Synthesis of Heterocyclic Compounds. LI [1]. Schiff Bases of Ethyl 2-Aminofurancarboxylates

J. A. Ciller, C. Seoane, J. L. Soto* and B. Yruretagoyena

Departamento de Química Orgánica, Facultad de Química, Universidad Complutense, 28040-Madrid, Spain

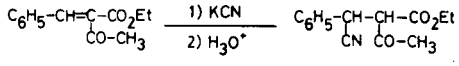
Received January 15, 1986

Diaryl- and Alkylaryl-substituted 2-aminofurancarboxylates have been obtained as Schiff bases **5,6** by cyclization of 2-ethoxycarbonyl-4-oxonitriles **3,4**; which result from hydrogen cyanide addition to ethyl α-acylcinnamates **1,2**.

J. Heterocyclic Chem., **23**, 1583 (1986).

Although carboxylic derivatives of furans are easily accessible by classical methods, such as the Feist-Benary and Paal-Knorr syntheses [2,3], the incorporation of an amino group into such compounds is difficult because of the known instability of furanamines [4]. In fact, little is known about the chemistry of aminofurancarboxylic derivatives [5-7]. On the other hand, we have reported in previous papers the synthesis of stable 2-furanamines by cyclization of 4-oxonitriles [8,9]. This synthesis could be used in the cyclization of 2-ethoxycarbonyl-4-oxonitriles, accessible through a conjugate addition of hydrogen cyanide to ethyl α-acylcinnamates, to get ethyl 2-aminofurancarboxylates. However, the addition of hydrogen cyanide to ethyl α-acetylcinnamate was studied by Ruheman [10] and the compound resulting from the conjugate addition of cyanide was obtained as the reaction product. No cyclization occurs (Scheme 1).

Scheme 1

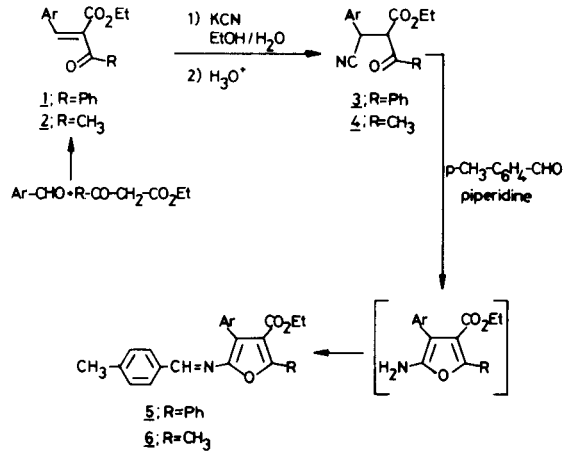


We now report that cyclization to a furan ring can be achieved by treating oxonitrile **2** with piperidine in the presence of an aromatic aldehyde, so that the resulting furanamine is converted as its Schiff base, a stable compound which can be easily isolated by filtration.

The reaction was applied to substituted α-acetylcinnamates **2** and α-benzoylcinnamates **1** and it proved to be a general one, leading to good yields of the corresponding oxonitriles **3,4**, all of which were cyclized to ethyl *N*-arylydene-2-aminofurancarboxylates **5,6** (Scheme 2).

It must be pointed out that oxonitriles **3** and **4** are obtained as a diastereomeric mixture, as shown by their ^{1}H-nmr spectra, but chirality is lost in the cyclization step and both diastereomers lead to the same result. Compounds **3** and **4** are obtained as non-distillable oils, and were purified by means of column chromatography. Fractional crystallization allowed in one example (**4c**) the isolation of a diastereomerically pure sample. In the case of nitro derivative **1d**, reaction with cyanide led to a complex mixture, from which no pure compound could be isolated.

Scheme 2



Ar = C_6H_5; p-CH_3-C_6H_4; p-CH_3O-C_6H_4; p-Cl-C_6H_4; p-NO_2-C_6H_4.

The cyclization step leading to **5** and **6** can be carried out at room temperature but yields are usually higher at reflux temperature, using absolute ethanol as the solvent.

Attempts to obtain the free furanamines from the Schiff bases failed. Thus, acid hydrolysis of **5** results in decomposition. Basic treatment brought about a ring cleavage and benzoic acid was isolated from the reaction mixture. Treatment of **5** with 2,4-dinitrophenylhydrazine with the aim of forming the 2,4-dinitrophenylhydrazone of the aldehyde and the free amino group did not produce any reaction.

