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Further Insight into the Reactivity of 3-(p-Chlorophenylimino-methyl) Chromone toward Phosphorus Reagents

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A SERIES of phosphono-substituted and 5-membered ring chromenes were prepared in reasonable yields from the reactions of 3-(p-chlorophenyl-iminomethyl) chromone (1) with diffrent types of the Wittig-Horner reagents 4a-c, 9 in the presence of a base. On the other hand by applying cyanomethylenetriphenylphosphonium chloride 12 and allyltriphenylphosphonium bromide 15 to 1, the corresponding propanenitrile and methylpropenyl chromene derivatives were obtained.

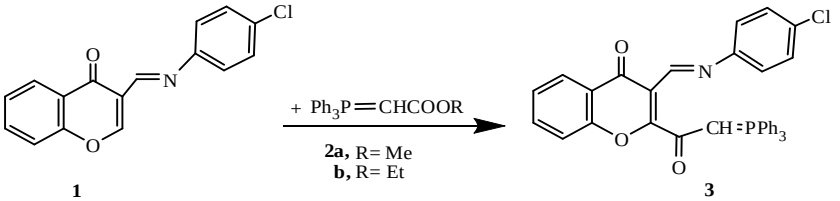
Keywords: 3-(Aryliminomethyl) chromone, Wittig-Horner reagents, Phosphonium salts, Phosphono and Substituted chromenes.

In a series of articles from this laboratory, we reported on the synthesis and reactions of new phosphono-substituted heterocycles starting from the inexpensive and easily accessible α-phosphonyl carbanions toward different unsaturated systems[1-7].

This article represents an efficient route to the synthesis of phosphono-substituted chromenes and azaphospholylchromene of potential interest to biochemistry and pharmaceutical chemistry. The methodology is based upon the application of α-phosphonyl carbanions (Wittig Horner-WH reagents) 4a-c, 9 and phosphonium salts 12, 15 toward 3-(p-chlorophenyl-iminomethyl) chromone (1).

Results and Discussion

In a previous study, it was reported[8] that chromone (1) underwent a condensation reaction when it was allowed to react with stabilized Wittig reagents 2a,b to give the complex ylidenetriphenylphosphorane structure 3 (Scheme 1).



1 **3**

Scheme 1

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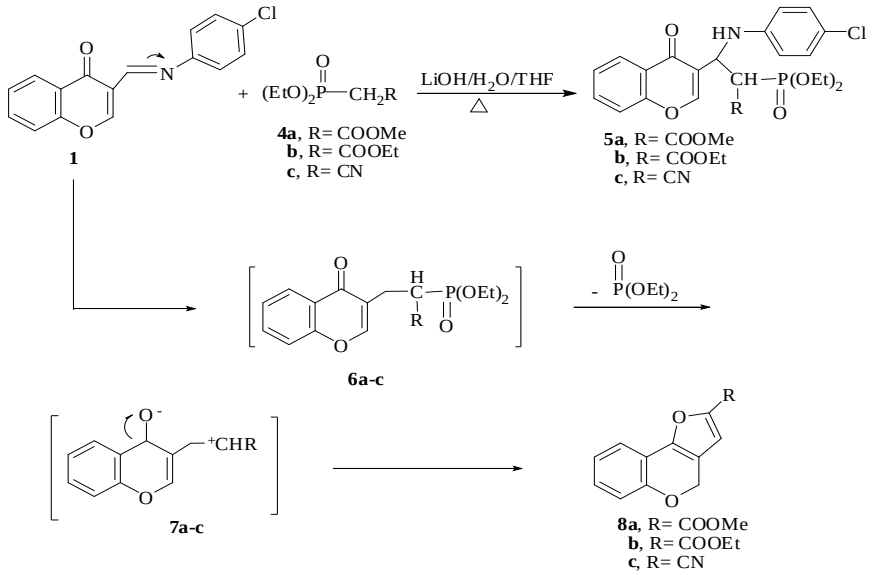
3-(*p*-Chlorophenyl- iminomethyl) chromone (1) was allowed to react with one equivalent of diethylphosphonoacetates 4a or 4b and diethylcyanomethylphosphonate 4c in refluxing tetrahydrofuran (THF) containing aqueous LiOH. The product mixture was then subjected to column chromatography to afford the phosphono-substituted chromenes 5a-c in ≈45% yield and chromene derivatives 8a-c in ≈28% yield (Scheme 2).



