



Synthesis of Some Phenylisoindoline-1,3-Diones and their Acetylcholinesterase and Butyryl Cholinesterase Inhibitory Activities

F. O. Taiwo^{a*}, C. A. Obafemi^a, E. M. Obuotor^b and I. J. Olawuni^b

^a Department of Chemistry, Obafemi Awolowo University, Nigeria.

^b Department of Biochemistry and Molecular Biology, Obafemi Awolowo University, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i51B33539

Editor(s):

(1) Dr. S. Prabhu, Sri Venkateswara College of Engineering, India.

Reviewers:

(1) Hasan Faisal Alesary, university of Kerbala, Iraq.

(2) Sadiq Karim, University of Babylon, Iraq.

Complete Peer review History, details of the editor(s), Reviewers and additional Reviewers are available here:
<https://www.sdiarticle5.com/review-history/71132>

Original Research Article

Received 15 May 2021

Accepted 21 July 2021

Published 26 November 2021

ABSTRACT

Aims: To synthesize some phthalimides derivatives and evaluate the compounds for their possible biological properties.

Methods: The substituted phenylisoindoline-1,3-dione were synthesized from the reactions of N-phenyl phthalimide with different substituted aromatic aldehyde. The synthesized compounds were characterized using nuclear magnetic resonance spectroscopic analysis. The acetylcholinesterase and butyryl cholinesterase inhibitions were determined by Spectro photochemical analysis of acetylthiocholine and butyryl choline chloride.

Results: Compounds 6 ($IC_{50} = 30 \pm 3 \mu\text{g/mL}$) and 4 ($IC_{50} = 141 \pm 60 \mu\text{g/mL}$) were found to be the most active inhibitors against acetylcholinesterase, while compounds 4 ($IC_{50} = 102 \pm 10 \mu\text{g/mL}$), 5 ($IC_{50} = 105 \pm 20 \mu\text{g/mL}$) and 2 ($IC_{50} = 190 \pm 10 \mu\text{g/mL}$), were found to be most active inhibitor against butyryl cholinesterase.

Conclusion: The considerable acetylcholinesterase and butyryl cholinesterase inhibitory activities of the synthesized compounds makes them good candidates for the development of selective acetylcholinesterase and butyryl cholinesterase inhibitors.

Keywords: Alzheimer's disease; acetylcholine; acetylcholinesterase; butyryl cholinesterase; serine; chalcones.

1. INTRODUCTION

Phthalimide derivatives have been reported to belong to a class of compounds possessing various pharmacological properties such as antimalarial (4), antihypertensive, antimicrobial (5), antiviral and as herbicides (6). Similarly, compounds derived from Chalcones have been found to possess useful pharmacological properties such as cytotoxicity[1], antioxidant[2], antibacterial [3], antileishmanial [4], anticancer [5], antiangiogenic [6], anti-infective, anti-inflammatory [7], antifungal [8], anti-malarial [9], anti-tumor [10], anti-protozoal [11] and cytotoxic properties [12].

2. EXPERIMENTAL

Melting points were determined with open capillary tube on a Gallenkamp (variable heater) melting point apparatus and were uncorrected. Infrared spectra were recorded as KBr pellets on a Bruker 2000 Spectrometer. The ^1H and ^{13}C NMR was run on a Bruker 600 MHz spectrometer (δ in ppm relative to Me_4Si) at the Department of Chemistry, Portland state University, Portland U.S.A. The purity of the compounds was routinely checked by TLC on silica gel G plates using n-hexane/ethyl acetate (1:1, v/v) solvent system and the developed plates were visualized by UV light. All reagents used were obtained from Sigma–Aldrich Chemical Ltd, except Glacial acetic acid, ethanol, oxalic acid and vanillin which were obtained from BDH Chemical Limited.

