

STUDIES ON KETENE AND ITS DERIVATIVES (XC)<sup>1</sup>

## REACTION OF DIKETENE WITH ETHYL CYANOACETATE AND MALONONITRILE

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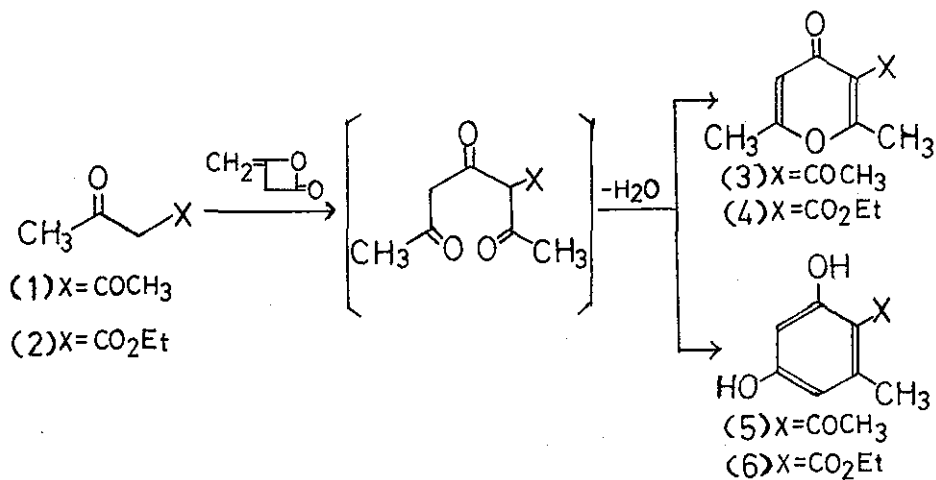
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Reaction of diketene with ethyl cyanoacetate (7) gives ethyl 2-amino-6-methyl-4-pyrone-3-carboxylate (9), which is transformed to ethyl 4-hydroxy-6-methyl-2-pyridone-3-carboxylate (11). Similarly, diketene reacts with malononitrile (8) to give 2-amino-3-cyano-6-methyl-4-pyrone (10), which is converted to 3-cyano-4-hydroxy-6-methyl-2-pyridone (12).

Hamamoto<sup>2</sup> reported that diketene reacted with acetylacetone (1) in the presence of an acidic catalyst to give 3-acetyl-2,6-dimethyl-4-pyrone (3). We reinvestigated this reaction and found that when the reaction was carried out under basic conditions, acetylorcinol (5) was obtained besides compound (3).<sup>3</sup> Similar reactions of  $\beta$ -ketoesters such as ethyl acetoacetate (2) gave the pyrone (4) and ethyl orsellinate (6).<sup>4</sup> These reactions involve acetoacetylation of the active methylene of acetylacetone (1) and

ethyl acetoacetate (2) followed by cyclization to give the pyrones (3 and 4) and the orcinol derivatives (5 and 6). Recently, Suzuki reported the application of this reaction using diethyl malonate<sup>5</sup> and diethyl acetonedicarboxylate<sup>6</sup> as active methylene compounds to give the pyrone and the resorcinol derivatives. In the present communication we wish to report the reaction of diketene with ethyl cyanoacetate (7) and malononitrile (8) to give the 2-amino-4-pyrone derivatives (9) and (10), respectively.



Ethyl cyanoacetate (7) was treated with an equimolar amount of sodium hydride in tetrahydrofuran (THF) under ice cooling. To the mixture was added an equimolar amount of diketene at  $-10^\circ$ . After stirring for 30 min, the mixture was neutralized with hydrochloric acid, and then condensed to dryness in vacuo at room temperature to give a 18% yield of the product (9) as colorless leaves, mp  $164 - 165^\circ$ . Anal. Calcd. for  $\text{C}_9\text{H}_{11}\text{NO}_4$ : C, 54.82; H, 5.62; N, 7.10. Found: C, 55.01; H, 5.70; N, 7.10. ir max ( $\text{CHCl}_3$ )

3480, 3285, 1685, and 1655  $\text{cm}^{-1}$ . nmr  $\delta$  ( $\text{CDCl}_3$  -  $\text{DMSO-d}_6$ ) 1.23 (3H, t,  $J = 7$  Hz,  $\text{OCH}_2\text{CH}_3$ ), 2.37 (3H, s, 6- $\text{CH}_3$ ), 4.18 (2H, q,  $J = 7$  Hz,  $\text{OCH}_2\text{CH}_3$ ), 5.69 (1H, s, 5-H), 8.42 (2H, br,  $\text{NH}_2$ ).