EXPERIMENTAL

Melting points were determined in capillary tubes and are uncorrected. The ir spectra were measured with a Perkin-Elmer 257 spectrophotometer in potassium bromide pellets. The ^{1}H-nmr spectra were obtained at 60 MHz with a Varian T-60 A spectrometer using TMS as the internal standard. Mass spectra were recorded with a Varian MAT 711 instrument at 100 eV. Thin-layer chromatography was performed on silica gel plates (Merck 60 F_{254}) using toluene-ethyl acetate as the eluant. Column chromatography was carried out on silica gel 60 (Merck) using toluene or toluene-ethyl acetate as the eluent. Microanalyses were performed by the "Centro Nacional de Química Orgánica" de Madrid.

Ethyl α-Acylcinnamates **1,2**.

These compounds were prepared by Knoevenagel condensations between aromatic aldehydes and ethyl acylacetates, according to literature procedures [10-18].

2-Aryl-3-ethoxycarbonyl-4-phenyl-4-oxobutanenitriles **3**. General Procedure.

To a suspension of 10 mmoles of the appropriate ethyl α-benzoylcinnamate (**1**) in 30 ml of ethanol, an equimolecular amount of acetic acid and 20 mmole of potassium cyanide dissolved in *c.a.* 5 ml of water are added. The mixture is stirred at room temperature until the starting material is exhausted (tlc). Then, the solvent is evaporated under vacuum and the residue is purified by means of column chromatography, using toluene or mixtures toluene/ethyl acetate as the eluent.

3-Ethoxycarbonyl-2,4-diphenyl-4-oxobutanenitrile (**3a**).

This compound was obtained in 55% yield; ir (film): 3060, 2980, 2940, 2245, 1730, 1680, 1590, 1575, 1490, 1445, 1365, 1270, 760, 700, 690 cm^{-1}; ^{1}H-nmr (deuteriochloroform): [19] δ 7.1-8.1 (m, 10H, aromatic), 4.80-4.93 (m, 2H, CH-CH), 3.9 and 4.5 (2q, 2H, CH_3-CH_2-O, J = 7 Hz), 0.8 and 1.2 (2t, 3H, CH_3-CH_2O, J = 7 Hz); ms: m/e 307 (M^+, 5), 234 (10), 174 (24), 156 (7), 129 (6), 106 (10), 105 (100), 103 (6), 91 (7), 78 (6), 77 (43).

Anal. Calcd. for $C_{19}H_{17}NO_3$: C, 74.25; H, 5.58; N, 4.56. Found: C, 74.26; H, 5.64; N, 4.71.

3-Ethoxycarbonyl-2-(*p*-methylphenyl)-4-phenyl-4-oxobutanenitrile (**3b**).

This compound was obtained in 68% yield; ir (film): 3010, 2980, 2220, 1730, 1680, 1590, 1575, 1510, 1445, 1355, 1265, 1020, 995, 810, 685 cm^{-1}; ^{1}H-nmr (deuteriochloroform): [19] δ 6.9-8.1 (m, 9H, aromatic), 4.80-4.92 (m, 2H, CH-CH), 3.9 and 4.2 (2q, 2H, CH_3-CH_2-O, J = 8 Hz), 2.2 and 2.3 (2s, 3H, CH_3), 0.9-1.2 (2t, 3H, CH_3-CH_2-O, J = 8 Hz).

Anal. Calcd. for $C_{20}H_{19}NO_3$: C, 74.74; H, 5.96; N, 4.36. Found: C, 74.42; H, 5.98; N, 4.15.

3-Ethoxycarbonyl-2-(*p*-methoxyphenyl)-4-phenyl-4-oxobutanenitrile (**3c**).

This compound was obtained in 87% yield; ir (film): 3060, 2980, 2820, 2240, 1740, 1680, 1610, 1580, 1510, 1450, 1370, 1250, 1115, 1030, 830, 740, 690 cm^{-1}; ^{1}H-nmr (deuteriochloroform): [19] δ 6.6-8.1 (m, 9H, aromatic), 4.75-4.88 (m, 2H, CH-CH), 3.7-4.5 (2q, 2H, CH_3-CH_2-O, J = 7 Hz), 3.67 and 3.77 (2s, 3H, OCH_3), 0.9 and 1.2 (2t, 3H, CH_3-CH_2-O, J = 7 Hz).

