

Synthesis and Reactions of Some New Benzopyranone Derivatives With Potential Biological Activities

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Abstract

Reaction of visnaginone which derived from the naturally occurring compound "visnagine", with allyl bromide gave O-allyl visnaginone 1, which underwent Claisen rearrangement to yield 7-allylbenzofuran 2 derivative. Vilsmeier Haack formylation of 2 afforded our versatile starting compound furochromene-6-carboxaldehyde (3) which was condensed with cyclohexane-1,3-dione, indandione, malononitrile or ethyl cyanoacetate to yield the ylidene nicotinonitrile and pyridone derivatives 4,7,10a-b. Reaction of 3 with aniline or aniline acting on multiple function X-H (X = NH, O, S) at its ortho position afforded the corresponding anils, imidazolylfurochromene and azepines compounds 11-17. On the other hand, oxidation of visnagin afforded chromene-6-carboxaldehyde derivative 18 which was condensed with different aryl or (heteroaryl) acetonitrile followed by hydrolysis to give pyrano[3,2-g]chromen-4,8-dione derivatives 20a-d and 22.

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References:

Title: SYNTHESIS OF SOME SCHIFFS BASES OF NATURALLY-OCCURRING
CHROMONE DERIVATIVES AND THEIR ANTIMICROBIAL ACTIVITY

Author(s): ABDELHAFEZ, O; ABDELALIM, MA; ELHAMOULY, WS; et al.

Source: PHARMAZIE Volume: 48 Issue: 4 Pages: 307-307 Published: APR 1993

Times Cited: 4 (from All Databases)

2. **Title:** [not available]

Author(s): ABELRAHMAN AH

Source: CHEM PAPERS Volume: 53 Pages: 323 Published: 1999

Times Cited: 1 (from All Databases)

3. **Title:** [not available]

Author(s): ABELRAHMAN AH

Source: HETEROATOM CHEM Volume: 16 Pages: 20 Published: 2005

Times Cited: 2 (from All Databases)

4. Title: SYNTHESIS AND ANTITUMOR-ACTIVITY OF SOME 8-SUBSTITUTED-4-OXO-4H-1-BENZOPYRANS
Author(s): ATASSI, G; BRIET, P; BERTHELON, JJ; et al.
Source: EUROPEAN JOURNAL OF MEDICINAL CHEMISTRY Volume: 20
Issue: 5 Pages: 393-402 Published: 1985
5. Title: [not available]
Author(s): ATIKEN RA
Source: ARCH PHARM PHARM MED Volume: 333 Pages: 181 Published: 2000
6. Title: [not available]
Author(s): BAILEY DM
Source: ANNU REP MED CHEM Volume: 19 Pages: 1212 Published: 1984
7. Title: 4',6-DICHLOROFLAVAN (BW683C), A NEW ANTI-RHINOVIRUS COMPOUND (View record in MEDLINE)
Author(s): BAUER, DJ; SELWAY, JWT; BATCHELOR, JF; et al.
Source: NATURE Volume: 292 Issue: 5821 Pages: 369-370 DOI: 10.1038/292369a0 Published: 1981
8. Title: SYNTHESIS AND ANTI-ARRHYTHMIC ACTIVITY OF NEW BENZOFURAN DERIVATIVES (View record in MEDLINE)
Author(s): BOURGERY, G; DOSTERT, P; LACOUR, A; et al.
Source: JOURNAL OF MEDICINAL CHEMISTRY Volume: 24 Issue: 2 Pages: 159-167 DOI: 10.1021/jm00134a007 Published: 1981
9. Title: [not available]
Author(s): CHARRLIER R
Source: PHARM CLIN FEATURES Volume: 118 Published: 1971
10. Title: STIMULATION OF MACROPHAGE TUMORICIDAL ACTIVITY BY 5,6-DIMETHYL-XANTHENONE-4-ACETIC ACID, A POTENT ANALOG OF THE ANTITUMOR AGENT FLAVONE-8-ACETIC ACID
Author(s): CHING, LM; JOSEPH, WR; BAGULEY, BC
Source: BIOCHEMICAL PHARMACOLOGY Volume: 44 Issue: 1 Pages: 192-195 Published: JUL 7 1992
11. Title: [not available]
Author(s): DEVI TK
Source: INDIAN DRUGS Volume: 24 Pages: 565 Published: 1987
12. Title: [not available]
Author(s): DURATE J
Source: EUR J PHARMACOL Volume: 286 Pages: 115 Published: 1995
13. Title: [not available]
Author(s): DURATE J
Source: J PLANTA MED Volume: 63 Pages: 233 Published: 1997
14. Title: Synthesis of some chromanone derivatives and the use of DNA in evaluation of their biological activity
Author(s): El-Desoky, EI; El-Telbani, EM; Hammad, MA; et al.
Source: ZEITSCHRIFT FUR NATURFORSCHUNG SECTION B-A JOURNAL OF CHEMICAL SCIENCES Volume: 53 Issue: 8 Pages: 909-915 Published: AUG 1998
15. Title: Synthesis and reactions of some new allyl furobenzopyranone derivatives
Author(s): El-Desoky, El-Sayed I.
Source: JOURNAL OF HETEROCYCLIC CHEMISTRY Volume: 44 Issue: 6 Pages: 1309-1315 Published: NOV-DEC 2007