2.1 Synthetic Work

2.1.1 Synthesis of 2-(4-acetylphenyl) isoindoline-1,3-dione

Phthalic anhydride (5 g), 4-ethoxyaniline (4.0g) in 50 mL glacial acetic acid reacted under reflux for 6 hours. The reaction mixture was poured into crushed ice to obtain 2-(4-acetylphenyl) isoindoline-1,3-dione. IR Spectra (KBr) 3073 cm^{-1} (C-H aromatic), 1736 cm^{-1} (C=O) imide, 1708 cm^{-1} (C=O) imide, 1689 cm^{-1} (C=O) ketone, 1593 cm^{-1} (C=C), 1384 cm^{-1} (C-N) imide. ^1H NMR (DMSO- d_6): 7.92(d, 2H, J=7.5, 1.5, ArH), 7.85(d, 2H, J=7.5, 1.5, ArH), 7.88(t, J=7.5, 1.5, ArH), 7.28(d, 2H, J=7.5, 1.5, ArH), 2.50(s, 3H, COCH_3). ^{13}C -NMR: 197(C=O), 167(CO-amide), 137, 136, 132, 129, 124, 123, 26(CH_3)

2.1.2 Synthesis of 2-(4-(3-(4-hydroxyphenyl) acryloyl) phenyl) isoindoline-1,3-dione 1

2-(4-acetylphenyl) isoindoline-1,3-dione (1.5 g, 0.00565 mol) was allowed to react with 4-hydroxybenzaldehyde (0.689 g, 0.00565 mol) in 20mL ethanol after which 10 % sodium hydroxide solution was added and the reaction mixture was stirred at room temperature for 48hours. The reaction mixture was poured into distilled water and hydrolyzed with 10 % hydrochloric acid solution to obtain a yellow product (2-(4-(3-(4-hydroxyphenyl) acryloyl) phenyl) isoindoline-1, 3-dione. The product was filtered, recrystallized and then oven-dried.

IR Spectra (KBr): 3469 cm^{-1} (O-H) p-hydroxyl phenol, 3074 cm^{-1} (C-H aromatic), 1735 cm^{-1} (C=O) imide, 1709 cm^{-1} (C=O) imide, 1680 cm^{-1} (C=C) chalcones, 1593 cm^{-1} (C=C), 1384 cm^{-1} (C-N) imide.

^1H NMR (DMSO- d_6): 8.06(d, 1H, J=15.1), 7.88(t, 2H, J=7.5, ArH), 7.87(t, J=7.5, ArH), 7.85(d, 2H, J=7.5, ArH), 7.65(d, 2H, J=7.5), 7.36(d, 2H, J=7.5), 7.59(d, 1H, J=15.1). ^{13}C -NMR: 190(C=O), 167(CO-amide), 145(C=C), 132, 131, 124, 121(C=C), 115.

2.1.3 Synthesis of 2-(4-(3-(3-hydroxyphenyl) acryloyl) phenyl) isoindoline-1,3-dione 2

2-(4-acetylphenyl)isoindoline-1,3-dione(1.5 g, 0.00565 mol) of was allowed to react with 3-hydroxybenzaldehyde (0.689 g, 0.00565 mol) in 20mL ethanol after which 10 % sodium hydroxide solution was added and the reaction mixture was stirred at room temperature for 48hours. The reaction mixture was poured into distilled water and hydrolysed with 10 % hydrochloric acid solution to obtain a yellow product (2-(4-(3-(3-hydroxyphenyl) acryloyl)phenyl) isoindoline-1,3-dione. IR Spectra (KBr) 3448 cm^{-1} (O-H) m-hydroxyl phenol, 3074 cm^{-1} (C-H aromatic), 1735 cm^{-1} (C=O) imide, 1709 cm^{-1} (C=O) imide, 1680 cm^{-1} (C=C) chalcones, 1593 cm^{-1} (C=C), 1384 cm^{-1} (C-N) imide. ^1H NMR (DMSO- d_6): 8.06(d, 1H, J=15.1), 7.88(t, 2H, J=7.5, ArH), 7.87(t, J=7.5, ArH), 7.85(d, 2H, J=7.5, ArH), 7.65(d, 2H, J=7.5), 7.36(d, 2H, J=7.5), 7.59(d, 1H, J=15.1). ^{13}C -NMR: 189.7(C=O), 167(CO-amide), 135(C=C), 132, 131, 124, 121(C=C), 117, 115.

