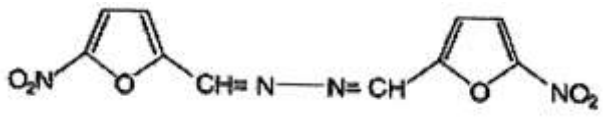
The content of $C_6H_6N_40_4$ is calculated based on the values of the optical densities and concentrations of the solutions.

Storage

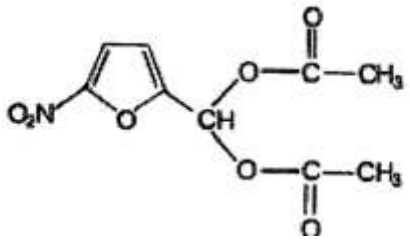
In a tightly closed container, in a place protected from light.

Impurities

A. 5- nitro-2-furaldehydezine



(5- nitro-2-furyl)methylene diacetate



Tabulettae Furacilini 0,02 ad usum externum

Furacilin tablets 0.02 g for external use

Ingredients for one tablet:

Furacilin 0.02 g

Sodium chloride 0.8 g

Description. Yellow or greenish-yellow tablets.

Identification. 1.2 g of the powder of crushed tablets gives the identity reactions indicated in the article “Furacillinum”.

0.1 g of powder of crushed tablets is dissolved in 10 ml of water, 0.5 ml of diluted nitric acid and 0.5 ml of silver nitrate solution are added; a white cheesy precipitate is formed.

Quantitative definition

About 0.8 g (exactly weighed) of the powder of crushed tablets is placed in a measuring flask with a capacity of 100 ml. Add 70 ml of water, dissolve at 70-80 in a water bath until a clear solution is obtained. The cooled solution is brought up to the mark with water, mixed well and further determined as indicated in the article "Furacillinum".

1 ml of 0.01 M iodine solution corresponds to 0.0004954 g of $C_6H_6N_40_4$, which should be 6.018-0.022 g, considering the average weight of one tablet.

One tablet (exactly weighed) is dissolved in water in a measuring flask; with a capacity of 100 ml, bring the volume of the solution up to the mark with water. 10 ml of the resulting solution is titrated with vigorous shaking with a 0.1 M solution of silver nitrate to an orange-yellow color (indicator - potassium chromate).

1 ml of 0.1 M silver nitrate solution corresponds to 0.005345 NaCI, which should be 0.76-0.84 g, considering the average weight of one tablet.

Storage. List B. In a place protected from light.

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LESSON No. 2

TOPIC: Anti-tuberculosis drugs. Characteristics, classification, relationship between structure and pharmacological action. Mechanism of action, methods of extraction, methods of analysis. Application in medicine.

PURPOSE: To study the classification, mechanism of action, as well as methods of standardization of anti-tuberculosis drugs.

TARGETS:

3.1. To learn the Latin names, synonyms, structural formulas, chemical names of the studied drug substances;

3.2. To study the physical and physico-chemical properties of drugs, derivatives of isonicotinic acid (isoniazid, ftivazid, metazide, saluzid, PASK, Bepask, etc.).

3.3. To study the structure of normative and technical documentation, quality control methods and quality indicators that are included in them;

3.4. To study methods of identification of drug substances of this group based on their physical and chemical properties;

3.5. To study methods of quantitative determination of studied drug substances;

3.6. To study the application, form of release, storage of drug substances;

3.7. To determine general and specific impurities;

3.8. To carry out calculations of weight, gram, percentage content;

3.9. To give a correct assessment of the obtained results of the analysis and draw a conclusion about the benign quality of drug substances of this group.

TASKS FOR STUDENTS' SELF-PREPARATION:

1. Chemical structure, Latin chemical names, synonyms of the studied drugs: isoniazid, ftivazid, metazid, saluzid, PASK, Bepask, etc.

2. Methods of obtaining the studied drugs.

3. Characterize the physical and chemical properties of drugs of this group.

4. Substantiate the chemical essence of methods of identification of drugs of this group.

5. Explain the origin and definition of specific impurities: hydrazide of isonicotinic acid and formaldehyde in metazide, vanillin and hydrazide of isonicotinic acid in ftivazide.

6. Based on chemical properties, justify the possible methods of quantitative analysis of the studied substances. Illustrate the answer with chemical reactions.

7. Know modern ideas about the mechanism of tuberculostatic action of isonicotinic acid derivatives. Dosage of drugs.

8. Release form, dosage, indications for use of the studied drugs. Based on the physical and chemical properties, justify the storage of drugs of the studied group.

TEST TASKS

1. The chemical name "3-methyl-4-oxybenzylidene hydrazide of nicotinic acid hydrate" corresponds to the substance:

A. Ftivazide

B. Metazid

C. Isoniazid

D. Saluzidum

E. Nicodinum

2. The chemical name "Isonicotinoyl hydrazide" corresponds to the substance:

A. Metazid

B. Ftivazide

C. Isoniazid

D. Saluzidum

E. Cordiamine

3. When one of the listed drug substances is heated with diluted hydrochloric acid, the smell of vanillin appears:

A. Ethacridine lactate

B. Isoniazid

C. Metazide

D. Quinazoline

E. Ftivazide

4. When determining the benign quality of ftivazide, a specific admixture is determined:

A. Benzoic acid

B. Vanillin

C. β-chloroethyl urethane

D. Formaldehyde

E. Timol

5. The technological scheme for obtaining ftivazide at the plant requires control of finished products for the absence of specific impurities. One of these impurities can be:

A. Pyridine

B. Isoniazid

C. 3-pyridinecarboxylic acid

D. Sodium nitrite

E. Sodium hydroxide

6. Which of the compounds is used as a reagent for the pyridine cycle:

A. Copper sulfate

B. Ammonium rhodanide

C. 2,4-dinitroaminobenzene

D. Cobalt nitrate

E. 2,4-dinitrochlorobenzene (in alcohol)

7. Derivatives of which drugs with a heterocyclic structure give a positive reaction with 2,4-dinitrochlorobesol?

A. Pyridine

B. Oxazol

C. Furan

D. Thiophene

E. Thiazol

8. For the antibacterial therapy of tuberculosis, the pharmacy of the phthisiatric sanatorium received the following drugs: ftivazid, saluzid, metazid. According to their chemical structure, these drugs are derivatives of:

A. 8-oxyquinoline

B. Isonicotinic acid hydrazide

C. Amide of sulfanilic acid

D. Barbituric acid

E. Ethyl ether of para-aminosalicylic acid

9. The substance of isoniazid was received in the drug quality control laboratory. In order to identify the substance, the laboratory specialist used the "silver mirror" reaction. This reaction confirms the presence of the substance under study in the molecule:

A. Hydrazide group

B. Pyridine cycle

C. Aldehyde group

D. Amino groups

E. Carboxyl group

10. While identifying isoniazid, the pharmacist boiled the substance with 2,4-dinitrochlorobenzene. As a result, a yellow color was formed, which changes to purple, and then to brown-red, when the alkali solution is added. The analytical effect of the reaction is explained by the formation of an aldehyde derivative:

A. Glutacon

B. Glucone

C. Glutamine

D. Glyoxal

E. Hexane

11. A batch of isoniazid tablets of 0.2 g was received in the pharmacy of the anti-tuberculosis dispensary. Chemically, which acid derivative does the indicated medicine belong to?

A. 3-aminosalicylic acid

B. p-aminobenzoic

C. 4-pyridinecarbon

D. 2-hydroxypropane

E. γ-chlorobutyric acid

12. One of the following anti-tuberculosis drugs is not an isonicotinoyl hydrazide derivative:

A. Pyrazinamide

B. Saluzide

C. Ftivazide

D. Isoniazid

E. Metazid

13. Indicate which of the reagents listed below must be added to isoniazid in order to form a blue color and a precipitate, which, when heated, acquires a light green color and the evolution of gas is observed:

A. Solution of copper (II) sulfate

B. Argentum nitrate solution

C. Alkali solution

D. Hydrochloric acid solution

E. Ferrum (III) chloride solution

14. The pharmacist released from the pharmacy a synthetic anti-tuberculosis drug, the active ingredient of which is chemically hydrazide of 4-pyridinecarboxylic acid. What drug did the pharmacist release?

A. Soluble saluzide

B. Gammalon

C. Saluzide

D. Isoniazid

E. Rifampicin

15. Restorative properties of isoniazid are due to the presence in its structure of:

A. Hydrazine residue

B. Excess of hydroxyquinoline

C. Vanillin

D. Formaldehyde

E. Carboxyl group

16. The pharmacist performs the identification of the isoniazid substance in accordance with the requirements of the SphU according to the melting point of the yellow precipitate obtained when interacting with the solution of:

A. Vanillin

B. Hydroxyquinoline

C. Sodium nitroprusside

D. Potassium bromide

E. Ammonium thiocyanate

17. What method is used for the quantitative determination of the antituberculosis drug isoniazid in accordance with the requirements of the SPhU?

A. Reverse bromatometry

B. Direct bromatometry

C. Direct iodometry

D. Reverse iodometry

E. Direct acidimetry

18. The pharmacist conducts the quantitative determination of isoniazid by the method of direct bromatometry [using a titrated solution of potassium bromate, a solution of potassium bromide, hydrochloric acid and the indicator methyl red]. This method is based on the reaction of:

A. Oxidation of the hydrazide group with bromine

B. Reduction of the hydrazine residue with bromine

C. Oxidation of the hydrazine residue with potassium bromide

D. Opening of the pyridine cycle

E. Oxidation of isonicotinic acid with potassium bromate

19. The quantitative determination of isoniazid by the iodometric method is based on its ability to:

A. Oxidation

B. Recovery

C. Complex formation

D. Electrophilic substitution

E. Decarboxylation

20. Which medicine corresponds to the chemical name "3-methoxy-4-oxybenzylidene hydrazide of isonicotinic acid hydrate"?

A. Nicotinamide

B. Adrenaline tartrate

C. Ftivazide

D. Caffeine monohydrate

E. Pyridoxine hydrochloride

21. The technological scheme for obtaining Ftivazide requires control of finished products for the absence of specific impurities. One of these impurities can be:

A. Free meadow

B. Pyridine

C. Pyridine-3-carboxylic acid

D. Sodium nitrite

E. Isoniazid

22. What specific impurity is determined during the quality control of the Ftivazide substance?

A. Vanillin

B. Benzoic acid

C. Phthalic anhydride

D. Formaldehyde

E. Thymol

23. What drug can be identified by the acid reaction
hydrolysis?

A. Ftivazide

B. Nicotinamide

C. Pyridoxine hydrochloride

D. Ascorbic acid

E. Isoniazid

24. What substances are formed during acid hydrolysis of Ftivazide?

A. Isoniazid, pyridine

B. Isoniazid, imidazole

C. Imidazole, benzaldehyde

D. Isoniazid, vanillin

E. Formaldehyde, pyridine

25. When heating which of these substances with dilute hydrochloric acid, the smell of vanillin is felt?

A. Furazolidone

B. Ftivazide

C. Phthalylsulfathiazole (phthalazole)

D. Metamizole sodium (Analgin)

E. Calcium lactate

26. A solution of alkali is added to the alcohol solution of Ftivazide, as a result of which the light yellow color changes to orange-yellow. Upon further addition of hydrochloric acid, the solution becomes light yellow again, and then orange-yellow. What properties of Ftivazide does this reaction confirm?

