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# Green synthesis of novel phosphonate derivatives using ultrasonic irradiation

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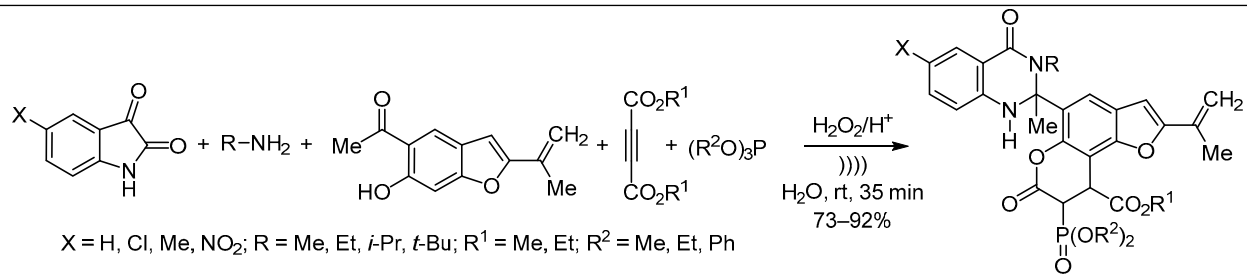



A novel and efficient procedure for the generation of quinazolinone phosphonate derivatives employing the reaction of euparin, isatin or its derivatives, primary amines, dialkyl acetylenedicarboxylates, trimethyl phosphite or triphenyl phosphite, and acidic solution of hydrogen peroxide in aqueous media at ambient temperature under ultrasonic irradiation was developed. Without ultrasonic irradiation, the reaction does not proceed and agitation of the reaction mixture is difficult. Some advantages of this procedure are: short time of reaction, high yields of products, easy isolation of products.

**Keywords**: euparin, isatin, primary amines, multicomponent reaction, ultrasonic irradiation.

Many diverse sonochemistry-based procedures have been developed recently.[1] Sonochemistry is as an original and valuable method attracting increasing interest for accelerating organic reactions.[2–5] Luche and coworkers have carried out a number of investigations which provided the basis for using sonochemistry in organic synthesis[6–9] offering significant features for organic reactions such as improvement of reaction rates, formation of pure products with high yields and easier process, energy saving, and waste decreasing when compared with traditional methods.[10,11] In our previous work,[12] we prepared phosphonate in $H_2O$ under conventional conditions at high temperature and with long reaction time, but under ultrasonic irradiation we managed to improve the course of the reaction in $H_2O$ in terms of chemoselectivity and economic issues.[12,13]

On the other hand, optically active phosphonates are valuable compounds,[14,15] displaying wide range of biological activity, including anti-influenza,[16] antipsoriatic,[17] antibiotic,[18] antibacterial,[19] enzyme inhibiting,[20] and herbicidal.[21–23] Many approaches to the synthesis of organophosphorus compounds exist and are described in current literarute.[24–31]

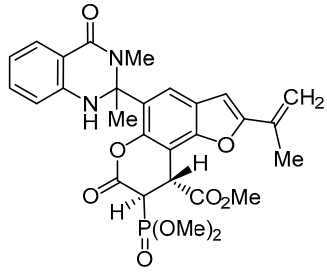
Another structural moiety that was targeted in this study was quinazolinone framework. Quinazolinones are important compounds with pharmacological and biological activities such as antifungal,[32] antibacterial,[33] and antitumor.[34] Because of these important properties, different procedures have been reported in literature for producing quinazolinone derivatives.[35–41]

Herein, in continuation of previous works[42,43] and our studies for discovering new synthetic methodologies, in this research, a series of novel phosphonate derivatives containing quinazolinone **6** were synthesized in excellent yields and short reaction time using the reaction of isatin or its derivatives **1**, primary amines **2**, euparin (**3**),[42] dialkyl acetylenedicarboxylates **4**, trimethyl phosphite or triphenyl phosphite **5** in the presence of acidic solution of hydrogen peroxide. Initially, for determination of the best conditions for generation of compound **6a**, the reaction of isatin **1a**, methylamine (**2a**), euparin (**3**),[42] dimethyl acetylenedicarboxylate (**4a**), and trimethyl phosphite (**5a**) in the

presence of acidic solution of $H_2O_2$ was selected as a model reaction (Table 1).[43]

Optimum conditions for the product **6a** generation were found by varying solvent and temperature. For this purpose, the model reaction was performed under conventional and ultrasonic irradiation conditions in $CH_2Cl_2$, MeCN, $CHCl_3$, $H_2O$, PhMe, DMF, and using solvent-free conditions (Table 1). Finally, excellent yields of compound **6a** were obtained in $H_2O$ under ultrasonic irradiation at room temperature as the best found conditions.

The structure of compound **6a** was confirmed by IR, $^1$H, $^{13}$C NMR, and mass spectral data. The $^1$H NMR spectrum of compound **6a** displays three singlets at 1.75, 2.15, and 2.56 ppm for methyl protons and one singlet at 3.69 ppm for methoxy protons. The methoxy groups of the phosphoranyl moiety are diastereotopic and display two doublets at 3.85 and 3.92 ppm. Two doublet doublets represent vicinal methine protons at 3.78 and 4.68 ppm. The NH group appeared at 6.23 ppm along with signals of aromatic moiety at lower fields. In the $^{13}$C NMR spectrum, the resonances related to 28 carbon atoms of compound **6a** appeared in agreement with the proposed structure. Observation of $^3J_{HH}$ = 11.6 Hz for the vicinal methine protons in compound **6a** indicates the dominance of *anti* arrangement (Fig. 1). Also, the observation of $^3J_{CP}$ of 22.5 Hz for the $CO_2Me$ group and $^3J_{CP}$ of zero for the C atom of benzene ring is in agreement with the (8*S*,9*S*)- or (8*R*,9*R*)-diastereoisomer.[27e,44]

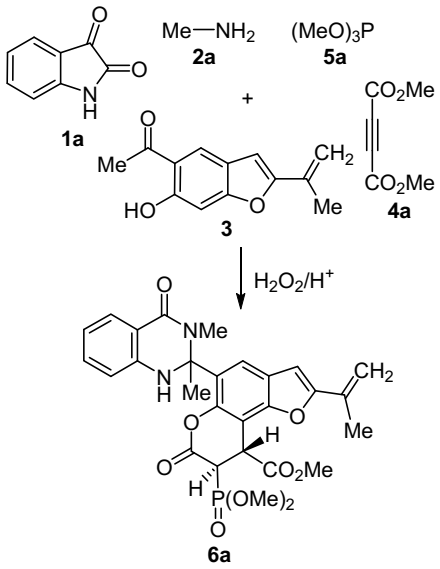



(8*S*,9*S*)-**6a** or (8*R*,9*R*)-**6a**

**Figure 1**. Diastereoisomer with *anti* HCCH arrangements.

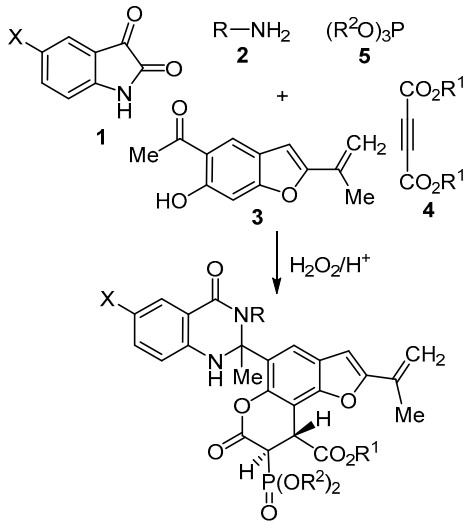
The next step after optimization of the synthesis of euparin-based quinazolinone **6a** was the synthesis of the number of its substituted derivatives **6b**–**n** (Table 2).