16. Title: Synthesis and reactions of some spirofurochromanone derivatives with potential biological activity
Author(s): ElDesoky, SI
Source: HETEROCYCLIC COMMUNICATIONS Volume: 2 Issue: 6 Pages: 559-565 Published: 1996
17. Title: [not available]
Author(s): ELDESOKY SI
Source: TETRAHEDRON Volume: 53 Pages: 15799 Published: 1997
18. Title: Synthesis of bis(C-glycosyl)flavonoid precursors
Author(s): El Telbani, E; El Desoky, S; Hammad, MA; et al.
Source: CARBOHYDRATE RESEARCH Volume: 306 Issue: 3 Pages: 463-467
Published: JAN 1998
19. Title: [not available]
Author(s): ELTELBANY EM
Source: EUR J ORG CHEM Volume: 2317 Published: 1998
20. Title: Reaction of chromone-3-carbaldehyde with alpha-amino acids - syntheses of 3- and 4-(2-hydroxybenzoyl)pyrroles
Author(s): Figueiredo, Andrea G. P. R.; Tome, Augusto C.; Silva, Artur M. S.; et al.
Source: TETRAHEDRON Volume: 63 Issue: 4 Pages: 910-917 DOI: 10.1016/j.tet.2006.11.034 Published: JAN 22 2007
21. Title: [not available]
Author(s): FITTON AO
Source: J CHEM RES S Volume: 248 Published: 1984
22. Title: TOTAL SYNTHESIS OF THE LIPID-ALTERING AND ANTI-ATHEROSCLEROTIC FUROCHROMONE KHELLIN - THE FUROIC ACID ROUTE TO HIGHLY FUNCTIONALIZED BENZOFURANS
Author(s): GAMMILL, RB; HYDE, BR
Source: JOURNAL OF ORGANIC CHEMISTRY Volume: 48 Issue: 21 Pages: 3863-3865 DOI: 10.1021/jo00169a069 Published: 1983
23. Title: 2-methyl-4-oxo-4H-1-benzopyran-4-one as a synthon in heterocyclic chemistry
Author(s): Ghosh, Chandra Kanta
Source: JOURNAL OF HETEROCYCLIC CHEMISTRY Volume: 43 Issue: 4 Pages: 813-820 Published: JUL-AUG 2006
24. Title: CHEMISTRY OF 4-OXO-4H-[1]BENZOPYRAN-3-CARBOXALDEHYDE
Author(s): GHOSH, CK
Source: JOURNAL OF HETEROCYCLIC CHEMISTRY Volume: 20 Issue: 6 Pages: 1437-1445 Published: 1983
25. Title: Heterocycles directly linked to 3-position of 1-benzopyran-4-ones
Author(s): Ghosh, CK
Source: HETEROCYCLES Volume: 63 Issue: 12 Pages: 2875-2898 Published: DEC 1 2004
26. Title: Cycloaddition reactions of 1-benzopyran-4-ones
Author(s): Ghosh, CK; Ghosh, C
Source: INDIAN JOURNAL OF CHEMISTRY SECTION B-ORGANIC CHEMISTRY INCLUDING MEDICINAL CHEMISTRY Volume: 36 Issue: 11 Pages: 968-980 Published: NOV 1997
27. Title: HETEROCYCLIC-SYSTEMS .14. CONDENSATION-REACTIONS OF 2-(4-OXO-4H-1-BENZOPYRAN-3-YL)-1,3-DIOXOLANE

