Ain Shams University
Faculty of Education
Department of Chemistry

Synthesis and chemical reactivity of 6,8-dibromo-7-hydroxychromone-3-carboxaldehyde towards some nucleophilic reagents

Thesis Submitted
By

Amira Mohsen Mohamed Abd El Monem

B.Sc., Ed. 2008

For

The Degree of
Master of Teacher's Preparation in Science
(Organic Chemistry)

Supervisors

Dr. Tarik El-Sayed Ali

Assistant Prof. of Organic Chemistry, Faculty of Education, Ain Shams University

Dr. Magdy Ahmed Mohamed

Assistant Prof. of Organic Chemistry, Faculty of Education, Ain Shams University

Dr. Azza Mohamed El-kazak

Lecturer of Organic Chemistry, Faculty of Education, Ain Shams University

Cairo

2013

Synthesis and chemical reactivity of 6,8-dibromo-7-hydroxychromone-3-carboxaldehyde towards some nucleophilic reagents

Amira Mohsen Mohamed

Department of Chemistry, Faculty of Education, Ain Shams University

Abstract

A novel 6,8-dibromo-7-hydroxychromone-3-carboxaldehyde (**4**) was prepared by the Vilsemier-Haack formylation of 3,5-dibromo-2,4-dihydroxyacetophenone (**3**). The chemical reactivity of carboxaldehyde **4** was studied towards some nitrogen nucleophilic reagents such as amines, 1,2-*N,N*-binucleophiles, 1,2-*N,O*-binucleophiles, 1,3-*N*,*N*-binucleophiles, 1,4-*N*,*N*-binucleophiles, 1,4-*N*,*O*-binucleophiles and 1,4-*N,S*-binucleophiles under different reaction conditions. Also, The chemical reactivity of carboxaldehyde **4** was studied towards some carbon nucleophiles as cyclic and acyclic active methylene nucleophiles and also, 1,3-*C*,*N*- and 1,3-*C*,*C*-binucleophiles as a route to achieve ring transformation producing a variety of heterocyclic systems. Structures of the newly synthesized products have been deduced on the basis of elemental analysis and spectral data.

Keywords: Chromone-3-carboxaldehyde, nitrogen nucleophiles, carbon nucleophiles, condensation reactions, ring opening ring closure reactions.

Supervisors:

1. Dr. Tarik El-Sayed Ali .....

Assistant Professor of Organic Chemistry, Faculty of Education, Ain Shams University.

2. Dr. Magdy Ahmed Mohamed .....

Assistant Professor of Organic Chemistry, Faculty of Education, Ain Shams University.

3. Dr. Azza Mohamed El-Kazak .....

Lecturer of Organic Chemistry, Faculty of Education, Ain Shams University.

Acknowledgement

*First of all, thanks to **GOD**, for helping me to accomplish this thesis.*

I would like to express my sincere gratitude and indebtedness to Dr. **Tarik El-Sayed Ali,** *Assistant Prof. of Organic Chemistry, Faculty of Education, Ain Shams University; for his continuous and valuable discussions during supervision, continuous encouragement, his valuable revision, lay out of this thesis, and to follow the progress of the work with keen interest and guidance.*

I would like to express deep thanks and gratitude to Dr. ***Magdy Ahmed Mohamed,*** *Assistant Prof. of Organic Chemistry, Faculty of Education, Ain Shams University; for his continuous and valuable discussions during supervision, for his suggestions the plan of research, valuable helping in interpretation of the results and lay out of this thesis.*

Also, I would like to express my sincere appreciation towards Dr. **Azza Mohamed El-Kazak** *Lecturer of Organic Chemistry, Faculty of Education, Ain Shams University; for her continuous and valuable discussions during supervision, continuous encouragement, and her valuable revision.*

I am truly thanks to Prof. Dr. **Mostafa Mohamed Ismail** the present Head of the Department of Chemistry and Prof. Dr. **Said Mohamed khalil**, the previous head, who introduced great kind facilities and encouragement.

Amira Mohsen Mohamed

Aim of the work

1. Synthesis of the novel 6,8-dibromo-7-hydroxychromone-3-carboxaldehyde (**4**) as the starting material.
2. Study the chemical reactivity of the starting compound **4** towards a variety of nitrogen nucleophiles.
3. Study the chemical behavior of compound **4** towards some of carbon nucleophiles.
4. Elucidation of the newly synthesized products using elemental analysis and different spectroscopic techniques.
5. Evaluation the antimicrobial activities of the newly synthesized compounds.