2.1.4 Synthesis of 2-(4-(3-(3*ah*-indol-3-yl)acryloyl)phenyl)isoindoline-1,3-dione(compound 3)

2-(4-acetylphenyl)isoindoline-1,3-dione (1.5 g, 0.00565 mol) was allowed to react with Indolecarbaldehyde (2.19 g, 0.015mol) in 20mL ethanol after which 10 % sodium hydroxide solution was added and the reaction mixture was stirred at room temperature for 48hours.The reaction mixture was poured into distilled water and hydrolysed with 10 % hydrochloric acid solution to obtain a yellow product 2-(4-(3-(3*ah*-indol-3-yl)phenyl)isoindoline-1,3-dione.

IR Spectra (KBr): 3221 cm^{-1} (N-H) indole, 3074 cm^{-1} (C-H aromatic), 1735 cm^{-1} (C=O) imide, 1709 cm^{-1} (C=O) imide, 1680 cm^{-1} (C=C) chalcones, 1593 cm^{-1} (C=C), 1384 cm^{-1} (C-N) imide.

¹H NMR (DMSO-*d*₆): 8.05(d, 1H, J=15.1), 7.87(t, 2H, J=7.5, ArH), 7.85(t, J=7.5, ArH), 7.84(d, 2H, J=7.5, ArH), 7.66(d, 2H, J=7.5), 7.38(d, 2H, J=7.5), 7.19(t, 1H, J=15.1), 7.14(d, 1H, J=7.5), 6.93(t, 1H, J=7.5). ¹³C-NMR: 192(C=O), 169(CO-amide), 145(C=C), 137, 133, 132, 127(C=C), 124, 111.

2.1.5 Synthesis of 2-(4-(3-(4-chlorophenyl)acryloyl) phenyl) isoindoline-1,3-dione 4

2-(4-acetylphenyl) isoindoline-1,3-dione (1.5 g, 0.00565 mol) was allowed to react with 4-chlorobenzaldehyde (1.12 g, 0.00795mol) in 20mL ethanol after which 10 % sodium hydroxide solution was added and the reaction mixture was stirred at room temperature for 48hours.The reaction mixture was poured into distilled water and hydrolyzed with 10 % hydrochloric acid solution to obtain a yellow product 2-(4-(3-(4-chlorophenyl) acryloyl) phenyl) isoindoline-1,3-dione 5. IR Spectra (KBr) 3074 cm^{-1} (C-H aromatic), 1735 cm^{-1} (C=O) imide, 1709 cm^{-1} (C=O) imide, 1680 cm^{-1} (C=C) chalcones, 1593 cm^{-1} (C=C), 1384 cm^{-1} (C-N) imide, 1091 cm^{-1} (C-Cl)

¹H NMR (DMSO-*d*₆): 8.03(d, 1H, J=15.1), 7.88(t, 2H, J=7.5, ArH), 7.87(t, J=7.5, ArH), 7.85(d, 2H, J=7.5, ArH), 7.68(d, 2H, J=7.5), 7.59(d, 2H, J=15), 7.44(d, 1H, J=7.5), 7.36(d, 2H, J=7.5). ¹³C-NMR: 188(C=O), 165(CO-amide), 145(C=C), 133, 132, 131, 128, 121(C=C), 117, 115.

2.1.6 Synthesis of 2-(4-(3-(3-methoxyphenyl)acryloyl) phenyl) isoindoline-1,3-dione 5

2-(4-acetylphenyl) isoindoline-1,3-dione (1.53g, 0.00577mol) was allowed to react with m-

methoxybenzaldehyde (0.785 g, 0.00577mol) in 20mL ethanol after which 10% sodium hydroxide was stirred at room temperature for 48hours.The mixture was poured into distilled water and hydrolyzed with 10% hydrochloric acid solution to obtain a red product, 2-(4-(3-(3-methoxyphenyl) acryloyl) phenyl) isoindoline-1,3-dione

IR Spectra (KBr): 3074 cm^{-1} (C-H aromatic), 1735 cm^{-1} (C=O) imide, 1709 cm^{-1} (C=O) imide, 1680 cm^{-1} (C=C) chalcones, 1593 cm^{-1} (C=C), 1384 cm^{-1} (C-N) imide, 1234 cm^{-1} C-O-C) methoxy, 1126 cm^{-1} (C-O-C) methoxy.