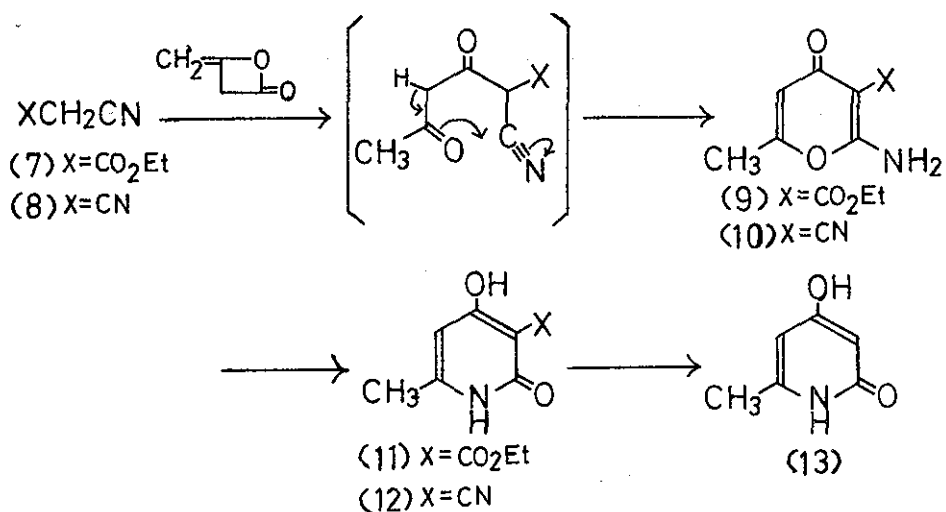
Compound (9) was dissolved in absolute ethanol saturated with hydrogen chloride, and the solution was refluxed for 10 hr to give the pyridone (11) in 60% yield, mp 205 - 206° (lit.<sup>7</sup> mp 206 - 206.5°). Refluxing of (11) in ethanol in the presence of potassium hydroxide gave the hydroxypyridone (13) in 70% yield, mp 318° (decomp.) (lit.<sup>7</sup> mp 320° (decomp.)).

Similarly, reaction of compound (8) with diketene in THF in the presence of sodium hydride gave a 81% yield of the product (10) as pale yellow needles (from ethanol), mp 275° (decomp.).

Anal. Calcd. for  $\text{C}_7\text{H}_6\text{N}_2\text{O}_2$ : C, 56.00; H, 4.03; N, 18.66. Found: C, 56.15; H, 4.14; N, 18.61. ir max (KBr) 3280, 2240, and 1675  $\text{cm}^{-1}$ . nmr  $\delta$  ( $\text{DMSO-d}_6$ ) 2.17 (3H, s, 6- $\text{CH}_3$ ), 5.86 (1H, s, 5-H), 8.46 (2H, br,  $\text{NH}_2$ ).

Compound (10) was dissolved in absolute ethanol, and the solution was saturated with hydrogen chloride. The mixture was refluxed for 5 hr, and condensed to dryness. Recrystallization of the residue gave the product (12) in 75% yield, mp 295° (decomp.).

Anal. Calcd. for  $\text{C}_7\text{H}_6\text{N}_2\text{O}_2$ : C, 56.00; H, 4.03; N, 18.66. Found: C, 55.83; H, 3.99; N, 18.48. ir max (KBr) 3460, 3170, 2260, and 1635  $\text{cm}^{-1}$ . nmr  $\delta$  ( $\text{DMSO-d}_6$ ) 2.44 (3H, s, 6- $\text{CH}_3$ ), 5.96 (1H, s, 5-H), 6.35 (1H, br, NH), 11.73 (1H, br, OH). Heating of compound (12) in 60% sulfuric acid gave rise to the known compound (13) in 73% yield.



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