

SYNTHESIS OF ORGANIC COMPOUNDS BY GREEN CHEMISTRY APPROACH

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ABSTRACT

Green chemistry has now become a new trend to design safe, eco-friendly technique in conversion of hazardous pollutants to environmental friendly compounds. The objective of green chemistry is not only to design environmental friendly chemicals but also to provide economic and social advantages. The % yield of benzoic acid obtained by green chemistry approach is 76.08% whereas conventional method procedure only 65.21%. Benzoic acid constant concentration of all reagents. Hence we concluded that this method is environment friendly and atom efficient. The % yield of nitration of phenol obtained by green chemistry approach is 94.98% whereas conventional method procedure only 85.47%.

KEYWORDS: Green chemistry, Benzoic acid, Conventional method, Phenol, Green chemistry.

INTRODUCTION

- Green chemistry has now become a new trend to design safe, eco-friendly technique in conversion of hazardous pollutants to environmental friendly compounds. The objective of green chemistry is not only to design environmental friendly chemicals but also to provide economic and social advantages.
- Green chemistry in very simple terms is just a different way of thinking about how chemistry and chemical engineering can be done.
- It is the branch of chemistry that deals with the design and optimization of processes and products in order to lower, or remove altogether, the production and use of toxic substances. Green chemistry is not the same as environmental chemistry.

Principle of green chemistry

The main principle of green chemistry are prevention of waste, atom economy, avoiding the generation of hazardous chemical, the design of safe chemical, design of safe auxiliaries and solvent, energy efficiency, incorporation of renewable feedstock, reduction in the generation of derivatives, incorporation of catalysis, designing the chemical for degradation, incorporating real time analysis and incorporation of safe chemistry for the prevention of accident.

Making connection with green chemistry

Green chemistry with growing public concern about environmental issues, current students are extremely

interested in learning about green chemistry and sustainability concepts.

Green protocol for API

Active pharmaceutical ingredients (API) should have adequate purity due to their use in human health. Any contamination coming from adopted protocols can influence the product.

Method and Material for Benzoic Acid

Chemical:- Benzil, Sodium Hydroxide, Hydrochloric Acid, Purified Water.

Apparatus:- Mortar and Pestle, Conical Flask, Funnel, Petri Dish, Watman Filter Paper, Beaker.

Preparation of Benzoic Acid by Green Chemistry Approach

- Reaction of Traditional Method to obtain Benzoic Acid from Benzil.

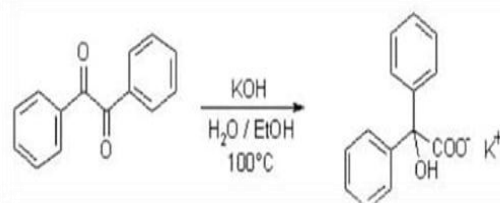


Fig: 1.

▪ **Reaction of Greener Approach to Obtain Benzilic Acid from Benzil.**

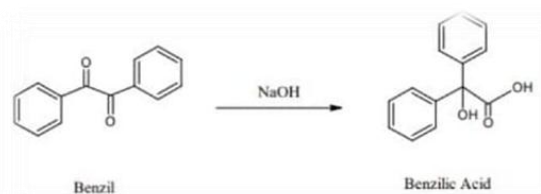


Fig: 2.

Procedure for benzilic acid

Benzilic acid is commonly prepared by KOH and ethanol at 100 °C. Potassium hydroxide causes direct effects on the skin, eyes and gastrointestinal tract. Higher exposures may cause a build up of fluid in the lungs, this can cause death. Another drawback of conventional method is

benzil is refluxed with ethanol hence further removal of ethanol requires time and energy. Therefore we introduced a green, solvent free and atom efficient method to synthesis of benzilic acid. In this method, 1 gm of benzil was grinded with 1 gm of NaOH in a mortar. Then it was taken in dry conical flask and heated on water bath at 20 min. Then it was cooled to room temperature and dissolved in minimum amount of water, which further acidified with HCL.

Method and Material for Nitration of Phenol

Chemical: - Phenol, Glacial Acetic Acid, Calcium Nitrate, Ice Cold Water.

Apparatus:- RBF, Magnetic Stirr, Conical Flask, Refrigerator, Oven, Measuring Cylinder.

Preparation of Nitration of Phenol by Green Chemistry Approach

▪ **Reaction of Traditional Method to obtain O-P-Nitrophenol.**

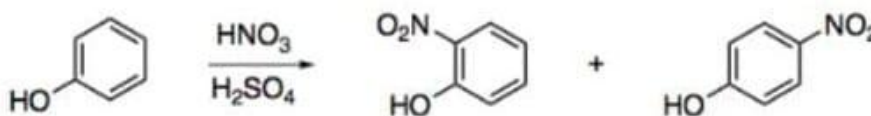


Fig: 3.