A. Amphoteric

B. Acidic

C. Oxidizing

D. Restorative

E. Basics

27. The ability of ftivazide to easily dissolve in aqueous alkali solutions is due to the presence in its structure of:

A. Pyridine cycle

B. Phenolic hydroxyl

C. Methoxyl group

D. Azomethine fragment

E. Complex ether connection

28. For the quantitative determination of ftivazid, the method of acidimetry, non-aqueous titration is used. In this case, the substance is dissolved in solvent (1) and a solution of substance (2) is used as a titrant:

A. Diethyl ether (1), sodium edetate (2)

B. Dimethylformamide (1), sulfuric acid (2)

C. Acetic acid anhydrous (1), perchloric acid (2)

D. Perchloric acid (1), anhydrous acetic acid (2)

E. Hydrochloric acid (1), sodium nitrite (2)

29. When certifying the Bepask substance, the pharmacist must identify the cation of:

A. Calcium

B. Potassium

C. Sodium

D. Iron (III)

E. Magnesium

30. The drug "Bepask" [Bepascum] contains Ca2+ cations. Name the method suitable for its quantitative determination after preliminary mineralization:

A. Complexonometry

B. Alkalimetry

C. Acidimetry

D. Argentometry

E. Permanganatometry

31. Indicate which substance is the starting point for the synthesis of sodium para-aminosalicylate:

A. *m*-nitrophenol

B. *p*-nitrobenzoic acid

C. *p*-phenetidine

D. *o*-anisidine

E. *p*-nitrophenol

32. Indicate which set of reagents is used by a pharmacist to confirm the presence of an amino group in the structure of sodium p-aminosalicylate:

A. Sodium nitrite, solution of hydrochloric acid, alkaline solution of β-naphthol

B. Sodium chloride, solution of hydrochloric acid, alkaline solution of β-naphthol

C. Copper sulfate, hydrochloric acid solution, phenol solution

D. Sodium thiosulfate solution, hydrochloric acid solution, resorcinol solution

E. Sodium nitrite, sodium hydroxide, alkaline β-naphthol solution

33. The formation of a colored product with lignin in the presence of concentrated sulfuric acid is characteristic of:

A. Sodium salicylate

B. Chloral hydrate

C. Hexamethylenetetramine

D. Sodium paraaminosalicylate

E. Sodium benzoate

34. The pharmacopoeial method of quantitative determination of sodium paraaminosalicylate is the method of:

A. Acidimetry in an aqueous environment

B. Nitritometry

C. Alkalimetry in a non-aqueous environment

D. Alkalimetry in an aqueous environment

E. Argentometry

35. The most appropriate method of determining Bepask is:

A. Argentometry

B. Non-aqueous titration

C. Complexonometry

D. Mercurimetry

E. Permanganatometry

TASKS:

1. In the iodometric determination of isoniazid (M.m. 137.14), an excess of 0.05 M iodine solution after the reaction with 0.1063 g of the drug was titrated with 18.53 ml of 0.1 M sodium thiosulfate solution (Kp = 1.0000) The volume of the control experiment was 49.25 ml. What is the content of isoniazid (%) in the preparation?

2. Calculate the volume of a 0.1 M perchloric acid solution (Kp = 1.0023), which will be spent on the titration of 0.1487 g of ftivazid (M.m. 271.28), if the content of the active substance in the preparation is 99, 15%, the volume of the control experiment was 0.12 ml, and the weight loss during drying was 4.35%.

3. Calculate the weight of isoniazid (M.m. 137.14), if 9.96 ml of 0.1 M perchloric acid solution (Kp = 0.9998) was used for its titration, and the percentage content of the drug is 100.01%.

4. In the iodometric determination of ftivazide (M.m. 271.28), 11.02 ml of 0.05 M iodine solution was used for the titration of 0.1002 g of the drug (Kp = 1.0012). Calculate the percent content of ftivazide (%) in the drug?

5. Calculate the percentage content of sodium para-aminosalicylate (M.m. 211.15) in the preparation, if 10.49 ml of 0.1 M sodium nitrite solution (Kp = 1.0018) was spent on the titration of a weight of 0.2256 g.

6. Calculate the mass of the Bepask sample (M.m. 642.6) if 10.09 ml of 0.05 M sodium edetate solution (Kp = 1.0025) was spent on its titration; and the percentage content of Bepask in the preparation is 100,2.

LABORATORY WORK.

When performing laboratory work, it is necessary to strictly follow the rules of safe work in a chemical laboratory.

Each student individually conducts an analysis of the quality of one of the above drug substances in accordance with the requirements of the State Pharmacopoeia or other documentation using the graphological structure of the analysis.

Educational and research work of students: Each student solves the question of one of the studied drug substances as an unknown based on physicochemical properties. In addition, he/she carries out quantitative determination of the analyzed drug substances according to the State Pharmacopoeia, as well as by other methods and gives a comparative description of methods of quantitative determination.

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LESSON No. 3

TOPIC: Antiseptic and disinfectants. Characteristics, classification, relationship between structure and pharmacological action. Mechanism of action, methods of extraction, methods of analysis. Application in medicine.

2. PURPOSE: To study the classification, mechanism of action, as well as standardization of antiseptic and disinfectant drugs.

3. TARGETS:

3.1. To study the characteristics and classification of antiseptic and disinfectant drugs;

3.2. To study the relationship between the structure and pharmacological action of antiseptic and disinfectant drugs;

3.3. To study the mechanism of action of antiseptic and disinfectant drugs;

3.4. Learn the Latin names, synonyms, structural formulas, chemical names of the studied drug substances (iodine, potassium permanganate, hydrogen peroxide, boric acid, zinc sulfate, ethyl alcohol, furacilin, formaldehyde, phenol, resorcinol, salicylic acid, chloramine, pantocid, ethacridine lactate) ;

3.5. To study the physical and physico-chemical properties of antiseptic and disinfectant drugs;

3.6. To study the structure of the analytical regulatory documentation, the quality control methods and the quality indicators that are included in them;

3.7. To determine general and specific impurities;

3.8. To carry out calculations of weight, gram, percentage content;

3.9. To study methods of identification of drug substances of this group based on their physical and chemical properties;

3.10. To study methods of quantitative determination of studied drug substances;

3.11. To study the application, form of release, storage of drug substances;

3.12. To give a correct assessment of the obtained results of the analysis and draw a conclusion about the benign quality of drug substances of this group.

EDUCATIONAL QUESTIONS FOR STUDENTS' SELF-PREPARATION

1. Characteristics and classification of antiseptic and disinfectant drugs.

2. Relationship between the structure and pharmacological action of antiseptic and disinfectant drugs.

3. Mechanism of action of drugs of this group.

4. Chemical structure, Latin names, synonyms of drugs of this group (iodine, potassium permanganate, hydrogen peroxide, boric acid, zinc sulfate, ethyl alcohol, furacilin, formaldehyde, phenol, resorcinol, salicylic acid, chloramine, pantocid, ethacridine lactate).

5. Methods of obtaining the researched drugs.

6. Characterize the physical and chemical properties of drugs of this group based on their structure.

7. Identification of drugs in accordance with the requirements of the SPhU. Chemism of reactions, conditions for their implementation.

8. Methods of quantitative determination, conditions and chemism of reactions.

9. Application in medicine.

10. To substantiate the conditions of storage of preparations of this group of drugs, based on their physical and chemical properties.

TEST TASKS:

1. Common reactions to boron drugs are:

A. formation of a complex ester with methanol (ethanol) in the presence of concentrated sulfuric acid

B. reaction with sodium cobaltinitrite

C. reaction with hydrochloric acid

D. reaction with potassium pyroantimonate

E. reaction with sodium hydroxide

2. Which alcohol solution burns with a flame with a green border (in the presence of sulfuric acid):

A. sodium bicarbonate

B. boric acid

C. calcium chloride

D. hydrochloric acid

3. In which of the drugs acid properties increase when glycerin or mannitol is added:

A. sodium bicarbonate

B. boric acid

C. hydrochloric acid

D. concentrated ammonia solution

E. sodium chloride

4. The pharmacist added diethyl ether and a few drops of potassium dichromate solution to the hydrogen peroxide solution acidified with sulfuric acid. After shaking, the ether layer became colored in:

A. blue color

B. red color

C. green color

D. purple color

E. yellow color

5. Hydrogen peroxide solution is identified when interacting with:

A. sulfuric acid
B. potassium sulfate in an acidic medium
C. potassium dichromate in an acidic medium
D. iron (III) chloride
E. copper sulfate

6. What should a chemist of the Technical Control Department of a pharmaceutical enterprise use as a titrant when performing quantitative determination of hydrogen peroxide:

A. potassium permanganate solution
B. sodium hydroxide solution
C. oxalic acid solution
D. trilon B solution (sodium edetate)
E. potassium bromate solution

7. Permanganatometric determination is carried out in an acidic environment. What acid should the chemist of the Technical Control Department of the pharmaceutical enterprise use?

A. sulfur
B. hydrogen chloride
C. nitrogen
D. vinegar
E. an ant

8. The pharmacist fixes the equivalence point in the permanganatometric method f hydrogen peroxide titration using:

A. excess drop of titrant (potassium permanganate)
B. litmus paper
C. bromophenol blue
D. metal indicators
E. phenolphthalein

9. When using starch as an indicator during the titration of drugs with sodium thiosulfate solution, the following appears:

A. yellow color
B. blue color
C. green color
D. purple color
E. yellow sediment

10. According to the requirements of the SPhU, identification of potassium permanganate is carried out based on its recovery:

A. hydrogen peroxide in an alkaline medium

B. sodium sulfate
C. sodium nitrate in an acidic environment
D. ethanol in an acidic environment
E. methanol in an alkaline environment

11. During the identification of the potassium permanganate substance, the pharmacist added one of the reagents recommended by the State Pharmacopoeia of Ukraine to detect the potassium cation, and a yellow precipitate fell out:

A. sodium cobalt nitrite solution in acetic acid
B. oxalic acid solution
C. solution of sodium sulfide in hydrochloric acid
D. sodium bicarbonate solution
E. sodium hydroxide solution

12. During the identification of the potassium permanganate substance, the pharmacist added one of the reagents recommended by the State Pharmacopoeia of Ukraine to identify the potassium cation, and a white precipitate fell out:

A. tartaric acid solution
B. sodium bicarbonate solution
C. sodium sulfide solution
D. sodium thiosulfate solution
E. sodium citrate solution

13. The potassium cation (K+) in the drug can be identified using the following reagents:

A. 20% solution of tartaric acid in the presence of sodium carbonate; cobalt nitrite solution, acetic acid; the colorless flame of the burner turns purple
B. 8-oxyquinoline
C. sodium hexacyanoferrate (III).
D. ammonium oxalate
E. zincuranyl acetate

14. One of the drug substances cannot be used as a titrated solution:

A. iodine
B. potassium permanganate
C. hydrogen peroxide
D. sodium thiosulfate
E. sodium nitrite

15. Determination of impurities of chlorides and bromides in crystalline iodine is based on:

A. different solubility of silver halides in water
B. different solubility of silver halides in nitric acid
C. different solubility of silver halides in ammonia solution

D. different reducing properties of chlorides, bromides and iodides

E. on the oxidation of chlorides and bromides

16. In accordance with the requirements of the State Pharmacopoeia of Ukraine, the quantitative determination of crystalline iodine is carried out using a titrated solution of:

A. sodium nitrite

B. potassium permanganate

C. potassium iodate

D. potassium dichromate

E. sodium thiosulfate

17. When using starch as an indicator during the titration of drugs with a 0.05M iodine solution, the following appears:

A. yellow color

B. blue color

C. green color

D. purple color

E. yellow sediment

18. Depending on the conditions of the redox reaction, the permanganate ion can be reduced to Mn^{2+}, Mn^{4+}, MnO_4^{2-}. What environment is necessary for the permanganate ion to be reduced to Mn^{2+}?