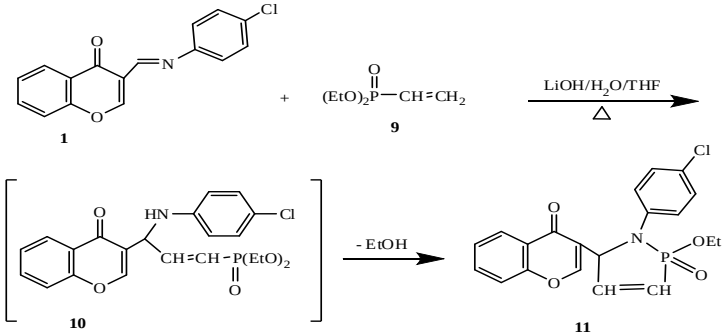
Scheme 2

The chemical structure of 5a was in accord with elemental analysis, molecular weight determination (MS) and spectroscopic data. The ^{31}P NMR spectrum showed a chemical shift = 20.2 ppm, that indicates a phosphonate structure[9,10]. The IR spectrum of 5a showed absorption bands at 1730 (C=O, ester), 3260 (NH) and 1269 (P=O); its ^{1}HNMR revealed the presence of two ethoxy groups attached to phosphorus, the two equivalent [$P(OC_2H_5)_2$] protons coupled with phosphorus appeared as a doublet of triplets (dt, J_{H-H} = 6.8 ,^{4} J_{H-P} = 4.6 Hz, 6H, 2xH_3CC.OP) at 1.3 ppm and 4.1 (dq, J_{H-H} = 6.8,^{3} J_{H-P} = 5.5 Hz, 4H, 2xH_2COP) whereas methoxy group appeared as a singlet at 3.7 ppm, the spectrum also showed two doublets (each with = J_{H-H} 9 Hz) due to aromatic protons of the N-C_6H_4-Cl moiety (4H) at 6.6 and 7.1. The remaining aromatic protons (5H) appeared as a multiplet in the 7.4-8.3 ppm region. The NH proton gave a D_2O exchangeable singlet at 9.19 whereas the exocyclic methine proton (C*H*-N) appeared as a doublet of doublet due to coupling with the phosphorus atom at 5.3 ppm $^{3}J_{H-P}$ =11.5 Hz, also a doublet of doublet ($^{2}J_{H-P}$ = 18 Hz) at 3.33 ppm due to (C*H*-P). In the ^{13}CNMR ($CDCl_3$, ppm) spectrum[11] of 5a carbon attached to phosphorus (-*C*H-P) appeared at 45.7 (d, ^{1} J_{C-P} =147 Hz) while the (-*C*H-N) located at 53.5 (d, ^{2} J_{C-P} = 33 Hz) other signals were displayed at 163.4 (d, $^{2}J_{C-P}$ = 28, *C*=O, ester), 185.7 (d, ^{4} J_{C-P} = 4.6, *C*=O, ring).

A reasonable mechanism of the formation of 5a-c might involve an initial nucleophilic[12] attack of the phosphonyl carbanions 4a-c on the azomethine-carbon atom in 1 to yield 5a-c. On the other hand, the spectroscopic analyses of the second product clearly demonstrated that the carboxylate products 8a,b, carbonitrile 8c were formed, The ^{1}HNMR ($CDCl_3$) spectrum of 8b showed a triplet at 1.3 ppm due to the C*H*$_3$CO, ester, J_{H-H} = 7.5 Hz, also at 4.30 ppm (q, 2H, C*H*$_2$.O, J_{H-H} = 7.5 Hz), whereas the singlet at 5.0 ppm was assigned to the methylene protons. The aromatic protons (5H) gave a multiplet in the 6.90-7.47 ppm region. In the ^{13}CNMR ($CDCl_3$, ppm) spectrum of 8b the carboxyl carbon (*C*=O) appeared at 160.42. According to the mechanism outlined in Scheme 2, the formation of 8a-c could be explained via decomposition of 1 and nucleophilic attack[13] of carbanion center of 4a-c onto the carbon -1, 2-azaphosphol-5-yl]-4*H*-chromen-4-one (11). According to the mechanism outlined in atom in 1 to afford intermediates 6a-c. Elimination of a phosphonate moiety and ring closure could explain the formation of the target chromene carboxylate 8a-c.