**Table 1**. Optimization of the reaction conditions for the synthesis of compound **6a**



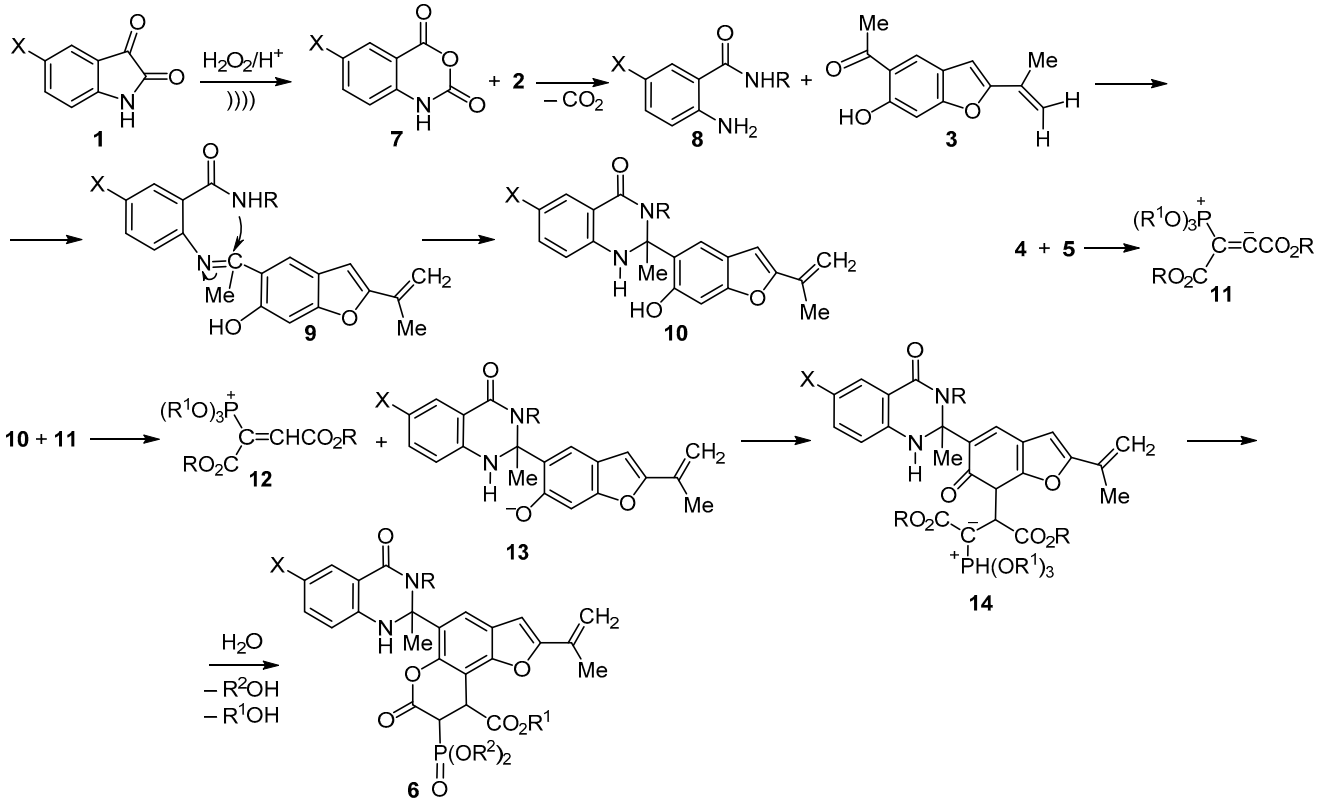

| Solvent | Temperature, °C | Conventional conditions | | Ultrasonic irradiation | |
|---|---|---|---|---|---|
| | | Time, h | Yield, % | Time, h | Yield, % |
| – | rt | 12 | – | 2 | 35 |
| **$H_2O$** | **rt** | **12** | **15** | **1** | **95** |
| MeCN | rt | 10 | 20 | 2 | 85 |
| PhMe | rt | 10 | 15 | 3 | 80 |
| $CH_2Cl_2$ | rt | 10 | 15 | 2 | 85 |
| $CHCl_3$ | rt | 12 | 20 | 2 | 90 |
| DMF | rt | 12 | – | 5 | 25 |
| – | 90 | 12 | – | 2 | 38 |
| $H_2O$ | 90 | 12 | 18 | 1 | 97 |
| MeCN | 90 | 10 | 24 | 2 | 88 |
| PhMe | 90 | 10 | 18 | 3 | 83 |
| $CH_2Cl_2$ | 90 | 10 | 19 | 2 | 87 |
| $CHCl_3$ | 90 | 12 | 19 | 2 | 92 |
| DMF | 90 | 12 | – | 5 | 28 |

**Table 2**. Green synthesis of euparin-based quinazolinones **6a**–**n** under ultrasonic irradiation




| Compound | R | $R^1$ | $R^2$ | X | Yield, % |
|---|---|---|---|---|---|
| **6a** | Me | Me | Me | H | 95 |
| **6b** | Et | Me | Me | H | 87 |
| **6c** | *t*-Bu | Me | Me | H | 85 |
| **6d** | *i*-Pr | Me | Me | H | 82 |
| **6e** | Me | Et | Me | H | 87 |
| **6f** | Me | Me | Ph | H | 80 |
| **6g** | Me | Me | Et | H | 85 |
| **6h** | Et | Me | Et | H | 87 |
| **6i** | *t*-Bu | Et | Ph | H | 73 |
| **6j** | Me | Me | Me | Me | 92 |
| **6k** | Et | Me | Me | Me | 90 |
| **6l** | *t*-Bu | Me | Me | $NO_2$ | 85 |
| **6m** | *i*-Pr | Me | Me | Cl | 87 |
| **6n** | Me | Me | Ph | Me | 87 |

**Scheme 1**. Proposed mechanism for the formation of compounds **6**

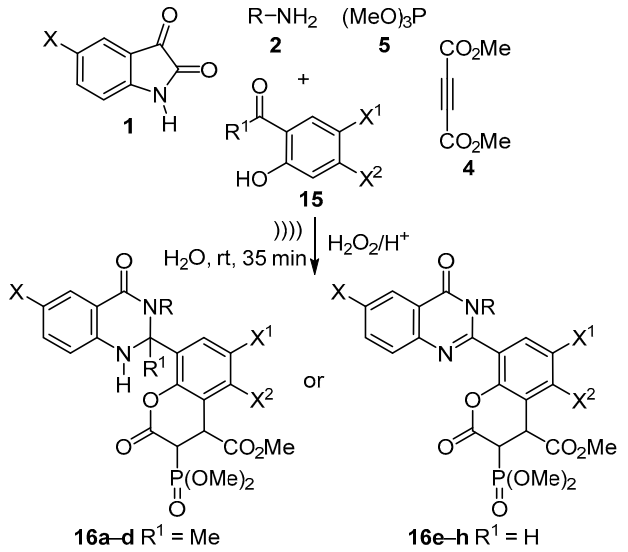


The putative mechanism of the reaction is shown in Scheme 1. According to the proposed mechanism, isatin **1** undergoes Baeyer–Villiger oxidation with $H_2O_2$ in acidic solution under ultrasonic irradiation to produce isatoic anhydride **7**. Isatoic anhydride **7** and primary amines **2** react to generate anthranilamide **8** with elimination of $CO_2$. Condensation of euparin (**3**)[42] with intermediate **8** produces quinazolinone **10** with intermediacy of imine **9** under ultrasonic irradiation. It should be noted that intramolecular cyclization does not proceed without ultrasonic irradiation. According to the known chemistry of phosphorus nucleophiles,[45,46] the addition of phosphite **5** to activated acetylenic compounds **4** produces compound **11** that deprotonate quinazolinone **10** to generate intermediates **12** and **13**. Further Michael addition of phenolate anion **13** to vinylphosponium salt **12**, cyclization of intermediate **14**, and hydrolysis of quasiphosphonium salt completes the formation of final product **6**.

Under similar conditions, a series of novel phosphonate derivatives containing quinazolinone framework **16** were synthesized by the reaction of isatins **1**, primary amines **2**, 2'-hydroxyacetophenones or salicylaldehydes **15**, dialkyl acetylenedicarboxylates **4**, trimethyl phosphite or triphenyl phosphite **5** in the presence of acidic solution of hydrogen peroxide at ambient temperature under ultrasonic irradiation in excellent yields and short reaction time (Table 3).

The structures of compounds **16** were confirmed by IR, $^1$H, $^{13}$C NMR, and mass spectral data. For example, the $^1$H NMR spectrum of compound **16a** showed two singlets at 1.65 and 2.58 ppm for methyl protons and one singlet at 3.75 ppm for methoxy protons. Two methoxy groups of the phosphoranyl moiety are diastereotopic and showed two

**Table 3**. Green synthesis of quinazolinone phosphonate derivatives **16a**–**h**



| Compound | R | $R^1$ | X | $X^1$ | $X^2$ | Yield, % |
|---|---|---|---|---|---|---|
| **16a** | Me | Me | H | H | H | 97 |
| **16b** | Et | Me | H | MeO | H | 95 |
| **16c** | *t*-Bu | Me | Me | MeO | H | 95 |
| **16d** | *i*-Pr | Me | $NO_2$ | H | Me | 90 |
| **16e** | Me | H | H | H | H | 97 |
| **16f** | Et | H | H | MeO | H | 95 |
| **16g** | *t*-Bu | H | Me | MeO | H | 95 |
| **16h** | *i*-Pr | H | $NO_2$ | H | MeO | 90 |

doublets at 3.87 and 3.93 ppm. Two doublet doublets represent vicinal methine protons at 3.83 and 4.72 ppm. The NH group appeared at 6.18 ppm along with signals for aromatic moiety. In the $^{13}$C NMR spectrum of compound **16a**, the resonances related to three carbonyl groups appeared at 160.3 (C=O), 161.3 (d, $^{2}J_{PC}$ = 6.8 Hz, C=O), 167.5 ppm (d, $^{3}J_{PC}$ = 22.5 Hz, C=O).

$^{1}$H NMR spectrum of compound **16e** exhibited two singlets at 3.48 and 3.75 ppm for NMe and methoxy protons, respectively. The methoxy groups of the phosphoranyl moiety are diastereotopic because of stereogenic center and display two doublets at 3.89 and 3.95 ppm and two doublet doublets for vicinal methine protons at 3.83 and 4.74 ppm along with signals for aromatic moiety. In the $^{13}$C NMR spectrum of compound **16e**, the resonances related to three carbonyl group appeared at 160.5, 161.6, 168.2 ppm.

In conclusion, in this research we described green, one-pot procedure for the synthesis of novel quinazolinone phosphonate derivatives starting from isatins, primary amine, euparin, 2-hydroxyacetophenone or its derivatives, 2-hydroxybenzaldehyde or its derivatives, activated acetylenic compounds, and trimethyl phosphite or triphenyl phosphite in the presence of acidic solution of $H_2O_2$ in water at room temperature under ultrasonic irradiation. This transformation proceeds only under ultrasonic irradiation and features excellent yields, short reaction time, high atom economy, and mild reaction conditions.