A. sour

B. weakly alkaline

C. neutral

D. alkaline

E. weakly acidic

19. Under what conditions should crystalline iodine be stored?

A. in glass jars with rubbed corks, in a cool place protected from light

B. in glass jars with rubber stoppers

C. in paper bags

D. in glass jars with cork stoppers

E. in iron containers

20. The titrant of the "Complexonometric titration" method, in accordance with the requirements of the SPhU, is:

A. sodium edetate solution (disodium salt of ethylenediaminetetraacetic acid)

B. hydrochloric acid solution

C. sodium hydroxide solution

D. potassium permanganate solution

E. sodium thiosulfate solution

21. What causes the color change of the solution at the equivalence point during direct complexometric titration?

A. by changing the pH of the reaction medium
B. destruction of the complex metal - trilon B (sodium edetate)
C. selection of the free form of the indicator
D. by changing the chemical structure of the indicator
E. decarboxylation of trilon B molecule (sodium edetate)

22. The chemist of the technical control department of the pharmaceutical enterprise fixes the equivalence point in complexonometry using:

A. paper impregnated with lead acetate
B. redox indicators
C. indicatorless method
D. iodine starch paper
E. metal indicators

23. To identify the aldehyde group in the structure of drugs, the pharmacist needs to conduct a reaction:

A. iodoform sample
B. indoenol sample
C. esterification
D. restoration
E. "Silver Mirror"

24. Based on the presence of an aldehyde group in the structure of the drug substance, which exhibits reducing properties, the pharmacist of the pharmacy proves its presence by a reaction with:

A. salts of divalent iron
B. potassium iodide solution
C. sodium hydroxide solution
D. a solution of p-dimethylaminobenzaldehyde in concentrated sulfuric acid
E. ammonia solution of silver nitrate

25. To identify the carbonyl of aldehyde or ketone groups, which are very often structural fragments of drugs, a control and analytical laboratory specialist uses a reaction with:

A. 2,4-dinitrochlorobenzene
B. hydroxylamine hydrochloric acid
C. sodium hydroxide
D. ninhydrin
E. acetic anhydride

26. The presence of aldehyde or ketone groups in the drug is confirmed by the reaction with:

A. potassium hydroxide
B. haloalkanes
C. glacial acetic acid
D. aromatic acids
E. primary aromatic amines

27. Determining the aldehyde group in the structure of the drug substance, the chemist of the pharmaceutical enterprise conducts a reaction with:

A. Nessler's or Fehling's reagents
B. hydrochloric acid
C. ammonium rhodanide solution
D. Marquis reagent
E. zinc uranyl acetate solution

28. It is possible to identify drug substances containing an aldehyde group in the structure by carrying out a condensation reaction (formation of auric dye). What reagents does the pharmacist-analyst use:

A. Marquis reagent
B. Dragendorff reagent
C. salicylic acid in the presence of concentrated sulfuric acid
D. ethyl alcohol in the presence of hydrochloric acid
E. ammonia solution of silver nitrate

29. Which reaction is not used when determining the aldehyde group in medicinal preparations:

A. azo compound
B. with Tollens' reagent
C. with Fehling's reagent
D. with Nessler's reagent
E. with primary aromatic amines

30. To determine the authenticity of the formaldehyde solution, the chemist of the control and analytical laboratory conducts a reaction with an ammonia solution of silver nitrate. At the same time, the following is observed:

A. appearance of green staining
B. precipitation of a dark gray precipitate
C. appearance of yellow staining
D. precipitation of a red precipitate
E. the appearance of a blue color

31. Choose the reagent that is most often used in pharmaceutical analysis to confirm the presence of phenolic hydroxyl in the structure of drugs:

A. solution of iron (III) chloride
B. potassium iodide solution

C. 2,4-dinitrochlorobenzene solution
D. hydroxylamine solution
E. sodium bicarbonate solution

32. To identify resorcinol according to the SPhU, the pharmacist uses the following reagents: concentrated sodium hydroxide solution and chloroform. What reaction product is formed?

A. aurine dye
B. indophenol dye
C. azomethine dye
D. diazo dye
E. oxyketone dye

33. Which of the following methods is used for quantitative determination of phenol and resorcinol:

A. bromatometry (back titration)
B. alkalimetry
C. gravimetry
D. complexonometry
E. nitritometry

34. Indicate which of the reagents is used to confirm the presence of sodium ion in sodium salicylate:

A. cobalt chloride
B. copper sulfate
C. silver nitrate
D. potassium permanganate
E. potassium pyroantimonate

35. A positive reaction to drugs from the phenol group (phenol, resorcinol) is an indophenol test. Specify the reagents necessary for its conducting:

A. reducing agent, ammonia solution
B. oxidizer, ammonia solution
C. hydrochloric acid, potassium bromide
D. formaldehyde, concentrated sulfuric acid
E. ammonia buffer solution, acid chrome dark blue

36. To identify phenolic hydroxyl in the chemical structure of drugs, the pharmacist must conduct a reaction with:

A. phosphoric acid
B. sulfuric acid
C. bromine water
D. barite water
E. perchloric acid

37. In the control and analytical laboratory to establish the authenticity of drug substances from the group of phenols (phenol, resorcinol), the pharmacist uses:

A. hydrochloric acid solution
B. sodium hydroxide solution
C. bromine water
D. Nessler's reagent
E. ammonia solution of silver nitrate

38. What are the starting compounds in the synthesis of nitrofuran (furacilin)?

A. 5-nitrofurfurol, semicarbazide
B. 5-nitrofurfurolacrolein diacetanil
C. 5-nitrofurfural, thiosemicarbazide
D. 1-aminohydantoin
E. thiosemicarbazide

39. Nitrofural (furacilin), furazolidone, furadonin - drugs of the nitrofuran series. With which solution is the reaction of the formation of colored products used for their identification:

A. sodium chloride
B. acetic acid
C. sodium hydroxide
D. ammonium rhodanide
E. chromotropic acid

40. The pharmacist in the pharmacy conducts an express analysis of nitrofuran (furacilin) solution. Furacilin belongs to drug substances of the nitrofuran series. To identify these compounds, the reaction of the formation of colored products with the solution is used:

A. sodium chloride
B. acetic acid
C. ammonium thiocyanate (rhodanide)
D. sodium hydroxide
E. chromotropic acid

7. TASKS

1. Calculate the weight of boric acid (M.m. 61.83), if 32.11 ml of 0.1 M sodium hydroxide solution (Kp = 0.9990) was spent on its titration, and its percentage content is 99.80%

2. During the quantitative determination of the hydrogen peroxide substance (M.m. 36.00) weighing 1.0000 g, 12.3 ml of a 0.02 M potassium permanganate solution (Kp = 1.0000) was used for the titration, taking into account the dilution (vol. of the measuring flask - 100.0 ml, volume of the pipette - 10.0 ml). Does the content of H_2O_2 meet the requirements of the SPhU.

3. Calculate the volume of 0.1 M sodium thiosulfate solution (Kp = 1.0012), which will be spent on the titration of 0.2016 g of iodine (Atm = 126.90), if its percentage content in the substance is 99.60%.

4. Calculate the weight of potassium permanganate (M.m. 158.04), if 23.68 ml of 0.1 M (Kp - 1.0000) sodium thiosulfate solution in the presence of potassium iodide and sulfuric acid is spent on its titration; its percentage content in the substance is 99.80%.

5. Calculate the weight of zinc sulfate (M.m. 287.54), if 10.36 ml of 0.05 M sodium edetate solution (trylon B Kp = 1.0000) was spent on its titration, and its percentage content in the preparation is 99.8%.

6. Calculate the percentage content of formaldehyde (M.m. 30.03) in the solution, if 7.54 ml of a 0.1 M solution of sodium thiosulfate was spent on the titration of 1.0216 g of the drug by oxidizing it with iodine in an alkaline medium (Kp = 0. 9980); volume of 0.05 M iodine solution - 20 ml, Kp = 1.0000; the volume of the measuring flask is 100 ml, the volume of the pipette is 5 ml.

7. Calculate the mass of resorcinol (M.m. 110.11), if 17.78 ml of 0.1 M sodium thiosulfate solution (Kp = 1.0000) was spent on its titration; volume of titrant in the control experiment - 39.48 ml; and the percentage content of resorcinol is 99.5%; taking into account the dilution, the volume of the measuring flask is 100 ml; pipette volume - 20 ml.

8. Calculate the percentage content of nitrofural (furacilin) (M.m. 198.14) in the preparation, if 2.84 ml of 0.01 M sodium thiosulfate solution (Kp = 0.9700) was spent on the titration of an excess of 0.005 M iodine solution. The weight of the sample is 0.0986 g, and the titrant volume in the control experiment is 4.85 ml; taking into account the dilution, the volume of the measuring flask is 500 ml; the volume of the pipette is 5 ml

When performing laboratory work, it is necessary to strictly follow the rules of safe work in a chemical laboratory.

Each student individually conducts an analysis of the quality of one of the above drug substances in accordance with the requirements of the State Pharmacopoeia or other documentation using the graphological structure of the analysis.

The student studies the received pharmacopoeial article:

HYDROGENII PEROXIDUM 3%

РОЗЧИН ВОДНЮ ПЕРОКСИДУ 3%

HYDROGEN PEROXIDE SOLUTION 3%

H_2O_2

A 3% hydrogen peroxide solution contains at least 2.5% (m/m) and no more than 3.5% H_2O_2 (M.m. 34.01). One volume of solution corresponds to approximately 10 times the volume of oxygen. A suitable stabilizer can be added.

Properties

Colorless transparent liquid (the student describes the properties of the obtained liquid).

Identification

0.2 ml of dilute sulfuric acid and 0.2 ml of 0.02 M potassium permanganate solution are added to 2 ml of the solution; the solution discolors or becomes slightly pink within 2 minutes.

0.2 ml (4 drops) of diluted sulfuric acid and 0.2 ml (4 drops) of 0.02 M potassium permanganate solution are added to 2 ml of the solution; discoloration of the solution is observed.

1 ml of diluted sulfuric acid, 2 ml of ether and 0.1 ml of potassium chromate solution are added to 0.5 ml of the solution, shaked; the ether layer is colored blue.

1 ml of diluted sulfuric acid, 2 ml of ether and 0.1 ml (2 drops) of potassium chromate solution are added to 0.5 ml of the solution, shaked; the ether layer is colored blue.

The solution must meet the requirements for H_2O_2 retention.

Purity test

Acidity. Add 20 ml of water and 0.25 ml (5 drops) of methyl red solution to 10 ml of solution. The color of the indicator should change when adding no less than 0.05 ml and no more than 1.0 ml of 0.1 M sodium hydroxide solution.

The student draws a conclusion about the permissible limits of acidity of the drug.

Organic stabilizers. 20 ml of the solution is successively shaken with 10 ml and with two portions of 5 ml each of chloroform. The combined chloroform extracts are evaporated under reduced pressure at a temperature not higher than 25 ° C, the resulting residue is dried in a desiccator. The mass of the residue should not exceed 5 mg (0.025%).

Dry residue. 10 ml of the solution is kept in a platinum cup until the release of gas bubbles completely stops, if necessary, it is cooled. The solution is evaporated to dryness in a water bath, the resulting residue is dried at a temperature from 100 °C to 105 °C. The mass of the residue should not exceed 20 mg (2 g/l).

Quantitative definition

10.0 g of the solution is brought to a volume of 100.0 ml with water. Add 20 ml of diluted sulfuric acid to 10.0 ml of the resulting solution and titrate with a 0.02 M potassium permanganate solution until a pink color appears.

1 ml of 0.02 M potassium permanganate solution corresponds to 1.701 mg of H2O2 or 0.56 ml of oxygen.

Performance of work:

The student calculates:

- Title;

- Estimated suspension calculated for 10 ml of 0.02M potassium permanganate solution.

In a 100 ml volumetric flask, place 5.0 ml of the solution (with a Mohr pipette) and bring it up to a volume of 100.0 ml with water. Place 10.0 ml of the resulting solution measured with a Mohr's pipette into a titration flask, add 20 ml of dilute sulfuric acid and titrate with a 0.02 M potassium permanganate solution until a pink color appears.