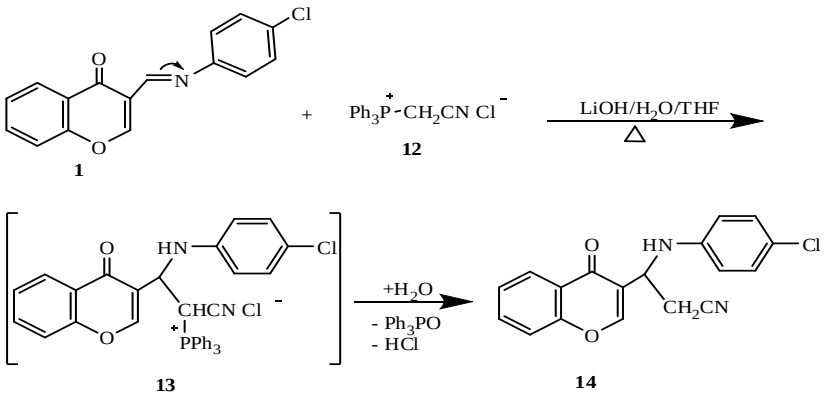
The behavior of arylimine 1 toward unsaturated phosphonyl carbanion, diethylvinylphosphonate 9 was investigated next. The reaction was carried out under similar reaction conditions, giving 3-[1-(4-chlorophenyl)-2-ethoxy-2-oxido-2, 5-dihydro-1*H* (Scheme 3), the addition of 9 to 1 gave intermediate 10, further intramolecular cyclisation of 10 afforded the phosphole 11 via the loss of ethanol molecule[14].

This new reaction led to the formation of the cyclic product 11. Compound 11 was isolated as pale brown crystals in 68% yield. The structure seemed possible for the reaction product since the IR (cm^{-1}) spectrum of 11 revealed the presence of strong absorption bands at 1248 (P=O), and 1098 (P-OC_2H_5), the ^{31}P NMR spectrum showed a chemical shift δ_P=12.2 ppm. Moreover, the ^{1}H NMR spectrum of compound 11 in $CDCl_3$ gave signals at 1.42 ppm (dt, J_{H-H} = 6.8, $^{4}J_{H-P}$= 4.4 Hz, 3H, *H*$_3$CC.OP), 3.89 (dq, J_{H-H} 6.8, $^{3}J_{H-P}$ = 5.6 Hz, 2H, *H*$_2$COP) corresponding to phospholyl moiety [EtOP(O)] and at 5.05 (d, $^{3}J_{H-P}$ = 5.2 Hz, 1H, C*H*-N) due to methine proton, also at 6.43, 6.51 (2d, $^{2}J_{H-P}$ = 13.5,1H, CH=C*H*-P).The remaining aromatic protons (9H) and 1H due to (C*H*=CH-P) appeared as a multiplet in the 7.5-8.48 ppm region.



Scheme 3

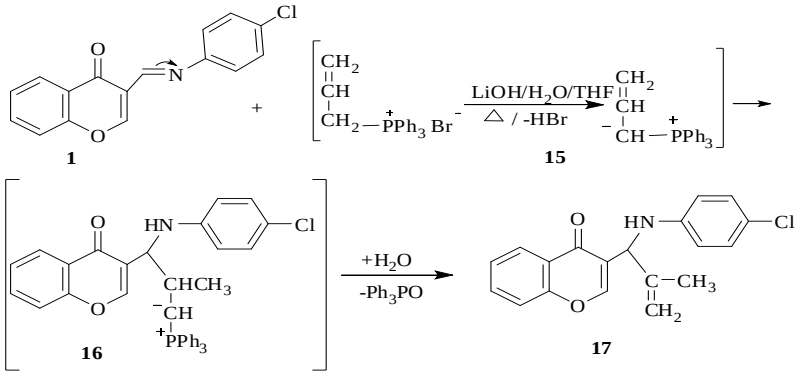
On treating arylimine 1 with cyanomethylenetriphenylphosphonium chloride 12 in THF/ LiOH/ H_2O, 3-[(4-chlorophenyl) amino]-3- (4-oxo-4*H*-chromen-3-yl) propanenitrile (14), 58% yield was obtained according to Scheme 4. Triphenylphosphine oxide $(C_6H_5)_3P(O)$ was isolated and identified (TLC) in this reaction. The product 14 had infrared bands at 2200 cm^{-1} (CN) and 3260 cm^{-1} attributed to the (NH). In the ^{1}HNMR of 14 the exocyclic proton was shown at 5.19 as a triplet while the methylene protons appeared as two doublets at 3.90, 4.09. The NH proton gave a D_2O-exchangeable singlet at 9.4 ppm. The azomethine-carbon atom at 47.49 and methylene carbon at 23.35 in the ^{13}C NMR spectrum of 14.



