MICROWAVE ASSISTED GREEN SYNTHESIS OF SUCCINIC ACID DERIVATIVES FROM FURFURAL AND STUDY OF THEIR ANTIBACTERIAL ACTIVITY

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Abstract

Green oxidation of inedible biomass based furfuraldehyde [furfural] to succinic acid [SA] using hydrogen peroxide as an oxidizing agent called as green oxidant takes place as following.

Ring opening reaction happens when furfural is added with hydrogen peroxide [H_2O_2], under certain temperature the ring opening of furfural leads to the formation of succinic acid as a product. The completion of the reaction can be checked through thin layer chromatography. We studied antibacterial activity for synthesized Succinic acid, 2-iodo succinic acid.

Key words-Succinic acid derivatives, Green synthesis, Microwave synthesis, Hydrogen peroxide, furfural.

I. INTRODUCTION

Green chemistry has been playing very great role in the field of organic chemistry for the synthesis of organic compounds. We planned for the green synthesis of Succinic acid by a simple microwave method [1-2]. Succinic acid was prepared by the starting material Furfural which undergoes oxidation and Iodination [3-5]. The reaction was done by microwave irradiation. Microwave energy provided the energy for chemical reaction and reaction time was very less compared to conventional method. Furfural is a five membered aldehyde cyclic ring which upon treated with H_2O_2 undergoes oxidation and ring opening takes place to form succinic acid. Later the same was treated with Potassium Iodide to undergo Iodination to form Iodo- succinic acid [6-7].

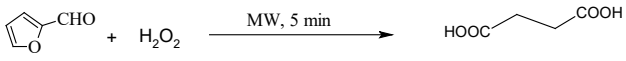
II. MATERIALS AND METHODS

EXPERIMENTAL WORK

General method for the Synthesis of Succinic acid and its substituents Synthesis of Succinic acid:

Firstly, succinic acid has been prepared by taking the reactant as furfural, which is an organic compound. 9ml of Furfural is measured and taken into a clean beaker and to this 25 ml of hydrogen peroxide has been added, which acts as an oxidizing agent and the reaction mixture of furfural and H_2O_2 is heated in the microwave oven for sometimes until the reaction completes and the completion of the reaction is checked through TLC. The obtained succinic acid product is filtered and washed with ethanol and dried, then weighed and its melting point is observed and the compound is collected in a sample bottle [8-11].

Reaction Scheme-1

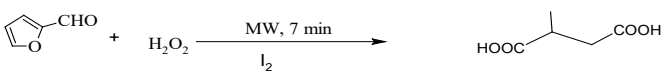


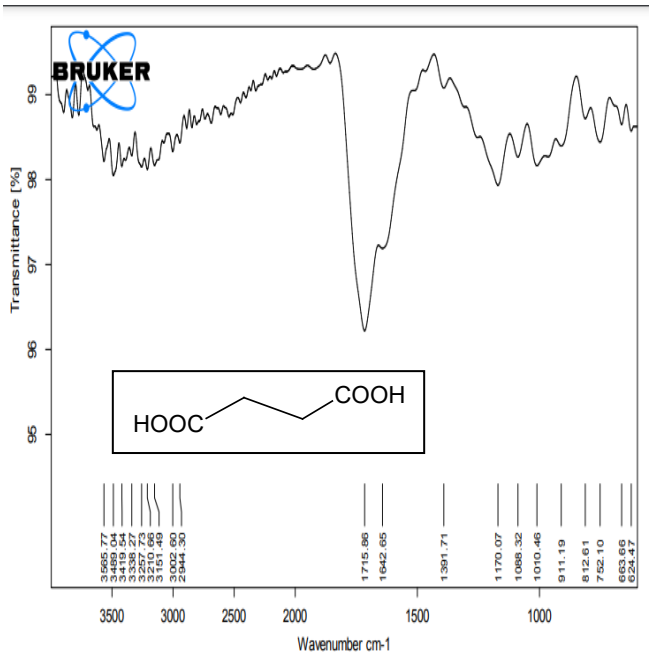
Synthesis of 2-Iodo Succinic acid:

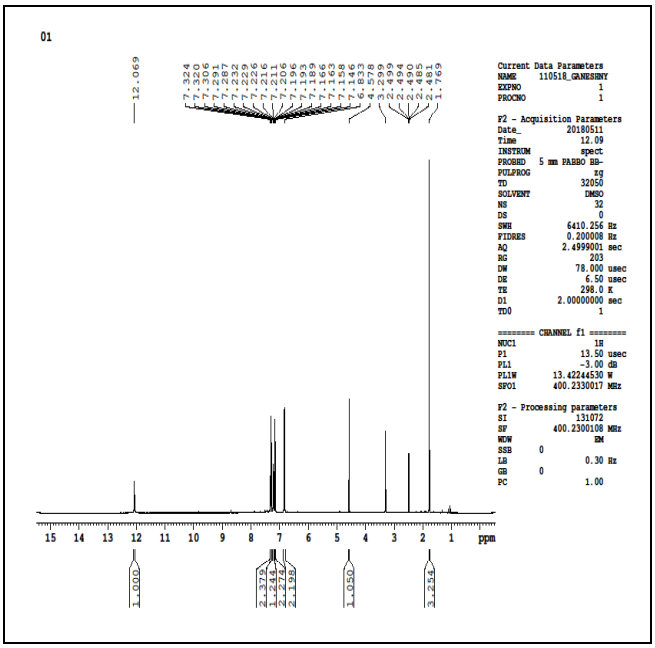
0.166g of potassium iodide is dissolved in 10ml of ethanol and the solution is added to the 9ml of furfural in a beaker the reaction mixture is heated for some time until the reaction completes. The completion of the reaction is checked through TLC. The obtained Iodo furfural product is filtered and washed with ethanol and dried, then weighed and its melting

point is observed and the compound is collected in a sample bottle[10].

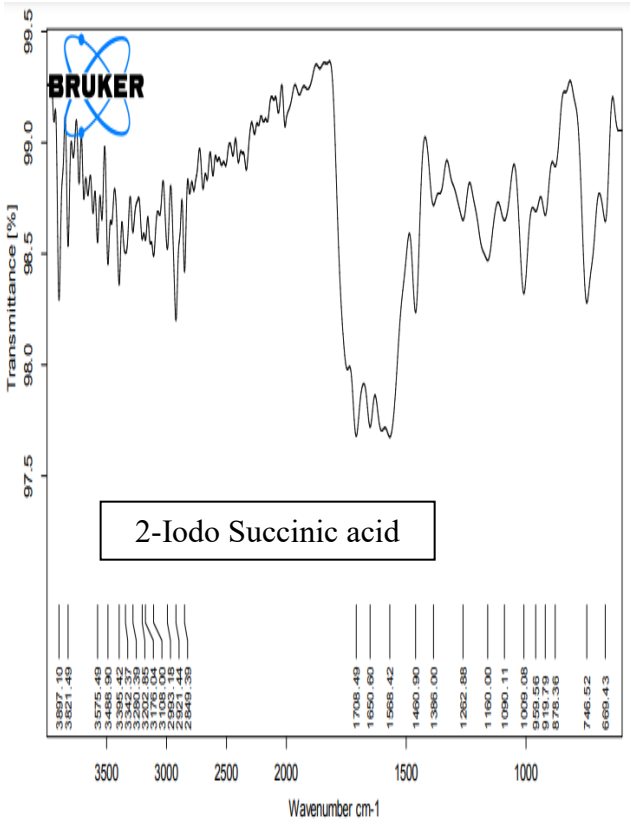
Reaction Scheme-2:

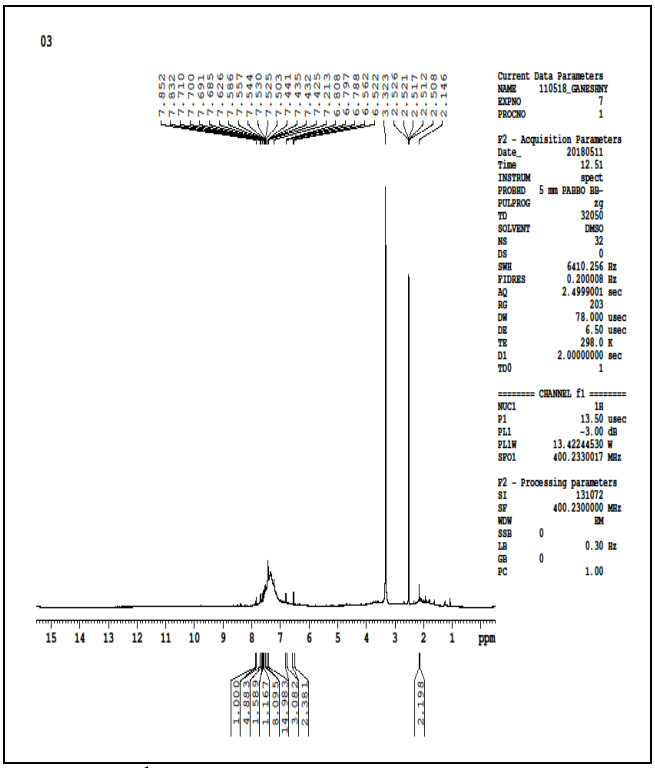




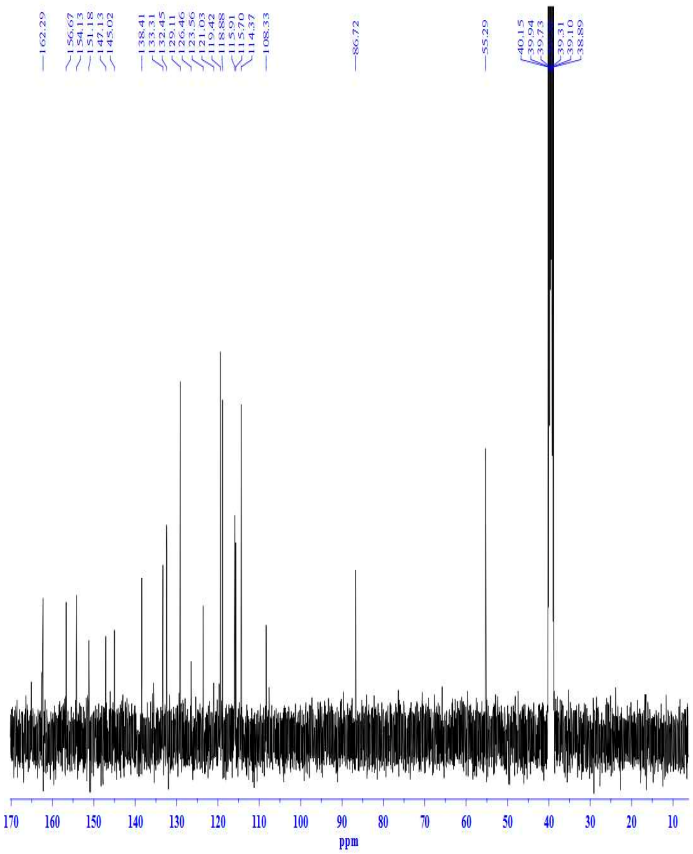


^{1}H NMR of Succinic acid

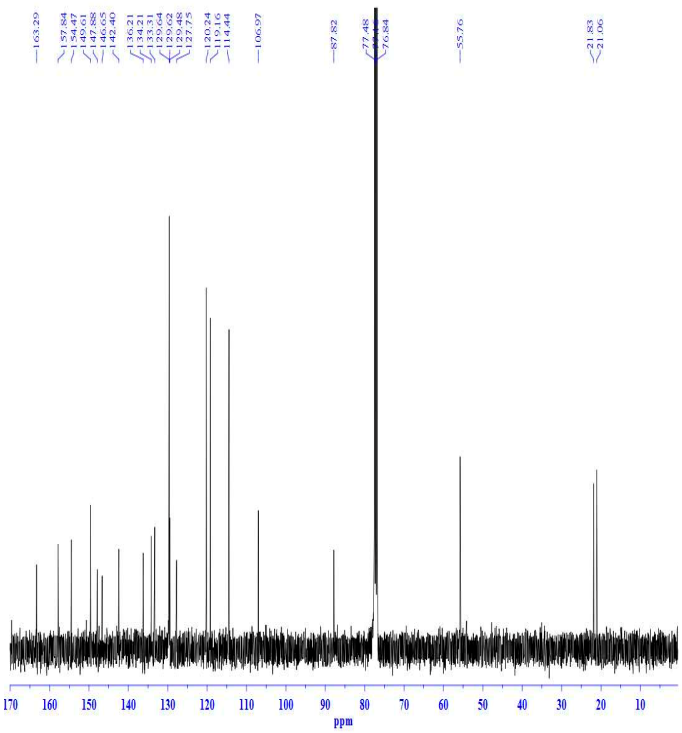




^{1}H NMR of 2-iodo-Succinic acid



^{13}C-NMR of Succinic acid



^{13}C-NMR of 2-iodo-Succinic acid

III. RESULTS AND DISCUSSION

Table 1. Reaction time of Succinic acid and its substituents

Compounds	Reaction Time in Minutes (MW)	Yield (%)	Color	m.p.
Succinic acid	5	88.00	Brown	181°C
2-iodo Succinic acid	7	74.00	Brown	198°C

Succinic acid: Brown solid, Yield= 88.00%, m.p: 181°C, IR (KBr) Cm^{-1}: 3395 (m, Carboxylic acids, stretch), 1715 (S, Carboxylic acids), 3002 (C-H, stretch), 1391.71 (m, CH_2).

2-Iodo Succinic acid: Brown solid, Yield= 74%, m.p: 198°C, IR (KBr) Cm^{-1}: 3342 (m, Carboxylic acids, stretch), 1708 (S, Carboxylic acids), 2993 (C-H, stretch), 1460.71 (m, CH_2).

In the table-1, Succinic acid formed in 5 mins under microwave irradiation and having 88.00% yield**.**

Similarly, 2-iodo succinic acid completed its reaction in 7 mins and having yield 74.00%.

Succinic acid possesses various applications in the field of medicine. After literature studies, Succinic acid prepared to use for the biological activities. Hence, we planned to study antibacterial activity [12-13].