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Additional

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LESSON No.4

TOPIC: Antidiabetic drugs. Characteristics, classification, relationship between structure and pharmacological action. Mechanism of action, methods of extraction, methods of analysis. Application in medicine.

2. PURPOSE: to study the classification, mechanism of action, as well as standardization of antidiabetic drugs.

3. TARGETS:

3.1. To study the characteristics and classification of antidiabetic drugs;

3.1. To study the relationship between the structure and pharmacological action of antidiabetic drugs;

3.2. To study the mechanism of action of antidiabetic drugs;

3.3. Learn the Latin names, synonyms, structural formulas, chemical names of the studied drug substances;

3.4. To study the classification, mechanism of action, as well as standardization of antidiabetic drugs;

3.5. To study the structure of the analytical regulatory documentation, the quality control methods and the quality indicators that are included in them.

3.6. To determine general and specific impurities;

3.7. To calculate weight, gram, and percentage content;

3.8. To study methods of identification of drug substances of this group based on their physical and chemical properties;

3.9. To study methods of quantitative determination of studied drug substances;

3.10. To study the application, form of release, storage of drug substances;

3.11. Give a correct assessment of the obtained results of the analysis and draw a conclusion about the benign quality of drug substances of this group.

EDUCATIONAL QUESTIONS FOR STUDENTS' SELF-PREPARATION

1. Characteristics and classification of antidiabetic drugs.

2. The relationship between the structure and pharmacological action of antidiabetic drugs.

3. Mechanism of action of drugs of this group.

4. Chemical structure, Latin names, synonyms of drugs of this group (chlorpropamide, butamide, bucarban, glibenclamide, predian).

5. Methods of obtaining the researched drugs.

6. To characterize the physical and chemical properties of drugs of this group based on their structure.

7. Identification of drugs in accordance with the requirements of the SPhU. Chemism of reactions, conditions for their implementation.

8. Methods of quantitative determination, conditions and chemism of reactions.

9. Application in medicine.

10. Substantiate the conditions of storage of drugs of this group, based on their physical and chemical properties

6. TEST TASKS

1. To which group of drug substances according to their chemical structure do gliclazide, glibenclamide, butamide belong?

A. Derivatives of sulfonylureas

B. Isonicotinic acid thioamide derivatives

C. Benzodiazepine derivatives

D. Derivatives of diphenylmethane

E. Derivatives of p-aminobenzoic acid

2. The glibenclamide substance was sent to the control and analytical laboratory for analysis. In accordance with the requirements of the SPhU, the quantitative content of glibenclamide is determined by the method of:

A. Iodometry

B. Alkalimetry

C. Acidimetry

D. Bromatometry

E. Iodochlormetry

3. According to the chemical classification, which of the following drug substances belongs to alkylureides derivatives of sulfonic acids?

A. Chlorpropamide

B. Nitroxoline

C. Chloramine

D. Paracetamol

E. Isoniazid

4. In the identification of chlorpropamide, in accordance with the requirements of the SPhU, covalently bound chlorine is detected. This test is carried out after mineralization of the substance by reaction with the solution of:

A. Silver nitrate

B. Copper(II) sulfate

C. Ammonium chloride

D. Sodium edetate

E. Potassium pyroantimonate

5. In order to confirm the presence of a sulfo group in the structure of chlorpropamide, the substance under study is heated with a mixture of sodium carbonate and sodium nitrate. After that, the mineralization products should give a positive reaction with the following reagent:

A. Sodium sulfide

B. Ammonia with molybdate

C. Argentum nitrate

D. Barium chloride

E. Cobalt(II) chloride

6. When identifying chlorpropamide, tests are carried out using a barium chloride solution to detect sulfogroups in its structure. Before performing the specified test, the drug substance should be subjected to:

A. Mineralization

B. Hydrolysis

C. Decarboxylation

D. Sulfation

E. Esterification

7. Indicate which set of reagents is used in pharmaceutical analysis to confirm the presence of a primary aromatic amino group in the bucarban structure:

A. Sodium nitrite, solution of hydrochloric acid, alkaline solution of β-naphthol

B. Sodium chloride, solution of hydrochloric acid, alkaline solution of β-naphthol

C. Copper(II) sulfate, hydrochloric acid solution, phenol solution

D. Sodium nitrate, sodium hydroxide solution, alkaline β-naphthol solution

E. Sodium thiosulfate solution, hydrochloric acid solution, resorcinol solution

8. Which compound is most often used in pharmaceutical analysis as an azo component in azo coupling reactions with aryldiazonium salts?

A. Naphthysin

B. Naphthalene

C. β-Naphthol

D. Ninhydrin

E. Nitrobenzene

9. To determine which functional group, in accordance with the requirements of the SPhU, the following reagents are used: dilute hydrochloric acid, sodium nitrite solution, β-naphthol?

A. Primary aromatic amines

B. Alcoholic hydroxyl

C. Ester group

D. Aldehyde group

E. Phenolic hydroxyl

10. Reactions for the formation of azo dyes are widely used to identify drug substances derived from:

A. Heterocyclic compounds

B. Tertiary aromatic amines and alcohols

C. Phenols and aromatic alcohols

D. Primary aromatic amines and phenols

E. Nitro compounds and primary aliphatic amines

11. The pharmacist identifies the substance "Bucarban" by adding solutions of hydrochloric acid, sodium nitrite and β-naphthol to the drug. At the same time, an intense red color is formed. Indicate which functional group is being reacted with:

A. Primary aromatic amino group

B. Ester group

C. Sulfamide group

D. Carboxyl group

E. Aldehyde group

12. For the quantitative determination of derivatives of primary aromatic amines, the following are most often used:

A. Nitritometry

B. Iodometry

C. Titration in anhydrous medium

D. Argentometry

E. Iodochlorometry

13. For the quantitative determination of bucarban, titration with sodium nitrite is used, because its molecule contains:

A. Aldehyde group

B. Primary aromatic amino group

C. Carboxyl group

D. Carbonyl group

E. Hydroxyl group

14. A specialist of the Technical Control Department of a pharmaceutical enterprise carries out quantitative determination of the bucarban substance by the nitritometry method, using as an external indicator:

A. Iodostarch paper

B. Congo red paper

C. Blue litmus paper

D. Universal indicator paper

E. Red litmus paper

15. Quantitative determination of glibenclamide, according to the SPhU, is carried out by the method of alkalimetry in the environment of:

A. Ethyl alcohol

B. Lactic acetic acids

C. Acids of glacial acetic acid and acetic anhydride

D. Alcohol-chloroform mixture

E. Acetate buffer solution

7. TASKS:

1. Calculate the weight of the chlorpropamide sample (M.m. 276.74) if 19.23 ml of 0.1 M sodium hydroxide solution (Kp = 1.0025) was spent on its titration; and the percentage content of chlorpropamide in the preparation is 100.15%.

2. Calculate the gram content of chlorpropamide (M.m. 276.74) in tablets, if 15.32 ml of 0.1 M sodium hydroxide solution (Kp = 1.0018) was used for the titration of a weight of 0.3252 g. The average weight of the tablet is 0.3326 g.

3. Calculate the volume of 0.1 M sodium hydroxide solution (Kp = 1.0008) needed to titrate 0.2986 g of butamide (M.m. = 270.35), if its percentage content in the preparation is 99, 23%.

8. LABORATORY WORK

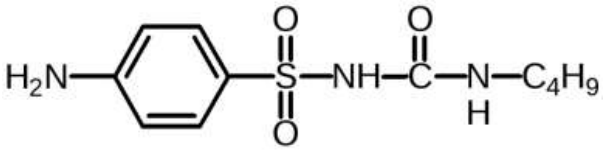
When performing laboratory work, it is necessary to strictly follow the rules of safe work in a chemical laboratory.

Each student individually conducts an analysis of the quality of one of the above drug substances in accordance with the requirements of the State Pharmacopoeia or other documentation using the graphological structure of the analysis.

Educational and research work of students: Each student solves the question of one of the studied drug substances as an unknown based on physicochemical properties. In addition, he/she carries out quantitative determination of the analyzed drug substances according to the State Pharmacopoeia, as well as by other methods and gives a comparative description of methods of quantitative determination.

Butamidum

Tolbutamidum



N- (-methylbenzenesulfonyl) -N'-butylurea

$C_{12}H_{18}N_2O_3S$ M. м. 270,35

Description. White crystalline powder without odor or with a very weak odor, slightly bitter taste.

Solubility. Practically insoluble in water, soluble in 95% alcohol, easily soluble in acetone and chloroform, slightly soluble in ether.

Identification. Add 5 ml of diluted sulfuric acid to 0.1 g of the drug and boil for 3 minutes, then carefully add 6 ml of 30% sodium hydroxide solution; oily drops of butylamine are formed on the surface, which has a characteristic smell.

0.2 g of the drug is mixed in a porcelain crucible with 0.5 g of the sintering mixture. The crucible is covered with a lid and the mixture is roasted for 15 minutes over low heat. After cooling, the contents of the crucible are dissolved in 5 ml of hydrochloric acid and filtered. Add 0.5 ml of barium chloride solution to the filtrate; a white crystalline precipitate is formed.

Add 40 ml of 50% sulfuric acid solution to 0.5 g of the drug and heat under reflux for 30 minutes. It is cooled in an ice bath, the crystals are filtered off, washed with water to a neutral reaction with methyl orange at 100-105 °C for 2 hours. The melting point of the obtained p-toluenesulfamide is 135-138 °C.

Melting point 126-130 °C.

Specific absorption index E\%см 405-435 at a wavelength of 226.5 nm (0.001% solution in 0.01 M sodium hydroxide solution).

Chlorides. 0.3 2 of the drug is shaken for 2 minutes with 30 ml of water and filtered. 10 ml of filtrate must pass the test for chlorides (no more than 0.02% in the preparation).

Sulfates. 10 ml of the same filtrate should not give a reaction to sulfates.

Weight loss during drying. About 0.5 g of the drug (exact weighing) is dried at 100-105°C to a constant weight. Weight loss should not exceed 0.5%.

Sulfate ash and heavy metals. Sulfated ash from 0.5 g of the preparation should not exceed 0.1% and should withstand the test for heavy metals (not more than 0.001% in the preparation).

Quantitative definition. Dissolve about 0.4 2 of the drug (exact weighing) in 20 ml of alcohol neutralized with thymolphthalein, add another 1 ml of thymolphthalein solution and titrate with 0.1 M sodium hydroxide solution to a blue color.

1 ml of 0.1 M sodium hydroxide solution corresponds to 0.02704 g of which the drug should contain at least 99.0%.

Storage. List B. In a well-closed container, in a dry place.

Higher single dose orally: 1,5 g.

Higher daily dose orally: 4,0 g.

Hypoglycemic (antidiabetic) agent.

Tabulettae Butamidi 0.25 aut 0.5

Butamide tablets 0.25 g or 0.5 g

Composition for one tablet:

Butamide - 0.25 g or 0.5 g

Sufficient amount of excipients.

Description. White tablets.

Identification. The powder of crushed tablets in the amount of 0.3 g gives the first and second identification reactions specified in the article “Butamidum”.

Quantitative definition. In the powder of crushed tablets in the amount of about 0.3 g (exact weighing), determination is carried out as indicated in the article “Butamidum”.

1 ml of 0.1 M sodium hydroxide solution corresponds to 0.02704 g $C_{12}H_{18}O_3S_2$, which, respectively, should be 0.238-0.262 g or 0.475-0.525 g, taking into account the average weight of one tablet.

Storage. List B.

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LESSON No.5

TOPIC: Sorbents, antidotes and complexons. Anti-ulcer drugs. Characteristics, classification, relationship between structure and pharmacological action. Mechanism of action, methods obtained, methods of analysis. Application in medicine.