- Author(s): GHOSH, CK; BANDYOPADHYAY, C; MORIN, C
Source: JOURNAL OF THE CHEMICAL SOCIETY-PERKIN TRANSACTIONS 1
Issue: 9 Pages: 1989-1994 DOI: 10.1039/p19830001989 Published: 1983
28. Title: SYNTHESSES OF PSORALEN ANALOGS AND EVALUATION OF THEIR INHIBITION OF EPIDERMAL GROWTH-FACTOR BINDING
Author(s): HEINDEL, ND; VANDONGEN, JMAM; SACHAIS, BS; et al.
Source: JOURNAL OF PHARMACEUTICAL SCIENCES Volume: 80 Issue: 7
Pages: 686-689 DOI: 10.1002/jps.2600800715 Published: JUL 1991
29. Title: [not available]
Author(s): Hishmat, O.H.; El-Naem, Sh.I.; Magd-El-Din, A.A.; et al; Fawzy, N.M.; Abd El-Aal, A.S.
Source: Egypt. J. Chem Volume: 43 Pages: 87-98 Published: 2000
30. Title: Synthesis and pharmacological activity of benzodipyrans derivatives
Author(s): Hishmat, OH; EIDIWANI, HI; Melek, FR; et al.
Source: INDIAN JOURNAL OF CHEMISTRY SECTION B-ORGANIC CHEMISTRY INCLUDING MEDICINAL CHEMISTRY Volume: 35 Issue: 1
Pages: 30-35 Published: JAN 1996
- 31- Title: REACTIONS OF 6-FORMYLKHELLIN AND 6-FORMYLVISNAGIN WITH AMINES AND HYDRAZINES
Author(s): HISHMAT, OH; ELDIWANI, HI; ELNAEM, SI; et al.
Source: POLISH JOURNAL OF CHEMISTRY Volume: 67 Issue: 11 Pages: 1987-1993 Published: NOV 1993
32. Title: A facile synthesis of 7,8/6,7 fused pyrano[4,3-b] pyridinochromones and evaluation of antibacterial activity
Author(s): Rao, YJ; Krupadanam, GLD
Source: INDIAN JOURNAL OF CHEMISTRY SECTION B-ORGANIC CHEMISTRY INCLUDING MEDICINAL CHEMISTRY Volume: 39 Issue: 8
Pages: 610-613 Published: AUG 2000
33. Title: Synthesis of halogen derivatives of benzo[h]chromene and benzo[a]anthracene with promising antimicrobial activities
Author(s): Khafagy, MM; Abd El-Wahab, AHF; Eid, FA; et al.
Source: FARMACO Volume: 57 Issue: 9 Pages: 715-722 Article Number: PII S0014-827X(02)01263-6 DOI: 10.1016/S0014-827X(02)01263-6 Published: SEP 2002
34. Title: Theoretical study of phototoxic reactions of psoralens
Author(s): Llano, J; Raber, J; Eriksson, LA
Source: JOURNAL OF PHOTOCHEMISTRY AND PHOTOBIOLOGY A-CHEMISTRY Volume: 154 Issue: 2-3 Pages: 235-243 Article Number: PII S1010-6030(02)00351-9 DOI: 10.1016/S1010-6030(02)00351-9 Published: JAN 24 2003
35. Title: Synthesis and biological study of a flavone acetic acid analogue containing an azido reporting group designed as a multifunctional binding site probe
Author(s): Malolanarasimhan, K; Lai, CC; Kelley, JA; et al.
Source: BIOORGANIC & MEDICINAL CHEMISTRY Volume: 13 Issue: 8
Pages: 2717-2722 DOI: 10.1016/j.bmc.2005.02.035 Published: APR 15 2005
36. Title: [not available]
Author(s): MIKEY JAA
Source: INDIAN J CHEM B Volume: 37 Pages: 68 Published: 1998
Times Cited: 2 (from All Databases)

