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SCREENING OF ANTIBACTERIAL POTENTIAL OF SYNTHESIZED AND CHARACTERIZED BENZOIC ACID BY AGITATION TECHNIQUE

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Abstract: An efficient and operatively simple reaction between benzaldehyde with potassium hydroxide gives corresponding potassium benzoate followed by reaction and this potassium benzoate in the presence of hydrochloric acid (HCl) afforded aromatic carboxylic acid derivatives by using grindstone (agitation technique) gives product yield of benzoic acid , and require short period of time avoid heating (conventional method require 1 hour heating) , environmental safer and notable advantage of this method. The structure of newly synthesized compound has been confirmed on the basis of elemental analysis and spectral data. Some of synthesized compounds exhibit significant antimicrobial activity.

Keywords: Aromatic carboxylic acid, Grinding (Agitation), Solid KOH, Antimicrobial activity.

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INTRODUCTION

Many exothermic reactions can be accomplished in high yield by using a technique known as "Grindstone chemistry" which is one of the "Green chemistry technique". Grinding finds it usage in industry and manufacturing process and is a very simple, efficient and effective process. Such reactions are simple to hand, reduce pollution comparatively cheaper to operate and may be regarded as more economically and ecologically favorable procedure in chemistry. Green chemistry- It is also called as sustained chemistry. "Green chemistry is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substance in the design, manufacturing and application of chemical products". Also described as- Sustainable chemistry, Chemistry that is benign by design, Pollution prevention at the molecular level. Benzoic acid is the simplest member of the aromatic carboxylic acid family and produced by the liquid phase air oxidation of toluene, benzoic acid, its salts and esters find application as raw materials for pharmaceutical applications, food, personnel care and industrial preservatives and in the manufacture of certain basic industrial chemicals, resin, plasticizer, dyestuffs and fibers. In addition, benzoic acid is weak acid and its salts are used as emulsion, toothpaste, jam or other foods bacteriostatic agent. Also used as intermediates of pharmaceutical and dyes, it can be use for the production of plasticizer. This mainly due to the easy preparation and important biological activity and therefore represents an interesting template for combinatorial as well as medicinal chemistry. The benzoic acid is a ubiquitous feature of medicinal agent such as anti-microbial, antibacterial and fungicidal activity etc. As a consequence, much attention has been paid to the design and synthesis of benzoic acid by grindstone chemistry.

Materials and Methods: The chemicals benzaldehyde, KOH, conc. HCl, Ether, water were of analytical reagent grade method used for synthesis of benzoic acid and their derivatives are grindstone chemistry technique melting point were determined in open capillary tubes and are uncorrected. The IR spectra were recorded on ATR-FTIR spectrometer with samples. Purity of the compounds was checked by Silica gel G TLC plates using n-hexane and ethyl acetate as solvent system. The visualization of spot was carried out in an iodine chamber.

EXPERIMENTAL PROCEDURE

- Synthesis of benzoic acid by conventional technique-

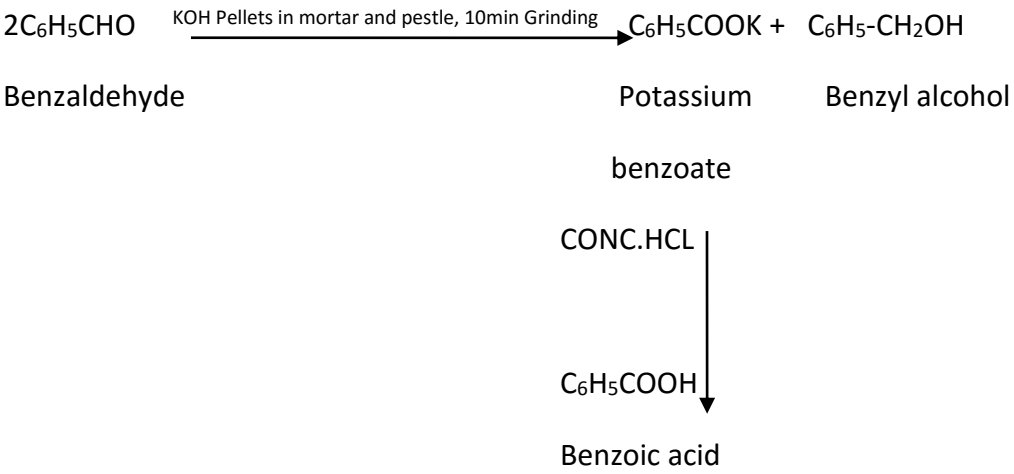
1. Dissolve 3.2gm of KOH in 15ml of H_2O in conical flask- cool the solution 20^0C in ice water.
2. Pour the solution into a 250 ml reagent bottle and 5.2gm of pure benzaldehyde. Fit the condenser to a flask and reflux 1hr and cool it. Allow the mixture to stand for 24hrs.