## Experimental

IR spectra were recorded on a Shimadzu IR-460 spectrometer in KBr pellets. $^{1}$H, $^{13}$C, and $^{31}$P NMR spectra were recorded on a Bruker Avance DRX-500 spectrometer (500, 126, and 202 MHz, respectively) in $CDCl_3$ solutions using TMS as internal standard or 85 mass % $H_3PO_4$ as external standard. The electron ionization mass spectra were recorded on a Finnigan MAT-8430 spectrometer operating at an ionization potential of 70 eV. The elemental analyses were performed on a Heraeus CHNO-Rapid analyzer. Melting points were measured on Electrothermal 9100 apparatus.

All the chemicals used in this work were purchased from Fluka (Buchs, Switzerland) and used without further purification.

**Preparation of 1-(6-hydroxy-2-isopropenyl-1-benzofuranyl)-1-ethanone (3)**. Dry, powdered rhizomes of *Petasites hybridus* (950 g) were extracted with THF–MeOH, 1:1 mixture. Evaporation of the solvent under reduced pressure and washing with cold $Et_2O$ gave euparin (**3**) as yellow solid.

**Synthesis of compounds 6a–n, 16a–h** (General method). A mixture of 1*H*-indole-2,3-dione **1** (2 mmol), AcOH (1 ml), 5 drops of concentrated $H_2SO_4$ and 20% (wt%) $H_2O_2$ were sonicated at room temperature for 10 min in a beaker equipped with ultrasonic probe under the power of 60 W. After 10 min, anhydrous primary amine **2** (2 mmol) was added. After 5 min, 1-(6-hydroxy-2-isopropenyl-1-benzofuranyl)-1-ethanone (euparin) (**3**) (2 mmol), or 1-(2-hydroxyphenyl)ethanone, or 2-hydroxybenzaldehyde **15** was added under ultrasonic irradiation. Dialkyl acetylenedicarboxylate **4** (2 mmol) and trimethyl phosphite or triphenyl phosphite **5** (2 mmol) were added after 10 min. Reaction completion at every stage was monitored by TLC employing 5:1 EtOAc–*n*-hexane as an eluent. After completion of the procedure, formed precipitate was filtered off and washed with $Et_2O$ to afford pure title compound **6a–n** or **16a–h**.

**Methyl (8*R*,9*R*)-8-(dimethoxyphosphoryl)-5-(2,3-dimethyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6a)**. Yield 1.04 g (95%), yellow powder, mp 193–195°C. IR spectrum, ν, cm$^{-1}$: 1742, 1738, 1695, 1625, 1585, 1468, 1375, 1294. $^{1}$H NMR spectrum, δ, ppm (*J*, Hz): 1.75 (3H, s, $CH_3$); 2.15 (3H, s, $CH_3$); 2.56 (3H, s, $CH_3$); 3.69 (3H, s, C(O)O$CH_3$); 3.78 (1H, dd, $^{2}J_{HP}$ = 19.8, $^{3}J_{HH}$ = 11.6, PCH); 3.85 (3H, d, $^{3}J_{HP}$ = 11.5, $CH_3$OP); 3.92 (3H, d, $^{3}J_{HP}$ = 11.5, $CH_3$OP); 4.68 (1H, dd, $^{3}J_{HH}$ = 11.6, $^{3}J_{HP}$ = 9.5, PCCH); 4.75 (1H, d, $^{2}J$ = 4.2, C=CH); 5.12 (1H, d, $^{2}J$ = 4.2, C=CH); 6.23 (1H, s, NH); 6.95 (1H, d, $^{3}J_{HH}$ = 7.8, H Ar); 7.15 (1H, t, $^{3}J_{HH}$ = 7.8, H Ar); 7.23 (1H, t, $^{3}J_{HH}$ = 7.8, H Ar); 7.43 (1H, s, H Ar); 7.52 (1H, s, H Ar); 7.93 (1H, d, $^{3}J_{HH}$ = 7.8, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 18.5; 25.3; 34.2; 42.3 (d, $^{2}J_{PC}$ = 9.3); 46.3 (d, *J* = 143.2); 51.2 (d, *J* = 8.7); 52.4 (d, $^{2}J_{PC}$ = 8.7); 52.8; 76.4; 105.2; 113.2; 114.2; 114.8; 121.6; 122.3; 122.4; 124.3; 125.2; 127.4; 133.6; 137.6; 142.3; 151.8; 152.3; 154.3; 160.3; 161.3 (d, *J* = 6.8); 167.5 (d, *J* = 22.5). $^{31}$P NMR spectrum, δ, ppm: 19.6. Mass spectrum, *m*/*z* ($I_{rel}$, %): 568 [M]$^{+}$ (10), 537 (92), 31 (100). Found, %: C 59.34; H 5.28; N 5.14. $C_{28}H_{29}N_2O_9P$. Calculated, %: C 59.16; H 5.14; N 4.93.

**Methyl (8*R*,9*R*)-8-(dimethoxyphosphoryl)-5-(3-ethyl-2-methyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6b)**. Yield 1.01 g (87%), yellow powder, mp 201–203°C. IR spectrum, ν, cm$^{-1}$: 1739, 1735, 1697, 1635, 1587, 1475, 1382, 1293. $^{1}$H NMR spectrum, δ, ppm (*J*, Hz): 1.25 (3H, t, $^{3}J_{HH}$ = 7.3, $CH_2C\underline{H}_3$); 1.73 (3H, s, $CH_3$); 2.16 (3H, s, $CH_3$); 2.75–2.83 (1H, m, CH); 3.12–3.22 (1H, m, CH); 3.75 (3H, s, C(O)O$CH_3$); 3.82 (1H, dd, $^{2}J_{HP}$ = 19.5, $^{3}J_{HH}$ = 11.5, PCH); 3.89 (3H, d, $^{3}J_{HP}$ = 11.7, $CH_3$OP); 3.95 (3H, d, $^{3}J_{HP}$ = 11.7, $CH_3$OP); 4.74 (1H, dd, $^{3}J_{HP}$ = 10.2, $^{3}J_{HH}$ = 11.5, PCCH); 4.83 (1H, d, $^{2}J$ = 4.5, C=CH); 5.23 (1H, d, $^{2}J$ = 4.5, C=CH); 6.18 (1H, s, NH); 7.02 (1H, d, $^{3}J_{HH}$ = 7.6, H Ar); 7.18 (1H , t, $^{3}J_{HH}$ = 7.6, H Ar); 7.28 (1H, t, $^{3}J_{HH}$ = 7.6, H Ar); 7.47 (1H, s, H Ar); 7.54 (1H, s, H Ar); 7.87 (1H, d, $^{3}J_{HH}$ = 7.6, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 14.2; 18.7; 25.4; 40.2; 42.5 (d, *J* = 9.7); 45.8 (d, *J* = 145.2); 51.2 (d, *J* = 9.2); 52.5 (d, *J* = 9.2); 53.4; 76.5; 106.2; 113.5; 114.3; 114.5; 121.7; 122.5; 122.9; 124.2; 125.3; 127.6; 132.8; 137.5; 142.4; 151.6; 152.6; 154.5; 160.5; 161.7 (d, *J* = 7.3); 168.2 (d, *J* = 22.4). $^{31}$P NMR spectrum, δ, ppm: 20.3. Mass spectrum, *m*/*z* ($I_{rel}$, %): 582 [M]$^{+}$ (15), 551 (86), 31 (100). Found, %: C 59.93; H 5.52; N 4.96. $C_{29}H_{31}N_2O_9P$. Calculated, %: C 59.79; H 5.36; N 4.81.

**Methyl (8*R*,9*R*)-5-[3-(*tert*-butyl)-2-methyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl]-8-(dimethoxyphosphoryl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6c)**. Yield 1.04 g (85%), yellow powder, mp 215–217°C. IR spectrum, ν, cm$^{-1}$: 1740, 1737, 1698, 1642, 1576, 1478, 1376, 1284. $^{1}$H NMR spectrum, δ, ppm

(*J*, Hz): 1.16 (9H, s, $C(CH_3)_3$); 1.68 (3H, s, $CH_3$); 2.18 (3H, s, $CH_3$); 3.72 (3H, s, $C(O)OCH_3$); 3.83 (1H, dd, $^2J_{HP}$ = 20.4, $^3J_{HH}$ = 12.2, PCH); 3.87 (3H, d, $^3J_{HP}$ = 11.8, $CH_3OP$); 3.95 (3H, d, $^3J_{HP}$ = 11.8, $CH_3OP$); 4.73 (1H, d, $^2J_{HH}$ = 4.7, C=CH); 4.86 (1H, dd, $^3J_{HH}$ = 12.2, $^3J_{HP}$ = 9.8, PCCH); 5.15 (1H, d, $^2J_{HH}$ = 4.7, C=CH); 6.25 (1H, s, NH); 7.04 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.18 (1H , t, $^3J_{HH}$ = 7.6, H Ar); 7.25 (1H, t, $^3J_{HH}$ = 7.7, H Ar); 7.45 (1H, s, H Ar); 7.56 (1H, s, H Ar); 8.02 (1H, d, $^3J_{HH}$ = 7.7, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 18.6; 27.5; 31.4; 42.7 (d, *J* = 10.2); 47.4 (d, *J* = 147.3); 51.5 (d, *J* = 9.5); 52.3 (d, *J* = 9.5); 52.8; 62.3; 77.4; 113.3; 114.2; 114.5; 115.3; 116.3; 123.2; 123.6; 124.5; 125.8; 127.6; 134.3; 137.2; 142.5; 152.3; 152.8; 154.8; 160.8; 161.6 (d, *J* = 6.5); 169.4 (d, *J* = 21.8). $^{31}$P NMR spectrum, δ, ppm: 21.6. Mass spectrum, *m/z* ($I_{rel}$, %): 610 $[M]^+$ (10), 553 (86), 57 (100), 31 (100). Found, %: C 61.16; H 5.89; N 4.78. $C_{31}H_{35}N_2O_9P$. Calculated, %: C 60.98; H 5.78; N 4.59.