37. Title: [not available]
Author(s): MUSTAFA A
Source: FUROPYRANES FUROPYRO Published: 1967
38. Title: THE INVOLVEMENT OF A CA²⁺ CHANNEL BLOCKING MODE OF ACTION IN THE PHARMACOLOGY OF AMMI-VISNAGA FRUITS
Author(s): RAUWALD, HW; BREHM, O; ODENTHAL, KP
Source: PLANTA MEDICA Volume: 60 Issue: 2 Pages: 101-105 DOI: 10.1055/s-2006-959426 Published: APR 1994
39. Title: 3-formylchromone as a versatile synthon in heterocyclic chemistry
Author(s): Sabitha, G
Source: ALDRICHIMICA ACTA Volume: 29 Issue: 1 Pages: 15-25 Published: 1996
40. Title: FURO-CHROMONES AND FURO-COUMARINS .7. DEGRADATION OF VISNAGIN, KHELLIN AND RELATED SUBSTANCES - EXPERIMENTS WITH CHROMIC ACID AND HYDROGEN PEROXIDE - AND A SYNTHESIS OF EUGENITIN
Author(s): SCHONBERG, A; BADRAN, N; STARKOWSKY, NA
Source: JOURNAL OF THE AMERICAN CHEMICAL SOCIETY Volume: 75 Issue: 20 Pages: 4992-4995 DOI: 10.1021/ja01116a032 Published: 1953
41. Title: A versatile route to 2-alkyl-/aryl-amino-3-formyl- and heteroannelated-chromones, through a facile nucleophilic substitution at C2 in 2-(N-methylanilino)-3-formylchromones
Author(s): Singh, G; Singh, R; Girdhar, NK; et al.
Source: TETRAHEDRON Volume: 58 Issue: 12 Pages: 2471-2480 Article Number: PII S0040-4020(02)00128-X DOI: 10.1016/S0040-4020(02)00128-X Published: MAR 18 2002
42. Title: The constitution of visnagin (From ammi visnaga). (II. Announcement. On natural chromones.)
Author(s): Spath, E; Gruber, W
Source: BERICHTE DER DEUTSCHEN CHEMISCHEN GESELLSCHAFT Volume: 74 Pages: 1492-1500 DOI: 10.1002/cber.19410740820 Part: Part 2 Published: 1941

Synthesis and reactions of some new allyl furobenzopyranone derivatives

El-Desoky, ESI (El-Desoky, El-Sayed I.

Abstract

Reaction of visnaginone 1 with allyl bromide gave O-allyl visnaginone 2 which underwent Claisen rearrangement to yield 7-allylbenzofuran derivative 3. Reaction of 3 with different aromatic aldehydes gave the corresponding 5-cinnamoylbenzofuran derivatives 4a-d. Condensation of the latter chalcones 4a,c,d with hydrazine hydrate and phenylhydrazine provided, the corresponding pyrazoline derivatives 7a-f. Claisen condensation of compound 3 with ethyl acetate and diethyl carbonate afforded Claisen adducts 8 and 12 which easily cyclized to 9 and 13, which are endowed with interesting biological properties.

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REFERENCES:

1. Title: [not available]

Author(s): ABDELRAHMAN AH

Source: NATUROFORSCHUNG Volume: 57 Pages: 557 Published: 2002

2. Title: [not available]

Author(s): ABELRAHMAN AH

Source: HETEROATOM CHEM Volume: 16 Pages: 20 Published: 2005

3. Title: [not available]

Author(s): ATIKEN RA

Source: ARCH PHARM PHARM MED Volume: 333 Pages: 181 Published: 2000

4. Title: EXPERIMENTS WITH FUROCHALKONES - ADDITION OF NUCLEOPHILIC-REAGENTS, DIAZOMETHANE, BENZONITRILE OXIDE,

HYDRAZINE HYDRATE, PHENYLHYDRAZINE, HYDROXYLAMINE,
THIOUREA AND SEMICARBAZIDE TO FUROCHALKONES

Author(s): AZIZ, G; NOSSEIR, MH; DOSS, NL; et al.