¹H NMR (DMSO-*d*₆): 8.05(d, 1H, J=15.1), 7.88(t, 2H, J=7.5, ArH), 7.87(t, J=7.5, ArH), 7.85(d, 2H, J=7.5, ArH), 7.68(d, 2H, J=7.5), 7.59(d, 2H, J=15), 7.44(d, 1H, J=7.5), 7.36(d, 2H, J=7.5), 7.16(s, 1H), 3.83(s, 3H(CO-CH₃)). ¹³C-NMR: 188(C=O), 160(CO-amide), 145(C=C), 133, 132, 131, 128, 121(C=C), 117, 115, 55(CO-CH₃)

2.1.7 Synthesis of 2-(4-(3-(2-hydroxy-4-methoxyphenyl) acryloyl) phenyl) isoindoline-1,3-dione 6

2-(4-acetylphenyl) isoindoline-1,3-dione (1.53g, 0.00577mol) was reacted with o-vanillin (0.975g, 0.00641mol) (0.785g,0.00577mol) in 20mL ethanol after which 10% sodium hydroxide was stirred at room temperature for 48hours.The mixture was poured into distilled water and hydrolyzed with 10% hydrochloric acid solution to obtain a red product 2-(4-(3-(2-hydroxy-4-methoxyphenyl)acryloyl)phenyl)isoindoline-1,3-dione 7.

IR Spectra (KBr): 3460 cm^{-1} (O-H) phenolic, 3074 cm^{-1} (C-H aromatic), 1735 cm^{-1} (C=O) imide, 1709 cm^{-1} (C=O) imide, 1680 cm^{-1} (C=C) chalcones, 1593 cm^{-1} (C=C), 1384 cm^{-1} (C-N) imide, 1233 cm^{-1} C-O-C) methoxy, 1124 cm^{-1} (C-O-C) methoxy. ¹H NMR (DMSO-*d*₆): 8.33(d, 1H, J=15.1), 7.99(d, 1H), 7.88(t, 2H, J=7.5, ArH), 7.87(t, J=7.5, ArH), 7.85(d, 2H, J=7.5, ArH), 7.68(d, 2H, J=7.5), 7.42(d, 2H, J=15), 7.44(d, 1H, J=7.5), 7.36(d, 2H, J=7.5), 3.43(s, 3H(CO-CH₃)). ¹³C-NMR: 189(C=O), 168(CO-amide), 146(C=C), 133, 132, 131, 128, 121(C=C), 117, 115, 55(CO-CH₃)

2.2 Biological Assays

2.2.1 In vitro acetylcholinesterase and butyryl cholinesterase inhibitory assays

The anti-cholinesterase (acetylcholinesterase and butyryl cholinesterase) inhibiting activities of

the synthesized compounds were determined by using modified method of Ellman et al. (1961) as described by Obuotor (2004). The synthesized compounds were prepared in a stock solution of DMSO in buffer and was used for the cholinesterase inhibition assay, while Eserine prepared in buffer was used as the reference compound (positive control).

Procedure: To triplicate test tube was added 240µl of buffer (50 mM Tris-HCl, pH 8.0) and 20 µl of varying concentration of the test compounds (10, 5, 2.5 and 1.25 mg/ mL), 20µl of the enzyme preparation, the reaction mixture was then incubated for 30mins at 37^oC, after which 20 µl of 10 mM 5,5'-dithiobis (2-nitrobenzoic acid), was added.

The reaction was then initiated by the addition of 20µl of 25mM ATChI (1.042 mM final concentration). The rate of hydrolysis of ATChI was then determined spectrophotometrically by measuring the change in the absorbance per minute (ΔA/min) due to the formation of the yellow 5-thio-2-nitrobenzoate anion at 412 nm over a period of 4min at 30s interval. A solution of buffer was used as negative control. The percentage inhibition (% I) of the synthesized compounds were obtained using the formula:

$$I (\%) = [(V_0 - V_i) / V_0] * 100$$

Where: I (%) = Percentage inhibition

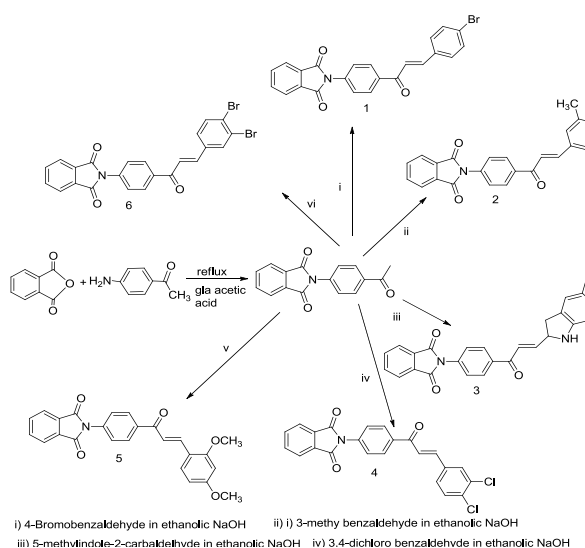
V_i = enzyme activity in the presence of synthesized compounds

V_0 = enzyme activity in the absence of synthesized compounds

3. RESULTS AND DISCUSSION

3.1 Chemistry

The respective chalcones were synthesized by reacting the phthalimide derivative 1, obtained from the reaction of 4-aminoacetophenone with phthalic anhydride in glacial acetic acid with different substituted aromatic aldehydes in the presence of ethanolic NaOH using the method described by Singh *et al.*, 2010 (Scheme 1). All the desired chalcones (1-6) were obtained in high yields with the percentage yield between 66.30% - 72.12%. The melting point of compounds (1-6) ranged between 155 and 238^oC (Table 1). The structures of the compounds were partially characterized using infrared, ¹H and ¹³C NMR spectroscopic methods. The diagnostic bands for presence of chalcones HC=CH bonds in the infrared spectral data was observed at 1680 cm⁻¹. The results of the ¹H spectroscopic data showed the presence of the olefinic protons of the chalcones appearing downfield between 7.36 and 7.68 ppm for the compounds synthesized. The results of the ¹³C NMR spectroscopic data showed the presence of the olefinic carbons of the chalcones appearing at 145 ppm.



Scheme 1

3.3 Biology

3.3.1 Acetylcholinesterase activity

The activity of the compounds ranged from 1.03 ± 0.3 to 4.83 ± 1.0 (Fig. 1). It was observed that compound 6 has the lowest IC_{50} value. This study indicated that compound 6 having IC_{50} value of 1.03 ± 0.3 has the highest activity compared to other compounds and eserine which is a standard drug used as a positive control. Moreover, all the six compounds showed activity that is higher than the standard drug Eserine that was used. The activity of compound 6 could be as a result of the presence of an electron donating groups at the ortho (hydroxyl) and para (methoxy) of the chalcone phenyl ring. The lower activity exhibited by compound 3 may be due to the presence of a bulky indole moiety of the chalcone which may exhibit some steric hindrance.

3.3.2 Butyrylcholinesterase activity

The activities observed ranged from 1.02 ± 0.1 to 4.99 ± 0.3 (Fig. 2). It was observed that compound 5 has the lowest IC_{50} value of 1.02 ± 0.1 which indicated that compound 5 has the highest Butyryl Cholinesterase inhibitory activity compared to rest of the compounds. Also, all the six compounds showed higher inhibitory properties than the standard drug Eserine used in this test. The higher inhibitory activity exhibited by compound 5 could be as a result of the presence of an electron withdrawing chloro-group that has 7 electrons in his valence orbitals of the chalcone ring. Looking at the lower activity obtained for compound 3 (4.99 ± 0.3) this could be as a result of steric hindrance caused by a bulky indole ring attached to the chalcone.