**Methyl (8*R*,9*R*)-8-(dimethoxyphosphoryl)-2-isopropenyl-5-(3-isopropyl-2-methyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6d)**. Yield 0.98 g (82%), yellow powder, mp 209–211°C. IR spectrum, ν, $cm^{-1}$: 1738, 1736, 1695, 1658, 1586, 1484, 1375, 1293. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.12 (6H, d, $^3J_{HH}$ = 6.7, $2CH_3$); 1.76 (3H, s, $CH_3$); 2.16 (3H, s, $CH_3$); 3.68 (3H, s, $C(O)OCH_3$); 3.74–3.85 (2H, m, 2CH); 3.89 (3H, d, $^3J_{HP}$ = 12.2, $CH_3OP$); 3.96 (3H, d, $^3J_{HP}$ = 12.2, $CH_3OP$); 4.75 (1H, d, $^2J$ = 4.8, C=CH); 4.87 (1H, dd, $^3J_{HH}$ = 12.0, $^3J_{HP}$ = 10.3, PCCH); 5.09 (1H, d, $^2J$ = 4.8, C=CH); 6.22 (1H, s, NH); 7.08 (1H, d, $^3J_{HH}$ = 7.5, H Ar); 7.23 (1H, t, $^3J_{HH}$ = 7.5, H Ar); 7.32 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.48 (1H, s, H Ar); 7.62 (1H, s, H Ar); 8.04 (1H, d, $^3J_{HH}$ = 7.6, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 18.5; 22.4; 26.4; 42.3 (d, *J* = 10.5); 43.5; 47.6 (d, *J* = 148.6); 51.7 (d, *J* = 10.2); 52.5 (d, *J* = 10.2); 53.2; 76.2; 105.3; 113.3; 114.3; 114.7; 121.4; 122.2; 122.5; 125.4; 125.8; 127.4; 133.6; 137.2; 142.2; 151.8; 153.2; 154.4; 161.2; 162.3 (d, *J* = 6.7); 170.3 (d, *J* = 22.3). $^{31}$P NMR spectrum, δ, ppm: 22.3. Mass spectrum, *m/z* ($I_{rel}$, %): 596 $[M]^+$ (15), 565 (84), 31(100). Found, %: C 60.58; H 5.74; N 4.86. $C_{30}H_{33}N_2O_9P$. Calculated, %: C 60.40; H 5.58; N 4.70.

**Ethyl (8*R*,9*R*)-8-(dimethoxyphosphoryl)-5-(2,3-dimethyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6e)**. Yield 1.01 g (87%), yellow powder, mp 186–188°C. IR spectrum, ν, $cm^{-1}$: 1740, 1737, 1698, 1634, 1587, 1476, 1378, 1297. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.23 (3H, t, $^3J_{HH}$ = 7.4, $CH_2C\underline{H}_3$); 1.72 (3H, s, $CH_3$); 2.18 (3H, s, $CH_3$); 2.48 (3H, s, $CH_3$); 3.75 (1H, dd, $^2J_{HP}$ = 19.5, $^3J_{HH}$ = 11.6, PCH); 3.83 (3H, d, $^3J_{HP}$ = 11.3, $CH_3OP$); 3.87 (3H, d, $^3J_{HP}$ = 11.3, $CH_3OP$); 4.12 (2H, q, $^3J_{HH}$ = 7.4, $CH_3C\underline{H}_2O$); 4.65 (1H, dd, $^3J_{HH}$ = 11.6, $^3J_{HP}$ = 9.8, PCCH); 4.78 (1H, d, $^2J_{HH}$ = 3.8, C=CH); 5.16 (1H, d, $^2J_{HH}$ = 3.8, C=CH); 6.16 (1H, s, NH), 6.92 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.12 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.24 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.38 (1H, s, H Ar); 7.43 (1H, s, H Ar); 7.87 (1H, d, $^3J_{HH}$ = 7.6, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 14.2; 18.3; 24.8; 34.5; 42.5 (d, *J* = 9.7); 46.8 (d, *J* = 147.4); 51.3 (d, *J* = 9.2); 52.3 (d, *J* = 9.2); 61.2; 78.3; 105.4; 112.8; 113.6; 114.2; 121.3; 122.5; 125.3; 125.8; 127.3; 133.2; 137.2; 142.5; 151.6; 153.4; 154.4; 160.5; 161.8 (d, *J* = 7.3); 168.4 (d, *J* = 21.8). $^{31}$P NMR spectrum, δ, ppm: 19.8. Mass spectrum, *m/z* ($I_{rel}$, %): 582 $[M]^+$ (15), 537 (76), 45 (100). Found, %: C 59.93; H 5.52; N 4.96. $C_{29}H_{31}N_2O_9P$. Calculated, %: C 59.79; H 5.36; N 4.81.

**Methyl (8*R*,9*R*)-5-(2,3-dimethyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-8-(diphenoxyphosphoryl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6f)**. Yield 1.07g (80%), pale-yellow powder, mp 216–218°C. IR spectrum, ν, $cm^{-1}$: 1745, 1742, 1698, 1667, 1589, 1486, 1385, 1297. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.65 (3H, s, $CH_3$); 2.14 (3H, s, $CH_3$); 2.48 (3H, s, $CH_3$); 3.68 (3H, s, $C(O)OCH_3$); 4.25 (1H, dd, $^2J_{HP}$ = 19.5, $^3J_{HH}$ = 11.8, PCH); 4.86 (1H, dd, $^3J_{HH}$ = 11.8, $^3J_{HP}$ = 10.4, PCCH); 4.93 (1H, d, $^2J_{HH}$ = 4.8, C=CH); 5.23 (1H, d, $^2J_{HH}$ = 4.8, C=CH); 6.32 (1H, s, NH); 6.86 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.12 (2H, d, $^3J_{HH}$ = 7.5, H Ar); 7.16 (2H, d, $^3J_{HH}$ = 7.5, H Ar); 7.22 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.28 (1H, t, $^3J_{HH}$ = 7.5, H Ar); 7.32 (1H, t, $^3J_{HH}$ = 7.5, H Ar); 7.37 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.42 (2H, t, $^3J_{HH}$ = 7.5, H Ar); 7.48 (2H, t, $^3J_{HH}$ = 7.5, H Ar); 7.52 (1H, s, H Ar); 7.58 (1H, s, H Ar); 7.96 (1H, d, $^3J_{HH}$ = 7.6, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 18.7; 24.6; 34.5; 37.8 (d, *J* = 9.6); 40.2 (d, *J* = 158.3); 51.6; 77.8; 107.2; 113.4; 114.2; 115.3; 120.5 (d, *J* = 23.4); 121.6 (d, *J* = 23.4); 122.5; 123.2; 123.5; 125.3; 125.8; 126.3; 127.4; 128.3; 128.8; 133.5; 137.5; 142.6; 151.3 (d, *J* = 10.4); 151.8 (d, *J* = 10.4); 152.2; 153.6; 154.5; 159.4; 160.8 (d, *J* = 7.3); 165.6 (d, *J* = 22.8). $^{31}$P NMR spectrum, δ, ppm: 19.6. Mass spectrum, *m/z* ($I_{rel}$, %): 692 $[M]^+$ (10), 661 (68), 31 (100). Found, %: C 66.04; H 4.95; N 4.22. $C_{38}H_{33}N_2O_9P$. Calculated, %: C 65.89; H 4.80; N 4.04.