Scheme 4

According to Scheme 4, an initial nucleophilic addition of the cabanion center of 12 to the azomethine-carbon atom led to the formation of zwitter ion 13. Elimination of triphenylphosphine oxide from 13 can lead to the formation of propanenitrile derivative 14 [15].

Finally, the heating of 1 with one equivalent of allyltriphenylphosphonium bromide 15 in THF under reflux with a catalytic amount of LiOH/H_2O gave 3-{1-[(4-chlorophenyl)amino]-2-methylprop-2-en-1-yl}-4*H*-chromen-4-one (17), 60% yield as the sole product (Scheme 5). Obviously, compound 17 is the product of the initial addition 1 to the beta-carbon in 15, further hydrolysis of 16 and elimination of triphenylphosphine oxide yielded the final product 17[16]. On the basis of comparative IR, ^{1}HNMR, MS and elemental analyses, the structure of compound 17 was deduced (*cf*. Experimental).



Scheme 5

Conclusion

In view of all the facts previously cited, it can be concluded that 3-(p-chlorophenyliminomethyl)-chromone (1) with Wittig 2a,b, 12, 15 and Wittig-Horner reagents 4a-c, 9 led to different products, depending on the nature of the phosphorus reagent used as well as on the stability of the addition products. The results of the previous and the present work point out the variety of the reactions, which can follow an initial attack of phosphorus carbanions onto the azomethine–carbon in 1. However, the transformations were quite different. The main difference between the present work and the corresponding work of the Wittig reagents with the same substrate 1 is that in the latter case, the transformation of the products was accompanied by elimination of the phosphorus moiety. This was because Ph_3P species was a much better leaving group than [$(EtO)_2PO^-$]. There was much precedence for this difference. Finally, the present work described an efficient and simple approach to the synthesis of a variety of phosphono-substituted and 5-membered ring chromenes derivatives in reasonable yields. This was achieved by application of the appropriated α-phosphonyl carbanions to 1. Data on the pharmaceutical potency as anti-inflammatory agents as well as fungicides or antibacterial of the new phosphorylated compounds will be published elsewhere.

Experimental

General

Melting points (m.p.) are uncorrected. Infrared sepectra were measured with a Perkin-Elmer IR-spectrometer model 597 using KBr discs.^{1}H and ^{31}C NMR spectra were recorded by a Bruker Model WH-270 MHz spectrometer, using TMS as an internal reference. Chemical shifts are given in the δ -scale (ppm), coupling constants J are given in Hz. ^{31}P NMR spectra were run on a Varian CFT-20 relative to external H_3PO_4. Mass spectra were run at 70 eV on a Schimatzu GCS-QPEX spectrometer provided with a data system. The

appropriate precautions in handling moisture-sensitive compounds were observed. The silica gel used for column chromatography was Kieselgel 60; particle size 0.2-0.5 mm (E. Merck, Darmstadt).The substrate monoanil 1 was prepared as described by Fitton *et al* [17].

Treatment of 3-(p-chlorophenyl-iminomethyl)chromone (1) with α-phosphonyl carbanions (4a-c). Preparation of 5a-c and 8a-c

General procedure

A solution of 4 mmol of Wittig-Horner reagents 4a, 4b or 4c and 1g of 1 (3.5mmol) in 30 ml THF was treated with 10 ml of aqueous LiOH solution (0.5M). The reaction mixture was stirred at r.t. for 2hr to ensure the complete dissolve of the reaction then heated under reflux for 6-8 hr (TLC). After removing the solvent, 20 ml of dist. H_2O was added and then extracted with $CHCl_3$. After evaporation of the dried $CHCl_3$ solution, the residue was chromatographed on silica gel using n-hexane with increasing amounts of AcOEt as eluents, whereupon compounds 5a-c and 8a-**c** were isolated.

[2-[(4-chlorophenyl)amino]-1-(methoxycarbonyl) -2-(4-oxo-4H- chromen-3-yl) ethyl] diethyl-phosphonate (5a)