ANTIMICROBIAL EVALUATION

The newly synthesized compounds were evaluated for their in *vitro* antibacterial activity against *Staphylococcus aureus* (ATCC 25923) and *Bacillus subtilis* (ATCC 6635) as examples of Gram-positive bacteria and *Escherichia coli* (ATCC 25922) and *Salmonella typhimurium* (ATCC 14028) as examples of Gram-negative bacteria. They were also evaluated against *Candida albicans* (ATCC 10231) as yeast and the fungus *Asperigillus fumigatus*. Agar diffusion technique was used for the determination of the preliminary antibacterial and antifungal activities [204]. The test was performed on medium potato dextrose agar (PDA) which contained infusion of 200 g potatoes, 6 g dextrose and 15 g agar. Uniform size filter paper disks (3 disks per compound) were impregnated by equal volume (10 µl) from the concentrations of 500 and 1000 µg/mL dissolved compounds in dimethylformamide (DMF) and carefully placed on inoculated agar surface. After incubation for 36 h at 27 °C in the case of bacteria and for 48 h at 24°C in the case of fungi. Cephalothin, Chloramphenicol and Cycloheximide were used as reference drugs for Gram-positive bacteria, Gram-negative bacteria and yeast and the fungus, respectively. The obtained results were recorded for each tested compound as average diameter of inhibition zones of the bacteria, yeast and fungus around the disks in mm at the concentrations 500 and 1000 µg/mL. The antimicrobial activities were determined by measuring the inhibition zones (Table 1).

[1] The results depicted in Table 1 revealed that the most of tested compounds displayed variable inhibitory effects on the growth of the tested Gram-positive and Gram-negative bacterial strains, and also against the yeast and antifungal strain.

[2] In general, most of the tested compounds revealed low to moderate activities against the microorganism strains.

[3] Most of the tested compounds recorded good activities against *Bacillus subtilis* and *Candida albicans*.

[4] Most of the tested compounds recorded no activities against *Asperigillus fumigatus.*

[5] Only, compounds **22**, **37** and **39** recorded high activities against *Bacillus subtilis*, and compound **23** against *Candida albicans*.

[6] Presence of the simple functional groups at position 3 of 7-hydroxy-6,8-dibromochromone moiety in compounds **4**, **12**, **13, 14**, **15** and **24** exhibited good activity profile.

[7] Conversion of 7-hydroxy-6,8-dibromo-3-formylchromone (**4**) to other heterocycles *via* its reaction with nucleophiles, unfortunately not produce noticeable antimicrobial activities.

[8] In conclusion, the objective of the present study was to synthesize and investigate the antimicrobial activities of some new functionalized 7-hydroxy-6,8-dibromochromone with the hope of discovering new structure leads serving as antimicrobial agents. Generally, the prepared compounds showed lower to moderate activities. However, none of the tested compounds was nearly or superior activity than the reference drugs.

Antimicrobial evaluation

Table 1: In *vitro* antimicrobial activities of the synthesized compounds **4-48** at 500 and 1000 μg/mL by disc diffusion assay.

Compd. No.	Conc. (μg/mL)	Zone of inhibition (mm)*					
		Bacteria Gram (+) ve		Bacteria Gram (−) ve		Yeast	Fungi
		S. aureus	*B. subtilis*	*E. coli*	*S. typhimurium*	*C. albicans*	*A. fumigatus*
4	500	9	12	10	10	15	7
	1000	12	15	14	12	20	12
9	500	10	12	8	11 8	8 8	10
	1000	12	13	10	12 10	9 10	15
10	500	8	10	9	16 7 8	12	11 - -
	1000	11	16	13	18 10	15	20 - -
11	500	-	9	11	7 6	- -	- -
	1000	-	12	13	8 10	- -	- -
12	500	9	11	7	11 10	12	14
	1000	13	14	10	14 14	18	20
13	500	11	8	11	12	7 14	15
	1000	16	12	14	15	10 19	18
14	500	12	16	10	7 11	8 15	7
	1000	15	18	13	8 13	10 18	12
15	500	8	11	10	7	- -	11
	1000	14	15	15	11	- -	15
17	500	8	16	7	7 -	16 -	10 12
	1000	11	21	11	10 -	21 -	16 17
18	500	-	18	17	- -	16 -	- -
	1000	-	23	20	10 -	23 -	- -
20	500	9	8	-	- -	8 12	- -
	1000	12	14	-	- -	10 16	- -
21	500	8	20	7	9 7 7	18	12 19
	1000	13	12	13	8 9	20	15 22
22	500	-	22	7	- -	11	17 -
	1000	-	27	11	- -	16	17 -
23	500	-	12	14	- -	7	20 -
	1000	-	17	20	- -	8	25 -
24	500	7	12	7	11	11	8 -
	1000	12	16	10	12	8	9 -
25	500	8	15	-	7 -	8	13 -
	1000	9	18	-	8 -	10	16 -