Anal. Calcd. for $C_{20}H_{19}NO_4$: C, 71.20; H, 5.67; N 4.15. Found: C, 70.96; H, 5.91; N, 4.16.

2-(*p*-Chlorophenyl)-3-ethoxycarbonyl-4-phenyl-4-oxobutanenitrile (**3e**).

This compound was obtained in 87% yield; ir (film): 3050, 2985, 2240, 1730, 1680, 1590, 1575, 1480, 1440, 1405, 1360, 1260, 1090, 1010, 815, 680 cm^{-1}; ^{1}H-nmr (deuteriochloroform): [19] δ 7.2-8.1 (m, 9H, aromatic), 4.80-4.90 (m, 2H, CH-CH), 3.9 and 4.2 (2q, 2H, CH_3-CH_2-O, J = 7 Hz), 0.9 and 1.2 (2t, 3H, CH_3-CH_2-O, J = 7 Hz).

Anal. Calcd. for $C_{19}H_{16}ClNO_3$: C, 66.76; H, 4.72; N, 4.10; Cl, 10.37. Found: C, 66.57; H, 4.85; N, 3.71; Cl, 10.21.

Reaction of Ethyl α-Benzoyl-*p*-nitrocinnamate (**1d**) with Potassium Cyanide.

Following the general procedure, the reaction leads to a complex mixture (tlc) from which no pure compound could be isolated. The same result is obtained when the reaction is carried out at 0°.

2-Aryl-3-ethoxycarbonyl-4-oxopentanenitriles **4**. General Procedure.

To a suspension of *ca.* 10 mmoles of the appropriate ethyl α-acetylcinnamate (**2**) in *ca.* 30 ml of ethanol, 35 mmoles of potassium cyanide dissolved in *ca.* 5 ml of water is added. The mixture is stirred at room temperature until the starting material is exhausted (tlc). Then, the reaction mixture is poured into 5% hydrochloric acid. An oil separates and it is extracted with ethyl ether. The organic layer is washed with 10% sodium bicarbonate, and then with water. After drying over magnesium sulphate, the ether is evaporated under vacuum. In most cases an oil is obtained, pure enough to use in further reactions. For analytical purposes, these products were purified by column chromatography (silica gel) using ethyl acetate/toluene (10:1) as the eluent.

3-Ethoxycarbonyl-2-phenyl-4-oxopentanenitrile (**4a**) [10].

This compound was obtained in 75% yield; ir (film): 3000, 2950, 2260, 1745, 1725, 1650, 1600, 1500, 1455, 1370, 1265, 1190, 1150, 1100, 1010, 760, 700 cm^{-1}; ^{1}H-nmr (deuteriochloroform): [19] δ 7.8 (s, 5H, aromatic), 3.8-4.6 (m, 4H, CH-CH and CH_3-CH_2-O), 2.1 and 2.3 (2s, 3H, $COCH_3$), 1.1 and 1.3 (2t, 3H, CH_3-CH_2-O, J = 8 Hz).

3-Ethoxycarbonyl-2-(*p*-methylphenyl)-4-oxopentanenitrile (**4b**).

This compound was obtained in 86% yield, mp 74-76° (from ethanol). It is first isolated as an oil and can be used as such in further reactions; ir (film): 2980, 2915, 2245, 1740, 1720, 1510, 1440, 1420, 1365, 1250, 1185, 1145, 1110, 1015, 810, 715 cm^{-1}; ^{1}H-nmr (deuteriochloroform): [19] δ 7.2 (s, 4H, aromatic), 3.9-4.7 (m, 4H, CH-CH and CH_3-CH_2-O), 2.37 (s, 3H, CH_3-C_6H_4), 2.1 and 2.4 (2s, 3H, CH_3CO), 1.0 and 1.4 (2t, 3H, CH_3-CH_2-O, J = 8 Hz).

Anal. Calcd. for $C_{15}H_{17}NO_3$: C, 69.47; H, 6.61; N, 5.40. Found: C, 69.32; H, 6.73; N, 5.51.

3-Ethoxycarbonyl-2-(*p*-methoxyphenyl)-4-oxopentanenitrile (**4c**).