3. Add just sufficient H_2O to dissolve the potassium benzoate.
4. Pour liquid into a separating funnel rinse out bottle with 30ml ether. Shake the solution then separate the lower aqueous solution.
5. Pour the aqueous solution remaining from the ether extraction with stirring into a mix of 80ml of conc. HCl , 80ml of H_2O and 100gm of crushed ice.
6. Filter the ppt. benzoic acid at the pump, wash it with a little cold water, drain and recrystallize from boiling water.

- Synthesis of benzoic acid by grindstone (Agitation) technique-

1. Take 10ml of benzaldehyde.
2. Prepare solution of 6gm of KOH in 50ml of water- solution.
3. Add this solution slowly in benzaldehyde in mortar and agitate for 30 min. until mixture becomes cloudy emulsion.
4. Add the above emulsion in 20ml ether in separating funnel.
5. Shake for 10 minute.
6. Add aqueous layer in the solution of 15ml of conc. HCl in 15ml cold water observed the ppt. if ppt. not obtained keep in freeze for 3hrs.
7. Filter and determine M.P of benzoic acid (121^{0C}). The reaction mixture was concentrated in vacuum and the solid so obtained was filtered, washed, dried and recrystallize from hot water and determine melting point of benzoic acid ($121^{0}C$). The completion of reaction was monitored by TLC.

Scheme:



RESULT AND DISCUSSION

The synthesis of benzoic acid were carried out by the reaction substituted benzaldehyde with potassium hydroxide gives corresponding potassium benzoate followed by cannizaro's reaction and potassium benzoate in the presence HCl by using grinding technique.

The agitation technique effectively reduced the reaction time were prepared in yields that were appreciably higher than the conventional method

The structures of the newly synthesized compounds were confirmed on the basis of spectral data.

UV spectroscopic studies:

Principle peak of UV was observed at 219nm.

Synthesis of benzoic acid was confirmed by the I.R spectra interpretations of these spectras were carried out in table.

- TLC studies:

The completion of reaction was monitored by TLC by using n-hexane: ethyl acetate (8:2 or 4:1)as solvents system.

R_f value of benzoic acid:-

R_f=$Distance\ travelled\ by\ the\ substance$ / Distance travelled by the solvents

In the present study, the newly synthesized compounds were screened for their antimicrobial activity using cup plate method against Gram +ve i.e. ***Bacillus substilus*** while Gram-ve i.e. *E.coli.* All the compounds were at the concentration of 100mg/ml. The zone of inhibition was measured in mm and ethanol was used as a solvent. Most of the compounds were found to be more active against gram positive than gram negative bacterial species. Among the screened compounds of benzoic acid by grinding (agitation) technique was exhibited more activity (against *E.coli* and *B.substilus*) than the conventional technique as compared to standard. The remaining aromatic carboxylic acid derivative were found to be less activity against gram positive and gram negative bacterial species.