2. PURPOSE: to study the classification, mechanism of action, as well as standardization of anti-ulcer drugs, as well as sorbents, antidotes and complexons.

3. TARGETS:

3.2. To study the characteristics and classification of anti-ulcer drugs, as well as sorbents, antidotes and complexes;

3.12. To study the relationship between the structure and pharmacological action of anti-ulcer drugs, as well as sorbents, antidotes and complexes;

3.13. To study the mechanism of action of anti-ulcer drugs, as well as sorbents, antidotes and complexes;

3.14. To learn the Latin names, synonyms, structural formulas, chemical names of the studied drug substances;

3.15. To study the physical and physico-chemical properties of anti-ulcer drugs, as well as sorbents, antidotes and complexes;

3.16. To study the structure of the analytical regulatory documentation, the quality control methods and the quality indicators that are included in them;

3.17. To determine general and specific impurities;

3.18. To carry out calculations of weights, grams, and percentages;

3.19. To study methods of identification of drug substances of this group based on their physical and chemical properties;

3.20. To study methods of quantitative determination of the studied drug substances;

3.21. To study the application, form of release, storage of drug substances;

3.22. To give a correct assessment of the obtained results of the analysis and draw a conclusion about the benign quality of drug substances of this group.

EDUCATIONAL QUESTIONS FOR STUDENTS' SELF-PREPARATION

1. Characteristics and classification of anti-ulcer drugs, as well as sorbents, antidotes and complexes.

2. The relationship between the structure and pharmacological action of anti-ulcer drugs, as well as sorbents, antidotes and complexes.

3. Mechanism of action of drugs of this group.

4. Chemical structure, Latin names, synonyms of drugs of this group (basic bismuth nitrate, aluminum hydroxide, hexamethylenetetramine, sodium thiosulfate).

5. Methods of obtaining the studied drugs.

6. Characteristics of the physical and chemical properties of drugs of this group based on their structure.

7. Identification of drugs in accordance with the requirements of the SPhU. Chemism of reactions, conditions for their conducting.

8. Methods of quantitative determination, conditions and chemism of reactions.

9. Application in medicine.

10. Substantiate the conditions of storage of drugs of this group, based on their physical and chemical properties.

6. TEST TASKS

1. To confirm the presence of bismuth ion in bismuth nitrate, reagents are mainly used:

A. thiourea, sodium sulfide
B. silver nitrate, nitric acid
C. potassium thiocyanate, hydrochloric acid
D. sodium cobaltinitrite, acetic acid
E. sodium nitrite, sulfuric acid

2. The titrant of the "Complexonometric titration" method, in accordance with the requirements of the SPhU, is:

A. sodium edetate solution (disodium salt of ethylenediaminetetraacetic acid)
B. hydrochloric acid solution
C. sodium hydroxide solution
D. potassium permanganate solution
E. sodium thiosulfate solution

3. What causes the color change of the solution at the equivalence point during direct complexometric titration?

A. by changing the pH of the reaction medium
B. destruction of the complex metal - trilon B (sodium edetate)
C. selection of the free form of the indicator
D. by changing the chemical structure of the indicator
E. decarboxylation of trilon B molecule (sodium edetate)

4. The chemist of the Technical Control Department of the pharmaceutical enterprise fixes the equivalence point in complexonometry using:

A. paper impregnated with lead acetate
B. redox indicators
C. indicatorless method
D. iodine starch paper

E. metal indicators

5. To identify the aldehyde group in the structure of drugs, the pharmacist-analyst needs to conduct a reaction:

A. iodoform sample
B. indoenol sample
C. "Silver Mirror"
D. restoration
E. esterification

6. Based on the presence in the structure of the drug substance of an aldehyde group, which exhibits reducing properties, the pharmacist of the pharmacy proves its presence by a reaction with:

A. salts of divalent iron
B. potassium iodide solution
C. sodium hydroxide solution
D. a solution of p-dimethylaminobenzaldehyde in concentrated sulfuric acid
E. ammonia solution of silver nitrate

7. To identify the carbonyl of aldehyde or ketone groups, which are very often structural fragments of medicinal products, a control and analytical laboratory specialist uses a reaction with:

A. 2, 4-dinitrochlorobenzene
B. hydroxylamine hydrochloric acid
C. sodium hydroxide
D. ninhydrin
E. acetic anhydride

8. The presence of aldehyde or ketone groups in the drug is confirmed by the reaction with:

A. potassium hydroxide
B. haloalkanes
C. glacial acetic acid
D. aromatic acids
E. primary aromatic amines

9. Determining the aldehyde group in the structure of the drug substance, the chemist of the technical control department of the pharmaceutical enterprise conducts a reaction with:

A. Nessler's or Fehling's reagents
B. hydrochloric acid
C. ammonium rhodanide solution
D. Marquis reagent
E. zinc uranyl acetate solution

10. It is possible to identify drug substances containing an aldehyde group in the structure by conducting a condensation reaction (formation of an auric dye). What reagents does the pharmacist use:

A. Dragendorff reagent
B. Marquis reagent
C. salicylic acid in the presence of concentrated sulfuric acid
D. ethyl alcohol in the presence of hydrochloric acid
E. ammonia solution of silver nitrate

11. A positive "silver mirror" reaction indicates the presence of chloral hydrate in the structure of:

A. aldehyde group
B. ester group
C. amide group
D. carboxyl group
E. nitro groups

12. Which reaction is not used when determining the aldehyde group in drugs:

A. with Nessler's reagent
B. with Tollens' reagent
C. with Fehling's reagent
D. azo compound
E. with primary aromatic amines

13. Indicate which of the listed methods is impossible to determine the quantitative content of hexamethylenetetramine (Urotropin, Urotropinum):

A. complexonometry (direct titration)
B. alkalimetry (back titration)
C. acidimetry (direct titration)
D. iodochlorometry (back titration)
E. argentometry (according to Volhard method)

14. Hexamethylenetetramine in the composition of powders can be identified by a pharmacist after boiling with dilute sulfuric acid by separating:

A. formaldehyde
B. sulfuric anhydride
C. carbon dioxide
D. nitrogen oxides
E. hydrogen chloride

15. Drug substances from the group of aldehydes can be quantitatively determined by the method of:

A. direct acidimetry
B. ion exchange chromatography

C. iodometry (inverse method)
D. iodometry (direct method)
E. non-aqueous titration

7. TASKS:

1. Calculate the volume of a 0.1 M solution of sodium edetate (trylon B Kp = 1.0000), which will be spent on the titration of 0.2230 g of basic bismuth nitrate (M.m. Bi2O3 - 465.66), if its percentage content in the drug - 80.0%.

2. Calculate the volume of 0.1 M sodium hydroxide solution (Kp = 1.0000), which will be spent on the titration of 0.1196 g of hexamethylenetetramine (M.m. 140.19) after hydrolysis in an acidic medium, if its percentage content in the preparation - 99.2%; volume of 0.05 M sulfuric acid solution - 50 ml; the volume of the titrant in the control experiment is 49.85 ml.

3. Calculate the mass of bismuth nitrate if 20.02 ml of 0.1 M sodium edetate solution (trilon B Kp = 1.0000) was spent on its titration (M.m. Bi_2O_3 465.66), and its percentage content in the preparation - 80.0%.

8. LABORATORY WORK

When performing laboratory work, it is necessary to strictly follow the rules of safe work in a chemical laboratory.

Each student individually conducts an analysis of the quality of one of the above drug substances in accordance with the requirements of the State Pharmacopoeia or other documentation using the graphological structure of the analysis.

Educational and research work of students: Each student solves the question of one of the studied drug substances as an unknown based on physicochemical properties. In addition, he/she carries out quantitative determination of the analyzed drug substances according to the State Pharmacopoeia, as well as by other methods and gives a comparative description of methods of quantitative determination.

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LESSON No. 6

TOPIC: "Control lesson on the section 2.3"

META: To form systematic knowledge of the theoretical basics and establish the benign quality of anti-tuberculosis, anti-diabetic, anti-ulcer, antiseptic and disinfectant agents, as well as sorbents, antidotes and complexes, derivatives of 8-oxyquinoline, quinoxaline and nitrofuran.

3. TARGET TASKS:

3.1. To check and consolidate theoretical knowledge and practical skills in determining the quality of anti-tuberculosis, anti-diabetic, anti-ulcer, antiseptic and disinfectant agents, as well as sorbents, antidotes and complexes, derivatives of 8-oxyquinoline, quinoxaline and nitrofuran;

3.2. To check the protocols of laboratory work and analyze the correctness of the course of analysis according to the requirements of the SPhU and other quality control methods (QCM).

4. CONTROL QUESTIONS OF THE LESSON

4.1. Characterization and classification of antituberculosis, antidiabetic, antiulcer, antiseptic, and disinfectant drugs, as well as sorbents, antidotes, and complexones, derivatives of 8-oxyquinoline, quinoxaline, and nitrofuran.

4.2. The mechanism of action of antituberculosis, antidiabetic, antiulcer, antiseptic, and disinfectant drugs, as well as sorbents, antidotes, and complexes, derivatives of 8-oxyquinoline, quinoxaline, and nitrofuran.

4.3. The relationship between the structure and pharmacological action of antituberculosis, antidiabetic, antiulcer, antiseptic, and disinfectant drugs, as well as sorbents, antidotes, and complexones, derivatives of 8-oxyquinoline, quinoxaline, and nitrofuran.

4.4. Analysis of drugs, derivatives of 8-oxyquinoline, quinoxaline and nitrofuran (Latin, Ukrainian, chemical name; chemical formula; description; extraction methods; all possible methods of identification; all possible methods of quantitative determination) on the example of nitroxoline, furacilin, furazolidone, furadonin.

4.5. Analysis of anti-tuberculosis drugs (Latin, Ukrainian, chemical name; chemical formula; description; extraction method; all possible methods of identification; all possible methods of quantitative determination) using the example of isoniazid, ftivazid, metazid, saluzid, PASK, Bepask.

4.6. Analysis of antiseptic and disinfectant drugs (Latin, Ukrainian, chemical name; chemical formula; description; method of extraction; all possible methods of identification; all possible methods of quantitative determination) on the example of iodine, potassium permanganate, hydrogen peroxide, boric acid, zinc sulfate, alcohol ethyl, furacilin, formaldehyde, phenol, resorcinol, salicylic acid, chloramine, pantocid, ethacridine lactate.

4.7. Analysis of antidiabetic drugs (Latin, Ukrainian, chemical name; chemical formula; description; method of extraction; all possible methods of identification; all possible methods of quantitative determination) on the example of chlorpropamide, butamide, bucarban, glibenclamide, predian.

4.8. Analysis of anti-ulcer drugs (Latin, Ukrainian, chemical name; chemical formula; description; method of extraction; all possible methods of identification; all possible methods of quantitative determination) on the example of bismuth nitrate mainly, aluminum hydroxide, thetacin calcium, disodium edetate, unitiol, dicaptol, activated carbon, hexamethylenetetramine.

4.9. Application in medicine.

4.10. To substantiate the conditions of storage of drugs of this group, based on their physical and chemical properties.

TEST TASKS

1. According to the chemical structure, the antiseptic drug furatsilin belongs to:

A. Nitrofuran derivatives
B. Derivatives of 8-oxyquinoline
C. Derivatives of polyatomic alcohols
D. Chlorine-containing compounds
E. Isonicotinic acid derivatives

2. The general reagent for the identification of drugs - derivatives of 5-nitrofuran, when heated with which an intense color is observed, is:

A. Sodium sulfide
B. Sodium nitroprusside
C. Sodium hydroxide
D. Sodium chloride
E. Sodium sulfate

3. Which of the drugs contains a residue of semicarbazid in its structure?

A. Furadonin
B. Furacilin
C. Furazolidone
D. Furagin
E. Furosemide

4. The pharmacist determines the quantitative content of nitrofural. What titrimetric method of quantification does he use?