* Low active: 6–12 mm; moderately active: 13–19 mm; highly active: 20–30 mm; –: No inhibition or inhibition less than 5 mm.

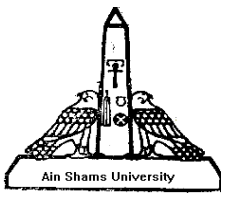
Continued Table 1: In *vitro* antimicrobial activities of the synthesized compounds **4-48** at 500 and 1000 μg/mL by disc diffusion assay.

* Low active: 6–12 mm; moderately active: 13–19 mm; highly active: 20–30 mm; –: No inhibition or inhibition less than 5 mm.

Continued Table 1: In *vitro* antimicrobial activities of the synthesized compounds **4-48** at 500 and 1000 µg/mL by disc diffusion assay**.**

Compd. No.	Conc. (µg/ml)	Zone of inhibition (mm)*					
		Bacteria Gram (+) ve		Bacteria Gram (−) ve		Yeast	Fungi
		S. aureus	*B. subtilis*	*E. coli*	*S. typhimurium*	*C. albicans*	*A. fumigatus*
46	500	-	7	-	-	15	-
	1000	-	10	-	-	19	-
47	500	7	10	-	7	10	-
	1000	10	15	-	9	17	-
48	500	-	9	-	5	7	-
	1000	-	14	-	8	10	-
Standard drug	500	26	25	28	27	28	26
	1000	35	35	36	38	35	37

* Low active: 6–12 mm; moderately active: 13–19 mm; highly active: 20–30 mm; –: No inhibition or inhibition less than 5 mm.



Ain Shams University
Faculty of Education
Department of Chemistry

Approval Sheet

Synthesis and chemical reactivity of 6,8-dibromo-7-hydroxychromone-3-carboxaldehyde towards some nucleophilic reagents

Supervisors	*Signature*
Dr. Tarik El-Sayed Ali	**.....**
Assistant Prof. of Organic Chemistry, Faculty of Education, Ain Shams University	
Dr. Magdy Ahmed Mohamed	**.....**
Assistant Prof. of Organic Chemistry, Faculty of Education, Ain Shams University.	
Dr. Azza Mohamed El-kazak	**.....**
Lecturer of Organic Chemistry, Faculty of Education, Ain Shams University**.**	

Head of Chemistry Department

Prof. Dr. Mostafa M. Ismail

…….

Higher studies:

The thesis was approved Approval date / / 2013

Approved by Council of Faculty Approved by Council of University

Date / / 2013 Date / / 2013

CONTENTS

Experimental

Melting points were determined on a digital Stuart SMP3 apparatus. Infrared spectra were measured on FTIR Nicolet IS10 spectrophotometer (cm^{-1}), using KBr disks. ^{1}H NMR (300 MHz) and ^{13}C NMR (75 MHz) spectra were measured on Mercury-300BB, using DMSO-d_6 as a solvent and TMS (δ) as the internal standard. Mass spectra were obtained using GC-2010 Shimadzu Gas chromatography instrument mass spectrometer (70 eV). Elemental microanalyses were performed Perkin-Elmer 2400II at the Chemical War department, Ministry of Defense, Egypt.

3,5-Dibromo-2,4-dihydroxyacetophenone (3)

To a solution of 2,4-dihydroxyacetophenone (**2**) (15.2 g, 0.1 mol) in acetic acid (80%, 20 mL), bromine (32 g, 10.4 mL, 0.2 mol) in acetic acid (10 mL), was added dropwise with continuous stirring for 30 minutes. The resulting solid was filtered off and crystallized from benzene to give compound **3** as white crystals, yield (14.4 g, 46%), m.p. 173–174 ºC (lit. 172–173 ºC) [190]. IR (KBr, cm^{-1}): 3399 (br, OH), 1624 (C=O $_{\text{Hydrogen bonded}}$), 1559 (C=C).