CONCLUSION

From the above result it is concluded that the benzoic acid prepared by agitation method yield more practical yield in a short time as compared to benzoic acid obtained by conventional method. Since agitation does not required heating leading to a safe and environmental friendly technique for the synthesis of large number of organic heterocyclic molecules. The benzoic acid prepared by agitation method gives same result such as IR spectra, UV spectra, Rf value and melting point to that of standard benzoic acid. Hence it is viable and feasible method for performing the synthesis of benzoic acid. All synthesized compounds were screened for the anti-microbial activities and found to be excellent activity as compared to standard drug. A few exhibited activities compared to those of standard drug.

Table No. 3.1: chemicals and their use

Sr. No.	Name of reagent	Use
1	Benzaldehyde	Reagent
2	Potassium hydroxide	Provide nucleophiles
3	Ether	For extraction of benzyl alcohol

COMPARISION BETWEEN AGITATION AND CONVENTIONAL TECHNIQUE-

Grinding technique/ sustainable technique	Conventional technique/ Classical technique
1. Improved yield(high)	1. Low (unsatisfactory) yield
2. Less time required for reaction.	2. Prolonged time required for reaction.
3. Less/No toxicity	3. High toxicity
4. Fast reaction	4. Slow reaction
5. Easy to operate	5. No energy to operate
6. No involvement of organic solvent	6. Use of organic solvents
7. Environment friendly reaction	7. Harmful the environment
8. No complication of the work-up process	8. Complication of the work-up process
9. Reaction is carried out at room temperature.	9. Reaction is carried out at high temperature
10. Use of inexpensive catalyst	10. Use of expensive catalyst/ reagent
11. Mild reaction condition. **12. Ex. The utilizes heating aniline, zinc dust in acetic acid for 2hrs further reaction mix is poured in water and crystals are collected by filtration. The method does not involve acetic anhydride, hazardous solvent less waste products.**	11. No mild reaction condition 12. Ex. Non green solvent dichloromethane is used pyridine is toxicity and is not eco-friendly. Acetic anhydride leaves one molecules of acetic acid unused which devoid the rule of atom economy.
13. No use of strong base	13. Use of strong base.
14. Less waste products	14. High waste products.
15. Less energy is requirement for such synthesis.	15. More energy is requirement for such synthesis.

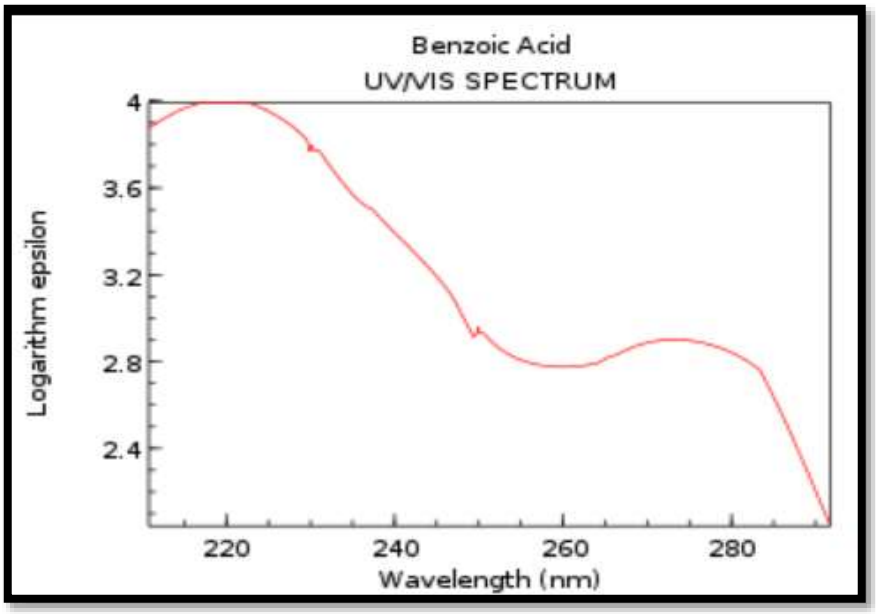


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Figure No. 4.1: UV spectrum of Benzoic acid by conventional technique