A. Iodometry
B. Permanganatometry
C. Alkalimetry

D. Argentometry

E. Nitritometry

5. A substance with the chemical name 5-nitro-8-hydroxyquinoline was obtained for analysis. What drug substance does this name correspond to?

A. Nitroxoline

B. Nitrazepam

C. Hinocid

D. Nitrofurantoin

E. Hingamin

6. A broad-spectrum antibacterial drug, the active ingredient of which chemically belongs to 8-oxyquinoline derivatives, was released from the hospital pharmacy to the urology department. What drug was released from the pharmacy?

A. Potassium permanganate

B. Oxylidine

C. Oxaphenamide

D. Nitroxoline

E. Chinocidum

7. During the identification of nitroxolin, a reaction was carried out, as a result of which a black-green color appears. What reagent was used?

A. Iron(III) chloride solution

B. Sodium hydroxide solution

C. Copper(II) sulfate solution

D. Nessler's reagent

E. Rhodanbromide reagent

8. The nitroxoline substance is analyzed for the quantitative content of the active substance by the method of alkalimetry in a non-aqueous medium. What titrant and indicator are used in this case?

A. Perchloric acid solution, crystalline violet

B. Sodium methylate solution, thymol blue

C. Sulfuric acid solution, naphtholbenzene

D. Sodium hydroxide solution, crystal violet

E. Potassium hydroxide solution, fluorescein

9. The presence of phenolic hydroxyl in the quinosol structure can be confirmed by the reaction with:

A. Diazo reagent or with diazotized primary aromatic amines

B. Concentrated sulfuric acid

C. Chloroacetic acid

D. p-dimethylaminobenzaldehyde

E. Sodium edetate

10. To confirm the presence of sulfate ion in the drug substance "Quinozol", the pharmacist of the pharmacy uses the following reagents:

A. Barium chloride solution and hydrochloric acid

B. A solution of ammonium chloride and ammonia

C. A solution of silver nitrate and nitric acid

D. Benzene sulfonic acid solution

E. Diphenylamine solution

11. The pharmacist identifies the substance quinozole sulfate. With the help of which reagent does he confirm the presence of sulfate ion in the substance under study?

A. Potassium permanganate

B. Sodium hydroxide

C. Barium chloride

D. Ammonium bromide

E. Zinc oxide

12. The presence of sulfate ion in drugs is detected by a solution of barium chloride in the presence of:

A. Dilute hydrochloric acid

B. Concentrated hydrochloric acid

C. Concentrated nitric acid

D. Dilute phosphoric acid

E. Dilute nitric acid

13. The presence of phenolic hydroxyl in the structure of nitroxolin can be confirmed using a solution of:

A. Sodium nitrite

B. Potassium permanganate

C. Sodium sulfate

D. Silver nitrate

E. Iron(III) chloride

14. Nitroxoline substance was received for analysis. When it interacts with a solution of ferrum(III) chloride, a blue-violet color is formed, which indicates the presence in its structure of:

A. Phenolic hydroxyl

B. Complex ether group

C. Keto groups

D. Aldehyde group

E. Alcoholic hydroxyl

15. When conducting a pharmaceutical analysis of nitroxoline, it is identified by its reaction with:

A. Potassium ferrocyanide

B. Silver nitrate
C. Barium chloride
D. Iron(III) chloride
E. Ammonium oxalate

16. Choose a reagent that can be used to confirm the presence of an aromatic nitro group in the structure of the drug substance:
A. Sodium hydroxide
B. Magnesium sulfate
C. Bromine water
D. Calcium chloride
E. Iron(III) chloride

17. What reagent should a pharmacist use to confirm the presence of an aromatic nitro group in the structure of drug substances (furacilin, furadonin, etc.)?
A. Hydrochloric acid
B. Copper(II) sulfate solution
C. Sodium hydroxide solution
D. Antipyrine
E. Hydrogen peroxide solution

18. What are the starting compounds in the synthesis of nitrofuran (furacilin)?
A. 5 nitrofurfural, semicarbazide
B. 5-nitrofurfurolacrolein diacetanil
C. 5-nitrofurfurol, thiosemicarbazide
D. 1-aminohydantoin
E. thiosemicarbazide

19. Nitrofural (furacilin), furazolidone, furadonin - drugs of the nitrofuran series. With which solution is the reaction of the formation of colored products used for their identification?
A. sodium chloride
B. acetic acid
C. sodium hydroxide
D. ammonium rhodanide
E. chromotropic acid

20. The pharmacist in the pharmacy conducts an express analysis of nitrofuran (furacilin) solution. Furacilin belongs to medicinal substances of the nitrofuran series. With which solution is the reaction of the formation of colored products used to identify these compounds?
A. sodium hydroxide
B. acetic acid
C. ammonium thiocyanate (rhodanide)

D. sodium chloride

E. chromotropic acid

21. Nitrofuran solution was taken to the control and analytical laboratory for analysis. It is necessary to choose the simplest and fastest method of quantitative determination of this dosage form. A method of quantitative determination of nitrofuran was chosen, according to which a solution of sodium hydroxide is added to its solution, which leads to the formation of a product colored in orange-red color. Such a procedure is necessary as a preliminary when determining by the method:

A. nitritometry

B. photocolorimetry

C. gravimetry

D. refractometry

E. polarimetry

22. Derivatives of 5-nitrofurfural (nitrofuran, furadonin, furazolidone) have a pharmacological effect:

A. antimicrobial

B. choleretic

C. antispasmodic

D. diuretic

E. hemostatic

23. The pharmacist of the control and analytical laboratory determines the quantitative content of nitrofuran. What titrimetric method of quantitative determination can he use?

A. alkalimetry

B. argentometry

C. nitritometry

D. permanganatometry

E. iodometry

24. Quantitative determination of the nitrofuran (furacilin) substance is carried out by the spectrophotometric method. The pharmacist can calculate its quantitative content by measuring:

A. optical density

B. melting point

C. rotation angle

D. refractive index

E. pH of the solution

25. The analyst determines the quantitative content of nitrofuran. What titrimetric method of quantitative determination can he use?

A. permanganatometry

B. iodometry
C. alkalimetry
D. argentometry
E. nitritometry

26. According to the chemical structure, the antiseptic drug furatsilin belongs to:

A. nitrofuran derivatives
B. 8-oxyquinoline derivatives
C. derivatives of polyatomic alcohols
D. chlorine-containing compounds
E. a derivative of isonicotinic acid

27. The chemical name "3-methyl-4-oxybenzylidene hydrazide of nicotinic acid hydrate" corresponds to the substance:

A. Ftivazide
B. Metazid
C. Isoniazid
D. Saluzidum
E. Nicodinum

28. The chemical name "Isonicotinoyl hydrazide" corresponds to the substance:

A. Metazid
B. Ftivazide
C. Isoniazid
D. Saluzidum
E. Cordiamine

29. When one of the listed drug substances is heated with diluted hydrochloric acid, the smell of vanillin appears:

A. Ethacridine lactate
B. Isoniazid
C. Metazide
D. Quinazoline
E. Ftivazide

30. When determining the benign quality of ftivazide, a specific admixture is determined:

A. Benzoic acid
B. Vanillin
C. β-chloroethyl urethane
D. Formaldehyde
E. Timol

31. The technological scheme for obtaining ftivazide at the plant requires control of finished products for the absence of specific impurities. One of these impurities can be:

A. Pyridine
B. Isoniazid
C. 3-pyridinecarboxylic acid
D. Sodium nitrite
E. Sodium hydroxide

32. Which of the compounds is used as a reagent for the pyridine cycle:

A. Copper sulfate
B. Ammonium rhodanide
C. 2,4-dinitroaminobenzene
D. Cobalt nitrate
E. 2,4-dinitrochlorobenzene (in alcohol)

33. Derivatives of which drugs with a heterocyclic structure give a positive reaction with 2,4-dinitrochlorobesol?

A. Pyridine
B. Oxazol
C. Furan
D. Thiophene
E. Thiazol

34. For the antibacterial therapy of tuberculosis, the pharmacy of the phthisiatric sanatorium received the following drugs: ftivazid, saluzid, metazid. According to their chemical structure, these drugs are derivatives of:

A. 8-oxyquinoline
B. Isonicotinic acid hydrazide
C. Amide of sulfanilic acid
D. Barbituric acid
E. Ethyl ether of para-aminosalicylic acid

35. The substance of isoniazid was received in the drug quality control laboratory. In order to identify the substance, the laboratory specialist used the "silver mirror" reaction. This reaction confirms the presence of the substance under study in the molecule:

A. Hydrazide group
B. Pyridine cycle
C. Aldehyde group
D. Amino groups
E. Carboxyl group

36. While identifying isoniazid, the pharmacist boiled the substance with 2,4-dinitrochlorobenzene. As a result, a yellow color was formed, which changes to purple, and then to brown-red, when the alkali solution is added. The analytical effect of the reaction is explained by the formation of an aldehyde derivative:

A. Glutacon
B. Glucone
C. Glutamine
D. Glyoxal
E. Hexane

37. A batch of isoniazid tablets of 0.2 g was received in the pharmacy of the anti-tuberculosis dispensary. Chemically, which acid derivative does the indicated medicine belong to?

A. 3-aminosalicylic acid
B. p-aminobenzoic
C. 4-pyridinecarbon
D. 2-hydroxypropane
E. γ-chlorobutyric acid

38. One of the following anti-tuberculosis drugs is not an isonicotinoyl hydrazide derivative:

A. Pyrazinamide
B. Saluzide
C. Ftivazide
D. Isoniazid
E. Metazid

39. Indicate which of the reagents listed below must be added to isoniazid in order to form a blue color and a precipitate, which, when heated, acquires a light green color and the evolution of gas is observed:

A. Solution of copper (II) sulfate
B. Argentum nitrate solution
C. Alkali solution
D. Hydrochloric acid solution
E. Ferrum (III) chloride solution

40. The pharmacist released from the pharmacy a synthetic anti-tuberculosis drug, the active ingredient of which is chemically hydrazide of 4-pyridinecarboxylic acid. What drug did the pharmacist release?

A. Soluble saluzide
B. Gammalon
C. Saluzide
D. Isoniazid

E. Rifampicin

41. Restorative properties of isoniazid are due to the presence in its structure of:

A. Hydrazine residue
B. Excess of hydroxyquinoline
C. Vanillin
D. Formaldehyde
E. Carboxyl group

42. The pharmacist performs the identification of the isoniazid substance in accordance with the requirements of the SphU according to the melting point of the yellow precipitate obtained when interacting with the solution of:

A. Vanillin
B. Hydroxyquinoline
C. Sodium nitroprusside
D. Potassium bromide
E. Ammonium thiocyanate

43. What method is used for the quantitative determination of the antituberculosis drug isoniazid in accordance with the requirements of the SPhU?