Source: INDIAN JOURNAL OF CHEMISTRY SECTION B-ORGANIC
CHEMISTRY INCLUDING MEDICINAL CHEMISTRY Volume: 14 Issue: 4
Pages: 286-291 Published: 1976

5. Title: [not available]

Author(s): BAILEY DM

Source: ANNU REP MED CHEM Volume: 19 Pages: 1212 Published: 1984

6. Title: 4',6-DICHLOROFLAVAN (BW683C), A NEW ANTI-RHINOVIRUS
COMPOUND (View record in MEDLINE)

Author(s): BAUER, DJ; SELWAY, JWT; BATCHELOR, JF; et al.

Source: NATURE Volume: 292 Issue: 5821 Pages: 369-370 DOI:
10.1038/292369a0 Published: 1981

7. Title: SYNTHESIS AND ANTI-ARRHYTHMIC ACTIVITY OF NEW
BENZOFURAN DERIVATIVES (View record in MEDLINE)

Author(s): BOURGERY, G; DOSTERT, P; LACOUR, A; et al.

Source: JOURNAL OF MEDICINAL CHEMISTRY Volume: 24 Issue: 2 Pages:
159-167 DOI: 10.1021/jm00134a007 Published: 1981

8. Title: Synthesis and reactions of some new substituted spirofurochromanone
derivatives

Author(s): ElDesoky, EI; Hammad, MA; Grant, N; et al.

Source: TETRAHEDRON Volume: 53 Issue: 46 Pages: 15799-15806 DOI:
10.1016/S0040-4020(97)10032-1 Published: NOV 17 1997

9. Title: Synthesis of some chromanone derivatives and the use of DNA in
evaluation of their biological activity

Author(s): El-Desoky, EI; El-Telbani, EM; Hammad, MA; et al.

Source: ZEITSCHRIFT FUR NATURFORSCHUNG SECTION B-A JOURNAL OF
CHEMICAL SCIENCES Volume: 53 Issue: 8 Pages: 909-915 Published: AUG
1998

10. Title: Synthesis and reactions of some spirofurochromanone derivatives with
potential biological activity

Author(s): ElDesoky, SI

Source: HETEROCYCLIC COMMUNICATIONS Volume: 2 Issue: 6 Pages: 559-
565 Published: 1996

11. Title: SYNTHESIS OF PROPANOYL BENZOFURAN DERIVATIVES FOR POSSIBLE BIOLOGICAL ACTIVITY

Author(s): EL-EBRASHI N M A; GOHAR A K M N; NASEF A M M; et al.

Source: Egyptian Journal of Pharmaceutical Sciences Volume: 26 Issue: 1-4
Pages: 261-266 Published: 1985

12. Title: Synthesis and antimicrobial activity of some novel 5- and 6-substituted furocoumarins

Author(s): Elgamal, MHA; Shalaby, NMM; Shaban, MA

Source: INDIAN JOURNAL OF CHEMISTRY SECTION B-ORGANIC CHEMISTRY INCLUDING MEDICINAL CHEMISTRY Volume: 37 Issue: 7
Pages: 662-668 Published: JUL 1998

13. Title: Synthesis of bis(C-glycosyl)flavonoid precursors

Author(s): El Telbani, E; El Desoky, S; Hammad, MA; et al.

Source: CARBOHYDRATE RESEARCH Volume: 306 Issue: 3 Pages: 463-467
Published: JAN 1998

14. Title: C-Glycosides of visnagin analogues

Author(s): El Telbani, E; El Desoly, S; Hammad, MA; et al.

Source: EUROPEAN JOURNAL OF ORGANIC CHEMISTRY Issue: 11 Pages:
2317-2322 Published: NOV 1998

15. Title: TOTAL SYNTHESIS OF THE LIPID-ALTERING AND ANTI-ATHEROSCLEROTIC FUROCHROMONE KHELLIN - THE FUROIC ACID ROUTE TO HIGHLY FUNCTIONALIZED BENZOFURANS

Author(s): GAMMILL, RB; HYDE, BR

Source: JOURNAL OF ORGANIC CHEMISTRY Volume: 48 Issue: 21 Pages:
3863-3865 DOI: 10.1021/jo00169a069 Published: 1983