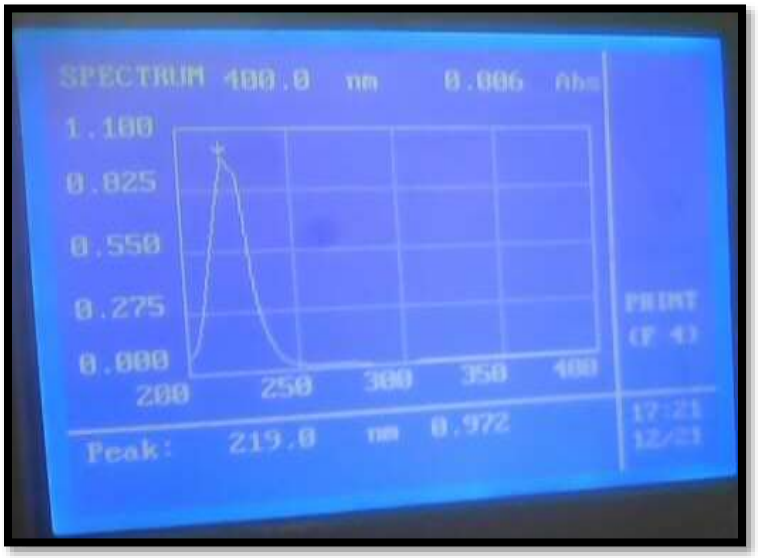


Figure No. 4.2: UV spectra of Benzoic acid by agitation technique

ATR-FTIR spectroscopic studies:

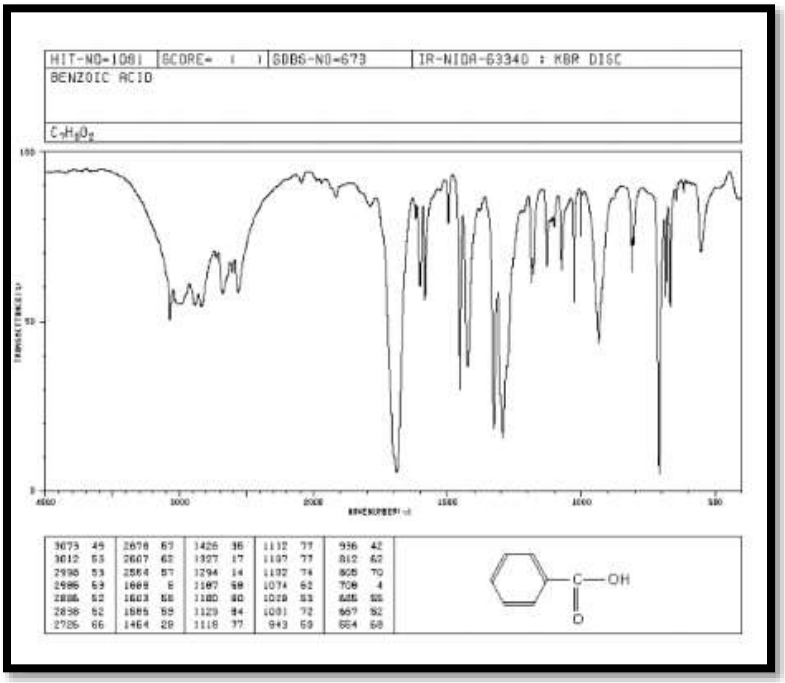


Figure No. 4.3: ATR-FTIR spectra of Benzoic acid synthesized by conventional technique

