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In Vitro ANTIOXIDANT ACTIVITY OF CHALCONE DERIVATIVES

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ABSTRACT

Chalcone derivatives have recently drawn the attention of the scientific community worldwide due to their wide range of bioactivities. Exploring creative frameworks for the design and synthesis of new antioxidant agents is crucial given the high need for new antioxidant agents. The objectives of the present article are to resynthesize some already developed chalcone derivatives and to assay their*in vitro* antioxidant potential. Subsequently, the test compounds were found to show remarkable *in vitro* antioxidant activity as compared with standard drugs. Antioxidant activity is assayed by the DPPH (Diphenylpicryl hydrazine) free radical method. The reference standard or positive control used was ascorbic acid (Vitamin C).

Keywords: Chalcone Derivatives, Antioxidant Agent, DPPH, Prop-2-en-1-one, Ascorbic Acid.

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INTRODUCTION

Antioxidant translates as "against oxidation". Any agent that considerably slows down or prevents the oxidation of a substrate when present in modest concentrations as compared to that substrate is referred to as an antioxidant[1-4]. High levels of free radicals can harm biomolecules in the cell membrane, including enzymes, proteins, lipids, and nucleic acids. As a result, conditions like diabetes, cancer, Alzheimer's disease, cardiomuscular and autoimmune illnesses, neurological disorders, and obesity may develop. Antioxidants are significant compounds that protect the cells from oxidative injury by reducing or neutralizing free radicals. Furthermore, the increased creation of free radicals may lead to an imbalance between oxidant and antioxidant activity, which is what causes oxidative stress[5-9]. Several biomolecules, including DNA, lipids, and proteins, have been demonstrated to be at risk due to an imbalance between oxidants and antioxidants, which is also known to promote the onset of many chronic diseases. The bulk of exogenous antioxidants is found in foods and medicines, including tomatoes, green tea, beta-carotene, lycopene, lutein, and zeaxanthin, as well as other vegetables, cereals, beverages, mushrooms, flowers, spices, fruits. In addition, the sectors that process agricultural by-products provide additional potential sources of natural antioxidants. The majority of these plant-based natural antioxidants are polyphenols (anthocyanins, phenolic acids, flavonoids, stilbenes, and lignans), carotenoids (xanthophylls and carotenes), and vitamin E and vitamin C. Chalcones belong to flavonoids family are 1,3-phenylprop-2-en-1-one structural derivatives widely present in natural goods. A literature survey revealed that chalcones possess a wide range of bioactivities, like anticancer, antimicrobial, antioxidant, antitubercular, anti-tumor, tubulinpolymerization inhibitors, antibacterial, antifungal,antimalarial, analgesic, anti-infective,and antioxidant properties *in-vivo* as well as *in-vitro* conditions[10-26]. The structure of the two aryl moieties (i.e. their substitution patterns) in the backbone of chalcone highly influences the antioxidant properties[27-41]. The antioxidant properties of 1,3-phenylprop-2-en-1-one derivatives have received very little attention, according to a detailed examination of the literature. So it was thought interesting to resynthesize previously developed 1,3-phenylprop-2-en-1-one derivatives and assay their antioxidant activity against DPPH (Diphenyl picryl hydrazine)free radical.

EXPERIMENTAL

General Procedure

Previously developed 1,3-phenylprop-2-en-1-one derivatives were re-synthesized and assayed for their antioxidant activity against Diphenyl picryl hydrazine free radicals and were evaluated using ascorbic acid as reference.

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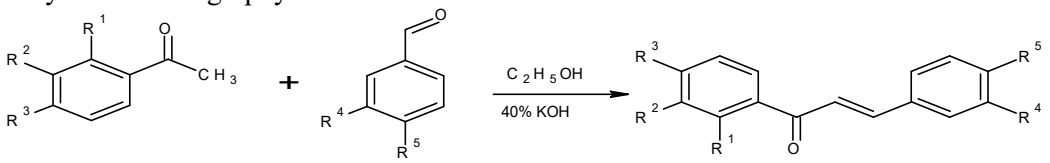
Synthesis of 3-(3-Bromophenyl)-1-(2-chlorophenyl)prop-2-en-1-one (Compound 1)

