[Communication from the Chemical Institute of the Serbian Academy of Sciences and the Chemical Institute of the Faculty of Sciences in Belgrade]

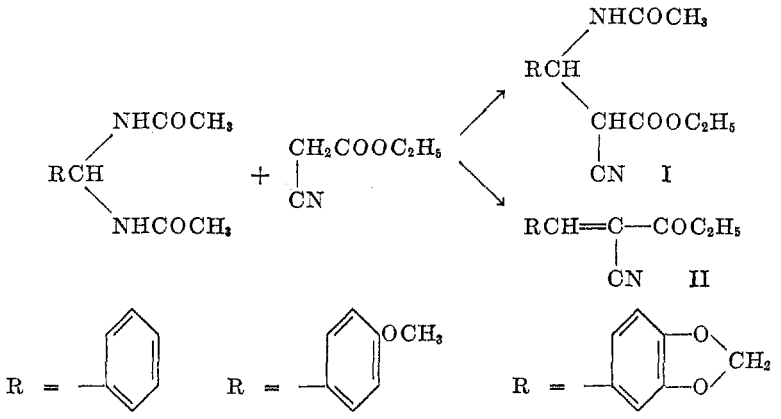
REACTIONS OF BISAMIDES. IV. SYNTHESIS OF DERIVATIVES OF α-CYANO-β-ARYLACRYLIC ACIDS

GJORGJE STEFANOVIĆ and ZORICA NIKIĆ

Received February 4, 1952

Studies described in previous papers of this series (1–3) have shown that bisamides react readily with compounds possessing active H atoms. Thus, by the reaction of bisamides with ethyl nitroacetate, derivatives of α-nitro-β-amino acids (1), with nitromethane α-nitro-β-amino hydrocarbons (2), and with ethyl acetoacetate α-carbethoxy-β-acetylamino-β-arylethyl methyl ketones (3) are obtained. The reaction takes place in every case with one amide group of the bisamide, the other one remaining unchanged.

In this paper we report the results of our studies on the effect of ethyl cyanoacetate on bisamides. It was assumed that ethyl cyanoacetate would also react with bisamides in the same manner as the reagents mentioned, that is, to form compounds of formula I. However, instead of I, the products of the reaction were β-aryl-α-cyanoacrylic acids (II). Probably the compounds I are formed in the first step of the reaction, but they easily lose the acetamido group, obviously because the cyano group weakens the bond connecting the acetamido group to the rest of the molecule.



Compounds of these types have previously been synthesized in several ways: from aromatic aldehydes and ethyl cyanoacetate in alcohol in the presence of sodium ethoxide as condensing agent (4); by action of hydramides on ethyl cyanoacetate in benzene (5); from substituted benzalmalonic acid diethyl esters and ethyl cyanoacetate in alcohol in the presence of diethylamine (6).

By action of ethyl cyanoacetate on benzylidenebisacetamide, we have obtained α-cyano-β-benzalacrylic acid ethyl ester (II, R = C_6H_5) which proved to

be identical with the compound Carrick (4) prepared. Likewise, from ethyl cyanoacetate and the corresponding bisamides we have obtained ethyl α-cyano-β-(3,4-methylenedioxyphenyl)acrylate (II, R = $CH_2O_2C_6H_3$) and ethyl α-cyano-β-(4-methoxyphenyl)acrylate (II, R = $CH_3OC_6H_4$); both proved to be identical with the compounds which Bechert (7) had synthesized in a different way.

All the reactions were carried out directly by heating equimolecular amounts of the bisamide and ethyl cyanoacetate in the absence of any solvent or condensing agent. The yields of crude α-cyano-β-arylacrylic acid esters range between 50% and 80%.

These condensations can also take place in the presence of acetic anhydride (5 moles of anhydride to 1 mole of reacting components), but in these cases the yields are considerably lower.