▪ **Reaction of Greener Method to obtain O-P-Nitrophenol.**

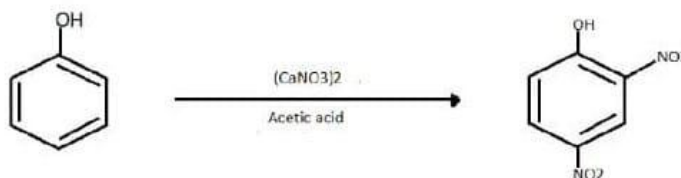


Fig: 4.

Procedure for nitration of phenol

In conventional method HNO₃ and concentrated H₂SO₄ are used as nitration agents. These hazardous and toxic chemicals were replaced by green nitration agents such as calcium nitrate [Ca(NO₃)₂] and glacial acetic acid. HNO₃ and concentrated H₂SO₄ are highly corrosive, hazardous and toxic to eyes, injure skin and the mucous membranes of the respiratory tract. To overcome those problems we have introduced eco-friendly nitration reactions that do not require strong acids such as nitric and sulfuric acids. This method is also fulfils the requirements of green chemistry. In this method 1.0 gm of Phenol, 5 ml of glacial acetic acid and 2.5 gm of calcium nitrate were mixed in a 250 ml glass round-bottom flask. The reaction mixture was stirred via a magnetic stir bar and hot plate. The reaction was performed with the microwave oven at a power of 320 W, heated to 120 °C via the microwave temperature control for 1 min. The reaction mixture was poured into ice cold water and stored for some time in a refrigerator.

The yellow crystals that separated were washed and free of acid with water and then allowed to dry. The reaction mixture was allowed to cool at room temperature. Then, 10 ml of ethyl acetate was added and the mixture stirred. The slurry was filtered.

Calculation of Benzilic Acid by Green Chemistry Approach

Molecular weight of Benzil = 210.23 gm/M

Molecular Weight of Benzilic Acid = 228.25 gm/M

Weight Taken of Benzil = 5 gm

Practical yield = 3.5 gm

Theoretical Yield = Mol. weight of precursor / Mol. weight of product × Quantity of precursor taken
= 210.23 / 228.25 × 5

= 0.921 × 5

= 4.60 gm

Percentage yield = Practical yield / Theoretical yield × 100 %

$$= 3.5 / 4.60 \times 100 \%$$

$$= 76.08 \%$$

Calculation of Nitration of Phenol by Green Chemistry Approach.

Molecular weight of Calcium Nitrate = 164.088 gm/M

Molecular Weight of O-P- Nitrophenol = 139.11 gm/M

Weight Taken of Calcium Nitrate = 5 gm

Practical yield = 5.3 gm

$$\text{Theoretical Yield} = \text{Mol. weight of precursor} / \text{Mol. weight of product} \times \text{Quantity of precursor taken}$$

$$= 164.088 / 139.11 \times 5$$

$$= 1.17 \times 5$$

$$= 5.85 \text{ gm}$$

$$\text{Percentage yield} = \text{Practical yield} / \text{Theoretical yield} \times 100 \%$$

$$= 5.3 / 5.85 \times 100 \%$$

$$= 94.98 \%$$

RESULT AND DISCUSSION

Sr. No.	Method	% Yield
1.	Synthesis of Benzilic Acid by Traditional Method.	65.21 %
2.	Synthesis of Benzilic Acid by Green Chemistry Approach.	76.08 %
3.	Preparation of Nitration of Phenol by tradition Method.	85.47 %
4.	Preparation of Nitration of Phenol by Green Chemistry Approach.	94.98 %

The % yield of benzilic acid obtained by green chemistry approach is 76.08% whereas conventional method procedure only 65.21%. Benzilic acid constant concentration of all reagents. Hence we concluded that this method is environment friendly and atom efficient.

The % yield of nitration of phenol obtained by green chemistry approach is 94.98% whereas conventional method procedure only 85.47%.

CONCLUSION

All the reactions of organic chemistry such as an electrophonic aromatic nitration reaction of phenol, benzilic acid rearrangement were performed in our laboratory by both green and conventional method. The yields of products obtained by green chemical method were compared with the yield obtained by conventional method. In green method various toxic, pollutants and hazardous substances such as bromine, KOH, H₂SO₄ and HNO₃ were replaced by green and eco-friendly reagents such as calcium nitrate, ceric ammonium nitrate, and acetic acid etc., solvent free conditions and without lose of energy and heat.

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