2-Chloro acetophenone (0.01M) dissolved in ethanol (15 ml) was treated with 3-bromo benzaldehyde (0.01M) with constant stirring and aqueous KOH solution (40%, 10 ml) was added drop by drop. The reaction mixture after stirring at room temperature,was kept overnight, then diluted with water and acidified by 10% HCl. The solid thus separated was filtered and recrystallized from acetic acid to get 3-(3-bromophenyl)-1-(2-chlorophenyl)prop-2-en-1-one. Similarly, compounds 2-11 were also synthesized by using different acetophenones and aldehydes adopting the same procedure followed for compound 1. The resynthesized compounds were characterized by elemental analysis, chemical tests, melting points, and Thin Layer Chromatography.



R_1 /R_2 /R_3 /R_4 /R_5 = -OH/ -Cl/ -F/ -NMe_2/ -NH_2 /-Br/ -H

Fig.-1: Scheme of Synthesis of prop-2-en-1-one Derivatives

S. No.	Sample code	Prop-2-en-1-one derivatives	Melting Point (°C)
1	A	3-(3-Bromophenyl)-1-(2-chlorophenyl)prop-2-en-1-one	81-83
2	B	3-[4-(Dimethylamino)phenyl]-1-phenyl prop-2-en-1-one	118-120
3	C	1-(3-Aminophenyl)-3-(3-fluorophenyl)prop-2-en-1-one	90-92
4	D	1-(3-Aminophenyl)-3-(3-bromophenyl)prop-2-en-1-one	173-175
5	E	3-(4-Chlorophenyl)-1-(2-Hydroxyphenyl)Prop-2-en-1-one	154-156
6	F	1,3-Bis(4-hydroxyphenyl)prop-2-en-1-one	208-210
7	G	3-(4-Chlorophenyl)-1-(4-hydroxyphenyl)prop-2-en-1-one	130-133
8	H	3-Phenyl-1-(4-hydroxyphenyl)prop-2-en-1-one	160-163
9	I	3-(2-Chlorophenyl)-1-(4-hydroxyphenyl)prop-2-en-1-one	174-176
10	J	3-Phenyl-1-(4-fluorophenyl)prop-2-en-1-one	79-80
11	K	3-(2-Chlorophenyl)-1-(4-fluorophenyl)prop-2-en-1-one	86-90

Determination of Antioxidant Activity

Some of these synthesized chalcones (Sample A-F) were evaluated for their antioxidant activities by the DPPH assay method.

DPPH (Diphenyl picryl hydrazine) Assay for Antioxidant Activity

Procedure

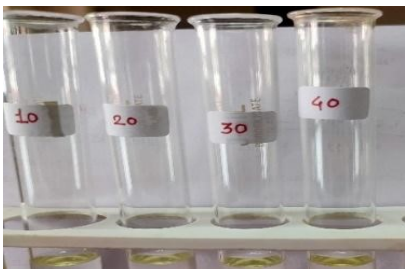
1. Stock solution of DPPH prepared by dissolving 1.083 mg/10 ml of ethanol.
2. Stock solution of formulation (100 µg/ml) was prepared by dissolving 1 ml of formulation/10 ml of ethanol from these stock solutions further dilutions were prepared in10, 20, .., and 50 µg/ml concentrations using ethanol.
3. Similarly,a stock solution of 1mg/ml standard ascorbic acid was prepared by dissolving 10 mg ascorbic acid/10 ml ethanol. From these stock solutions, further dilution of concentration 1, 2, 3, 4, and 5 µg/ml were prepared.
4. Absorbance of blank 5ml ethanol and 1ml DPPH as a positive control was recorded using UV at 420 nm.
5. Similarly absorbance of formulations and comparative standard ascorbic acid were taken at 420 nm and recorded.
6. Since the color of the formulation after adding DPPH was interfering with absorbance, the absorbance of all concentration of the formulation were taken before the addition of DPPH, and those were subtracted from the final absorbance of all concentration to remove the error.