The oil obtained following the general procedure crystallized in some days or by addition of ethanol in 86% yield mp 76-78° (from ethanol); ir (potassium bromide): 2245, 1735, 1705, 1610, 1580, 1510, 1375, 1350, 1270, 1230, 1200, 1175, 1145, 1030, 1020, 1015, 840, 820, 785, 770 cm^{-1}; ^{1}H-nmr (deuteriochloroform): [19] δ 7.7 (s, 4H, aromatic), 3.87-4.7 (m, 4H, CH-CH and CH_3-CH_2-O), 2.1 and 2.3 (2s, 3H, CH_3CO), 1.1 and 1.3 (2t, 3H, CH_3-CH_2-O, J = 8 Hz).

Anal. Calcd. for $C_{15}H_{17}NO_4$: C, 65.44; H, 6.22; N, 5.09. Found: C, 65.72; H, 6.35; N, 5.33.

2-(*p*-Chlorophenyl)-3-ethoxycarbonyl-4-oxopentanenitrile (**4e**).

This compound is isolated as an oil, and used as such in further reactions. An attempt to purify it by column chromatography (silica gel) caused decomposition, but it could crystallize from ethanol in 88% yield, mp 64°; ir (film): 2980, 2920, 2240, 1740, 1720, 1600, 1490, 1410, 1370, 1250, 1190, 1010, 810, 715, 690 cm^{-1}; ^{1}H-nmr (deuteriochloroform): [19] δ 7.7 (s, 4H, aromatic), 3.87-4.7 (m, 4H, CH-CH and CH_3-CH_2-O), 2.1 and 2.3 (2s, 3H, CH_3CO), 1.1 and 1.3 (2t, 3H, CH_3-CH_2-O, J = 8 Hz); ms: Calcd. 279.0655. Found: 279.0657.

Anal. Calcd. for $C_{14}H_{14}ClNO_3$: C, 60.11; H, 5.01; N, 5.01; Cl, 12.70. Found: C, 58.83; H, 5.23; N, 5.00; Cl, 12.53. A more satisfactory elemental analysis could not be obtained.

5-Substituted ethyl *N*-(*p*-methylbenzylidene)-3-aryl-2-aminofuran-4-carboxylates **5,6**. General Procedure.

Procedure A.

To a solution of the corresponding 2-aryl-3-ethoxycarbonyl-4-phenyl-4-oxobutanenitrile (**3**) or 2-aryl-3-ethoxycarbonyl-4-oxopentanenitrile (**4**) (6-10 mmoles) in absolute ethanol (~20 ml) 1.5 times the equimolecular amount of *p*-methylbenzaldehyde is added together with a few drops of piperidine as the catalyst. The mixture is stirred at room temperature for some hours (sometimes days). The furanamine precipitates in the reaction medium. It is separated by filtration and recrystallized from ethanol.

Procedure B.

Between 5 to 10 mmoles of 2-aryl-3-ethoxycarbonyl-4-phenyl-4-oxobutanenitrile (**3**) or 2-aryl-3-ethoxycarbonyl-4-oxopentanenitrile (**4**) is dissolved in absolute ethanol (20-30 ml). Then, equimolecular amount of *p*-methylbenzaldehyde is added together with some drops of piperidine as the catalyst. The reaction is refluxed for a few hours (5-40) until the starting material is exhausted (tlc). Then it is cooled down to room temperature. Furanamines precipitate in the reaction medium and are filtered off and recrystallized from ethanol.

Ethyl 3,5-Diphenyl-*N*-(*p*-methylbenzylidene)-2-aminofuran-4-carboxylaqte (**5a**).

This compound was obtained in 55% yield (Procedure A) and in 72% yield (Procedure B), mp 102-104° (from ethanol); ir (potassium bromide): 1700, 1600, 1585, 1530, 1440, 1360, 1300, 1225, 1100, 1035, 850, 815, 755, 695 cm^{-1}; ^{1}H-nmr (deuteriochloroform): δ 8.72 (s, 1H, CH=N), 7.1-7.9 (m, 14H, aromatic), 4.2 (q, 2H, CH_3-CH_2, J = 7 Hz), 2.37 (s, 3H, CH_3-C_6H_4), 1.1 (t, 3H, CH_3-CH_2-O, J = 7 Hz); ms: m/e 410 (M^+ + 1, 31), 409 (M^+, 100), 380 (15), 308 (22), 206 (16), 205 (17), 146 (17), 105 (69), 103 (19), 101 (25), 100 (19), 78 (16), 77 (43).

