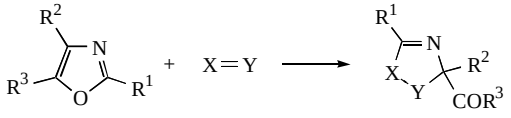
# Reaction of acylisothiocyanates with 5-isopropoxy-4-methyloxazole

**Anton V. Dudin,* Nicolai E. Agafonov and Viktor M. Zhulin**

*N. D. Zelinsky Institute of Organic Chemistry, Russian Academy of Sciences, 117913 Moscow, Russian Federation.*
*Fax: +7 095 135 5328*

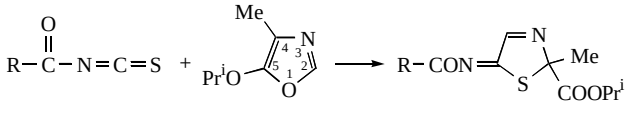
Formal [3+2]-cycloaddition of acylisothiocyanates to 5-isopropoxy-4-methyloxazole gives derivatives of 5-acylimino-3-thiazoline.

In recent years, extensive studies have been carried out on the formal [3+2]-cycloaddition to oxazoles **1** accompanied by opening of the oxazole ring and formation of another heterocycle **3** (Scheme 1).



**Scheme 1**

A series of 'ene' components **2** of this reaction, such as C=C,[1] C=N,[2] N=N,[2,3] C=O[2,4] and N=O[5] bonds have been studied; the addition of oxazoles to the C=S group of thioaldehydes generated *in situ* has also been reported.[6]



**4a–c** **5**

**6a** R = Ph (69%)
**6b** R = Me (25%)
**6c** R = *p*-$NO_2C_6H_4$ (75%)

**Scheme 2**

We found that acylisothiocyanates **4a–c** reacted with 5-isopropoxy-4-methyloxazole **5** to give hitherto unknown 5-acylimino-2-isopropoxycarbonyl-2-methyl-3-thiazolines **6a–c**, *i.e.* the transformation occured *via* formal [3+2]-cycloaddition of the C=S bond of acylisothiocyanate to the 2nd and 4th atoms of the oxazole ring (Scheme 2). Thus, we show for the first time that oxazoles react by the above mechanism not only with heteroolefins but also with heterocumulenes.†

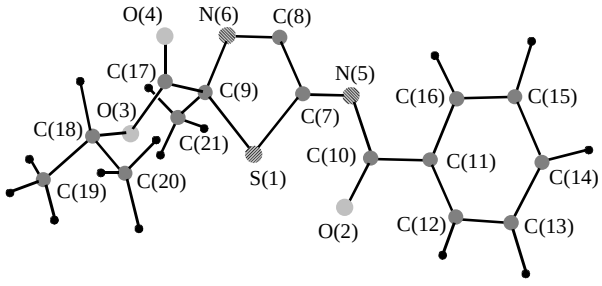


**Figure 1** The structure of compound **6a**. Bond lengths (Å): S(1)–C(7) 1.763(5), S(1)–C(9) 1.859(6), O(2)–C(10) 1.227(8), O(3)–C(17) 1.345(7), O(3)–C(18) 1.461(7), O(4)–C(17) 1.226(8), N(5)–C(7) 1.283(8), N(5)–C(10) 1.421(7), N(6)–C(8) 1.292(9), N(6)–C(9) 1.401(7), C(7)–C(8) 1.429(9), C(9)–C(17) 1.492(10), C(9)–C(21) 1.513(8), C(10)–C(11) 1.519(10), C(11)–C(12) 1.341(8), C(12)–C(13) 1.391(10), C(13)–C(14) 1.363(9), C(14)–C(15) 1.417(10), C(15)–C(16) 1.435(10), C(16)–C(11) 1.383(8), C(18)–C(19) 1.527(8), C(18)–C(20) 1.512(10). Bond angles (°): C(7)–S(1)–C(9) 89.3(3), S(1)–C(7)–C(8) 107.5(5), S(1)–C(7)–N(5) 128.5(5), N(5)–C(7)–C(8) 124.0(6), C(7)–C(8)–N(6) 120.6(6), C(8)–N(6)–C(9) 112.0(6), S(1)–C(9)–N(6) 110.0(5), S(1)–C(9)–C(17) 104.0(5), S(1)–C(9)–C(21) 110.9(5), N(6)–C(9)–C(17) 109.9(5), N(6)–C(9)–C(21) 111.0(5), C(17)–C(9)–C(21) 110.8(6), C(7)–N(5)–C(10) 115.7(5), O(2)–C(10)–N(5) 125.6(7), O(2)–C(10)–C(11) 120.1(7), N(5)–C(10)–C(11) 114.3(5), C(10)–C(11)–C(12) 118.9(6), C(10)–C(11)–C(16) 119.6(7), C(12)–C(11)–C(16) 121.4(7), C(11)–C(12)–C(13) 121.3(6), C(12)–C(13)–C(14) 119.3(8), C(13)–C(14)–C(15) 121.5(8), C(14)–C(15)–C(16) 117.0(6), C(15)–C(16)–C(11) 119.2(7), C(9)–C(17)–O(4) 124.9(7), O(3)–C(17)–O(4) 120.7(6), O(3)–C(17)–C(9) 114.4(5), O(3)–C(18)–C(19) 104.6(3), O(3)–C(18)–C(20) 105.8(6), C(17)–O(3)–C(18) 119.4(5), C(19)–C(18)–C(20) 110.2(6).