**Methyl (8*R*,9*R*)-8-(diethoxyphosphoryl)-5-(2,3-dimethyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6g)**. Yield 1.01 g (85%), yellow powder, mp 198–200°C. IR spectrum, ν, $cm^{-1}$: 1739, 1737, 1696, 1647, 1587, 1465, 1376, 1297. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.18 (3H, t, $^3J_{HH}$ = 7.4, $OCH_2C\underline{H}_3$); 1.23 (3H, t, $^3J_{HH}$ = 7.4, $OCH_2C\underline{H}_3$); 1.72 (3H, s, $CH_3$); 2.16 (3H, s, $CH_3$); 2.47 (3H, s, $CH_3$); 3.68 (3H, s, $C(O)OCH_3$); 3.82 (1H, dd, $^2J_{HP}$ = 20.4, $^3J_{HH}$ = 12.3, PCH); 3.92–4.05 (2H, m, $OC\underline{H}_2CH_3$); 4.12–4.22 (2H, m, $OC\underline{H}_2C\underline{H}_3$); 4.87 (1H, dd, $^3J_{HH}$ = 12.3, $^3J_{HP}$ = 10.3, PCCH); 4.93 (1H, d, $^2J_{HH}$ = 5.4, C=CH); 5.16 (1H, d, $^2J_{HH}$ = 5.4, C=CH); 6.28 (1H, s, NH); 7.08 (1H, d, $^3J_{HH}$ = 7.7, H Ar); 7.16 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.26 (1H, t, $^3J_{HH}$ = 7.5, H Ar); 7.52 (1H, s, H Ar); 7.63 (1H, s, H Ar); 8.04 (1H, d, $^3J_{HH}$ = 7.6, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 15.2 (d, *J* = 8.2); 16.4 (d, *J* = 8.2); 18.7; 24.8; 34.7; 42.5 (d, *J* = 9.8); 47.2 (d, *J* = 156.4); 51.4; 62.4 (d, *J* = 9.3); 63.2 (d, *J* = 9.3); 77.3; 105.6; 113.4; 113.8; 114.2; 122.3; 123.4; 123.8; 124.8; 125.6; 127.6; 133.8; 137.2; 142.6; 152.3; 153.4; 154.5; 161.2; 162.4 (d, *J* = 6.5); 168.2 (d, *J* = 21.8). $^{31}$P NMR spectrum, δ, ppm: 20.3. Mass spectrum, *m/z* ($I_{rel}$, %): 596 $[M]^+$ (15), 551 (68), 45 (100), 31 (100). Found, %: C 60.58; H 5.76; N 4.87. $C_{30}H_{33}N_2O_9P$. Calculated, %: C 60.40; H 5.58; N 4.70.

**Ethyl (8*R*,9*R*)-8-(diethoxyphosphoryl)-5-(2,3-dimethyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate**

**(6h)**. Yield 1.06 g (87%), yellow powder, mp 203–205°C. IR spectrum, ν, $cm^{-1}$: 1745, 1739, 1698, 1652, 1583, 1468, 1386, 1295. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.15 (3H, t, $^3J_{HH}$ = 7.4, $OCH_2C\underline{H}_3$); 1.25 (3H, t, $^3J_{HH}$ = 7.4, $OCH_2C\underline{H}_3$); 1.34 (3H, t, $^3J_{HH}$ = 7.5, $NCH_2C\underline{H}_3$); 1.78 (3H, s, $CH_3$); 2.14 (3H, s, $CH_3$); 2.45–2.58 (2H, m, $NC\underline{H}_2CH_3$); 3.72 (3H, s, $C(O)OCH_3$); 3.84 (1H, dd, $^2J_{HP}$ = 19.4, $^3J_{HH}$ = 11.2, PCH); 3.95–4.09 (2H, m, $OC\underline{H}_2CH_3$); 4.15–4.26 (2H, m, $OC\underline{H}_2CH_3$); 4.65 (1H, dd, $^3J_{HH}$ = 11.2, $^3J_{HP}$ = 10.5, PCCH); 4.84 (1H, d, $^2J_{HH}$ = 5.8, C=CH); 5.03 (1H, d, $^2J_{HH}$ = 5.8, C=CH); 6.32 (1H, s, NH); 7.02 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.15 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.32 (1H, t, $^3J_{HH}$ = 7.5, H Ar); 7.46 (1H, s, H Ar); 7.58 (1H, s, H Ar); 7.89 (1H, d, $^3J_{HH}$ = 7.6, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 14.2; 14.8 (d, *J* = 9.4); 15.6 (d, *J* = 9.4); 18.6; 25.4; 40.2; 41.6 (d, *J* = 11.2); 47.5 (d, *J* = 155.8); 51.6; 61.8 (d, *J* = 9.8); 62.6 (d, *J* = 9.8); 76.3; 106.4; 113.6; 114.3; 114.8; 121.4; 122.3; 123.2; 124.8; 125.8; 128.2; 133.4; 137.6; 143.2; 151.6; 152.8; 154.3; 160.8; 161.6 (d, *J* = 8.3); 169.4 (d, *J* = 22.3). $^{31}$P NMR spectrum, δ, ppm: 23.4. Mass spectrum, *m/z* ($I_{rel}$, %): 610 $[M]^+$ (10), 565 (54), 45 (100), 31 (100). Found, %: C 60.63; H 5.92; N 4.76. $C_{31}H_{35}N_2O_9P$. Calculated, %: C 60.48; H 5.78; N 4.59.

**Ethyl (8*R*,9*R*)-5-[3-(*tert*-butyl)-2-methyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl]-8-(diphenoxyphosphoryl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6i)**. Yield 1.09 g (73%), pale-yellow powder, mp 221–223°C. IR spectrum, ν, $cm^{-1}$: 1742, 1738, 1697, 1675, 1587, 1487, 1387, 1295. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.23 (9H, s, $(CH_3)_3C$); 1.28 (3H, t, $^3J_{HH}$ = 7.4, $OCH_2C\underline{H}_3$); 1.67 (3H, s, $CH_3$); 2.15 (3H, s, $CH_3$); 4.12 (2H, q, $^3J_{HH}$ = 7.4, $OC\underline{H}_2C\underline{H}_3$); 4.27 (1H, dd, $^2J_{HP}$ = 19.8, $^3J_{HH}$ = 12.0, PCH); 4.90 (1H, dd, $^3J_{HH}$ = 12.0, $^3J_{HP}$ = 10.7, PCCH); 4.97 (1H, d, $^2J_{HH}$ = 4.2, C=CH); 5.28 (1H, d, $^2J_{HH}$ = 4.2, C=CH); 6.25 (1H, s, NH); 6.86 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.14 (2H, d, $^3J_{HH}$ = 7.6, H Ar); 7.18 (2H, d, $^3J_{HH}$ = 7.5, H Ar); 7.22 (1H, t, $^3J_{HH}$ = 7.5, H Ar); 7.28 (1H, t, $^3J_{HH}$ = 7.5, H Ar); 7.33 (1H, t, $^3J_{HH}$ = 7.5, H Ar); 7.42 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.48 (2H, t, $^3J_{HH}$ = 7.5, H Ar); 7.52 (2H, t, $^3J_{HH}$ = 7.5, H Ar); 7.63 (1H, s, H Ar); 7.68 (1H, s, H Ar); 8.12 (1H, d, $^3J_{HH}$ = 7.6, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 14.2; 18.5; 26.8; 31.2; 38.2 (d, *J* = 11.4); 41.2 (d, *J* = 156.7); 60.3; 62.3; 77.2; 113.5; 114.3; 115.2; 116.3; 117.3; 120.7 (d, *J* = 22.8); 121.5 (d, *J* = 22.8); 123.4; 123.8; 125.3; 125.8; 126.3; 126.8; 127.6; 128.2; 128.6; 134.2; 137.6; 142.8; 151.6 (d, *J* = 10.8); 152.3 (d, *J* = 10.8); 152.6; 153.6; 154.2; 159.6; 161.2 (d, *J* = 7.8); 168.4 (d, *J* = 21.7). $^{31}$P NMR spectrum, δ, ppm: 22.6. Mass spectrum, *m/z* ($I_{rel}$, %): 748 $[M]^+$ (10), 691 (64), 57 (100). Found, %: C 67.53; H 5.73; N 3.92. $C_{42}H_{41}N_2O_9P$. Calculated, %: C 67.37; H 5.52; N 3.74.

**Methyl (8*R*,9*R*)-8-(dimethoxyphosphoryl)-5-(2,3,6-trimethyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6j)**. Yield 1.07 g (92%), yellow powder, mp 201–203°C. IR spectrum, ν, $cm^{-1}$: 1743, 1737, 1697, 1648, 1574, 1478, 1364, 1285. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.65 (3H, s, $CH_3$); 2.17 (3H, s, $CH_3$); 2.36 (3H, s, $CH_3$); 2.63 (3H, s, $CH_3$); 3.75 (3H, s, $C(O)OCH_3$); 3.83 (1H, dd, $^2J_{HP}$ = 19.5, $^3J_{HH}$ = 11.7, PCH); 3.87 (3H, d, $^3J_{HP}$ = 11.7, $CH_3OP$); 3.95 (3H, d, $^3J_{HP}$ = 11.7, $CH_3OP$); 4.72 (1H, dd, $^3J_{HH}$ = 10.2, $^3J_{HP}$ = 8.7, PCCH); 4.83 (1H, d, $^2J_{HH}$ = 3.8, C=CH); 5.16 (1H, d, $^2J_{HH}$ = 3.8, C=CH); 6.28 (1H, s, NH); 7.02 (1H, d, $^3J_{HH}$ = 7.8, H Ar); 7.24 (1H, d, $^3J_{HH}$ = 7.8, H Ar); 7.45 (1H, s, H Ar); 7.58 (1H, s, H Ar); 7.95 (1H, s, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 18.6; 21.2; 25.4; 34.5; 42.5 (d, *J* = 9.5); 46.4 (d, *J* = 144.7); 51.3 (d, *J* = 8.6); 52.5 (d, *J* = 8.6); 53.2; 76.5; 105.3; 113.4; 114.3; 115.3; 121.6; 122.5; 122.7; 123.4; 124.4; 127.6; 133.7; 137.8; 142.5. $^{31}$P NMR spectrum, δ, ppm: 19.8. Mass spectrum, *m/z* ($I_{rel}$, %): 582 $[M]^+$ (10), 551 (86), 31 (100). Found, %: C 59.92; H 5.52; N 4.97. $C_{29}H_{31}N_2O_9P$. Calculated, %: C 59.79; H 5.36; N 4.81.