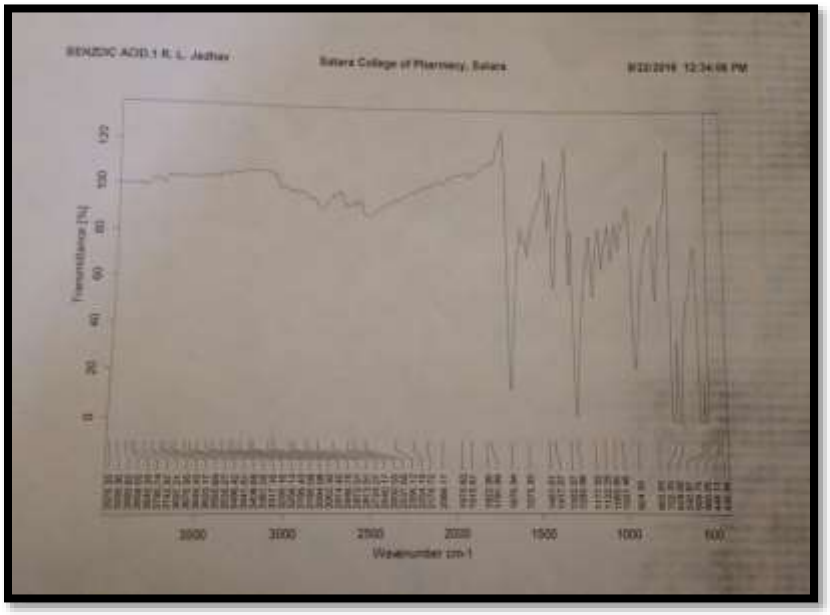
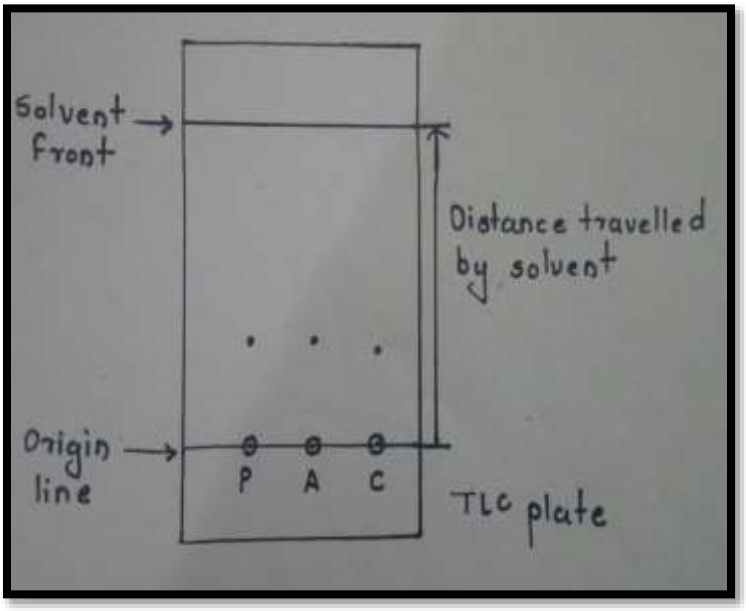


Figure No. 4.4: ATR-FTIR spectra of Benzoic acid synthesized by agitation technique

Table No. 4.1: Interpretation of IR spectra of Benzoic acid

SR.NO	IR RANGE (cm^{-1})	Peak intensity	Peak due to
1.	1676	Sharp	C=O Stretching
2.	1283	Sharp	O-C Stretching
3.	924	Broad	O-H Bending
4.	3317-3094	Broad	OH stretching

Synthesis of benzoic acid was confirmed by the I.R spectra interpretations of these spectras were carried out in table.



P- Pure Benzoic acid, A-Benzoic acid by agitation technique, C- Benzoic acid by conventional technique

Figure No. 4.5 : TLC of Benzoic acid

Table No. 4.2: R_f value of Benzoic acid

Spot	R_f value	Solvent system
P	0.45	Hexane: Ethyl acetate (8:2/4:1)
A	0.45	
C	0.43	

- Physical data of heterocyclic molecules and comparative study of conventional technique versus agitation (grinding) technique.