5a was obtained (4:6, v/v) as pale brown crystals 44% m.p. 198-200 ºC (from benzene). (Found: C, 55.54; H, 4.9; Cl, 7.35; N, 3.0; P, 6.19. $C_{23}H_{25}ClNO_7P$ (493.89), requires C, 55.93; H, 5.10; Cl, 7.18; N, 2.84; P, 6.27); IR (KBr): $\widetilde{\nu}$ = 1640 (C=O, ring), 1730 (C=O, ester), 1269 (P=O), 1128 (P-O-C), 3260 (NH) cm^{-1}; ^{1}H NMR ($CDCl_3$): δ = 1.3 (dt, J_{H-H} 6.8, $^4J_{H-P}$ 4.6, 6H, 2xH_3CC.OP), 3.3 (dd, 1H, $^2J_{H-P}$ 18, C*H*-P), 3.7 (s, 3H, CH_3O, ester) , 4.1 (dq, J_{H-H} 6.8 $^3J_{H-P}$ 5.5, 4H, 2xH_2COP), 5.3 (dd, 1H, $^3J_{H-P}$ 11.5 C*H*-N), 6.6, 7.1(2d, 4H, J_{H-H} 9, N-C_6H_4-Cl), 7.4-8.3 (m, 5H, *H*-Ar), 9.1 (s, NH) ppm; ^{13}C NMR ($CDCl_3$): δ = 16.3 (d, $^3J_{C-P}$ 6.6, 2*C*H_3C.OP), 45.7 (d, $^1J_{C-P}$147,*C*H-P), 53.5 (d, $^2J_{C-P}$ 33, *C*H-N), 62.2 (d, $^2J_{C-P}$ 27, 2*C*H_2.OP), 108.8, 115.3, 117.6, 124.9, 129.8, 130.1, 132.5, 139.9, 141.3, 144.8, 149.8, 153.4, 155.5 (*C*=*C*, Ar), 163.4 (d, $^2J_{C-P}$ 28, *C*=O, ester), 185.7 (d, $^4J_{C-P}$ 4.6, *C*=O, ring) ppm; ^{31}P NMR ($CDCl_3$): δ = 20.0 ppm; *m/z* (EI) = 493 [M^+] (20).

[2-[(4-chlorophenyl)amino]-1- (ethoxycarbonyl)-2- (4-oxo-4H-chromen-3-yl) ethyl] diethyl- phosphonate (5b)

5b was obtained (1:1, v/v) as brown crystals 40% m.p. 186-188 ºC (from acetone) (Found: C, 56.31; H, 5.16; Cl; 7.0; N, 2.91; P, 6.45. $C_{24}H_{27}ClNO_7P$ (507.92) requires C, 56.75; H, 5.36; Cl, 6.98; N, 2.76; P, 6.1); IR (KBr): $\widetilde{\nu}$ = 1640 (C=O, ring), 1720 (C=O, ester), 1263 (P=O), 1043 (P-O-C); 3240 (NH) cm^{-1}; ^{1}H NMR ($CDCl_3$): δ = 1.2 (dt, J_{H-H} 7.9, $^4J_{H-P}$ 4.5, 6H, 2xH_3CC.OP), 1.3 (3H, t, J_{H-H} 7.1, O-C.CH_3, ester), 3.5 (dd, $^2J_{H-P}$ 21, 1H, C*H*-P), 4.3 (dq, J_{H-H} 7.9 $^3J_{H-P}$ 5.4, 4H, 2xH_2COP), 4.5 (q, J_{H-H} 7.4, 2H, H_2CO, ester), 5.1 (dd, $^3J_{H-P}$ 11.5,1H, C*H*-N), 6.5, 7.1 (2d, 4H, J_{H-H}12.5, N-C_6H_4-Cl), 7.2-8.2 (m, 5H, *H*-Ar), 9.1 (1H, s, N*H*) ppm; ^{13}C NMR ($CDCl_3$): δ = 14.3 (*C*H_3C.O, ester), 16.4 (d, $^3J_{C-P}$ 6.2, 2*C*H_3C.OP), 42.5 (d, $^1J_{C-P}$ 145, *C*H-P), 53.2 (d, $^2J_{C-P}$ 33, *C*H-N), 61.6 (d, $^4J_{C-P}$ 3.8 *C*H_2.O, ester), 62.3 (d, $^2J_{C-P}$ 35, 2*C*H_2.OP), 108.8, 115.2, 118.1, 124.5, 129.7, 130.4, 132.5, 139.8, 141.5, 143.7, 148.8, 153.5, 155.4 (*C*=*C*, Ar), 163.4 (d, $^2J_{C-P}$ 28,

C=O, ester), 185.7 (d, $^{4}J_{C-P}$ 4.6, *C*=O, ring) ppm; ^{31}P NMR ($CDCl_3$): δ = 22.1 ppm; *m/z* (EI) = 507 [M^+] (22).

