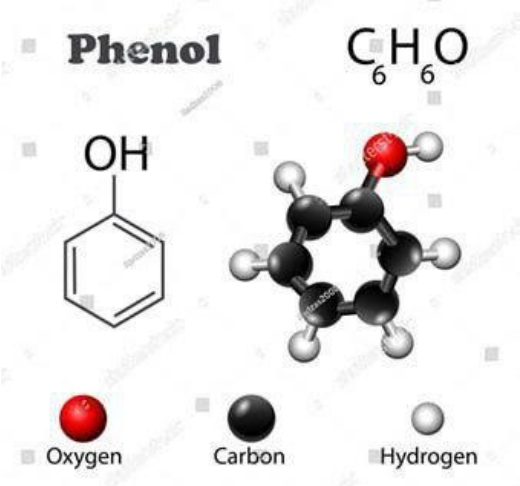
University Of Basrah
College Of Pharmacy
Department Of Pharmaceutical Chemistry

2nd stage 2nd Semester

2024-2025

LABORATORY OF ORGANIC CHEMISTRY

IDENTIFICATION OF PHENOLS



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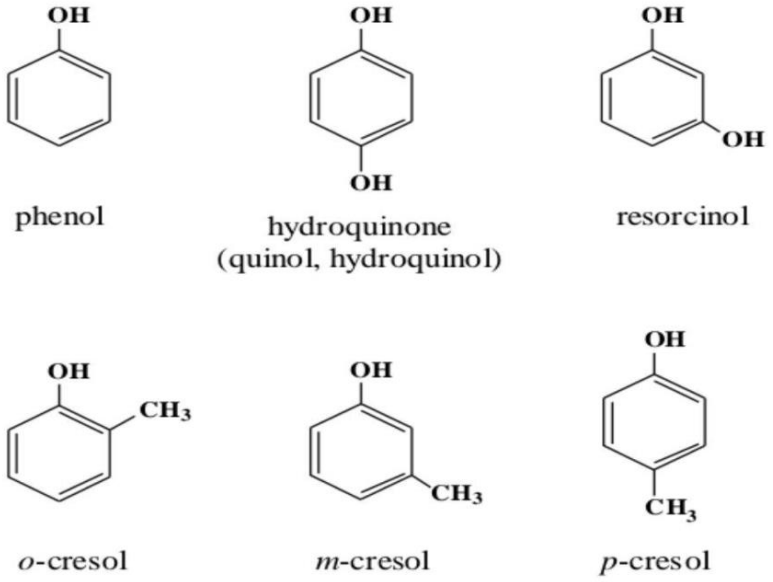
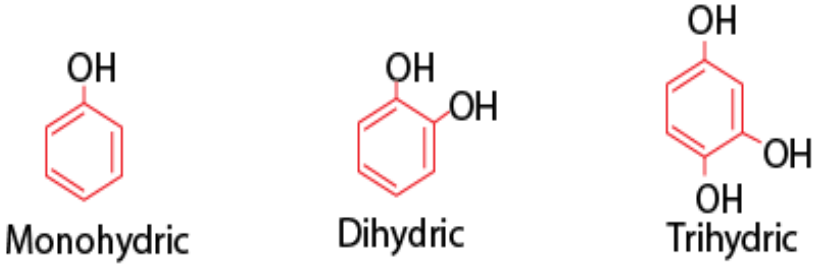
Phenols are organic compounds with a hydroxyl group directly attached to benzene ring. They have the general formula Ar-OH. Examples of them include phenol (also known as carbolic acid), hydroquinone, resorcinol, o-cresol, m-cresol, p-cresol, etc.



Classification of Phenol : Depending on the number of hydroxyl groups attached to the aromatic ring, phenols can be classified into three types.