Compound name	Standard M.P (^{0}c)	Conventional technique			Agitation technique		
		Time hrs	% yield	M.P (^{0}c)	Time hrs	% yield	M.P (^{0}c)
Benzoic acid	121-123^{0}c	1	25.08	121	30	30.43	121

- Anti-microbial screening :-

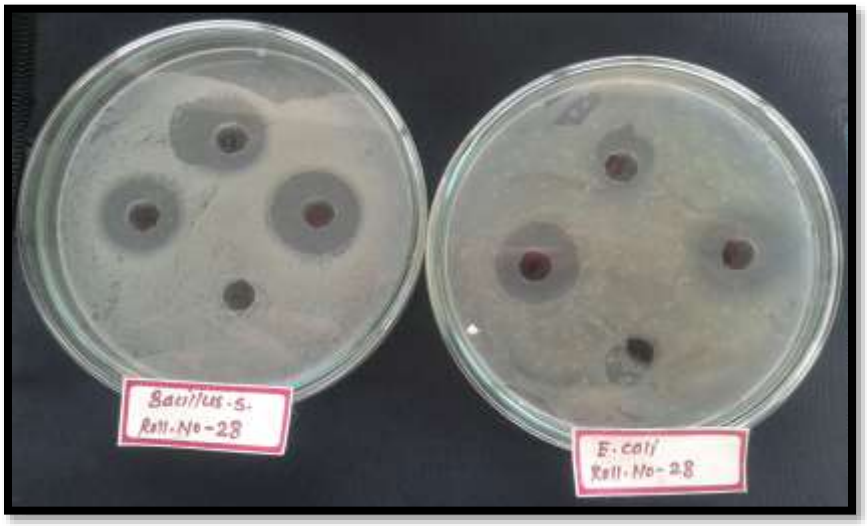
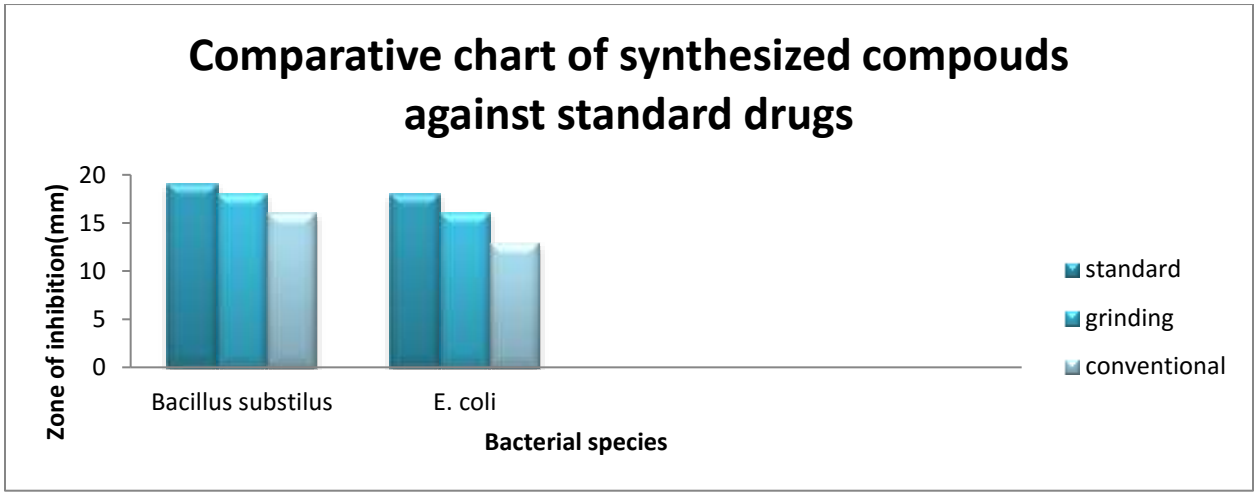


Figure No. 4.6: Anti-microbial screening of Benzoic acid

Table No. 4.4:- Anti-microbial activity of synthesized compound

compound No.	zone of inhibition(mm)	
	Gram(+ve) Bacillus substilus	Gram(-ve) E.coli
1. Standard technique	19	18
2. Grinding technique	18	16
3. Conventional technique	16	13
4. Solvent	0	0

NOTE: Duration 24 hours.



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