6,8-Dibromo-7-hydroxychromone-3-carboxaldehyde (4).

Method A: Phosphoryl chloride (3 mL) was added dropwise with continuous stirring to a pre-cooled DMF (10 mL) and the mixture was further stirred at room temperature for 30 minutes. Then 3,5-dibromo-2,4-dihydroxyacetophenone (**3**) (0.93 g, 3 mmol) in DMF (10 mL) was added dropwise with continuous stirring. The mixture was stirred at room temperature for 2 h, left overnight and poured onto crushed ice (50 g). The resulting solid was filtered off, air dried and crystallized from ethanol to give compound **4** as yellow crystals, yield (0.80 g, 77%), m.p. 250–251 ºC.

Method B: A mixture of 7-hydroxychromone-3-carboxaldehyde (**5**) (0.57 g, 3 mmol) and bromine (0.96 g, 0.32 mL, 6 mmol) in acetic acid (80%, 5 mL) was stirred at room temperature for 1 h. The resulting solid was filtered off and crystallized from ethanol to give compound **4** as yellow crystals, yield (0.61 g, 59%), m.p. 250–251 °C. IR (KBr, cm^{-1}): 3235 (OH), 3058 (CH_{arom}), 1685 ($C=O_{formyl}$), 1667 ($C=O_{\gamma\text{-pyrone}}$), 1599 (C=C). ^{1}H-NMR (DMSO-d_6): 8.16 (s, 1H, H–$5_{chromone}$), 8.89 (s, 1H, H–$2_{chromone}$), 10.07 (s, 1H, CHO). ^{13}C-NMR (DMSO-d_6): 100.4 (C–8), 110.8 (C–6), 118.9 (C–3), 119.7 (C–4a), 127.6 (C–5), 153.1 (C–8a), 156.9 (C–7), 163.2 (C–2), 172.8 (C=O), 187.9 (CHO). MS (*m/z*, I%): 350 (M+4, 2), 348 (M+2, 5), 346 (M^+, 2), 322 (52), 320 (100), 318 (50), 296 (8), 294 (16), 292 (8), 280 (3), 278 (7), 276 (3), 215 (2), 213 (2), 199 (3), 197 (3), 187 (3), 185 (4), 175 (2), 173 (2), 159 (2), 157 (2), 133 (3), 119 (2), 91 (2). Anal. Calcd for $C_{10}H_4Br_2O_4$ (347.94): C, 34.52; H, 1.16%. Found: C, 34.17; H, 1.16%.

Synthesis of Schiff bases 9-11; General procedure for reaction of carboxaldehyde 4 with heterocyclic amines:

To a hot solution of carboxaldehyde **4** (0.35 g, 1 mmol) in absolute ethanol (15 mL), each one of the heterocyclic amines namely: 4-amino-5-phenyl-2,4-dihydro-[1,2,4]triazole-3-thione (**6**), 4-amino-6-methyl-3-thioxo-3,4-dihydro-1,2,4-triazin-5(2*H*)-one (**7**) and 3-amino-2-phenylquinazoline-4(3*H*)-one (**8**) (1 mmol) was added with continuous stirring. The mixture was heated under reflux for 30 minutes. The resulting solids after cooling were filtered off and crystallized from ethanol to give compounds **9-11**, respectively, as yellow crystals.

***6,8-Dibromo-7-hydroxy-3-{[(5-phenyl-3-thioxo-1,3-dihydro-4H-1, 2, 4-triazol-4-yl)imino] methyl}-4H-chromone (9)*:** Yield (0.31 g, 59%), m.p. 291–292 ºC. IR (KBr, cm^{-1}): 3311 (OH, NH), 1654 ($C=O_{\gamma\text{-pyrone}}$), 1610 (C=N), 1595 (C=C). ^{1}H-NMR (DMSO-d_6): 7.59–7.89 (m, 5H,

Ph–H), 8.15 (s, 1H, H–$5_{chromone}$), 8.75 (s, 1H, CH=N), 9.13 (s, 1H, H–$2_{chromone}$), 12.00 (brs, 1H, OH exchangeable with D_2O), 13.63 (brs, 1H, $NH_{triazole}$ exchangeable with D_2O). Anal. Calcd for $C_{18}H_{10}Br_2N_4O_3S$ (522.17): C, 41.40; H, 1.93; N, 10.73; S, 6.14%. Found: C, 41.32; H, 1.74; N, 11.02; S, 5.84%.