**Methyl (8*R*,9*R*)-8-(dimethoxyphosphoryl)-5-(3-ethyl-2,6-dimethyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6k)**. Yield 1.07 g (90%), yellow powder, mp 207–209°C. IR spectrum, ν, $cm^{-1}$: 1742, 1736, 1698, 1637, 1589, 1482, 1387, 1295. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.27 (3H, t, $^3J_{HH}$ = 7.4, $CH_2C\underline{H}_3$); 1.75 (3H, s, $CH_3$); 2.16 (3H, s, $CH_3$); 2.35 (3H, s, $CH_3$); 2.76–2.85 (1H, m, $CH_3C\underline{H}_2$); 3.13–3.27 (1H, m, $CH_3C\underline{H}_2$); 3.78 (3H, s, $C(O)OCH_3$); 3.83 (1H, dd, $^2J_{HP}$ = 19.7, $^3J_{HH}$ = 11.5, PCH); 3.92 (3H, d, $^3J_{HP}$ = 11.5, $CH_3OP$); 3.96 (3H, d, $^3J_{HP}$ = 11.5, $CH_3OP$); 4.75 (1H, dd, $^3J_{HH}$ = 11.6, $^3J_{HP}$ = 10.3, PCCH); 4.85 (1H, d, $^2J_{HH}$ = 4.7, C=CH); 5.26 (1H, d, $^2J_{HH}$ = 4.7, C=CH); 6.22 (1H, s, NH); 7.12 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.28 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.49 (1H, s, H Ar); 7.56 (1H, s, H Ar); 7.93 (1H, s, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 14.2; 18.6, 22.4; 25.6; 40.5; 42.7 (d, $^2J_{PC}$ = 9.8); 45.9 (d, $^1J_{PC}$ = 145.3); 51.4 (d, *J* = 9.3); 52.6 (d, *J* = 9.3); 53.5; 76.7; 106.3; 113.7; 114.2; 114.7; 121.9; 122.6; 123.2; 123.8; 124.5; 127.5; 131.6; 137.4; 142.3; 151.4; 152.2; 154.7; 160.7; 161.6 (d, *J* = 6.8); 168.4 (d, *J* = 22.5). $^{31}$P NMR spectrum, δ, ppm: 21.2. Mass spectrum, *m/z* ($I_{rel}$, %): 596 $[M]^+$ (15), 565 (84), 31 (100). Found, %: C 60.52; H 5.73; N 4.85. $C_{30}H_{33}N_2O_9P$. Calculated, %: C 60.40; H 5.58; N 4.70.

**Methyl (8*R*,9*R*)-5-[3-(*tert*-butyl)-2-methyl-6-nitro-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl]-8-(dimethoxyphosphoryl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6l)**. Yield 1.11 g (85%), yellow powder, mp 222–224°C. IR spectrum, ν, $cm^{-1}$: 1739, 1735, 1685, 1656, 1578, 1486, 1383, 1292. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.18 (9H, s, $C(CH_3)_3$); 1.65 (3H, s, $CH_3$); 2.23 (3H, s, $CH_3$); 3.75 (3H, s, $C(O)OCH_3$); 3.87 (1H, dd, $^2J_{HP}$ = 21.2, $^3J_{HH}$ = 12.3, PCH); 3.92 (3H, d, $^3J_{HP}$ = 12.3, $CH_3OP$); 3.96 (3H, d, $^3J_{HP}$ = 12.3, $CH_3OP$); 4.75 (1H, d, $^2J_{HH}$ = 5.2, C=CH); 4.88 (1H, dd, $^3J_{HH}$ = 11.7, $^3J_{HP}$ = 9.5, PCCH); 5.18 (1H, d, $^2J_{HH}$ = 5.2, C=CH); 6.27 (1H, s, NH); 7.15 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.32 (1H , d, $^3J_{HH}$ = 7.6, H Ar); 7.46 (1H, s, H Ar); 7.58 (1H, s, H Ar); 8.37 (1H, s, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 18.5; 27.6; 31.6; 43.2 (d, *J* = 10.5); 47.6 (d, *J* = 148.4); 51.6 (d, *J* = 9.2); 52.4 (d, *J* = 9.2); 53.2; 62.5; 77.8; 113.6; 114.5; 114.9; 115.5; 116.7; 123.4; 123.9; 124.6; 127.8; 134.6; 137.5; 138.8; 142.3; 152.7; 153.2; 155.3; 161.2; 161.7 (d, *J* = 6.7); 169.5 (d, *J* = 21.4). $^{31}$P NMR spectrum, δ, ppm: 22.3. Mass spectrum, *m/z* ($I_{rel}$, %): 655 $[M]^+$ (10), 598 (78), 31 (100). Found, %: C 56.92; H 5.43; N 6.67. $C_{31}H_{34}N_3O_{11}P$. Calculated, %: C 56.79; H 5.23; N 6.41.

**Methyl (8*R*,9*R*)-5-(6-chloro-3-isopropyl-2-methyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl]-8-(dimethoxyphosphoryl)-2-isopropenyl-7-oxo-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9-carboxylate (6m)**. Yield 1.09 g (87%), yellow powder, mp 232–235°C. IR spectrum, ν, cm$^{-1}$: 1739, 1735, 1692, 1663, 1585, 1486, 1378, 1295. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.16 (6H, d, $^3J_{HH}$ = 6.8, C(CH$_3$)$_2$); 1.75 (3H, s, CH$_3$); 2.18 (3H, s, CH$_3$); 3.73 (3H, s, C(O)OCH$_3$); 3.75–3.86 (2H, m, 2 CH); 3.92 (3H, d, $^3J_{HP}$ = 11.8, CH$_3$OP); 3.97 (3H, d, $^3J_{HP}$ = 11.8, CH$_3$OP); 4.76 (1H, d, $^2J_{HH}$ = 4.9, C=CH); 4.86 (1H, dd, $^3J_{HH}$ = 11.3, $^3J_{HP}$ = 10.5, PCCH); 5.12 (1H, d, $^2J_{HH}$= 4.9, C=CH); 6.22 (1H, s, NH); 7.16 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.37 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.52 (1H, s, H Ar); 7.67 (1H, s, H Ar); 8.23 (1H, s, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 18.6; 22.5; 26.5; 42.7 (d, *J* = 10.7); 43.7; 47.8 (d, *J* = 148.5); 51.4 (d, *J* = 10.3); 52.7 (d, *J* = 10.3); 53.5; 76.4; 105.8; 113.6; 114.7; 115.2; 121.5; 122.4; 122.7; 126.2; 127.6; 128.2; 133.7; 137.5; 142.6; 152.3; 153.4; 154.6; 161.7; 162.5 (d, *J* = 6.9); 172.3 (d, *J* = 22.5). $^{31}$P NMR spectrum, δ, ppm: 22.8. Mass spectrum, *m*/*z* (*I*$_{rel}$, %): 631 [M]$^+$ (15), 600 (68), 31 (100). Found, %: C 57.25; H 5.27; N 4.62. $C_{30}H_{32}ClN_2O_9P$. Calculated, %: C 57.10; H 5.11; N 4.44.

**Methyl (8*R*,9*R*)-8-(diphenoxyphosphoryl)-2-isopropenyl-7-oxo-5-(2,3,6-trimethyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-8,9-dihydro-7*H*-furo[2,3-*f*]chromene-9--carboxylate (6n)**. Yield 1.23g (87%), pale-yellow powder, mp 218–220°C. IR spectrum, ν, cm$^{-1}$: 1742, 1738, 1695, 1673, 1587, 1485, 1389, 1295. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.67 (3H, s, CH$_3$); 2.16 (3H, s, CH$_3$); 2.27 (3H, s, CH$_3$); 2.52 (3H, s, CH$_3$); 3.67 (3H, s, C(O)OCH$_3$); 4.28 (1H, dd, $^2J_{HP}$ = 18.7, $^3J_{HH}$= 11.5, PCH); 4.87 (1H, dd, $^3J_{HH}$ = 11.5, $^3J_{HP}$ = 10.5, PCCH); 4.95 (1H, d, $^2J_{HH}$ = 5.3, C=CH); 5.25 (1H, d, $^2J_{HH}$ = 5.3, C=CH); 6.37 (1H, s, NH); 6.95 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.15 (2H, d, $^3J_{HH}$ = 7.5, H Ar); 7.18 (2H, d, $^3J_{HH}$ = 7.5, H Ar); 7.25 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.32 (1H, t, $^3J_{HH}$ = 7.5, H Ar); 7.38 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.45 (2H, t, $^3J_{HH}$ = 7.5, H Ar); 7.52 (2H, t, $^3J_{HH}$ = 7.5, H Ar); 7.58 (1H, s, H Ar); 7.63 (1H, s, H Ar); 8.12 (1H, s, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 18.6; 22.4; 24.7; 34.6; 38.2 (d, *J* = 9.8); 40.4 (d, *J* = 158.5); 51.8; 78.2; 107.6; 113.5; 114.3; 115.6; 121.2 (d, *J* = 22.8); 121.7 (2CH, d, $^3J_{PC}$ = 22.8); 122.7 (C); 123.2 (CH); 123.6 (C); 124.2 (C); 125.4 (2CH); 126.4 (CH); 127.5 (CH); 128.5 (2CH); 129.2 (2CH); 133.6 (CH); 137.8 (C); 142.3 (C); 151.7 (d, $^2J_{PC}$ = 10.5); 152.3 (d, $^2J_{PC}$ = 10.7); 152.6 (C); 153.8 (C); 154.7 (C); 159.6 (C=O); 161.2 (d, $^2J_{PC}$ = 7.5, C=O); 166.3 (d, $^3J_{PC}$ = 22.5, C=O). $^{31}$P NMR spectrum, δ, ppm: 21.3. Mass spectrum, *m*/*z* (*I*$_{rel}$, %): 706 [M]$^+$ (10), 675 (74), 31 (100). Found, %: C 66.42; H 5.16; N 4.23. $C_{39}H_{35}N_2O_9P$. Calculated, %: C 66.28; H 4.99; N 3.96.