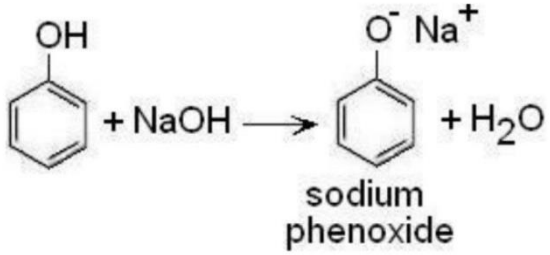
- **Monohydric phenols: They contain one -OH group.**
- **Dihydric phenols: They contain two -OH groups. They may be ortho-, meta- or para- derivative.**
- **Trihydric phenols: They contain three -OH groups.**



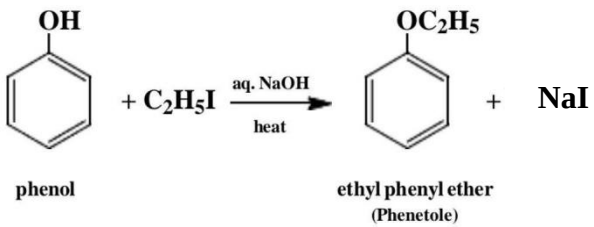
Properties of phenol:

- **Pure phenol compounds can appear as white solids at room temperature (e.g., phenol and resorcinol) or a colorless liquid (e.g., m-cresol). It acquires light color on exposure to air or light, it is due to its oxidation. Have a special odor.**
- **Due to intermolecular hydrogen bonding phenols have high boiling point as compared to corresponding hydrocarbons.**
- **Phenol is somewhat soluble in water because of its ability to form hydrogen bonds with the water.**
- **Phenols are weak acidic compounds, (more acidic than alcohols, but less acidic than carboxylic acids). Phenols does not react with weak bases like Na_2CO_3, $NaHCO_3$.**
- **Phenols burn with a yellow smoky flame due to the presence of aromatic ring.**
- **Phenols show two types of reactions:**
  1-Reactions at the phenolic hydroxyl group (-OH); e.g., salt formation and ether formation:

➢ **phenol reacts with sodium hydroxide to form sodium phenoxide.**

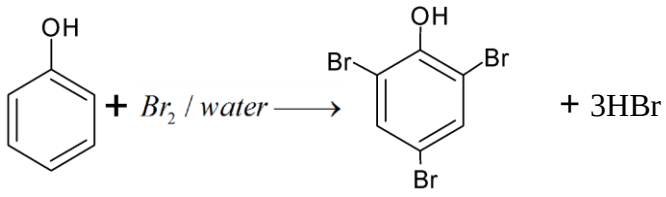


➢ **ethyl phenyl ether is formed when phenol reacts with ethyl iodide.**



2-Substitution at the aromatic ring; e.g., bromination and nitration reactions:

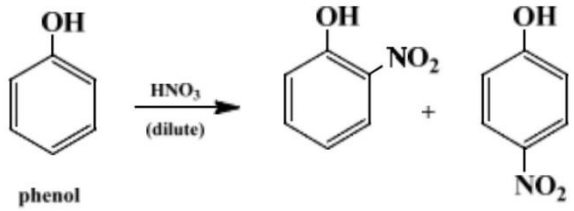
- **reaction with bromine water.**



phenol

2,4,6-tribromophenol
(White precipitate)

- **reaction with dilute nitric acid.**



phenol

o- and *p*-nitrophenol

Detection of Phenols

Detection of phenol functional group can be done by following tests:

1-Litmus test

2-Ferric chloride test

3-Phthalein dye test

4-Libermann's test

5-Bromine water test

1-Litmus test: Litmus paper changes color if the solution is acidic or basic. Acidic solutions turn blue litmus paper into red and basic solutions turn red litmus paper into blue. Phenols are acidic, so they show the litmus test.

