

# Unusual Reactions of 5,5-Dimethyl-2-(indenyl-2)-3-pyrazolidinone with Acetylenedicarboxylates

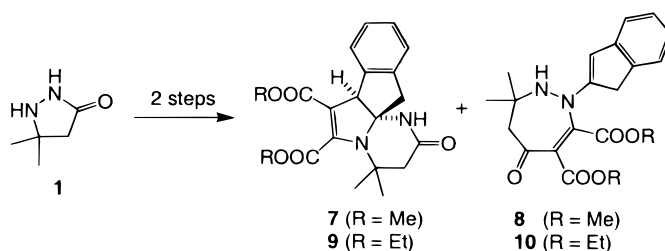
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## ABSTRACT



Reaction of 5,5-dimethyl-3-pyrazolidinone (**1**) with 2-indanone (**2**) gave 5,5-dimethyl-2-(1*H*-indenyl-2)-3-pyrazolidinone (**3**) instead of the expected azomethine imine **4**. Although reaction of 2-substituted 3-pyrazolidinones with acetylenedicarboxylates usually gives ring expansion products, such as 1,2-diazepines, treatment of **3** with dialkyl acetylenedicarboxylates (**5**, R = Me; **6**, R = Et) resulted in the formation of *rel*-(7*aR*,12*aS*)-6,7-bis(alkoxycarbonyl)-3,4-dihydro-4,4-dimethyl-7*aH*-indano[1,2-*b*]pyrrolo[1,2-*a*]pyrimidin-2-ones (**7**, R = Me; **9**, R = Et) as major products and 3,4-bis(alkoxycarbonyl)-7,7-dimethyl-2-(indenyl-2)-6,7-dihydro-2*H*,6*H*-1,2-diazepin-5-ones (**8**, R = Me; **10**, R = Et) as minor products.

In the last two decades, substituted 3-pyrazolidinones have become an important class of compounds exhibiting biological activity and a wide applicability for industrial and synthetic purposes.<sup>1,2</sup> Previously, we reported on stereoselective 1,3-dipolar cycloaddition reactions of azomethine imines derived from diazoalkane–pyridazine cycloadducts<sup>3</sup> *rel*-(4*R*,5*R*)-4-benzoylamino-5-phenyl-3-pyrazolidinone<sup>4</sup> and (*S*)-1-benzoyl-3-[(*E*)-cyanomethylidene]-5-methoxycarbonyl-2-pyrrolidinone,<sup>5</sup> and, recently, the utilization of *rel*-(4*R*,5*R*)-

4-benzoylamino-5-phenyl-3-pyrazolidinone in the synthesis of 3-alkylamino- and 3-(pyrazolyl-1)-substituted alanine derivatives.<sup>6</sup>

We now report unusual transformations of 5,5-dimethyl-3-pyrazolidinone (**1**)<sup>7</sup> with 2-indanone (**2**) and further transformations of the condensation product **3** with dimethyl (**5**) and diethyl acetylenedicarboxylate (**6**).

Reactions of 3-pyrazolidinones with electrophiles, e.g., aldehydes and ketones, usually proceed at the nitrogen at position 1, furnishing the corresponding azomethine imines.<sup>1</sup>