A. Reverse bromatometry
B. Direct bromatometry
C. Direct iodometry
D. Reverse iodometry
E. Direct acidimetry

44. The pharmacist conducts the quantitative determination of isoniazid by the method of direct bromatometry [using a titrated solution of potassium bromate, a solution of potassium bromide, hydrochloric acid and the indicator methyl red]. This method is based on the reaction of:

A. Oxidation of the hydrazide group with bromine
B. Reduction of the hydrazine residue with bromine
C. Oxidation of the hydrazine residue with potassium bromide
D. Opening of the pyridine cycle
E. Oxidation of isonicotinic acid with potassium bromate

45. The quantitative determination of isoniazid by the iodometric method is based on its ability to:

A. Oxidation
B. Recovery
C. Complex formation
D. Electrophilic substitution
E. Decarboxylation

46. Which medicine corresponds to the chemical name "3-methoxy-4-oxybenzylidene hydrazide of isonicotinic acid hydrate"?

A. Nicotinamide

B. Adrenaline tartrate

C. Ftivazide

D. Caffeine monohydrate

E. Pyridoxine hydrochloride

47. The technological scheme for obtaining Ftivazide requires control of finished products for the absence of specific impurities. One of these impurities can be:

A. Free meadow

B. Pyridine

C. Pyridine-3-carboxylic acid

D. Sodium nitrite

E. Isoniazid

48. What specific impurity is determined during the quality control of the Ftivazide substance?

A. Vanillin

B. Benzoic acid

C. Phthalic anhydride

D. Formaldehyde

E. Thymol

49. What drug can be identified by the acid reaction hydrolysis?

A. Ftivazide

B. Nicotinamide

C. Pyridoxine hydrochloride

D. Ascorbic acid

E. Isoniazid

50. What substances are formed during acid hydrolysis of Ftivazide?

A. Isoniazid, pyridine

B. Isoniazid, imidazole

C. Imidazole, benzaldehyde

D. Isoniazid, vanillin

E. Formaldehyde, pyridine

51. When heating which of these substances with dilute hydrochloric acid, the smell of vanillin is felt?

A. Furazolidone

B. Ftivazide

C. Phthalylsulfathiazole (phthalazole)

D. Metamizole sodium (Analgin)

E. Calcium lactate

52. A solution of alkali is added to the alcohol solution of Ftivazide, as a result of which the light yellow color changes to orange-yellow. Upon further addition of hydrochloric acid, the solution becomes light yellow again, and then orange-yellow. What properties of Ftivazide does this reaction confirm?

A. Amphoteric
B. Acidic
C. Oxidizing
D. Restorative
E. Basics

53. The ability of ftivazide to easily dissolve in aqueous alkali solutions is due to the presence in its structure of:

A. Pyridine cycle
B. Phenolic hydroxyl
C. Methoxyl group
D. Azomethine fragment
E. Complex ether connection

54. For the quantitative determination of ftivazid, the method of acidimetry, non-aqueous titration is used. In this case, the substance is dissolved in solvent (1) and a solution of substance (2) is used as a titrant:

A. Diethyl ether (1), sodium edetate (2)
B. Dimethylformamide (1), sulfuric acid (2)
C. Acetic acid anhydrous (1), perchloric acid (2)
D. Perchloric acid (1), anhydrous acetic acid (2)
E. Hydrochloric acid (1), sodium nitrite (2)

55. When certifying the Bepask substance, the pharmacist must identify the cation of:

A. Calcium
B. Potassium
C. Sodium
D. Iron (III)
E. Magnesium

56. The drug "Bepask" [Bepascum] contains Ca2+ cations. Name the method suitable for its quantitative determination after preliminary mineralization:

A. Complexonometry
B. Alkalimetry
C. Acidimetry
D. Argentometry
E. Permanganatometry

57. Indicate which substance is the starting point for the synthesis of sodium para-aminosalicylate:

A. *m*-nitrophenol

B. *p*-nitrobenzoic acid

C. *p*-phenetidine

D. *o*-anisidine

E. *p*-nitrophenol

58. Indicate which set of reagents is used by a pharmacist to confirm the presence of an amino group in the structure of sodium p-aminosalicylate:

A. Sodium nitrite, solution of hydrochloric acid, alkaline solution of β-naphthol

B. Sodium chloride, solution of hydrochloric acid, alkaline solution of β-naphthol

C. Copper sulfate, hydrochloric acid solution, phenol solution

D. Sodium thiosulfate solution, hydrochloric acid solution, resorcinol solution

E. Sodium nitrite, sodium hydroxide, alkaline β-naphthol solution

59. The formation of a colored product with lignin in the presence of concentrated sulfuric acid is characteristic of:

A. Sodium salicylate

B. Chloral hydrate

C. Hexamethylenetetramine

D. Sodium paraaminosalicylate

E. Sodium benzoate

60. The pharmacopoeial method of quantitative determination of sodium paraaminosalicylate is the method of:

A. Acidimetry in an aqueous environment

B. Nitritometry

C. Alkalimetry in a non-aqueous environment

D. Alkalimetry in an aqueous environment

E. Argentometry

61. The most appropriate method of determining Bepask is:

A. Argentometry

B. Non-aqueous titration

C. Complexonometry

D. Mercurimetry

E. Permanganatometry

62. . Common reactions to boron drugs are:

A. formation of a complex ester with methanol (ethanol) in the presence of concentrated sulfuric acid

B. reaction with sodium cobaltinitrite
C. reaction with hydrochloric acid
D. reaction with potassium pyroantimonate
E. reaction with sodium hydroxide

63. Which alcohol solution burns with a flame with a green border (in the presence of sulfuric acid):
A. sodium bicarbonate
B. boric acid
C. calcium chloride
D. hydrochloric acid

64. In which of the drugs acid properties increase when glycerin or mannitol is added:
A. sodium bicarbonate
B. boric acid
C. hydrochloric acid
D. concentrated ammonia solution
E. sodium chloride

65. The pharmacist added diethyl ether and a few drops of potassium dichromate solution to the hydrogen peroxide solution acidified with sulfuric acid. After shaking, the ether layer became colored in:
A. blue color
B. red color
C. green color
D. purple color
E. yellow color

66. Hydrogen peroxide solution is identified when interacting with:
A. sulfuric acid
B. potassium sulfate in an acidic medium
C. potassium dichromate in an acidic medium
D. iron (III) chloride
E. copper sulfate

67. What should a chemist of the Technical Control Department of a pharmaceutical enterprise use as a titrant when performing quantitative determination of hydrogen peroxide:
A. potassium permanganate solution
B. sodium hydroxide solution
C. oxalic acid solution
D. trilon B solution (sodium edetate)
E. potassium bromate solution

68. Permanganatometric determination is carried out in an acidic environment. What acid should the chemist of the Technical Control Department of the pharmaceutical enterprise use?

A. sulfur
B. hydrogen chloride
C. nitrogen
D. vinegar
E. an ant

69. The pharmacist fixes the equivalence point in the permanganatometric method f hydrogen peroxide titration using:

A. excess drop of titrant (potassium permanganate)
B. litmus paper
C. bromophenol blue
D. metal indicators
E. phenolphthalein

70. When using starch as an indicator during the titration of drugs with sodium thiosulfate solution, the following appears:

A. yellow color
B. blue color
C. green color
D. purple color
E. yellow sediment

71. According to the requirements of the SPhU, identification of potassium permanganate is carried out based on its recovery:

A. hydrogen peroxide in an alkaline medium
B. sodium sulfate
C. sodium nitrate in an acidic environment
D. ethanol in an acidic environment
E. methanol in an alkaline environment

72. During the identification of the potassium permanganate substance, the pharmacist added one of the reagents recommended by the State Pharmacopoeia of Ukraine to detect the potassium cation, and a yellow precipitate fell out:

A. sodium cobalt nitrite solution in acetic acid
B. oxalic acid solution
C. solution of sodium sulfide in hydrochloric acid
D. sodium bicarbonate solution
E. sodium hydroxide solution

73. During the identification of the potassium permanganate substance, the pharmacist added one of the reagents recommended by the State Pharmacopoeia of Ukraine to identify the potassium cation, and a white precipitate fell out:

A. tartaric acid solution
B. sodium bicarbonate solution
C. sodium sulfide solution
D. sodium thiosulfate solution
E. sodium citrate solution

74. The potassium cation (K+) in the drug can be identified using the following reagents:

A. 20% solution of tartaric acid in the presence of sodium carbonate; cobalt nitrite solution, acetic acid; the colorless flame of the burner turns purple
B. 8-oxyquinoline
C. sodium hexacyanoferrate (III).
D. ammonium oxalate
E. zincuranyl acetate

75. One of the drug substances cannot be used as a titrated solution:

A. iodine
B. potassium permanganate
C. hydrogen peroxide
D. sodium thiosulfate
E. sodium nitrite

76. Determination of impurities of chlorides and bromides in crystalline iodine is based on:

A. different solubility of silver halides in water
B. different solubility of silver halides in nitric acid
C. different solubility of silver halides in ammonia solution
D. different reducing properties of chlorides, bromides and iodides
E. on the oxidation of chlorides and bromides

77. In accordance with the requirements of the State Pharmacopoeia of Ukraine, the quantitative determination of crystalline iodine is carried out using a titrated solution of:

A. sodium nitrite
B. potassium permanganate
C. potassium iodate
D. potassium dichromate
E. sodium thiosulfate

78. When using starch as an indicator during the titration of drugs with a 0.05M iodine solution, the following appears:

A. yellow color
B. blue color
C. green color
D. purple color
E. yellow sediment

79. Depending on the conditions of the redox reaction, the permanganate ion can be reduced to Mn2 +, Mn4 +, MnO42-. What environment is necessary for the permanganate ion to be reduced to Mn2 +?

A. sour
B. weakly alkaline
C. neutral
D. alkaline
E. weakly acidic

80. Under what conditions should crystalline iodine be stored?

A. in glass jars with rubbed corks, in a cool place protected from light
B. in glass jars with rubber stoppers
C. in paper bags
D. in glass jars with cork stoppers
E. in iron containers

81. The titrant of the "Complexonometric titration" method, in accordance with the requirements of the SPhU, is:

A. sodium edetate solution (disodium salt of ethylenediaminetetraacetic acid)
B. hydrochloric acid solution
C. sodium hydroxide solution
D. potassium permanganate solution
E. sodium thiosulfate solution

82. What causes the color change of the solution at the equivalence point during direct complexometric titration?

A. by changing the pH of the reaction medium
B. destruction of the complex metal - trilon B (sodium edetate)
C. selection of the free form of the indicator
D. by changing the chemical structure of the indicator
E. decarboxylation of trilon B molecule (sodium edetate)

83. The chemist of the technical control department of the pharmaceutical enterprise fixes the equivalence point in complexonometry using:

A. paper impregnated with lead acetate
B. redox indicators
C. indicatorless method
D. iodine starch paper

E. metal indicators

84. To identify the aldehyde group in the structure of drugs, the pharmacist needs to conduct a reaction:

A. iodoform sample

B. indoenol sample

C. esterification

D. restoration

E. "Silver Mirror"

85. Based on the presence of an aldehyde group in the structure of the drug substance, which exhibits reducing properties, the pharmacist of the pharmacy proves its presence by a reaction with:

A. salts of divalent iron

B. potassium iodide solution

C. sodium hydroxide solution

D. a solution of p-dimethylaminobenzaldehyde in concentrated sulfuric acid

E. ammonia solution of silver nitrate

86. To identify the carbonyl of aldehyde or ketone groups, which are very often structural fragments of drugs, a control and analytical laboratory specialist uses a reaction with:

A. 2,4-dinitrochlorobenzene

B. hydroxylamine hydrochloric acid

C. sodium hydroxide

D. ninhydrin

E. acetic anhydride

87. The presence of aldehyde or ketone groups in the drug is confirmed by the reaction with:

A. potassium hydroxide

B. haloalkanes

C. glacial acetic acid

D. aromatic acids

E. primary aromatic amines

88. Determining the aldehyde group in the structure of the drug substance, the chemist of the pharmaceutical enterprise conducts a reaction with:

A. Nessler's or Fehling's reagents

B. hydrochloric acid

C. ammonium rhodanide solution

D. Marquis reagent

E. zinc uranyl acetate solution

89. It is possible to identify drug substances containing an aldehyde group in the structure by carrying out a condensation reaction (formation of auric dye). What reagents does the pharmacist-analyst use:

A. Marquis reagent
B. Dragendorff reagent
C. salicylic acid in the presence of concentrated sulfuric acid
D. ethyl alcohol in the presence of hydrochloric acid
E. ammonia solution of silver nitrate

90. Which reaction is not used when determining the aldehyde group in medicinal preparations:

A. azo compound
B. with Tollens' reagent
C. with Fehling's reagent
D. with Nessler's reagent
E. with primary aromatic amines

91. To determine the authenticity of the formaldehyde solution, the chemist of the control and analytical laboratory conducts a reaction with an ammonia solution of silver nitrate. At the same time, the following is observed:

A. appearance of green staining
B. precipitation of a dark gray precipitate
C. appearance of yellow staining
D. precipitation of a red precipitate
E. the appearance of a blue color

92. Choose the reagent that is most often used in pharmaceutical analysis to confirm the presence of phenolic hydroxyl in the structure of drugs:

A. solution of iron (III) chloride
B. potassium iodide solution
C. 2,4-dinitrochlorobenzene solution
D. hydroxylamine solution
E. sodium bicarbonate solution

93. To identify resorcinol according to the SPhU, the pharmacist uses the following reagents: concentrated sodium hydroxide solution and chloroform. What reaction product is formed?

