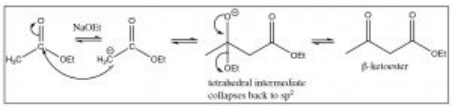
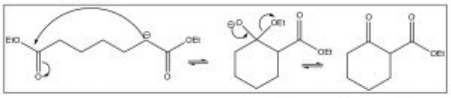
9.3: The Claisen Condensation

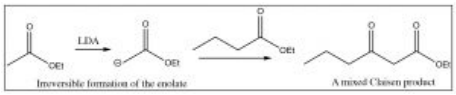
As we have noted, all carbonyl compounds are capable of forming enols and enolate anions, and just as aldehydes and ketones undergo condensation reactions with each other, so then to esters. The ester version of the aldol is called a Claisen condensation, but the essential details are very similar in terms of the initial mechanistic sequence.



The enolate anion of the ester attacks the carbonyl of another molecule and the resulting tetrahedral intermediate collapses back to the carbonyl by regenerating the ethoxide anion that was used to initiate enolate formation. The difference between the Claisen and the aldol reactions is that the Claisen product is a β-ketoester, which can be a useful species in its own right. Claisen condensations can also form rings via intramolecular condensations (which are known as Dieckmann cyclizations).



Both Aldol and Claisen condensations can be carried out between two different carbonyl compounds: however, if both are capable of forming enolates, there is the possibility of forming four different products. Consider two carbonyl compounds A and B, if enol A reacts with carbonyl B, we get product AB, but if enol B reacts with carbonyl A we get product BA (which would have a different structure). A can also condense with another A to form product AA, and similarly we could get BB. Therefore, it is important to control the reaction conditions carefully: for example, by using an irreversible base such as LDA to form the enolate first. This precludes the possibility of the enolate reacting with itself. Then, the other component can be added slowly to the reaction mixture and the condensation can be carried out.



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