

DOCTORAL DISSERTATION ABSTRACT

Title of the doctoral dissertation:

N-Heterocyclic carbenes as catalysts in stereoselective synthesis of heterocycles: annulation and cascade reaction strategies

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The current thesis focuses on enantioselective organic synthesis with the use of N-heterocyclic carbenes (NHC) as organocatalysts. The main part of the research explores different activation strategies for α,β -unsaturated enals and ynals. The special attention was given to methodologies involving *umpolung* and *non-umpolung* concepts, which are highly effective ways to achieve the desired stereoselectivity of the products. The research consists of four different and carefully designed distinct synthetic models, which were performed and analyzed to demonstrate the unique abilities of NHC catalysis across various reactions. By utilizing cascade and annulation processes, it was possible to obtain complex structures in an effective and economical way. These techniques facilitated the synthesis of complex, multicyclic, organic molecules and paved the way towards new approaches in organic synthesis. In the presented research, the versatility of NHCs as organocatalysts was demonstrated through precisely selected substrates. Carbene catalysis has opened the possibility of obtaining variable-size lactones. Those lactone rings are fused with pharmaceutically crucial structural motifs, for example, 1,2-benzothiazine-1,1-dioxide, its isomer 2,1-benzothiazine-2,2-dioxide, and dihydroquinoline. Furthermore, employing a prochiral substrate containing a trifluoromethyl group leads to γ -lactone and dihydroquinoline cores with a fluorinated group placed in the stereogenic center on the sp^3 carbon atom. For all presented in the thesis models the mechanistic analysis of reactions were guided allowing to deeper insight into the interaction of the substrate with chosen catalyst and the influence of reaction conditions on the product and its performance. That, in turn, is an important part of described research as it gives hints in the topic of subtle equilibrium between factors influencing on the selectivity and yield of the process.