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MICROWAVE ASSISTED SYNTHESIZED NOVEL CHALCONE DERIVATIVES AND EVALUATION OF THEIR ANTI-OXIDANT ACTIVITY

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Abstract:

Green synthesis is a method of thinking in chemistry that aims to eliminate harmful waste and reduce energy consumption. Chalcones are an acetophenone derived chalcones found in many plants. Microwave –assisted synthesis was used to create the chalcones. An assessment of their antioxidant activity was conducted. TLC plates were used to monitor the reaction. For spectral analyses such as IR NMR, and mass spectrometry, the synthesized compounds were screened.

Key Words: *Green synthesis- Microwave assisted synthesis- chalcones -Antioxidant activity.*

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INTRODUCTION:

Green synthesis:

Green synthesis is an ecologically friendly approach that offers an alternative perspective on chemistry with the goals of removing harmful waste, using less energy, and utilizing ecological solvents (such as water, ethanol, ethyl acetate, etc.).

Chalcones:

Chalcones are formed from acetophenone molecules in which a benzylidene group has taken the place of one of the methyl hydrogen's. It performs the role of a plant metabolite. It is a part of the chalcones and styrenes.

Vegetables, fruits, teas, and other naturally occurring chemicals all contain chalcones, which are chemical scaffolds. The word "chalcone," which describes the colors of the majority of natural chalcones, comes from the Greek Word "chalcos," which means "bronze."

Importance:

- Chalcones have both direct and indirect redox activities. They also inhibit aldose reductase ALR2, an enzyme with anti-inflammatory and anti-oxidative effects.
- As flavonoids, chalcones are important for pathogen and insect defence in addition to being important for flower pigmentation and their role as pollination attractants.
- Chalcones and their derivatives have shown great promise has anti-diabetic, anti-cancer, anti-inflammatory, anti-microbial, anti-oxidant, antiparasitic, psychoactive, and neuro protective agents based on pre-clinical research
- The usual method for creating chalcone involves an aldol condensation between Acetophenone and Benzaldehyde.
- Green synthesis is the process of developing dependable, environmentally friendly, and sustainable synthesis processes in order to avoid undesirable or hazardous by-products.
- In order to stop air pollution.
- The philosophy of "green chemistry" advocates for the creation of novel chemical reactivity's and reaction conditions that may improve chemical synthesis's selectivity, ease of operation, and efficiency with resources and energy**.**

Difference betwen conventional and microwave assisted synthesis[2]

S.NO	CONVENTIONAL SYNTHESIS	MICROWAVE ASSISTED SYNTHESIS
1.	Heat flow: outside to inside	Heat flow: inside to outside
2.	Efficient external heating	Efficient internal heating
3.	No specific temperature	Specific temperature
4.	Decrease in reaction rate	Increase in reaction rate
5.	More solvent	Less solvent
6.	Longer processing times	Very short and instant heating
7.	High energy consumption	Moderate to low consumption
8.	Product quality and quantity can be affected.	Higher product quality and quantity possible.

Conditions appropriate for microwave synthesis :

Inert atmosphere:

Inert atmosphere is not initially employed, if needed flush the vial with an inert gas before capping.

Time[2]

Typically, most reactions require 2-15 min of irradiation.

Temperature:

Maintain the temperature b/w 60°c to250°c.

Pressure:

The reaction can be safely performed at pressure of up to 20 bar

Time prediction:

Reactions proceed faster using microwave synthesis simply because they are conducted at higher temperature, like based on Arrhenius equation a ten degree increase in reaction temperature doubles the reaction speed.

Optimization:

Optimizing a microwave synthesis is similar to optimizing a conventional synthesis like if reaction fails changing the target temperature and reaction time can cause significant improvement.

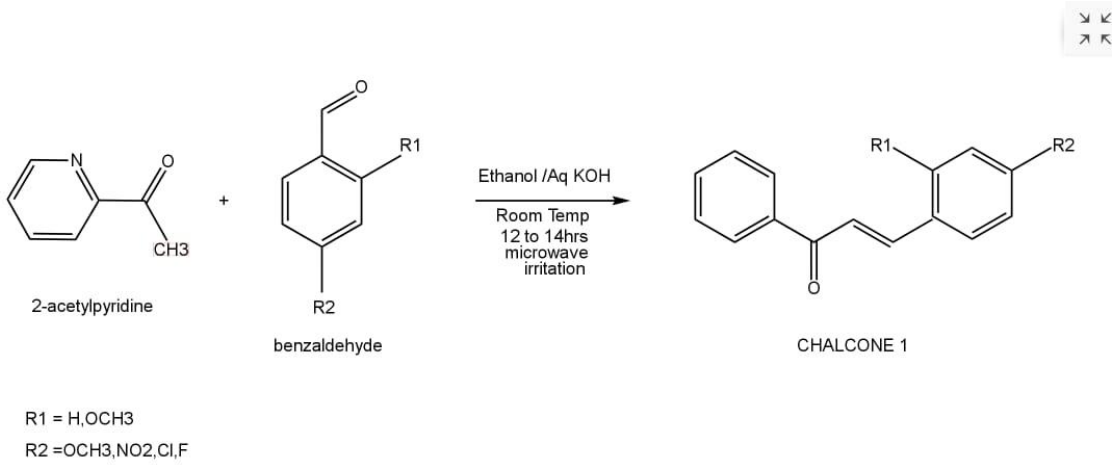
Experimental:

General procedure for the synthesis of chalcones by Claisen-Schmidt condensation 17-21

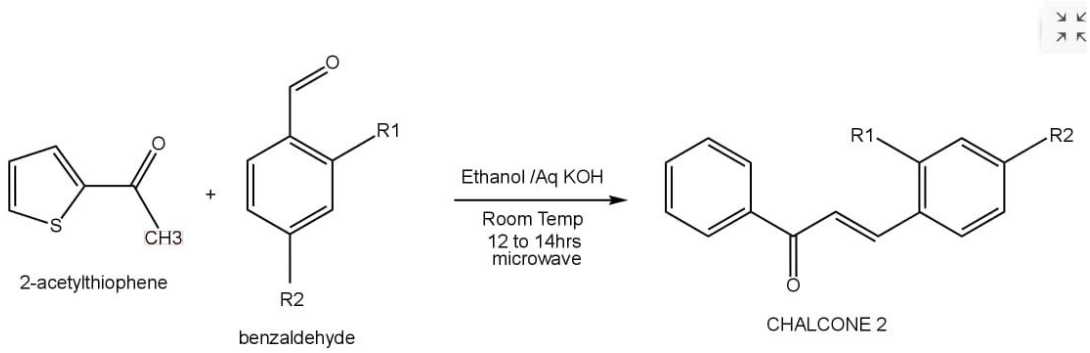
Synthesis of chalcones (1-5):

(MWI). Equimolar quantities (0.001mol) of 2-acetyl-thiopene,2-acetyl-pyridine and respective aldehydes (0.001mol) were mixed and dissolved in minimum amount (3ml) of alcohol. To this, aqueous potassium hydroxide solution (0.003mol) was added slowly and mixed. The entire reaction mixture was microwave irradiated for about 2-6 minutes at 180 watts .

Scheme:



R1 = H,OCH3
R2 =OCH3,NO2,Cl,F



R1 =H,OCH3
R2 =OCH3,NO2,Cl,F

Table 1 : Amount Of Percentage Yield

S. No.	Code No.	% Yield	M.p. (ºC)	R_f Value*	Elemental Analysis (%) Calcd. (Found)		
					C	H	N/Cl
1	C1	72	168-169	0.68	70.31 (70.29)	4.72 (4.73)	-
2	C2	74	175-176	0.66	71.10 (71.09)	5.22 (5.21)	-
3	C3	79	197-198	0.73	65.58 (65.56)	4.04 (4.05)	12.91 (12.92)
4	C4	63	210-212	0.82	63.16 (63.15)	3.89 (3.87)	4.91 (4.92)
5	C5	67	186-187	0.77	67.99 (67.97)	5.37 (5.38)	-

Table 2: Spectral data of synthesized compounds

S. No.	CodeNo.	IR (KBr) v (cm-1)
1	C1	3261 (O-H str.), 3015 (Ar=C-H str.), 1674 (C=O str.), 1590 (C-C str.), 1554, 1461, 1429 (Ar C=C str.)
2	C2	3310 (O-H str.), 3037 (Ar=C-H str.), 2842 (C-H str.), 1675 (C=O str.), 1592 (C-C str.), 1552, 1448, 1412 (Ar C=C str.), 1120 (C-O str.)
3	C3	3326 (O-H str.), 3032 (Ar=C-H str.), 1680 (C=O str.), 1594 (C-C str.), 1563, 1507, 1465 (Ar C=C str.), 668 (C-Cl str.)
4	C4	3206 (O-H str.), 3094 (Ar=C-H str.), 1680 (C=O str.), 1593 (C-C str.), 1550, 1477, 1415 (Ar C=C str.), 1490 (N-O asym. str.), 1366 (N-O sym.str.)
5	C5	3260 (O-H str.), 3035 (Ar=C-H str.), 2844 (C-H str.), 1683 (C=O str.), 1580 (C-C str.), 1557, 1476, 1454 (Ar C=C str.), 1212 (C-O str.)