16. Title: 2-methyl-4-oxo-4H-1-benzopyran-4-one as a synthon in heterocyclic chemistry

Author(s): Ghosh, Chandra Kanta

Source: JOURNAL OF HETEROCYCLIC CHEMISTRY Volume: 43 Issue: 4
Pages: 813-820 Published: JUL-AUG 2006

17. Title: Synthesis of some potentially bioactive compounds from visnaginone

Author(s): Hafez, OMA; Ahmed, KM; Haggag, EE

Source: MOLECULES Volume: 6 Issue: 4 Pages: 396-405 Published: APR 2001

18. Title: SYNTHESIS OF 3-SUBSTITUTED BENZOFURYL-4-ARYLAZO-5-PYRAZOLONE DERIVATIVES AND THEIR ANTIBACTERIAL ACTIVITY

Author(s): HISHMAT, OH; GOHAR, AKMM; NASEF, AMM; et al.

Source: INDIAN JOURNAL OF CHEMISTRY SECTION B-ORGANIC CHEMISTRY INCLUDING MEDICINAL CHEMISTRY Volume: 21 Issue: 8 Pages: 790-792 Published: 1982

19. Title: ANTIPICORNAVIRUS FLAVONE RO-09-0179 (View record in MEDLINE)

Author(s): ISHITSUKA, H; OHSAWA, C; OHIWA, T; et al.

Source: ANTIMICROBIAL AGENTS AND CHEMOTHERAPY Volume: 22 Issue: 4 Pages: 611-616 Published: 1982

20. Title: A facile synthesis of 7,8/6,7 fused pyrano[4,3-b] pyridinochromones and evaluation of antibacterial activity

Author(s): Rao, YJ; Krupadanam, GLD

Source: INDIAN JOURNAL OF CHEMISTRY SECTION B-ORGANIC CHEMISTRY INCLUDING MEDICINAL CHEMISTRY Volume: 39 Issue: 8 Pages: 610-613 Published: AUG 2000

21. Title: [not available]

Author(s): MIKEY JAA

Source: INDIAN J CHEM B Volume: 37 Pages: 68 Published: 1998

22. Title: [not available]

Author(s): MOUSTAFA A

Source: LIEBIGS ANN Volume: 692 Pages: 166 Published: 1966

23. Title: [not available]

Author(s): MUSTAFA A

Source: FUROPYRANES FUROPYRO Published: 1967

24. Title: Psoralen analogues: synthesis, inhibitory activity of growth of human tumor cell lines and computational studies

Author(s): Oliveira, AMAG; Raposo, MMM; Oliveira-Campos, AMF; et al.

Source: EUROPEAN JOURNAL OF MEDICINAL CHEMISTRY Volume: 41 Issue: 3 Pages: 367-372 DOI: 10.1016/j.ejmech.2005.10.016 Published: MAR 2006

25. Title: FUROCHROMONES AND COUMARINS .6. DEMETHYLATION OF XANTHOTOXIN, KHELLIN AND KHELLOL WITH ANILINE HYDROCHLORIDE AND MAGNESIUM IODIDE

Author(s): SCHONBERG, A; AZIZ, G

Source: JOURNAL OF THE AMERICAN CHEMICAL SOCIETY Volume: 75
Issue: 13 Pages: 3265-3266 DOI: 10.1021/ja01109a066 Published: 1953

26. Title: The constitution of visnagin (From ammi visnaga). (II. Announcement.
On natural chromones.)

Author(s): Spath, E; Gruber, W

Source: BERICHTE DER DEUTSCHEN CHEMISCHEN GESELLSCHAFT
Volume: 74 Pages: 1492-1500 DOI: 10.1002/cber.19410740820 Part: Part 2
Published: 1941

27. Title: New synthetic routes to furocoumarins and their analogs: A review

Author(s): Traven, VF

Source: MOLECULES Volume: 9 Issue: 3 Pages: 50-66 DOI: 10.3390/90300050
Published: MAR 2004

28. Title: SYNTHESIS OF KHELLIN AND ITS ANALOGS VIA CHROMIUM
CARBENE COMPLEXES

Author(s): YAMASHITA, A; TOY, A; SCAHILL, TA

Source: JOURNAL OF ORGANIC CHEMISTRY Volume: 54 Issue: 15 Pages:
3625-3634 DOI: 10.1021/jo00276a024 Published: JUL 21 1989