**Methyl (3*R*,4*R*)-3-(dimethoxyphosphoryl)-8-(2,3-dimethyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-2-oxo-4-chromene carboxylate (16a)**. Yield 0.95 g (97%), white powder, mp 115–117°C. IR spectrum, ν, cm$^{-1}$: 1743, 1735, 1687, 1637, 1587, 1465, 1378, 1286. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.65 (3H, s, CH$_3$); 2.58 (3H, s, CH$_3$); 3.75 (3H, s, C(O)OCH$_3$); 3.83 (1H, dd, $^2J_{HP}$ = 18.7, $^3J_{HH}$ = 11.5, PCH); 3.87 (3H, d, $^3J_{HP}$ = 10.8, CH$_3$OP); 3.93 (3H, d, $^3J_{HP}$ = 10.8, CH$_3$OP); 4.72 (1H, dd, $^3J_{HH}$ = 11.5, $^3J_{HP}$ = 9.2, PCCH); 6.18 (1H, s, NH); 6.95 (1H, d, $^3J_{HH}$ = 7.8, H Ar); 7.15 (1H, t, $^3J_{HH}$ = 7.8, H Ar); 7.18 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.23 (1H, t, $^3J_{HH}$ = 7.8, H Ar); 7.34 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.62 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.93 (1H, d, $^3J_{HH}$ = 7.8, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 25.3; 34.2; 42.3 (d, *J* = 9.3); 46.3 (d, *J* = 143.2); 51.2 (d, *J* = 8.7); 52.4 (d, *J* = 8.7); 52.8; 76.4; 110.3; 114.8; 121.6; 123.4 (d, *J* = 5.6); 124.3; 125.2; 126.4; 127.4; 128.3; 133.6; 142.3; 152.3; 160.3; 161.3 (d, *J* = 6.8); 167.5 (d, *J* = 22.5). $^{31}$P NMR spectrum, δ, ppm: 20.3. Mass spectrum, *m*/*z* (*I*$_{rel}$, %): 488 [M]$^+$ (15), 457 (68), 31 (100). Found, %: C 56.72; H 5.32; N 5.92. $C_{23}H_{25}N_2O_8P$. Calculated, %: C 56.56; H 5.16; N 5.74.

**Methyl (3*R*,4*R*)-3-(dimethoxyphosphoryl)-8-(3-ethyl-2-methyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-6-methoxy-2-oxo-4-chromene carboxylate (16b)**. Yield 1.01 g (95%), white powder, mp 123–125°C. IR spectrum, ν, cm$^{-1}$: 1742, 1738, 1695, 1654, 1593, 1487, 1395, 1286. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.27 (3H, t, $^3J_{HH}$ = 7.3, CH$_3$); 2.17 (3H, s, CH$_3$); 2.76–2.84 (1H, m, CH$_3$C<u>H</u>$_2$); 3.15–3.25 (1H, m, CH$_3$C<u>H</u>$_2$); 3.75 (3H, s, CH$_3$O); 3.78 (3H, s, CH$_3$O); 3.83 (1H, dd, $^2J_{HP}$ = 19.7, $^3J_{HH}$ = 11.6, PCH); 3.92 (3H, d, $^3J_{HP}$ = 11.5, CH$_3$OP); 3.96 (3H, d, $^3J_{HP}$ = 11.5, CH$_3$OP); 4.75 (1H, dd, $^3J_{HH}$ = 11.6, $^3J_{HP}$ = 10.4, PCCH); 6.22 (1H, s, NH); 6.75 (1H, s, H Ar); 7.05 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.08 (1H, s, H Ar); 7.23 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.32 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.85 (1H, d, $^3J_{HH}$ = 7.6, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 13.8; 24.3; 41.3; 42.7 (d, *J* = 9.5); 46.2 (d, *J* = 146.3); 51.5 (d, *J* = 9.7); 52.7 (d, *J* = 9.7); 53.4; 55.6; 77.5; 110.3; 112.2; 114.2; 115.2; 122.2; 122.7; 123.4; 125.6; 128.4; 142.5; 143.4; 155.6; 161.2; 162.3 (d, *J* = 7.5); 168.5 (d, *J* = 21.8). $^{31}$P NMR spectrum, δ, ppm: 21.2. Mass spectrum, *m*/*z* (*I*$_{rel}$, %): 582 [M]$^+$ (15), 551 (86), 31 (100). Found, %: C 56.52; H 5.63; N 5.42. $C_{25}H_{29}N_2O_9P$. Calculated, %: C 56.39; H 5.49; N 5.26.

**Methyl (3*R*,4*R*)-8-[3-(*tert*-butyl)-2,6-dimethyl-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl]-3-(dimethoxyphosphoryl)-6-methoxy-2-oxo-4-chromene carboxylate (16c)**. Yield 1.09 g (95%), white powder, mp 127–129°C. IR spectrum, ν, cm$^{-1}$: 1742, 1738, 1687, 1653, 1584, 1483, 1378, 1262. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.18 (9H, s, C(CH$_3$)$_3$); 1.75 (3H, s, CH$_3$); 2.36 (3H, s, CH$_3$); 3.75 (3H, s, CH$_3$O); 3.83 (1H, dd, $^2J_{HP}$ = 20.6, $^3J_{HH}$ = 11.8, PCH); 3.87 (3H, s, CH$_3$O); 3.92 (3H, d, $^3J_{HP}$ = 11.5, CH$_3$OP); 3.97 (3H, d, $^3J_{HP}$ = 11.5, CH$_3$OP); 4.86 (1H, dd, $^3J_{HH}$ = 11.5, $^3J_{HP}$ = 9.5, PCCH); 6.27 (1H, s, NH); 6.95 (1H, s, H Ar); 7.06 (1H, s, H Ar); 7.12 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.27 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 8.14 (1H, s, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 21.3; 27.6; 31.5; 42.8 (d, *J* = 10.2); 47.5 (d, *J* = 147.4); 51.6 (d, *J* = 9.7); 52.4 (d, *J* = 9.7); 53.6; 55.7; 62.5; 81.3; 106.3; 111.4; 113.3; 122.4; 123.2; 124.8; 125.4; 127.2; 129.4; 143.2; 145.3; 158.3; 161.6 (d, *J* = 6.7); 162.3; 168.7 (d, *J* = 21.5). $^{31}$P NMR spectrum, δ, ppm: 21.7. Mass spectrum, *m*/*z* (*I*$_{rel}$, %): 574 [M]$^+$ (15), 517 (64), 57 (100), 31 (100). Found, %: C 58.52; H 6.32; N 4.97. $C_{28}H_{35}N_2O_9P$. Calculated, %: C 58.53; H 6.14; N 4.88.

**Methyl (3*R*,4*R*)-3-(dimethoxyphosphoryl)-8-(3-isopropyl-2-methyl-6-nitro-4-oxo-1,2,3,4-tetrahydro-2-quinazolinyl)-5-methyl-2-oxo-4-chromene carboxylate (16d)**. Yield 0.98 g (90%), pale-yellow powder, mp 147–149°C. IR spectrum, ν, cm$^{-1}$: 1740, 1738, 1692, 1667, 1587, 1485,

1384, 1295. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.15 (6H, d, $^3J_{HH}$ = 6.7, C(CH$_3$)$_2$); 1.75 (3H, s, CH$_3$); 2.23 (3H, s, CH$_3$); 3.75 (3H, s, C(O)OCH$_3$); 3.75–3.86 (2H, m, CH(CH$_3$)$_2$, PCH); 3.83 (3H, d, $^3J_{HP}$ = 11.8, CH$_3$OP); 3.89 (3H, d, $^3J_{HP}$ = 12.2, CH$_3$OP); 4.85 (1H, dd, $^3J_{HH}$ = 12.2, $^3J_{HP}$ = 10.5, PCCH); 6.25 (1H, s, NH); 7.12 (1H, d, $^3J_{HH}$ = 7.5, H Ar); 7.27 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.63 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 8.16 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 8.68 (1H, s, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 21.4; 22.4; 26.4; 42.5 (d, *J* = 10.6); 43.7; 47.7 (d, *J* = 147.2); 51.8 (d, *J* = 10.2); 52.6 (d, *J* = 10.2); 53.4; 78.3; 112.2; 112.6; 121.3; 124.2; 127.2; 129.7; 130.2; 131.5; 132.3; 138.3; 146.4; 148.6; 161.4; 162.5 (d, *J* = 6.7); 172.6 (d, *J* = 22.3). $^{31}$P NMR spectrum, δ, ppm: 23.4. Mass spectrum, *m*/*z* ($I_{rel}$, %): 575 [M]$^+$ (15), 544 (68), 31 (100). Found, %: C 54.42; H 5.43; N 7.45. $C_{26}H_{30}N_3O_{10}P$. Calculated, %: C 54.26; H 5.25; N 7.30.