Anal. Calcd. for $C_{27}H_{23}NO_3$: C, 79.19; H, 5.66; N, 3.42. Found: C, 78.80; H, 5.63; N, 3.45.

Ethyl 3-(*p*-Methylphenyl)-5-phenyl-*N*-(*p*-methylbenzylidene)-2-aminofuran-4-carboxylate (**5b**).

This compound was obtained in 56% yield (Procedure A) and in 57% yield (Procedure B), mp 142-144° (from ethanol); ir (potassim bromide): 1700, 1600, 1590, 1480, 1365, 1220, 1170, 1100, 960, 850, 820, 760, 730 690 cm^{-1}; ^{1}H-nmr (deuteriochloroform): δ 8.70 (s, 1H, CH=N), 7.1-7.8 (m, 13H, aromatic), 4.2 (q, 2H, CH_3-CH_2-O, J = 7 Hz), 2.43 (s, 6H, 2 CH_3-C_6H_4), 1.1 (t, 3H, CH_3-CH_3-O, J = 7 Hz).

Anal. Calcd for $C_{28}H_{25}NO_3$: C, 79.41; H, 5.95; N, 3.31. Found: C, 79.64; H, 6.37; N, 3.60.

Ethyl 3-(*p*-Methoxyphenyl-5-phenyl-*N*-(*p*-methylbenzylidene)-2-aminofuran-4-carboxylate (**5c**).

This compound was obtained in 36% yield (Procedure A) and in 64% yield (Procedure B), mp 132-134° (from ethanol); ir (potassium bromide): 1700, 1600, 1530, 1500, 1480, 1430, 1360, 1280, 1250, 1180, 1090, 850, 830, 810, 750, 680 cm^{-1}; ^{1}H-nmr (deuteriochloroform): δ 8.73 (s, 1H, CH=N), 6.8-7.9 (m, 13H, aromatic), 4.2 (q, 2H, CH_3-CH_2-O, J = 8 Hz), 3.87 (s, 3H, OCH_3), 2.36 (s, 3H, CH_3-C_6H_4), 1.1 (t, 3H, CH_3-CH_2-O, J = 8 Hz).

Anal. Calcd. for $C_{28}H_{25}NO_4$: C, 76.51; H, 5.73; N, 3.19. Found: C, 76.42; H, 5.40; N, 3.42.

Ethyl 3-(*p*-Chlorophenyl)-5-phenyl-*N*-(*p*-methylbenzylidene)-2-aminofuran-4-carboxylate (**5e**).

This compound was obtained in 44% yield (Procedure B), mp 124-126° (from ethanol); ir (potassium bromide): 1700, 1485, 1360, 1300, 1290, 1225, 1200, 1170, 1100, 1035, 830, 760, 730, 690 cm^{-1}; ^{1}H-nmr (deuteriochloroform): δ 8.70 (s, 1H, CH=N), 7.1-7.9 (m, 13H, aromatic), 4.2 (q, 2H, CH_3-CH_2-O, J = 8 Hz), 2.37 (s, 3H, CH_3-C_6H_4), 1.1 (t, 3H, CH_3-CH_2-O, J = 8 Hz).

Anal. Calcd. for $C_{27}H_{22}ClNO_3$: C, 73.05; H, 4.99; N, 3.15; Cl, 7.99. Found: C, 72.80; H, 4.96; N, 3.49; Cl, 8.29.

Ethyl 5-Methyl-3-phenyl-*N*-(*p*-methylbenzylidene)-2-aminofuran-4-carboxylate (**6a**).

This compound was obtained in 16% yield (Procedure A) and in 93% yield (Procedure B), 136-138° (from ethanol); ir (potassium bromide): 1705, 1610, 1590, 1550, 1510, 1490, 1470, 1445, 1415, 1320, 1310, 1230, 1175, 1150, 1090, 820, 790, 780, 760, 700 cm^{-1}: ^{1}H-nmr (deuteriochloroform): δ 8.57 (s, 1H, CH=N), 7.1-7.7 (m, 9H, aromatic), 4.23 (q, 2H, CH_3-CH_2-O, J = 7 Hz), 2.65 (s, 3H, CH_3), 2.37 (s, 3H, CH_3-C_6H_4), 1.2 (t, 3H, CH_3-CH_2-O, J = 7 Hz); ms: m/e 347 (M^+, 100), 319 (17), 318 (57), 276 (9), 256 (6), 248 (6), 146 (23), 130 (8), 129 (17), 103 (13), 77 (10).