Table 1. Some physical properties of the synthesized compounds

Compound No	Molecular Formula	Molecular Weight ($g\text{mol}^{-1}$)	Yield (%)	Melting Point($^{\circ}\text{C}$)
1	$\text{C}_{23}\text{H}_{15}\text{NO}_4$	369.0	72.12	155-158
2	$\text{C}_{23}\text{H}_{15}\text{NO}_4$	369.0	71.80	174-176
3	$\text{C}_{25}\text{H}_{16}\text{N}_2\text{O}_3$	392.0	67.57	235-238
4	$\text{C}_{22}\text{H}_{14}\text{NO}_3\text{Cl}$	375.5	70.57	165-167
5	$\text{C}_{23}\text{H}_{17}\text{NO}_4$	371.0	71.50	229-231
6	$\text{C}_{24}\text{H}_{18}\text{NO}_3$	400.0	66.30	235-238

Table 2. The selectivity value of AChE and BUCHE

Sample	AChE inhibition IC_{50} Mg/ml	BUCHE inhibition IC_{50} Mg/ml	Selectivity for AChE	Selectivity for BUCHE
1	4.09 ± 0.06	3.36 ± 0.4	0.82	1.22
2	2.76 ± 0.6	1.90 ± 0.01	0.69	1.45
3	4.83 ± 1.0	4.99 ± 0.3	1.03	0.97
4	1.41 ± 0.6	1.28 ± 0.01	0.91	1.1
5	2.12 ± 0.5	1.02 ± 0.1	0.48	2.08
6	1.03 ± 0.3	1.05 ± 0.2	1.01	0.98
Eserine	9.97 ± 1.3	6.24 ± 0.3	0.63	1.6

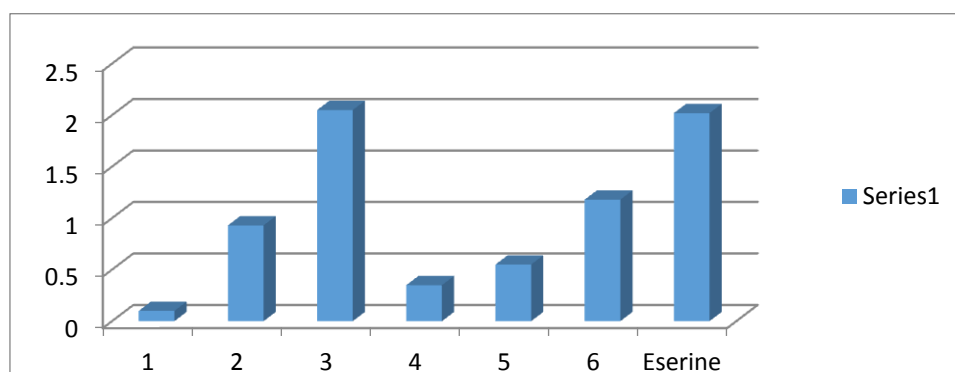


Fig. 1. The IC_{50} of Acetylcholinesterase plotting compounds against the concentration

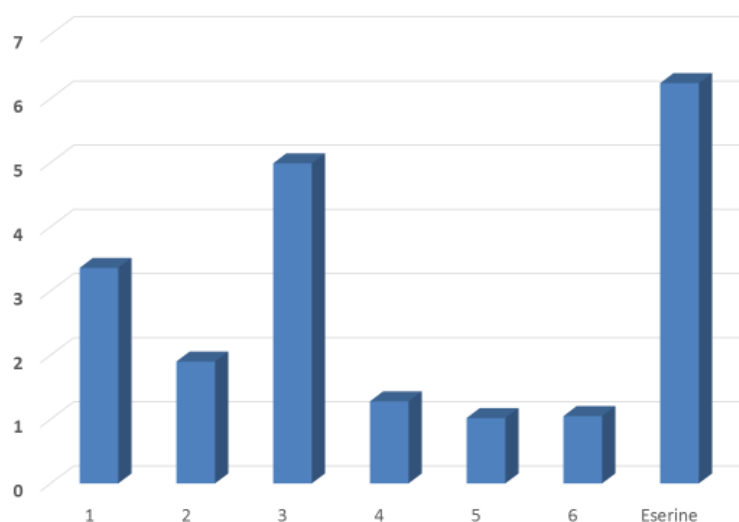


Fig. 2. The IC₅₀ of Butrylcholinesterase plotting compounds against the concentration

4. CONCLUSION

It can be concluded that the synthesis of compounds 1-6 was successful and the workup stage was environmentally friendly. The bioactivities of all synthesized chalcones analogues 1-6 were tested in vitro by using the standard activity protocol. It was observed that this study identifies a new class of potential AChE, BuChE, nitric oxide and FRAP actives that could be developed into drugs.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Vogel S, Ohmayer S, Brunner G, Heilmann J. Natural and nonnatural prenylated chalcones: Synthesis, cytotoxicity and antioxidative activity. *Bioorg. Med. Chem.* 2008;16:4286–4293.
- Babasaheb PB, Sachin AP, Rajesh NG, Balaji LK, Balwant SH, Santosh NK, et al. Synthesis and biological evaluation of

nitrogen-containing chalcones as possible anti-inflammatory and antioxidant agents. *Bioorg. Med. Chem. Lett.* 2010;20:730–733.