Biological activity

Procedure

Well diffusion method

In Fig 1, the mechanism has been studied that how the compounds inhibit the bacteria. Prepare agar medium by taking proportions of calculated weight of Peptone, Beef extract, NaOH Solution in conical flask.

Sterilize the petri plates, pour the agar medium and dry. Keep these petri plates in incubation. Make the desired size of wells to the dried agar medium. Scrub the bacterial cultures on the plates. Keep the plates for incubation to grow the bacteria.

Apply the synthesized compounds Succinic acid and 2-iodo-succinic acid of desired concentrations on the wells. Keep them for 24hrs incubation and measure the zone of inhibition of compounds which inhibit the bacterial growth.

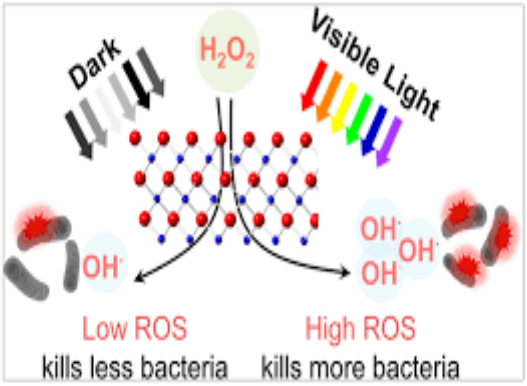


Fig 1. Mechanism of Bacterial inhibition

Firstly, desired bacterial cultures for the study required. After the studies on bacteria E.Coli, Streptococcus, Staphylo cocci, afforded good positive results. In fig 2, zone of inhibition has been marked in the petri plates. In fig 3, MTT image of inhibition for succinic acid has been displayed [14-15].

In the table 2, Succinic acid showed zone of inhibition 16mm for E.Coli, 24mm for Staphylococcus aureus and 17mm for Bacillus cereus. Similarly, 2-iodo succinic acid exhibited 27mm for E.Coli, 14mm for Staphylococcus aureus and 18mm for Bacillus cereus.

Table2. Zone of Inhibition of compounds Succinic Acid and 2-Iodo-Succinic acid

Compound Name	*Zone of Inhibition (mm)*		
	E.Coli	*Staphylococcus aureus*	*Bacillus cereus*
Succinic Acid	*16*	*24*	*B. 17*
2-Iodo-Succinic Acid	*27*	*14*	*18*

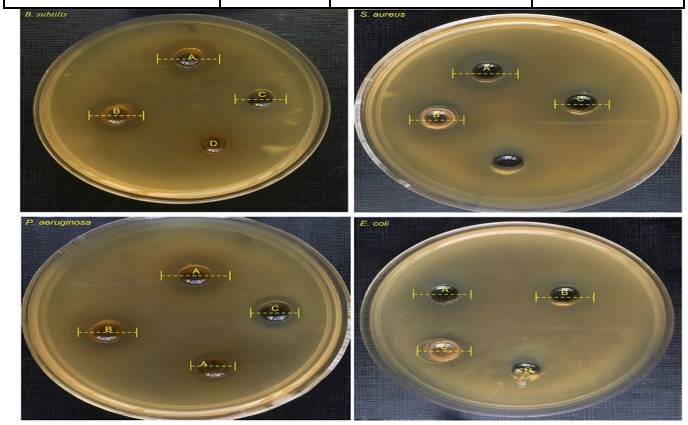


Fig 2. Images of Inhibition in agar media

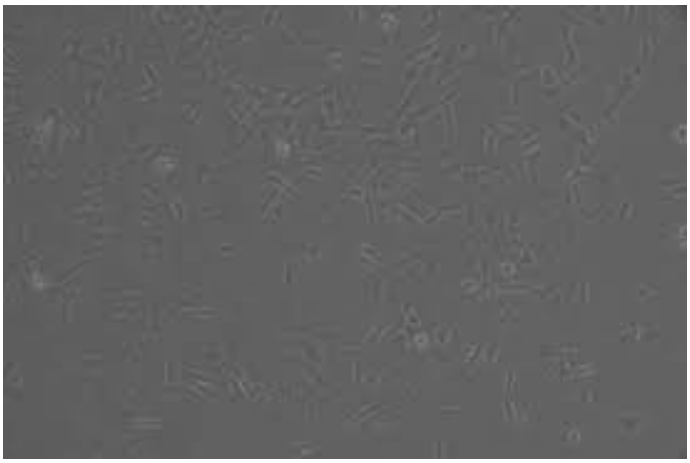


Fig 3. MTT assay

IV. CONCLUSION

- We followed Green chemistry for the synthesis of succinic acid and its substituents so that this work is mainly on the concern of environment protection.
- The FT-IR characterization confirmed the strucutre of all synthesized compounds.

V. ACKNOWLEDGEMENT

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