EXPERIMENTAL

1. Ethyl α-cyano-β-benzalacrylate (II, R = C_6H_5). *A. Prepared from benzylidenebisacetamide and ethyl cyanoacetate.* Benzylidenebisacetamide (20.6 g.) melting at 240° (0.1 mole) and 11.3 g. of freshly distilled ethyl cyanoacetate (0.1 mole) are placed in a 100-cc. flask provided with an air-condenser. The mixture is heated for 8 hours in an oil-bath at 140–150°. After having cooled down, the reaction mixture is washed two to three times with approximately 50 cc. of hot water in order to remove acetamide. The crystalline mass is shaken several times with 50 cc. of ether. The ether extract is distilled to dryness. The remaining crystalline mass is crystallized from 96% ethyl alcohol, yielding 12.1 g. (yield 60.2%) of crude product melting at 49°. After several crystallizations from 96% ethyl alcohol with charcoal, colorless crystals of m.p. 51° are obtained. Carrick (4) gives m.p. 51°.

B. Prepared from benzylidenebisacetamide and ethyl cyanoacetate in the presence of acetic anhydride. Benzylidenebisacetamide (10.3 g., 0.05 mole), 5.6 g. of ethyl cyanoacetate (0.05 mole), and 25.5 g. of acetic anhydride (5 × 0.05 mole) are mixed in a 100-cc. flask. The mixture is heated for 4 hours as under *1A*. It is then allowed to stand on ice for 48 hours, during which time crystals of acetamide separate. They are filtered, and the filtrate is distilled *in vacuo* in order to remove acetic anhydride and unreacted ethyl cyanoacetate. The solid mass which remains in the distilling flask is washed with warm water in order to remove the rest of acetamide, and the residue is crystallized from 96% ethyl alcohol, yielding 1 g. (10.8%) of crude product, m.p. 48°. After several crystallizations, the pure product melting at 51° is obtained.

Anal. Calc'd for $C_{12}H_{11}NO_2$: N, 6.96. Found: N, 7.19.

2. Ethyl α-cyano-β-(4-methoxyphenyl)acrylate (II, R = $CH_3OC_6H_4$). 4-Methoxybenzylidenebisacetamide melting at 231° (11.8 g., 0.05 mole) is mixed with 5.6 g. of ethyl cyanoacetate (0.05 mole) and heated for 8 hours to a bath temperature of 140–150°. Following the procedure described under *1A*, 7.2 g. (62.2%) of crude product of m.p. 81° is obtained. After several recrystallizations from 96% ethyl alcohol, with the addition of charcoal, crystals of a hardly noticeable green tint were obtained, m.p. 85°. M.p. of Bechert's product (7) is 85°.

Anal. Calc'd for $C_{13}H_{13}NO_3$: N, 6.06. Found: N, 6.27.

3. Ethyl α-cyano-β-(3,4-methylenedioxyphenyl)acrylate (II, R = $CH_2O_2C_6H_3$). Following the procedure of Exp. *1A*, 12.5 g. of 3,4-methylenedioxybenzylidenebisacetamide melting at 238° (0.05 mole) and 5.6 g. of ethyl cyanoacetate (0.05 mole) yielded 12.3 g. (90.8%) of crude product, m.p. 101°. After several recrystallizations from 96% ethyl alcohol, with the addition of charcoal, crystals of a very faint green color melting at 106° were obtained. Bechert (6) gives m.p. 106°. Piccinini (8) m.p. 110°.

Anal. Calc'd for $C_{13}H_{11}NO_4$: N, 5.71. Found: N, 5.96.

SUMMARY

When bisamides are reacted with ethyl cyanoacetate, one acetamido group is substituted by the cyanoacetate radical and the second acetamido group is split off, leading to the formation of β-aryl derivatives of α-cyanoacrylic esters.

STUDENTSKI TRG 1
BELGRADE, YUGOSLAVIA

REFERENCES

(1) STEFANOVIĆ AND BOJANOVIĆ, *J. Org. Chem.*, **17**, 816 (1952).
(2) STEFANOVIĆ, BOJANOVIĆ, AND SIROTANOVIĆ, *J. Org. Chem.*, **17**, 1110 (1952).
(3) STEFANOVIĆ AND STEFANOVIĆ, *J. Org. Chem.*, **17**, 1114 (1952).
(4) CARRICK, *J. prakt. Chem.*, **45**, 501 (1892).
(5) BECCARI, *Chem. Zentr.*, II, 741 (1902).
(6) SCHEIBER AND MEISEL, *Ber.*, **48**, 253 (1915).
(7) BECHERT, *J. prakt. Chem.*, **50**, 10, 18 (1894).
(8) PICCININI, *Chem. Zentr.*, II, 622 (1905).