- Avila HP, Smania E, Monache FD, Smania A. Structure-activity relationship of antibacterial chalcones. *Bioorg. Med. Chem.* 2008;16:9790–9794.
- Suryawanshi SN, Chandra N, Kumar P, Porwal J, Gupta, S. Chemotherapy of leishmaniasis part-VIII: Synthesis and bioevaluation of novel chalcones. *Eur. J. Med. Chem.* 2008;43:2473–2478.
- Lawrence NJ, Patterson RP, Ooi LL, Cook D, Ducki S. Effects of α -substitutions on structure and biological activity of anticancer chalcones. *Bioorg. Med. Chem. Lett.* 2006;16:5844–5848.
- Mojzis J, Varinska L, Mojzisova G, Kostova I, Mirossay L. Antiangiogenic effects of flavonoids and chalcones. *Pharmacol. Res.* 2008;57:259–265. *Molecules* 2013; 18 2707
- Cheng JH, Hung CF, Yang SC, Wang JP, Won SJ, Lin CN. Synthesis And Cytotoxic, Anti-Inflammatory, and Anti-Oxidant Activities Of 2',5'-Dialkoxyl chalcones As Cancer Chemopreventive Agents. *Bioorg. Med. Chem.* 2008;16:7270–7276.
- Lahtchev KL, Batovska DI, Parushev SP, Ubiyovk VM, Sibirny AA. Antifungal activity of chalcones: A mechanistic study using various yeast strains. *Eur. J. Med. Chem.* 2008;43:2220–2228.
- Liu M, Wilairat P, Cropft SL, Tan ALC, Go ML. Structure-activity relationships of

- antileishmanial and antimalarial chalcones. *Bioorg. Med. Chem.* 2003;11:2729–2738.
10. Go ML, Wu X, Liu XL. Chalcones: An update on cytotoxic and chemoprotective properties. *Curr. Med. Chem.* 2005;12: 483–499.
 11. Liu M, Wilairat P, Go ML. Antimalarial alkoxyated and hydroxylated chalcones: Structure activity relationship analysis. *J. Med. Chem.* 2001;44:4443–4452.
 12. Bhat BA, Dhar KL, Puri SC, Saxena AK, Shanmugavel M, Qazi GN. Synthesis and biological evaluation of chalcones and their derived pyrazoles as potential cytotoxic agents. *Bioorg. Med. Chem. Lett.* 2005;15: 3177–3180.

APPENDIX

Result of Acetylcholinesterase inhibitory activity of the Chalcones

Compounds	% Inhibition
1	82.88±3.0
2	98.24±3.0
3	58.24±1.0
4	81.36±4.0
5	86.24±0.01
6	87.84±0.9
Eserine	77.04±0.02

Results of IC50 values for acetylcholinesterase activity of the Chalcones

Compounds	IC50(mg/ml)
1	4.09±0.06
2	2.76±0.6
3	4.83±1.0
4	1.41±0.6
5	2.12±0.5
6	1.03±0.3
Eserine	9.97±1.3

Results of butyrylcholinesterase inhibitory activity of the Chalcones

Compounds	% Inhibition
1	72.11±4.0
2	91.83±3.0
3	77.00±2.0
4	85.28±5.0
5	98.72±3.0
6	79.22±2.
Eserine	77.00±2.0

Result of IC50 values for butyrylcholinesterase activity of the Chalcones

Compounds	IC50(mg/ml)
1	3.36±0.4
2	1.90±0.01
3	4.99±0.3
4	1.28±0.01
5	1.02±0.1
6	1.05±0.2
Eserine	6.24±0.3

© 2021 Taiwo et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:

<https://www.sdiarticle5.com/review-history/71132>