2- Ferric chloride test: This test is based on the fact that the phenols give a colored complex with neutral ferric chloride solution, such as C_6H_5OH (simplest phenol) reacts with ferric chloride to forms a violet colored complex $[Fe(C_6H_5O)_6]^{3-}$. The reaction is given below:

$$6C_6H_5OH + FeCl_3 \longrightarrow [Fe(C_6H_5O)_6]^{3-} + 3HCl + 3H^+$$

Phenol Ferric chloride Violet complex

Procedure- 1- In a clean test tube dissolve the given organic compound in water or acetone. 2- Add 1 drop of ferric chloride solution and observe the resulting color.

The colors produced by simple phenolic compounds with ferric chloride solution are listed below:

Phenol, Resorcinol, o-cresol, p-cresol	Violet or blue
Catechol	Green
Hydroquinone	Deep green
Pyrogallol	Blue rapidly changing to red

3- Phthalein dye test: Most of the phenols give this test accurately and show the result precisely.

Phenol gets condensed on heating with phthalic anhydride in the presence of concentrated Sulfuric acid forms phenolphthalein. Phenolphthalein gives pink-colored compounds on reaction with a limited amount of sodium hydroxide while more than sodium hydroxide it gives a colorless compound.

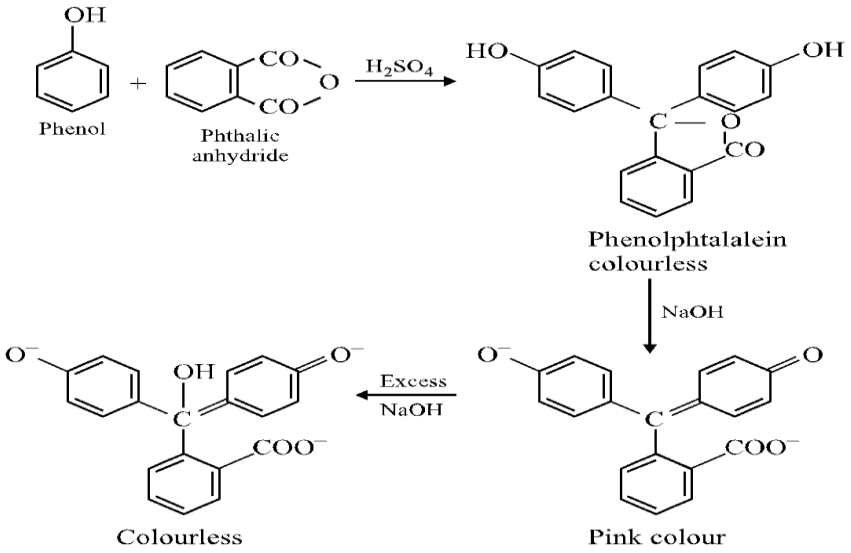
Procedure- 1- In a dry test tube put about 100mg of the given organic compound and an equal amount of phthalic anhydride. 2- Add 2-3 drops of concentrated sulfuric acid. 3- Heat the solution for 2-3 minutes. 4- Cool the mixture and pour it into a beaker containing dilute sodium hydroxide solution.

Observe the color change: If the color of the reaction mixture changes to pink, red, green or blue then it indicates the presence of phenyl group in the given organic compound.

The colors produced by different phenolic compounds in phthalein dye test is listed below:

Phenol	Reddish pink
o-cresol	Red
m-cresol	Blue or violet blue
1-naphthol	Green
2-naphthol	Faint green
Resorcinol	Yellow-green fluorescence
Hydroquinone	Deep purple

The chemical reaction is given below:



5- Bromine water test : **Phenol undergoes electrophilic substitution reaction with bromine. When bromine water is added to aqueous solution of phenol the brown color of bromine disappears and a white precipitate of tribromophenol is formed.**

Procedure- **1- Dissolve the given sample in a small quantity of glacial acetic acid in a clean and dry test tube. 2- Add bromine water to the test tube slowly.**

(White precipitate confirms the presence of phenol in the given sample).

Lecturer:

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