RESULTS AND DISCUSSION

The antioxidant activities of prop-2-en-1-one derivatives (Sample A-F) are depicted in Table-2 to 8.

Table-2: Antioxidant Activity of Standard Ascorbic Acid

S. No.	Concentration of ascorbic acid µg/ml	Absorbance of blank	Absorbance of ascorbic acid	Percentage of free radical inhibition
1	1	0.413	0.247	40.19%
2	2		0.222	46.24%
3	3		0.187	54.72%
4	4		0.141	65.85%
5	5		0.104	74.81%



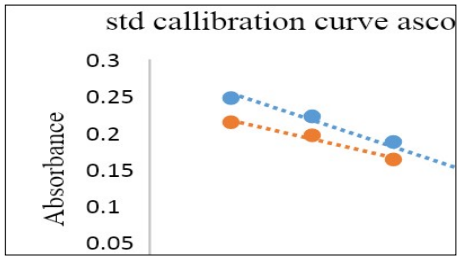
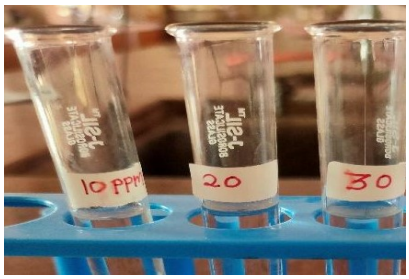


Fig.-1:Ascorbic Acid Dilutions

Table-3: Antioxidant Activity of Sample A

S. No.	Concentration of Sample µg/ml	Absorbance of blank	Absorbance of sample	Percentage of free radical inhibition
1	10	0.413	0.214	48.18%
2	20		0.196	52.54%
3	30		0.163	60.53%



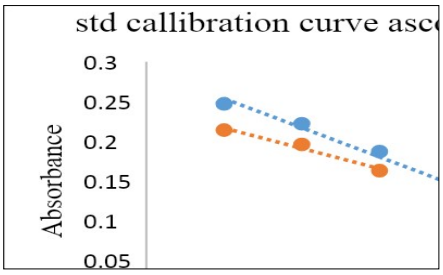
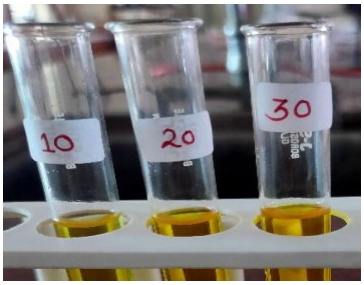


Fig.-2: Sample A dilutions

Table-4: Antioxidant Activity of Sample B

S.No.	Concentration of Sample µg/ml	Absorbance of blank	Absorbance of sample	Percentage of free radical inhibition
1	10	0.301	0.237	21.26%
2	20		0.196	34.88%
3	30		0.148	50.83%



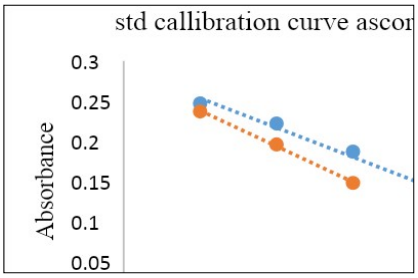


Fig.-3: Sample B dilutions

Table-5: Antioxidant Activity of Sample C

S.No.	Concentration of Sample µg/ml	Absorbance of blank	Absorbance of sample	Percentage of free radical inhibition
1	10	0.347	0.256	26.22%
2	20		0.213	38.61%
3	30		0.168	51.58%

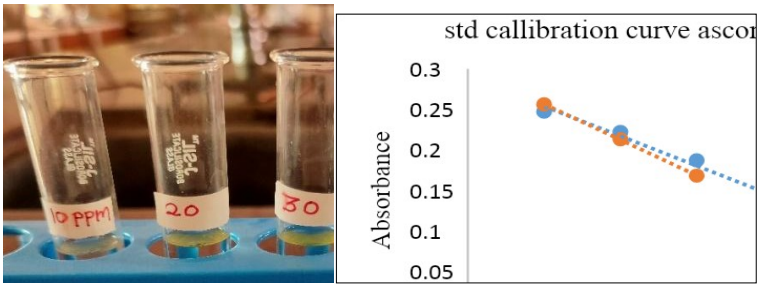


Fig.-4: Sample C dilutions

Table-6: Antioxidant Activity of Sample D

S. No.	Concentration of Sample µg/ml	Absorbance of blank	Absorbance of sample	Percentage of free radical inhibition
1	10	0.296	0.229	22.63%
2	20		0.179	39.52%
3	30		0.136	54.05%