Anal. Calcd. for $C_{22}H_{21}NO_3$: C, 76.05; H, 6.09; N, 4.03. Found: C, 76.38; H, 6.35; N, 3.88.

Ethyl 5-Methyl-3-(*p*-methylphenyl)-*N*-(*p*-methylbenzylidene)-2-aminofuran-4-carboxylate (**6b**).

This compound was obtained in 35% yield (Procedure A) and in 69% yield (Procedure B), mp 118-119° (from ethanol); ir (potassim bromide): 1700, 1610, 1590, 1545, 1420, 1315, 1305, 1265, 1230, 1140, 1080, 1030, 960, 855, 820, 810 cm^{-1}; ^{1}H-nmr (deuteriochloroform): δ 8.53 (s, 1H, CH=N), 7.1-7.7 (m, 8H, aromatic), 4.43 (q, 2H, CH_3-CH_2, J = 8 Hz), 2.63 (s, 3H, CH_3), 2.38 (s, 3H, CH_3-C_6H_4), 2.37 (s, 3H, CH_3-C_6H_4), 1.2 (t, 3H, CH_3-CH_2-O, J = 8 Hz).

Anal. Calcd. for $C_{23}H_{23}NO_3$: C, 76.43; H, 6.41; N, 3.87. Found: C, 76.25; H, 6.37; N, 4.10.

Ethyl 3-(*p*-Methoxyphenyl)-5-methyl-*N*-(*p*-methylbenzilidene)-2-aminofuran-4-carboxylate (**6c**).

This compound was obtained in 11% yield (Procedure A) and in 76% yield (Procedure B), mp 124-125° (from ethanol); ir (potassium bromide): 1700, 1610, 1550, 1510, 1430, 1320, 1310, 1290, 1250, 1230, 1170, 1145, 1085, 1030, 830, 820, 790 cm^{-1}; ^{1}H-nmr (deuteriochloroform): δ 8.37 (s, 1H, CH=N) 6.7-7.6 (m, 8H, aromatic), 4.15 (q, 2H, CH_3-CH_2, J = 7 Hz), 3.8 (s, 3H, J = 7 Hz), 3.8 (s, 3H, OCH_3), 2.58 (s, 3H, CH_3-C_6H_4), 2.33 (s, 3H, CH_3-C_6H_4), 1.2 (t, 3H, CH_3-CH_2-O, J = 7 Hz).

Anal. Calcd. for $C_{23}H_{23}NO_4$: C, 73.19; H, 6.14; N, 3.71. Found: C, 73.00; H, 6.40; N, 3.70.

Ethyl 3-(*p*-Chlorophenyl)-5-methyl-*N*-(*p*-methylbenzylidene)-2-aminofuran-4-carboxylate (**6e**).

This compound was obtained in 34% yield (Procedure A), and in 66% yield (Procedure B), mp 137-138° (from ethanol); ir (potassium bromide): 1700, 1610, 1580, 1550, 1490, 1420, 1315, 1310, 1230, 1145, 1090, 855, 820, 785 cm^{-1}; ^{1}H-nmr (deuteriochloroform): δ 8.57 (s, 1H, CH=N), 7.1-7.7 (m, 8H, aromatic), 4.2 (q, 2H, CH_3-CH_2-O, J = 7 Hz), 2.63 (s, 3H, CH_3), 2.37 (s, 3H, CH_3-C_6H_4), 1.2 (t, 3H, CH_3-CH_2-O, J = 7 Hz).

Anal. Calcd. for $C_{22}H_{20}ClNO_3$: C, 69.20; H, 5.28; N, 3.67; Cl, 9.30. Found: C, 69.57; H, 5.17; N, 3.44; Cl, 9.78.

Ethyl 5-Methyl-3-(*p*-nitrophenyl)-*N*-(*p*-methylbenzylidene)-2-aminofuran-4-carboxylate (**6d**).