***6,8-Dibromo-7-hydroxy-3-{[(6-methyl-3-thioxo-3,4-dihydro-5-oxo-1,2,4-triazin-4-yl)imino]methyl}-4H-chromone (10)*:** Yield (0.33 g, 68%), m.p. 229–230 ºC. IR (KBr, cm^{-1}): 3207 (OH), 3080 (CH_{arom}), 2982 (CH_{aliph}), 1697 ($C=O_{triazine}$), 1641 ($C=O_{\gamma\text{-pyrone}}$), 1596 (C=N), 1580 (C=C). ^{1}H-NMR (DMSO-d_6): 2.18 (s, 3H, $CH_{3\ triazine}$), 8.20 (s, 1H, H–$5_{chromone}$), 8.70 (s, 1H, CH=N), 9.16 (s, 1H, H–$2_{chromone}$), 13.75 (brs, 1H, $NH_{triazine}$ exchangeable with D_2O). Anal. Calcd for $C_{14}H_8Br_2N_4O_4S$ (488.11): C, 34.45; H, 1.65; N, 11.48; S, 6.57%. Found: 34.23; H, 1.60; N, 11.16; S, 6.42%.

***6,8-Dibromo-7-hydroxy-3-{[(2-phenyl-4-oxo-quinazolin-3-yl)imino]methyl}-4H-chromone (11)*:** Yield (0.39 g, 69%), m.p. 248–250 ºC. IR (KBr, cm^{-1}): 3249 (OH), 3073 (CH_{arom}), 1661 ($C=O_{quinazolinone}$ and $C=O_{\gamma\text{-pyrone}}$), 1597 (C=N). ^{1}H-NMR (DMSO-d_6): 7.47–7.89 (m, 8H, Ar–H), 8.18 (s, 1H, H–$5_{chromone}$), 8.23 (d, 1H, *J*=6.9 Hz, Ar–H,), 8.70 (s, 1H, CH=N), 9.11 (s, 1H, H–$2_{chromone}$). MS (*m/z*, I%): 565 (M^+, 3), 548 (4), 537 (4), 519 (5), 318 (3), 293 (2), 236 (100), 222 (6), 208 (9), 180 (17), 152 (13), 103 (14), 90 (13), 77 (16). Anal. Calcd for $C_{24}H_{13}Br_2N_3O_4$ (567.49): C, 50.82; H, 2.31; N, 7.41%. Found: C, 50.76; H, 2.24; N, 7.77%.

6,8-Dibromo-7-hydroxy-4*H*-chromone-3-carboxaldehyd-oxime (12).

To a solution of carboxaldehyde **4** (0.70 g, 2 mmol) in 95% ethanol (15 mL), hydroxylamine hydrochloride (0.15 g, 2.2 mmol) in

water (10 mL) was added. The reaction mixture was heated under reflux for 10 minutes. The resulting solid after cooling was filtered off and crystallized from DMF/H_2O to give compound **12** as yellow crystals, yield (0.51 g, 70%), m.p > 300 °C. IR (KBr, cm^{-1}): 3274 (2 OH), 1660 ($C=O_{\gamma\text{-pyrone}}$), 1620 (C=N), 1590 (C=C). ^{1}H-NMR (DMSO-d_6): δ 8.14 (s, 1H, H-$5_{chromone}$), 8.32 (s, 1H, CH=N), 8.78 (s, 1H, H-$2_{chromone}$), 11.87 (brs, 1H, OH exchangeable with D_2O), 12.44 (brs, 1H, OH exchangeable with D_2O). Anal. Calcd for $C_{10}H_5Br_2NO_4$ (362.96): C, 33.09; H, 1.39; N, 3.86%. Found: C, 32.78; H, 1.31; N, 3.59%.

6,8-Dibromo-7-hydroxy-4*H*-chromone-3-carbonitrile (13).