A. aurine dye
B. indophenol dye
C. azomethine dye
D. diazo dye
E. oxyketone dye

94. Which of the following methods is used for quantitative determination of phenol and resorcinol:

A. bromatometry (back titration)
B. alkalimetry
C. gravimetry
D. complexonometry
E. nitritometry

95. Indicate which of the reagents is used to confirm the presence of sodium ion in sodium salicylate:

A. cobalt chloride
B. copper sulfate
C. silver nitrate
D. potassium permanganate
E. potassium pyroantimonate

96. A positive reaction to drugs from the phenol group (phenol, resorcinol) is an indophenol test. Specify the reagents necessary for its conducting:

A. reducing agent, ammonia solution
B. oxidizer, ammonia solution
C. hydrochloric acid, potassium bromide
D. formaldehyde, concentrated sulfuric acid
E. ammonia buffer solution, acid chrome dark blue

97. To identify phenolic hydroxyl in the chemical structure of drugs, the pharmacist must conduct a reaction with:

A. phosphoric acid
B. sulfuric acid
C. bromine water
D. barite water
E. perchloric acid

98. In the control and analytical laboratory to establish the authenticity of drug substances from the group of phenols (phenol, resorcinol), the pharmacist uses:

A. hydrochloric acid solution
B. sodium hydroxide solution
C. bromine water
D. Nessler's reagent
E. ammonia solution of silver nitrate

99. What are the starting compounds in the synthesis of nitrofuran (furacilin)?

A. 5-nitrofurfurol, semicarbazide
B. 5-nitrofurfurolacrolein diacetanil
C. 5-nitrofurfural, thiosemicarbazide

D. 1-aminohydantoin

E. thiosemicarbazide

100. Nitrofural (furacilin), furazolidone, furadonin - drugs of the nitrofuran series. With which solution is the reaction of the formation of colored products used for their identification:

A. sodium chloride

B. acetic acid

C. sodium hydroxide

D. ammonium rhodanide

E. chromotropic acid

101. The pharmacist in the pharmacy conducts an express analysis of nitrofuran (furacilin) solution. Furacilin belongs to drug substances of the nitrofuran series. To identify these compounds, the reaction of the formation of colored products with the solution is used:

A. sodium chloride

B. acetic acid

C. ammonium thiocyanate (rhodanide)

D. sodium hydroxide

E. chromotropic acid

102. To which group of drug substances according to their chemical structure do gliclazide, glibenclamide, butamide belong?

A. Derivatives of sulfonylureas

B. Isonicotinic acid thioamide derivatives

C. Benzodiazepine derivatives

D. Derivatives of diphenylmethane

E. Derivatives of p-aminobenzoic acid

103. The glibenclamide substance was sent to the control and analytical laboratory for analysis. In accordance with the requirements of the SPhU, the quantitative content of glibenclamide is determined by the method of:

A. Iodometry

B. Alkalimetry

C. Acidimetry

D. Bromatometry

E. Iodochlormetry

104. According to the chemical classification, which of the following drug substances belongs to alkylureides derivatives of sulfonic acids?

A. Chlorpropamide

B. Nitroxoline

C. Chloramine

D. Paracetamol

E. Isoniazid

105. In the identification of chlorpropamide, in accordance with the requirements of the SPhU, covalently bound chlorine is detected. This test is carried out after mineralization of the substance by reaction with the solution of:

A. Silver nitrate

B. Copper(II) sulfate

C. Ammonium chloride

D. Sodium edetate

E. Potassium pyroantimonate

106. In order to confirm the presence of a sulfo group in the structure of chlorpropamide, the substance under study is heated with a mixture of sodium carbonate and sodium nitrate. After that, the mineralization products should give a positive reaction with the following reagent:

A. Sodium sulfide

B. Ammonia with molybdate

C. Argentum nitrate

D. Barium chloride

E. Cobalt(II) chloride

107. When identifying chlorpropamide, tests are carried out using a barium chloride solution to detect sulfogroups in its structure. Before performing the specified test, the drug substance should be subjected to:

A. Mineralization

B. Hydrolysis

C. Decarboxylation

D. Sulfation

E. Esterification

108. Indicate which set of reagents is used in pharmaceutical analysis to confirm the presence of a primary aromatic amino group in the bucarban structure:

A. Sodium nitrite, solution of hydrochloric acid, alkaline solution of β-naphthol

B. Sodium chloride, solution of hydrochloric acid, alkaline solution of β-naphthol

C. Copper(II) sulfate, hydrochloric acid solution, phenol solution

D. Sodium nitrate, sodium hydroxide solution, alkaline β-naphthol solution

E. Sodium thiosulfate solution, hydrochloric acid solution, resorcinol solution

109. Which compound is most often used in pharmaceutical analysis as an azo component in azo coupling reactions with aryldiazonium salts?

A. Naphthysin

B. Naphthalene
C. β-Naphthol
D. Ninhydrin
E. Nitrobenzene

110. To determine which functional group, in accordance with the requirements of the SPhU, the following reagents are used: dilute hydrochloric acid, sodium nitrite solution, β-naphthol?

A. Primary aromatic amines
B. Alcoholic hydroxyl
C. Ester group
D. Aldehyde group
E. Phenolic hydroxyl

111. Reactions for the formation of azo dyes are widely used to identify drug substances derived from:

A. Heterocyclic compounds
B. Tertiary aromatic amines and alcohols
C. Phenols and aromatic alcohols
D. Primary aromatic amines and phenols
E. Nitro compounds and primary aliphatic amines

112. The pharmacist identifies the substance "Bucarban" by adding solutions of hydrochloric acid, sodium nitrite and β-naphthol to the drug. At the same time, an intense red color is formed. Indicate which functional group is being reacted with:

A. Primary aromatic amino group
B. Ester group
C. Sulfamide group
D. Carboxyl group
E. Aldehyde group

113. For the quantitative determination of derivatives of primary aromatic amines, the following are most often used:

A. Nitritometry
B. Iodometry
C. Titration in anhydrous medium
D. Argentometry
E. Iodochlorometry

114. For the quantitative determination of bucarban, titration with sodium nitrite is used, because its molecule contains:

A. Aldehyde group
B. Primary aromatic amino group
C. Carboxyl group

D. Carbonyl group

E. Hydroxyl group

115. A specialist of the Technical Control Department of a pharmaceutical enterprise carries out quantitative determination of the bucarban substance by the nitritometry method, using as an external indicator:

A. Iodostarch paper

B. Congo red paper

C. Blue litmus paper

D. Universal indicator paper

E. Red litmus paper

116. Quantitative determination of glibenclamide, according to the SPhU, is carried out by the method of alkalimetry in the environment of:

A. Ethyl alcohol

B. Lactic acetic acids

C. Acids of glacial acetic acid and acetic anhydride

D. Alcohol-chloroform mixture

E. Acetate buffer solution

117. To confirm the presence of bismuth ion in bismuth nitrate, reagents are mainly used:

A) thiourea, sodium sulfide

B) silver nitrate, nitric acid

C) potassium thiocyanate, hydrochloric acid

D) sodium cobaltinitrite, acetic acid

E) sodium nitrite, sulfuric acid

118. The titrant of the "Complexonometric titration" method, in accordance with the requirements of the SPhU, is:

A. sodium edetate solution (disodium salt of ethylenediaminetetraacetic acid)

B. hydrochloric acid solution

C. sodium hydroxide solution

D. potassium permanganate solution

E. sodium thiosulfate solution

119. What causes the color change of the solution at the equivalence point during direct complexometric titration?

A. by changing the pH of the reaction medium

B. destruction of the complex metal - trilon B (sodium edetate)

C. selection of the free form of the indicator

D. by changing the chemical structure of the indicator

E. decarboxylation of trilon B molecule (sodium edetate)

120. The chemist of the Technical Control Department of the pharmaceutical enterprise fixes the equivalence point in complexonometry using:

A. paper impregnated with lead acetate
B. redox indicators
C. indicatorless method
D. iodine starch paper
E. metal indicators

121. To identify the aldehyde group in the structure of drugs, the pharmacist-analyst needs to conduct a reaction:

A. iodoform sample
B. indoenol sample
C. "Silver Mirror"
D. restoration
E. esterification

122. Based on the presence in the structure of the drug substance of an aldehyde group, which exhibits reducing properties, the pharmacist of the pharmacy proves its presence by a reaction with:

A. salts of divalent iron
B. potassium iodide solution
C. sodium hydroxide solution
D. a solution of p-dimethylaminobenzaldehyde in concentrated sulfuric acid
E. ammonia solution of silver nitrate

123. To identify the carbonyl of aldehyde or ketone groups, which are very often structural fragments of medicinal products, a control and analytical laboratory specialist uses a reaction with:

A. 2, 4-dinitrochlorobenzene
B. hydroxylamine hydrochloric acid
C. sodium hydroxide
D. ninhydrin
E. acetic anhydride

124. The presence of aldehyde or ketone groups in the drug is confirmed by the reaction with:

A. potassium hydroxide
B. haloalkanes
C. glacial acetic acid
D. aromatic acids
E. primary aromatic amines

125. Determining the aldehyde group in the structure of the drug substance, the chemist of the technical control department of the pharmaceutical enterprise conducts a reaction with:

A. Nessler's or Fehling's reagents
B. hydrochloric acid
C. ammonium rhodanide solution
D. Marquis reagent
E. zinc uranyl acetate solution

126. It is possible to identify drug substances containing an aldehyde group in the structure by conducting a condensation reaction (formation of an auric dye). What reagents does the pharmacist use:

A. Dragendorff reagent
B. Marquis reagent
C. salicylic acid in the presence of concentrated sulfuric acid
D. ethyl alcohol in the presence of hydrochloric acid
E. ammonia solution of silver nitrate

127. A positive "silver mirror" reaction indicates the presence of chloral hydrate in the structure of:

A. aldehyde group
B. ester group
C. amide group
D. carboxyl group
E. nitro groups

128. Which reaction is not used when determining the aldehyde group in drugs:

A. with Nessler's reagent
B. with Tollens' reagent
C. with Fehling's reagent
D. azo compound
E. with primary aromatic amines

129. Indicate which of the listed methods is impossible to determine the quantitative content of hexamethylenetetramine (Urotropin, Urotropinum):

A. complexonometry (direct titration)
B. alkalimetry (back titration)
C. acidimetry (direct titration)
D. iodochlorometry (back titration)
E. argentometry (according to Volhard method)

130. Hexamethylenetetramine in the composition of powders can be identified by a pharmacist after boiling with dilute sulfuric acid by separating:

A. formaldehyde

B. sulfuric anhydride
C. carbon dioxide
D. nitrogen oxides
E. hydrogen chloride

131. Drug substances from the group of aldehydes can be quantitatively determined by the method of:

A. direct acidimetry
B. ion exchange chromatography
C. iodometry (inverse method)
D. iodometry (direct method)
E. non-aqueous titration

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