[2-[(4-chlorophenyl) amino]-1-cyano-2- (4-oxo-4H-chromen-3-yl) ethyl] diethylphosphonate (5c)

5c was obtained (1:1, v/v) as yellow crystals 40% m.p. 179-181 ºC (from actone-ether) (Found : C, 57.12; H, 4.55; Cl, 7.71; N, 5.98; P,6.45; $C_{22}H_{22}ClN_2O_5P$ (460.86), requires C, 57.34; H, 4.81; Cl, 7.69; N, 6.08; P, 6.72); IR (KBr): $\tilde{\nu}$ = 1642 (C=O, ring), 2200 (CN), 1220 (P=O), 1030 (P-O-C), 3240 (NH) cm^{-1}; ^{1}H NMR ($CDCl_3$): δ = 1.2 (dt, J_{H-H} 7.9, $^{4}J_{H-P}$ 4.6, 6H, 2x*H*$_3$CC.OP), 3.4 (dd, $^{2}J_{H-P}$ 18,1H, C*H*-P), 4.2 (dq, J_{H-H} 7.9 $^{3}J_{H-P}$ 5.8, 4H, 2x*H*$_2$C.OP), 5.5 (dd, $^{3}J_{H-P}$ 11.5, 1H, C*H*-N), 6.6, 7.1 (2d, J_{H-H} 12.6, 4H, N-C$_6$*H*$_4$-Cl), 7.3-8.3 (m, 5H, *H*-Ar), 9.5 (s, NH) ppm; ^{13}C NMR ($CDCl_3$): δ = 16.2 (d, $^{3}J_{C-P}$ 6.7, 2*C*H$_3$C.OP), 32.5 (d, $^{1}J_{C-P}$147,*C*H-P), 52.4 (d, $^{2}J_{C-P}$ 30, *C*H-N), 61.6 (d, $^{2}J_{C-P}$ 35, 2*C*H$_2$OP), 115.2 (*C*N), 109.4, 115.3, 117.6, 122.1, 124.3, 129.5, 131.5, 133.4, 141.5, 143.7, 149.6, 153.8, 157.1 (*C*=*C*, Ar), 183.6 (d, $^{4}J_{C-P}$ 4.5, *C*=O, ring); ppm; ^{31}P NMR ($CDCl_3$): δ = 20.2 ppm; *m/z* (EI) = 460 [M^+] (18).

Methyl-4H -furo[3,2-c]chromene-2-carboxylate (8a)

8a was obtained (8:2, v\v) as yellow crystals, 26%, m.p. 142-144 ºC (From cyclohexane) (Found : C, 67.53; H, 4.62 $C_{13}H_{10}O_4$ (230.22), requires C, 67.82, H, 4.38); IR (KBr): $\tilde{\nu}$ = 1550 (CH=CH), 1730 (C=O) cm^{-1}; ^{1}H NMR ($CDCl_3$): δ = 3.7 (s, 3H, C*H*$_3$O), 5.2 (s, 2H, ,CH_2-ring), 6.8-7.5 (m, 5H, *H*-Ar) ppm; ^{13}C NMR ($CDCl_3$): δ = 51.5 (*C*H$_3$O), 65.5 (*C*H$_2$-ring), 113.1, 114.1, 119.5, 120.1, 122.3, 123.8, 129.6, 143.2, 144.5, 155.6 (*C*=*C*, Ar), 158.8 (*C*=O); ppm; *m/z* (EI) = 230 [M^+] (24).

Ethyl4H -furo[3,2-c] chromene-2carboxylate (8b)

8b was obtained (7:3, v\v) as yellow crystals 28% m.p., 130-132 ºC (From cyclohexane) (Found : C, 68.67; H, 4.72 $C_{14}H_{12}O_4$ (244.25), requires C 68.85, H, 4.95); IR (KBr): $\tilde{\nu}$ = 1590 (CH=CH), 1740, (C=O) cm^{-1}; ^{1}H NMR ($CDCl_3$): δ = 1.3 (t, J_{H-H} 7.5, 3H, C*H*$_3$C.O), 4.3 (q, J_{H-H} 7.5, 2H, CH_2.O), 5.0 (s, 2H, CH_2.ring) , 6.9-7.4 (m, 5H, *H*-Ar) ppm; ^{13}C NMR ($CDCl_3$): δ = 14.5 (*C*H$_3$C.O), 62.66 (*C*H$_2$.O), 64.6 (*C*H$_2$-ring), 112.5, 113.1, 119.3, 120.2, 122.8, 123.6, 129.5, 142.2, 143.4, 155.6 (*C*=*C*, Ar), 160.4 (*C*=O); ppm; *m/z* (EI) =244 [M^+] (18).

