Objectives

After completing this section, you should be able to

1. write an equation to illustrate the formation of a conjugated enone from a β-hydroxy aldehyde or ketone.
2. write a detailed mechanism for the basic or acidic elimination of water from a β-hydroxy aldehyde or ketone.
3. explain why β-hydroxy aldehydes and ketones undergo elimination reactions much more readily than most other alcohols.
4. identify the enone products from the aldol condensation of a given aldehyde or ketone.

Study Notes

Conjugated enones, like conjugated dienes, have more inherent stability compared with their non-conjugated counterparts. You may wish to review Section 14.1 on dienes, which gives a molecular orbital description showing π electron distribution over four atomic centres.

Note that both of the elimination mechanisms described here (acidic and basic) involve either the enol form or the enolate anion of the β-hydroxy carbonyl compound.

Aldol Condensation: the dehydration of Aldol products to synthesize α, β unsaturated carbonyls (enones)

The products of aldol reactions often undergo a subsequent elimination of water, made up of an alpha-hydrogen and the beta-hydroxyl group. The product of this \(\text{\beta}\text{-elimination}\) reaction is an α,β-unsaturated aldehyde or ketone. Base-catalyzed elimination occurs with heating. The additional stability provided by the conjugated carbonyl system of the product makes some aldol reactions thermodynamically driven and mixtures of stereoisomers (E & Z) are obtained from some reactions. Reactions in which a larger molecule is formed from smaller components, with the elimination of a very small by-product such as water, are termed Condensations. Hence, the following examples are properly referred to as aldol condensations. Overall the general reaction involves a dehydration of an aldol product to form an alkene:

Figure: General reaction for an aldol condensation
Going from reactants to products simply

**Figure**: The *aldol condensation* example

Example 23.3.2: Aldol Condensation

Aldol Condensation Base Catalyzed Mechanism

1) Form enolate

2) Form enone

Aldol Condensation Acid Catalyzed Mechanism

Under Acidic conditions an enol is formed and the hydroxy group is protonated. Water is expelled by either and E1 or E2 reaction.

When performing both reactions together always consider the aldol product first then convert to the enone. Note! The
double bond always forms in conjugation with the carbonyl.

Example 23.3.3

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