The structure of adduct **6a** was confirmed by X-ray diffraction analysis‡ (Figure 1), while the structures of compounds **6b**,**c** were established by comparing their $^1$H and $^{13}$C NMR and mass spectra with those of compound **6a**.

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## References

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† 5-*Benzoylimino*-2-*isopropoxy*-2-*methyl*-3-*thiazoline* **6a** was obtained by refluxing oxazole **5**[7] (1.0 g, 7.1 mmol) and isothiocyanate **4a** (1.16 g, 7.1 mmol) in toluene for 7 h under argon. The resulting mixture was chromatographed on a column with $SiO_2$ using benzene as an eluent to give 1.50 g of compound **6a** as large yellow prisms, mp 84–85.5 °C (from hexane), $R_f$ (Silufol, $Et_2O$–benzene, 1:1) 0.53–0.56. Found (%): C 59.00, H 5.36, N 9.29, S 10.30. Calc. for $C_{15}H_{16}N_2O_3S$ (%): C 59.19, H 5.30, N 9.21, S 10.53.

$^1$H NMR (300 MHz, $CDCl_3$) $\delta$: 1.23 [m, 6H, $CH(CH_3)_2$], 2.00 (s, 3H, $CH_3$), 5.04 [m, 1H, $CH(CH_3)_2$], 7.51 (m, 3H, Ph), 8.30 (t, 3H, Ph and N=CH). $^{13}$C NMR (75.5 MHz, $CDCl_3$) $\delta$: 21.3 [q, $CH(CH_3)_2$], 24.7 (q, $CH_3$), 70.7 [d, $CH(CH_3)_2$], 93.7 (s, S–*C*–$CH_3$), 128.5 and 130.4 (d, Ph, *o*- and *m*-CH), 133.7 (d, Ph, *p*-CH), 134.4 (s, Ph, quaternary C), 163.7 (d, N=CH), 167.1 (s, N=C–S), 177.6 and 178.3 (s, N–C=O and O–C=O). MS (EI, 70 eV) *m*/*z* 304 $[M]^+$.

Adducts **6b** [bp 144–145 °C (1 mmHg)] and **6c** (mp 99–101.5 °C) were synthesized similarly to adduct **6a**.

‡ *X-ray diffraction analysis*. Crystals of compound **6a** in the form of tetrahedral prisms were grown from pentane, triclinic, $a$ = 10.164(1) Å, $b$ = 9.732(1) Å, $c$ = 7.877(1) Å, $\alpha$ = 96.40(1)°, $\beta$ = 93.30(1)°, $\gamma$ = 98.92(1)°, $Z$ = 2, space group $P\bar{1}$, $C_{15}H_{16}N_2O_3S$. A complete set of 1295 independent reflections with $I > 2\sigma(I)$ was obtained on a RED-4 four-circle automatic diffractometer ($\lambda$ Cu-K$\alpha$, graphite monochromator, $\omega$–$\theta$/2$\theta$ scanning, $\theta \leq 60°$).

The structure of compound **6a** was solved by a direct method. The coordinates of non-hydrogen atoms were refined by the least-squares method in an anisotropic approximation; the hydrogen atom coordinates were refined isotropically. The final value of $R$ was 0.07. Atomic coordinates, bond lengths and thermal parameters have been deposited at the Cambridge Crystallographic Data Centre (CCDC). For details, see Notice to Authors, *Mendeleev Commun.*, 1998, issue 1. Any request to the CCDC should quote the full literature citation and the reference number 1135/23.