4H-furo [3,2-c] chromene-2-carbonitrile (8c)

8c was obtained (7:3, v\v) as yellow crystals 25% m.p., 122-124 ºC (From ether) (Found: C, 72.97; H, 3.19; N, 7.32 $C_{12}H_7NO_2$ (197.196), requires C, 73.09; H, 3.58; N; 7.10); IR (KBr): $\tilde{\nu}$ = 1600 (CH=CH), 2220 (CN) cm^{-1}; ^{1}H NMR ($CDCl_3$): δ = 4.9 (s, 2H, CH_2- ring), 6.7-7.7 (m, 5H, *H*-Ar) ppm; ^{13}C NMR ($CDCl_3$): δ = 64.6 (*C*H$_2$-ring), 110.4 (*C*N), 112.2, 114.2, 118.6, 120.5, 123.7, 125.7, 129.6, 142.1, 143.6, 155.4 (*C*=*C*, Ar); ppm; *m/z* (EI) = 197 [M^+] (25).

Reaction of 3-(p-chlorophenyl-iminomethyl) chromone (1) with diethylvinylphosphonate (9): A preparation of compound 11

To a stirred solution of 1g (3.5 mmol) 1 and 0.65 g (4 mmol) 9 in 30 ml THF, freshly prepared 20 ml LiOH solution (0.5M) was added in one portion. The reaction mixture was stirred at r.t. for 2hr to ensure the complete dissolve of the reaction and then heated under reflux for 10hr (TLC). After removing the solvent; 20 ml of dist. H_2O was added and then extracted with $CHCl_3$. After evaporation of the dried $CHCl_3$ solution, the residue was chromatographed on silica gel using n-hexane- $CDCl_3$ as the eluents whereupon compound 11 and unidentified products were isolated.

3-[1-(4-chlorophenyl)-2-ethoxy-2-oxido-2,5-dihydro-1H-1,2-azaphosphol-5-yl]-4H-chromen-4-one (11)

11 was obtaind (1:1, v\v) as pale brown crystals 68%, m.p. 206-208 ºC (From $CDCl_3$) (Found: C, 59.62; H, 4.48; Cl, 8.65; N, 3.52; P, 7.55 $C_{20}H_{17}ClNO_4P$ (401.79) requires :C, 59.79; H, 4.26; Cl, 8.82; N, 3.49; P, 7.71); IR (KBr): $\tilde{\nu}$ = 1248 (P=O), 1098 (P-OC_2H_5) cm^{-1}; ^1H NMR ($CDCl_3$): δ = 1.42 (dt, $_{H\text{-}H}$ 6.8, $^4J_{H\text{-}P}$ 4.4, 3H, H_3CC.OP), 3.8 (dq, $J_{H\text{-}H}$ 6.8, $^3J_{H\text{-}P}$ 5.6, 2H, H_2COP), 5.0 (d, $^3J_{H\text{-}P}$ 5.2, 1H, C*H*-N), 6.4, 6.5 (2d, $^2J_{H\text{-}P}$ 13.5, 1H, CH=C*H*-P), 7.5-8.48 (m, 10H, C*H*=CH-P, H-Ar) ppm; ^{13}C NMR ($CDCl_3$): δ = 16.4 (d, $^3J_{C\text{-}P}$ 6.4, H_3*C*C.OP), 60.7 (d, $^2J_{C\text{-}P}$ 37, H_2*C*O.P), 59.7 (d, $^3J_{C\text{-}P}$ 5.5, *C*H-N),107.0, 10.2, 117.1, 119.0, 121.7, 124.0, 124.3,127.8, 128.1, 133.3, 138.4, 153.4, 155.2, 157.5(*C*=*C*, phenyl), 178.4 (*C*=O) ppm; ^{31}P NMR ($CDCl_3$): δ = 12.2ppm; *m/z* (EI) = 401 [M^+] (13).

Reaction of 1 with cyanomethylenetriphenylphosphonium chloride (12): A preparation of compound 14

A stirred solution of 1g (3.5 mmol) 1 and 1.34g (4 mmol) of 12 in 30 ml THF was treated with 10 ml of aqueous LiOH solution (0.5M) and the mixture was heated under reflux for 8hr. The reaction mixture was worked up as described for the reaction 1+9, and separated by column chromatography, using n-hexane-AcOEt as eluents yielding compound 14.