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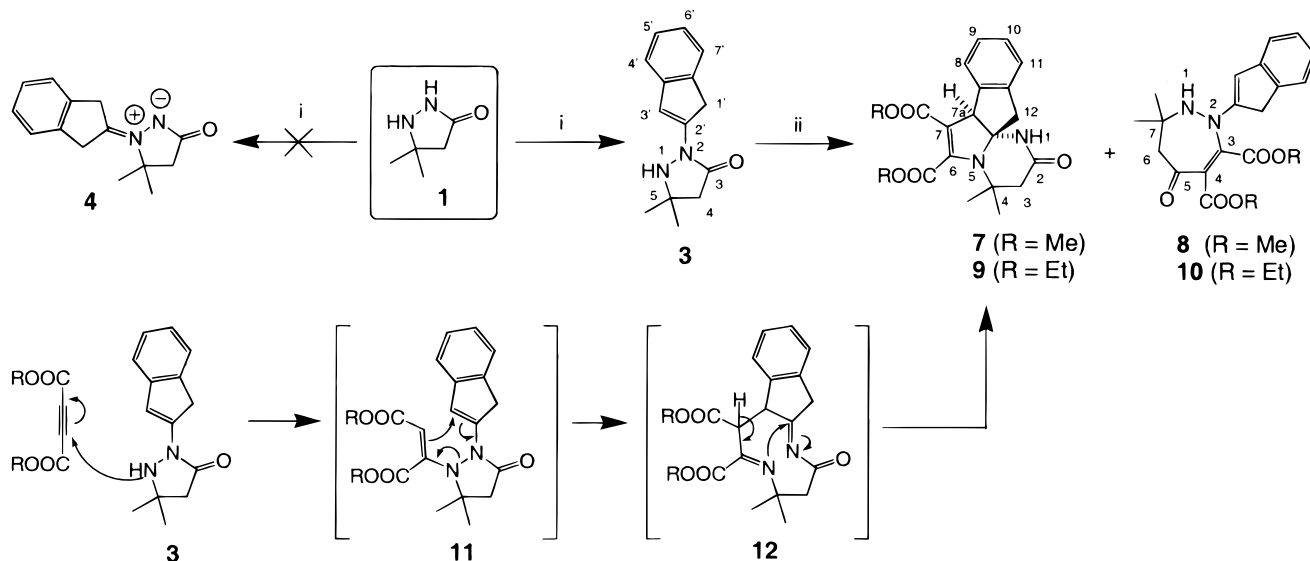
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Scheme 1



To our surprise, 5,5-dimethyl-2-(1*H*-indenyl-2)-3-pyrazolidinone (**3**) was obtained instead of the expected azomethine imine **4** after acid-catalyzed treatment of 5,5-dimethyl-3-pyrazolidinone (**1**) with 2-indanone (**2**). According to previous reports,<sup>8</sup> reaction of **3** with dimethyl acetylenedicarboxylate (**5**) should give the corresponding diazepine **8** and/or Michael adduct **11**. However, reaction of 5,5-dimethyl-2-(1*H*-indenyl-2)-3-pyrazolidinone (**3**) with dimethyl acetylenedicarboxylate (**5**) afforded *rel*-(7*aR*,12*aS*)-6,7-bis(methoxycarbonyl)-3,4-dihydro-4,4-dimethyl-7*aH*-indano[1,2-*b*]pyrrolo[1,2-*a*]pyrimidin-2-one (**7**) as the main product together with 3,4-bis(methoxycarbonyl)-7,7-dimethyl-2-(1*H*-indenyl-2)-6,7-dihydro-2*H*,6*H*-1,2-diazepin-5-one (**8**) as the minor product. Similarly, treatment of **3** with diethyl acetylenedicarboxylate (**6**) gave *rel*-(7*aR*,12*aS*)-6,7-bis(ethoxycarbonyl)-3,4-dihydro-4,4-dimethyl-7*aH*-indano-[1,2-*b*]pyrrolo[1,2-*a*]pyrimidin-2-one (**9**) and 3,4-bis(ethoxycarbonyl)-7,7-dimethyl-2-(1*H*-indenyl-2)-6,7-dihydro-2*H*,6*H*-1,2-diazepin-5-one (**10**). So far, we do not have firm proof for the mechanism of the transformation of **3** into tetracyclic compounds **7** and **9**; however, we presume that this trans-

formation proceeds via formation of Michael adduct **11** which then undergoes a 3,3-aza-Cope sigmatropic rearrangement to **12** followed by intramolecular cyclization to **7** or **9**. The proposed mechanism is supported by the fact that 3-pyrazolidinones give Michael adducts as primary products upon treatment with acetylenedicarboxylates.<sup>1,8</sup> Furthermore, a closely related example of the formation of 7*aH*-indano-[1,2-*b*]pyrrolo[1,2-*a*]pyrimidin-2-ones from 2-phenyl-3-pyrazolidinone and cyclopentanone has been previously reported in the literature (Scheme 1).<sup>9</sup>

Structures of compounds **3** and **7–10** were determined by NMR and analyses for C, H, and N. The structures of compounds **3** and **7** were also confirmed by X-ray analysis.

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**Supporting Information Available:** Experimental procedures, characterization data for all new compounds, and X-ray analyses for compounds **3** and **7**. This material is available free of charge via the Internet at <http://pubs.acs.org>.

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