***In-vitro* antioxidant activity of synthesized chalcones:**

In the present study, *in-vitro* antioxidant activity of newly synthesized compounds was performed by DPPH model[25,26]. The method employed was by determining the free radical inhibitory ability of different antioxidant by using very stable free radical such as 2,2-diphenyl-1-picrylhydrazyl (DPPH) in methanol. Stock solution of DPPH (1.3 mg/mL) in methanol was prepared. Stock solution of DPPH 100 µL was added to 3.0 mL of methanol and absorbance was recorded at 516 nm. The various concentrations of compounds (25, 50 and 100 µg/mL) were prepared. All sample solutions 1.0 mL each is diluted with 3.0 mL with methanol and 100 µL of stock solution of DPPH was added. Test tubes were kept for 30 min in light to complete the reaction.

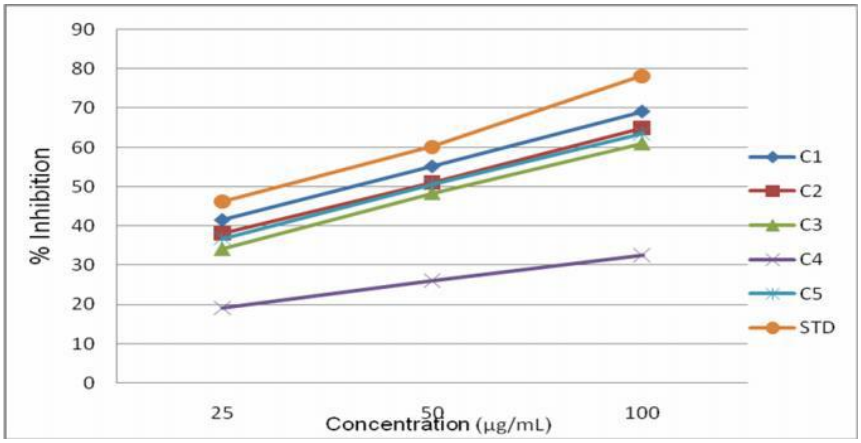
After 30 min, absorbance of each test tube was recorded at 516 nm on UV-VIS spectrophotometer against methanol as a blank. The effective concentration of sample required to scavenge DPPH radical by 50% (IC_{50} value) was obtained by linear regression analysis of dose-response curve plotting between % inhibition and concentrations (figure: 1 & 2). Regression equations to derived IC_{50} values showed inverse relationship between IC_{50} values and percentage scavenging potential of compound. Where;Control is absorbance of a DPPH solution without compound;Test is the absorbance of the test compound with DPPH.The degree of discoloration indicates the free radical scavenging efficiency of the compound. Ascorbic acid was used as the free radical scavenger reference compound.

The DPPH free radical scavenging activity was calculated using the following formula:

$$\% \text{ scavenging} = \frac{\text{Absorbance of control - Absorbance of test sample}}{\text{Absorbance of control}} \times 100$$

RESULT:

S. No.	Code No.	% Inhibition (DPPH-Scavenging)			IC_{50} (µg/mL)
		25 µg/mL	50 µg/mL	100 µg/Ml	
1	C1	41.05±0.02	55.12±0.04	69.08±0.17	40.52
2	C2	38.04±0.01	51.05±0.23	65.05±0.11	47.45
3	C3	34.22±0.37	48.44±0.15	61.09±0.16	57.98
4	C4	19.01±0.12	26.00±0.2	32.50±0.09	>100
5	C5	36.80±0.14	50.60±0.03	63.54±0.12	49.12



DISCUSSION:

From the literature survey, 2-acetyl thiophene and 2-acetyl pyridine chalcones were designed and synthesized under novel microwave assisted synthesis using 4-acetyl thiopene, 4-acetyl pyridine, and 4-chlorobenzaldehyde, 4-fluorobenzaldehyde,4-nitrobenzaldehyde. After five compounds were synthesized, named CHA-I, CHA-II, CHAIII, CHA-IV, CHA-V.

Among five synthesized compounds 3 compounds were made using
4-acetyl thiopene and were the other 2 compounds made using 4-acetyl pyridine.

All the structures of the synthesized compounds were consistent with IR spectra. The
spectral data of all synthesized compounds are discussed below.

All synthesized compounds have better physical data such as colour, odour, melting
point, physical nature, solubility, molecular structure, molecular weight, theoretical yield, practical yield, percentage yield. Among the physical data of the synthesized compounds
CHA-IV has better physical activity and better yield (99.64%).

The antioxidant activity of synthesized compounds was analyzed under DPPH model.

All the synthesized compounds where shown antioxidant activity and the activity increases as the concentration increases among the five synthesized chalcones CH-I,CH-II,CH-V shown moderate anti-oxidant activity .

The reason m ay be CHA-III and CHA-IV havingstrong electronegative groups respectively. Other compounds also shown satisfactory antioxidant activity.

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