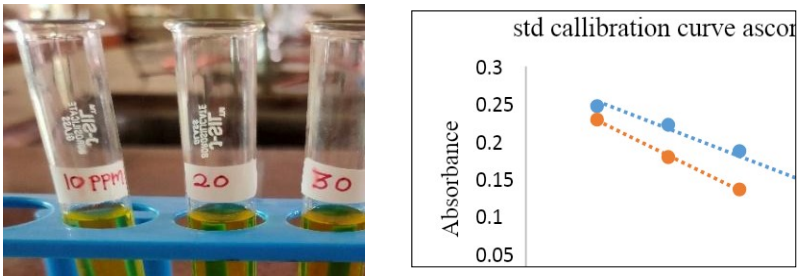


Fig.-5: Sample D dilutions

Table-7: Antioxidant Activity of Sample E

S. No.	Concentration of Sample µg/ml	Absorbance of blank	Absorbance of sample	Percentage of free radical inhibition
1	10	0.274	0.184	32.84%
2	20		0.153	44.16%
3	30		0.114	58.39%

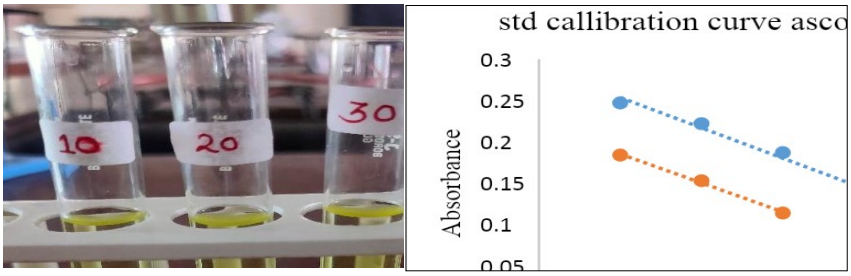


Fig.-6: Sample E dilutions

Table-8: Antioxidant Activity of Sample F

S. No.	Concentration of Sample µg/ml	Absorbance of blank	Absorbance of sample	Percentage of free radical inhibition
1	10	0.413	0.192	53.51%
2	20		0.171	58.59%
3	30		0.154	62.71%

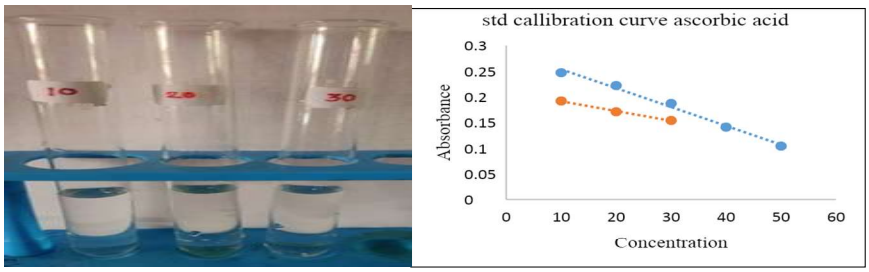


Fig.-7: Sample F dilutions

CONCLUSION

The present study reveals the resynthesis of chalcone derivatives by a base-catalyzed Claisen-Schmidt condensation of various substituted acetophenone with different aryl aldehydes. Some of the test compounds were assayed for their anti-oxidant activities and were found to show moderate to excellent activity, the results are illustrated in Table 2-8. Most of the compounds were found to contain noteworthy antioxidant properties in comparison with the reference standard Ascorbic acid.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS

All the authors contributed significantly to this manuscript, participated in reviewing/editing, and approved the final draft for publication. The research profile of the authors can be verified from their ORCID IDs, given below:

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