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Domino reactions based on Knoevenagel condensation in the synthesis of heterocyclic compounds. Recent advances.

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1. Introduction

In modern-day organic chemistry, a growing tendency towards green and sustainable synthesis has been well illustrated by domino reactions, which allow the direct synthesis of complex molecules in a highly efficient way [1]. The synthesis of complex organic substances needs to rely on methods that provide the maximum efficiency. Organic reactions are traditionally viewed as linear and stepwise processes in which the isolation and purification of key intermediates often leads to low yields. Domino reactions, on the other hand, allow access to complex molecules in an effective, atom-economical manner.

In recent years, Knoevenagel-condensation-triggered domino reactions have emerged as a powerful protocol that not only allows the efficient synthesis of complex heterocyclic compounds including natural products starting from simple substrates but also permits the preparation of highly diverse molecules.

In this article, rather than attempting to provide an exhaustive treatment, we will focus on highlighting advances in the synthesis of heterocycles based on domino reactions initiated by the Knoevenagel condensation except those, followed by the Diels-Alder reaction, which were reviewed earlier [2].

2. Five-membered heterocycles

2.1 With one heteroatom

2.1.1 Nitrogen

Polysubstituted pyrrolidines condensed with a phenanthridine ring **1** can be prepared under mild conditions in excellent yields through a multicomponent reaction of benzaldehydes, malononitrile, isocyanides, and phenanthridine (Scheme 1). It was assumed that the domino reaction began with a Knoevenagel condensation. This was followed by the addition of isonitrile to the resulting double bond, addition of phenanthridine to intermediate **2**, and finally

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