A mixture of carboxaldehyde **4** (0.70 g, 2 mmol) and hydroxylamine hydrochloride (0.15 g, 2.2 mmol) in 95% ethanol (20 mL) and concentrated hydrochloric acid (5 mL) was heated under reflux for 4 h. After cooling, the reaction mixture was poured onto crushed ice. The resulting solid was filtered off and crystallized from ethanol to give compound **13** as pale yellow crystals, yield (0.45 g, 65%), m.p. 274–275 °C. IR (KBr, cm^{-1}): 3308 (OH), 3020 (CH_{arom}), 2216 (C≡N), 1618 (C=O), 1540 (C=C). ^{1}H-NMR (DMSO-d_6): 8.19 (s, 1H, H–$5_{chromone}$), 8.96 (s, 1H, H–$2_{chromone}$), 12.44 (brs, 1H, OH exchangeable with D_2O). MS (*m/z*, I%): 347 (M+4, 24), 345 (M+2, 48), 343 (M^+, 23), 321 (16), 319 (36), 317 (18), 296 (48), 294 (100), 292 (49), 280 (14), 278 (29), 276 (15), 215 (33), 213 (34), 199 (12), 197 (13), 159 (45), 157 (26), 129 (78), 89 (72). Anal. Calcd for $C_{10}H_3Br_2NO_3$ (344.94): C, 34.82; H, 0.88; N, 4.06%. Found: C, 34.65; H, 0.85; N, 4.02%.

2-Amino-6,8-dibromo-7-hydroxy-4*H*-chromone-3-carboxamide (14).

A mixture of carboxaldehyde **4** (0.70 g, 2 mmol) and hydroxylamine hydrochloride (0.15 g, 2.2 mmol) in ethanol (10 mL) and sodium hydroxide solution (1%, 10 mL), was heating on a water

bath for 2 h. After cooling, the reaction mixture was neutralized with diluted hydrochloric acid. The resulting solid was filtered off and crystallized from acetic acid to give compound **14** as yellow crystals, yield (0.36 g, 48%), m.p > 300 °C. IR (KBr, cm^{-1}): 3446, 3308, 3253, 3142 (OH, 2 NH_2), 1640 (2 C=O), 1593 (C=C). ^{1}H-NMR (DMSO-d_6): 7.45 (brs, 1H, NH exchangeable with D_2O), 8.05 (s, 1H, H–$5_{chromone}$), 9.31 (brs, 1H, NH exchangeable with D_2O), 9.46 (brs, 1H, NH exchangeable with D_2O), 10.52 (brs, 1H, NH exchangeable with D_2O). MS (*m/z*, I%): 380 (M+4, 34), 378 (M+2, 67), 376 (M^+, 34), 363 (24), 361 (43), 359 (23), 336 (2), 334 (5), 332 (3), 296 (24), 294 (49), 292 (25), 268 (2), 266 (5), 264 (3), 250 (5), 248 (4), 159 (13), 157 (13), 77 (38), 68 (100). Anal. Calcd for $C_{10}H_6Br_2N_2O_4$ (377.97): C, 31.78; H, 1.60; N, 7.41%. Found: C, 31.66; H, 1.52; N, 7.19%.

2-Amino-6,8-dibromo-7-hydroxy-4*H*-chromone-3-carboxaldehyde (15).

A mixture of carboxaldehyde **4** (0.70 g, 2 mmol) and hydroxylamine hydrochloride (0.15 g, 2.2 mmol) in 95% ethanol (15 mL) was refluxed for 5 minutes. Ammonium hydroxide (5 mL) was added into the reaction mixture and heated further for 30 minutes. The resulting solid during heating was filtered off and crystallized from acetic acid to give compound **15** as yellow crystals, yield (0.43 g, 59%), m.p. > 300 °C. IR: (KBr, cm^{-1}): 3214 (OH, NH_2), 3072 (CH_{arom}), 1675 ($C=O_{formyl}$), 1656 ($C=O_{\gamma\text{-pyrone}}$), 1594 (C=C). ^{1}H-NMR (DMSO-d_6): 8.05 (s, 1H, H–5), 9.65 (s, 1H, NH exchangeable with D_2O), 9.83 (s, 1H, NH exchangeable with D_2O), 10.03 (s, 1H, CHO). Anal. Calcd for $C_{10}H_5Br_2NO_4$ (362.96): C, 33.09; H, 1.39; N, 3.86%. Found: C, 32.82; H, 1.28; N, 3.69%.

6,8-Dibromo-3-{[2-(7-chloroquinolin-4-yl)hydrazinylidene] methyl}-7-hydroxy-4*H*-chromone (17).