3-[(4-chlorophenyl)amino]-3-(4-oxo-4H-chromen-3-yl)propanenitrile (14)

14 was obtained (7:3, v\v) as yellow crystals 58% m.p. 180-182 ºC (from CH_2Cl_2) (Found: C, 66.32; H, 3.99; Cl, 10.81; N, 8.42 $C_{18}H_{13}ClN_2O_2$ (324.77) requires C, 66.57; H, 4.03; Cl, 10.92; N, 8.63); IR (KBr): $\tilde{\nu}$ = 3260 (NH), 2200 (CN) cm^{-1}; ^1H NMR ($CDCl_3$): δ = 3.9,4.0 (2d, $J_{H\text{-}H}$ 6.8, 2H, CH_2-CN), 5.1 (t, $J_{H\text{-}H}$ 6.8, 1H, C*H*-CH_2), 6.6-8.2 (m, 9H, *H*-Ar), 9.4 (s,1H, N*H*) ppm; ^{13}C NMR ($CDCl_3$): δ = 23.3 (*C*H_2), 47.4 (*C*H), 114.6 (*C*N), 107.1, 110.7, 116.2, 117.0, 121.6, 121.8, 124.0, 127.8, 129.0, 133.3, 151.4, 155.3, 157.9 (*C*=*C*, phenyl), 180.3 (C=O) ppm; *m/z* (EI) = 324 [M^+] (16).

Reaction of 1 with allyltriphenylphophhonium bromide (15): A preparation of compound 17

A solution of 1.35g phophonium bromide 15 and 1g of chromone 1 in 30 ml THF was treated with 10 ml of aqueous LiOH (0.5M) for 1hr at room temperature, and then refluxed for 5hr. The reaction mixture was worked up as

described for the reaction 1+9 and separated by column chromatography using n-hexane-AcOEt as eluents yielding 17.

3-{1-[(4-chlorophenyl)amino]-2-methylprop-2-en-1-yl}-4H-chromen-4-one (17) was obtained (1:1, v/v) as yellow crystals 60% , m.p. 220-222 ºC (from CH_2Cl_2) (Found : C, 70.31; H, 5.01; Cl, 10.76; N, 4.52 $C_{19}H_{16}ClNO_2$ (325.79) requires: C, 70.05; H, 4.95; Cl, 10.88; N, 4.30); IR (KBr): $\tilde{\nu}$ = 1645 (C=O, ring), 3200 (NH) cm^{-1}; ^{1}H NMR ($CDCl_3$): δ = 1.9 (s, 3H, C*H*$_3$), 4.8, 5.1 (2d, $J_{H\text{-}H}$ 1.8, 2H, C*H*$_2$=C), 5.5 (s, 1H, C*H*-N), 6.5-8.2 (m, 9H, *H*-Ar), 9.3 (s,1H, N*H*) ppm; ^{13}C NMR ($CDCl_3$): δ = 23.0 (*C*H$_3$), 56.1 (*C*H), 109.3, 114.7, 116.2, 119.2, 120.5, 121.8, 124, 125.5, 128.7, 133.3, 150.7, 151.6, 152.6, 155.7 (*C*=*C*, phenyl), 181.7 (*C*=O) ppm; *m/z* (EI) = 325 [M^+] (21).

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دراسة تكميلية لنشاط ٣-p-كلوروفنيل-أمينوميثل كرومون نحو كواشف الفسفور

مها درويش خضر
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يعنى هذا البحث بدراسه مقارنه لسلوك نمطين من بعض كواشف فيتج وهورنر نحو ٣-p-كلوروفنيل-أمينوميثل كرومون (١) .

هذا وقد أمكن تشييد أنواع مختلفة من مشتقات الكرومين الفسفونيه لمركبات حلقيه غير متجانسه من بعض كواشف هورنر و البحث يعد إضافه جديدة لإمكانيه كواشف هورنر فى تشييد مركبات حلقيه غير متجانسه وتحتوى على مجموعة الفسفونات .

قدم البحث أيضا دراسه مقارنة لنتائج التفاعلات ونتائج سلوك كواشف فيتج المقابله نحو نفس المركب (١) وقد وجد تبانيا كبيرا فى النتائج رغم الإتفاق فى نقط الهجوم الأولى حيث تم الحصول على مشتقات الكرومين التى لا تحتوى على مجموعة الفسفونات وذلك فى اطار تحضير مركبات ذات فوائد إقتصادية (عقاقير) حيث أنه من المعروف أن الكرومون والكرومين ذات فوائد فارماكولجية .

قدمت ميكانيكية لشرح مسار التفاعلات البنائيه للمركبات بواسطة الأساليب المختلفه كما دعمت التركيبات التحليلية والطيفية المختلفة (IR, MS, ^{1}H , ^{13}C, ^{31}P, NMR) .