**Methyl (3*R*,4*R*)-3-(dimethoxyphosphoryl)-8-(3-methyl-4-oxo-3,4-dihydro-2-quinazolinyl)-2-oxo-4-chromene carboxylate (16e)**. Yield 0.92 g (97%), white powder, mp 112–114°C. IR spectrum, ν, cm$^{-1}$: 1740, 1739, 1685, 1638, 1575, 1478, 1386, 1274. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 3.48 (3H, s, NCH$_3$); 3.75 (3H, s, C(O)OCH$_3$); 3.83 (1H, dd, $^2J_{HP}$ = 18.7, $^3J_{HH}$ = 11.4, PCH); 3.89 (3H, d, $^3J_{HP}$ = 11.6, CH$_3$OP); 3.95 (3H, d, $^3J_{HP}$ = 11.6, CH$_3$OP); 4.74 (1H, dd, $^3J_{HH}$ = 11.4, $^3J_{HP}$ = 8.9, PCCH); 7.34 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.48 (1H , t, $^3J_{HH}$ = 7.6, H Ar); 7.56 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.68 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.74 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.85 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 8.22 (1H, d, $^3J_{HH}$ = 7.6, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 32.3; 43.4 (d, *J* = 144.7); 46.5 (d, *J* = 10.8); 51.3 (d, *J* = 8.9); 52.5 (d, *J* = 8.9); 53.2; 121.3; 122.4; 125.3; 126.2; 126.8; 127.5; 128.3; 129.2; 130.2; 135.6; 146.2; 156.2; 160.5; 161.6 (d, *J* = 6.7); 165.2; 168.2 (d, *J* = 22.5). $^{31}$P NMR spectrum, δ, ppm: 21.2. Mass spectrum, *m*/*z* ($I_{rel}$, %): 472 [M]$^+$ (15), 441 (86), 31 (100). Found, %: C 56.12; H 4.62; N 6.16. $C_{22}H_{21}N_2O_8P$. Calculated, %: C 55.94; H 4.48; N 5.93.

**Methyl (3*R*,4*R*)-3-(dimethoxyphosphoryl)-8-(3-ethyl-2-methyl-4-oxo-3,4-dihydro-2-quinazolinyl)-6-methoxy-2-oxo-4-chromene carboxylate (16f)**. Yield 0.98 g (95%), white powder, mp 123–125°C. IR spectrum, ν, cm$^{-1}$: 1742, 1738, 1689, 1678, 1565, 1478, 1376, 1295. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.27 (3H, t, $^3J_{HH}$ = 7.3, CH$_3$CH$_2$N); 3.34 (2H, q, $^3J_{HH}$ = 7.3, CH$_3$CH$_2$N); 3.75 (3H, s, CH$_3$O); 3.83 (3H, s, CH$_3$O); 3.88 (1H, dd, $^2J_{HP}$ = 18.7, $^3J_{HH}$ = 11.5, PCH); 3.92 (3H, d, $^3J_{HP}$ = 11.5, CH$_3$OP); 3.97 (3H, d, $^3J_{HP}$ = 11.5, CH$_3$OP); 4.76 (1H, dd, $^3J_{HH}$ = 11.5, $^3J_{HP}$ = 10.5, PCCH); 6.95 (1H, s, H Ar); 7.12 (1H, s, H Ar); 7.45 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.65 (1H, t, $^3J_{HH}$ = 7.6, H Ar); 7.78 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 8.12 (1H, d, $^3J_{HH}$ = 7.6, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 13.8; 38.2; 43.4 (d, *J* = 9.7); 46.2 (d, *J* = 146.3); 51.3 (d, *J* = 9.7); 52.6 (d, *J* = 9.7); 53.3; 55.8; 109.2; 114.3; 121.3; 122.4; 126.2; 127.4; 128.6; 134.2; 145.2; 149.5; 157.2; 160.7; 162.3 (d, *J* = 7.5); 165.6; 168.4 (d, *J* = 21.7). $^{31}$P NMR spectrum, δ, ppm: 21.6. Mass spectrum, *m*/*z* ($I_{rel}$, %): 516 [M]$^+$ (10), 485 (64), 31 (100). Found, %: C 55.97; H 4.96; N 5.63. $C_{24}H_{25}N_2O_9P$. Calculated, %: C 55.82; H 4.88; N 5.42.

**Methyl (3*R*,4*R*)-8-[3-(*tert*-butyl)-6-methyl-4-oxo-3,4-dihydro-2-quinazolinyl]-3-(dimethoxyphosphoryl)-6-methoxy-2-oxo-4-chromene carboxylate (16g)**. Yield 1.06 g (95%), white powder, mp 136–138°C. IR spectrum, ν, cm$^{-1}$: 1742, 1739, 1688, 1674, 1587, 1469, 1372, 1295. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.46 (9H, s, C(CH$_3$)$_3$); 2.35 (3H, s, CH$_3$); 3.75 (3H, s, CH$_3$O); 3.78 (3H, s, CH$_3$O); 3.82 (1H, dd, $^2J_{HP}$ = 19.8, $^3J_{HH}$ = 11.5, PCH); 3.88 (3H, d, $^3J_{HP}$ = 11.5, CH$_3$OP); 3.95 (3H, d, $^3J_{HP}$ = 11.5, CH$_3$OP); 4.87 (1H, dd, $^3J_{HH}$ = 11.7, $^3J_{HP}$ = 9.5, PCCH); 6.85 (1H, s, H Ar); 7.05 (1H, s, H Ar); 7.56 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.82 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.97 (1H, s, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 21.3; 30.7; 42.8 (d, *J* = 10.6); 48.2 (d, *J* = 147.5); 51.7 (d, *J* = 9.8); 52.4 (d, *J* = 9.8); 52.8; 55.7; 61.3; 111.3; 114.5; 121.3; 122.8; 124.3; 125.6; 128.4; 131.4; 137.2; 143.4; 151.2; 157.4; 160.2 (d, *J* = 6.3); 161.4; 164.3; 167.4 (d, *J* = 21.5). $^{31}$P NMR spectrum, δ, ppm: 22.4. Mass spectrum, *m*/*z* ($I_{rel}$, %): 558 [M]$^+$ (10), 527 (78), 31 (100). Found, %: C 58.24; H 5.75; N 5.18. $C_{27}H_{31}N_2O_9P$. Calculated, %: C 58.06; H 5.59; N 5.02.

**Methyl (3*R*,4*R*)-3-(dimethoxyphosphoryl)-8-(3-isopropyl-6-nitro-4-oxo-3,4-dihydro-2-quinazolinyl)-5-methoxy-2-oxo-4-chromene carboxylate (16h)**. Yield 1.04 g (90%), pale-yellow powder, mp 145–147°C. IR spectrum, ν, cm$^{-1}$: 1743, 1739, 1698, 1678, 1582, 1487, 1363, 1258. $^1$H NMR spectrum, δ, ppm (*J*, Hz): 1.28 (6H, d, $^3J_{HH}$ = 6.9, CH(CH$_3$)$_2$); 3.68 (3H, s, CH$_3$O); 3.74 (1H, dd, $^2J_{HP}$ = 19.5, $^3J_{HH}$ = 11.8, PCH); 3.80 (3H, s, CH$_3$O); 3.85 (3H, d, $^3J_{HP}$ = 11.8, CH$_3$OP); 3.93 (3H, d, $^3J_{HP}$ = 11.8, CH$_3$OP); 4.93 (1H, dd, $^3J_{HH}$ = 11.8, $^3J_{HP}$ = 10.8, PCCH); 5.65–5.72 (1H, m, NCH), 6.68 (1H, d, $^3J_{HH}$ = 7.8, H Ar); 7.57 (1H, d, $^3J_{HH}$ = 7.8, H Ar); 7.63 (1H, d, $^3J_{HH}$ = 7.6, H Ar); 7.87 (1H, d, $^3J_{HH}$ = 7.8, H Ar); 8.47 (1H, s, H Ar). $^{13}$C NMR spectrum, δ, ppm (*J*, Hz): 21.8; 42.5 (d, *J* = 10.8); 46.8; 47.9 (d, *J* = 147.5); 51.3 (d, *J* = 10.6); 52.2 (d, *J* = 10.6); 52.8; 55.4; 112.4; 113.8; 120.4; 122.3; 123.4; 125.2; 128.2; 130.4; 147.2; 149.3; 153.2; 154.8; 160.2; 161.8 (d, *J* = 6.3); 163.8; 168.3 (d, *J* = 21.7). $^{31}$P NMR spectrum, δ, ppm: 22.8. Mass spectrum, *m*/*z* ($I_{rel}$, %): 575 [M]$^+$ (10), 544 (68), 31(100). Found, %: C 52.28; H 4.72; N 7.45. $C_{25}H_{26}N_3O_{11}P$. Calculated, %: C 52.18; H 4.55; N 7.30.

Supplementary information file contaning $^1$H and $^{13}$C NMR spectra of selected compounds is available at the journal website at http://link.springer.com/journal/10593.

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