Following the general procedure for the synthesis of 2-aryl-3-ethoxycarbonyl-4-oxopentanenitriles **4** to a suspension of 2 g of ethyl α-acetyl-*p*-nitrocinnamate (**2d**) (7.6 mmoles) in 20 ml of ethanol a solution of 2.07 g of potassium cyanide (31.8 mmoles) in *ca.* 5 ml of water is added. The reaction is stirred for 1.5 hours, and 1.43 g of oily product is obtained. It could not be purified by column chromatography and was used in the next reaction without further purification. This product (1.22 g) is dissolved in 11 ml of absolute ethanol, then 0.53 g of *p*-methylbenzaldehyde (4.4 mmoles) and a few drops of piperidine are added. This reaction is stirred overnight at room temperature. Then 0.2 g of solid is separated by filtration and recrystallization from ethanol in 12% yield, mp 194-196° (from ethanol); ir (potassium bromide): 1710, 1590, 1555, 1510, 1430, 1325, 1310, 1230, 1150, 1090, 860, 850, 810, 790, 770, 700 cm^{-1}; ^{1}H-nmr (deuteriochloroform): δ 8.62 (s, 1H, CH=N), 7.1-8.3 (m, 8H, aromatic), 4.25 (q, 2H, CH_3-CH_2-O, J = 7 Hz), 2.68 (s, 3H, CH_3), 2.42 (s, 3H, CH_3-C_6H_4), 1.2 (t, 3H, CH_3-CH_2-O, J = 7 Hz).

Anal. Calcd. for $C_{22}H_{20}N_2O_5$: C, 67.33; H, 5.14; N, 7.14. Found: C, 67.04; H, 5.10; N, 7.39.

Acknowledgement.

Support of this work by a grant from the Comisión Asesora de Investigación Científica y Técnica of the Presidencia de Gobierno of Spain is gratefully acknowledged. One of us (J. A. C.) would like to thank the Ministerio de Educación y Ciencia of Spain for a fellowship. We are indebted to Professor A. Garcia-Martinez for the mass spectra.

REFERENCES AND NOTES

[1] Previous paper in this series: M. J. Rubio, C. Seoane, J. L. Soto and A. Susaeta, *Ann. Chem.*, 210 (1986).

[2] D. M. X. Donnelly and M. J. Meegan in A. R. Katritzky and C. W. Rees, "Comprehensive Heterocyclic Chemistry", Vol **4**, Pergamon Press, Oxford, New York, 1984, pp 657-712.

[3] J. A. Joule and G. F. Smith "Heterocyclic Chemistry", 2nd Ed,

Van Nostrand-Reinhold, London, 1978.

[4] M. V. Sargent and T. M. Cresp in "Comprehensive Organic Chemistry", D. H. R. Barton, ed, Vol **4**, Pergamon Press, 1979, pp 725-727.

[5] L. Capuano and W. Fischer, *Chem. Ber.*, **109**, 212 (1976).

[6] T. Kato, H. Kimura, and K. Tankji, *Chem. Pharm. Bull.*, **26**, 3880 (1978).

[7] K. Gewald, *Chem. Ber.*, **99**, 1002 (1966).

[8] V. J. Arán and J. L. Soto, *Synthesis*, 513 (1982).

[9] V. J. Arán and J. L. Soto, *An. Quim.*, **79C**, 340 (1983).

[10] S. Ruheman, *J. Chem. Soc.*, **85**, 1456 (1904).

[11] J. P. Vecchionacci, J. C. Canévet and Y. Graff, *Bull. Soc. Chim. France*, 1683 (1974).

[12] I. Gosney and D. Loyd, *Tetrahedron*, **29**, 1697 (1973).

[13] R. Danion-Bougot and R. Carrie, *Bull. Soc. Chim. France*, 2526 (1698).

[14] K. Folkers, *J. Am. Chem. Soc.*, **58**, 1558 (1936).

[15] B. Flürscheim, *Chem. Ber.*, **34**, 788 (1901).

[16] R. F. Silver, K. Ann. Kerr, P. D. Frandsen, S. J. Kelley and H. L. Holmes, *Can. J. Chem.*, **45**, 1001 (1967).

[17] G. Heller, H. Lanth and A. Buchwaldt, *Chem. Ber.*, **55**, 486 (1922).

[18] P. P. Bagchi and P. I. Ittyerah, *Agra, Univ. J. Res.*, **4**, 5 (1955).

[19] The duplicity of signals is due to the diastereomeric mixture.