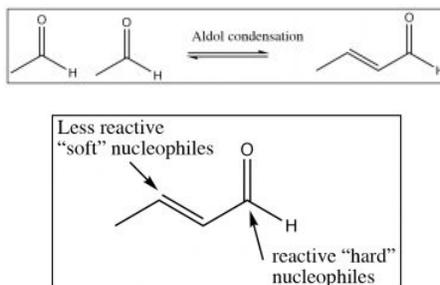


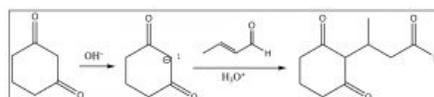
9.6: Michael Reactions

Recall that aldol condensations result in α, β -unsaturated carbonyl compounds, a functionality that we have already discussed at some length.

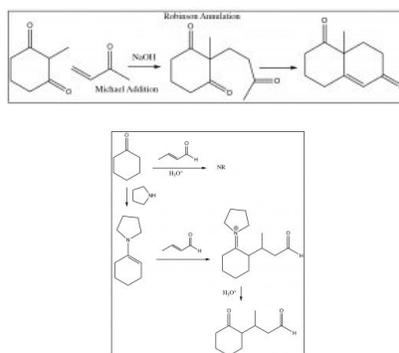


These conjugated carbonyl groups can undergo nucleophilic attack at either the carbonyl carbon or at the β carbon, depending on the nature of the nucleophile. For example: highly reactive (or “hard”) nucleophiles like Grignards or alkyl lithiums tend to react at the carbonyl carbon, while less reactive (soft) nucleophiles like dialkyl cuprates or reversible nucleophiles like amines or alcohols tend to react at the β carbon.

Anions formed from β -diketones are relatively unreactive (they are stabilized) and, therefore, we might predict that they will attack the conjugated carbonyl at the β position – and we would be correct! This reaction is called the Michael reaction.



In fact, we can condense the same β -diketone with a different conjugated ketone (not formed from an aldol condensation) to produce an intermediate that can then undergo an intramolecular aldol condensation as shown below. This two-step procedure is called the Robinson Annulation.



Unfortunately, this reaction only works well with beta-diketones; a simple ketone does not attack the conjugated system. However, there is a relatively simple solution to this, which is to modify the ketone to form an enamine, which will then react as shown below. This variation is known as the Stork enamine synthesis.

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