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ARYNIC CONDENSATIONS OF KETONE ENOLATES XII[‡]

CONDENSATION OF α,β UNSATURATED KETONE ENOLATES ON BENZYNE, SIMPLE SYNTHESIS OF TETRALONES OR INDANONES

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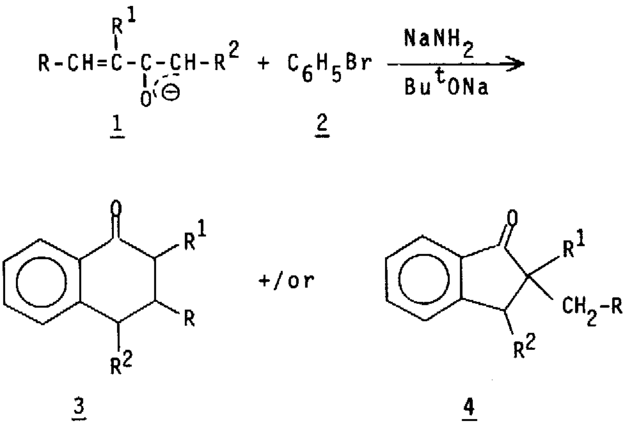
In earlier papers (1) we have shown that arynic condensations of saturated ketone enolates are interesting tools for the synthesis of many structures. With unsaturated ketone enolates a few results have been already obtained by Sammes and al. (2) and by ourselves (3).

We report here new and rather surprising results in this field. In our last paper, we had shown that in the presence of complex base "NaNH$_2$-Bu^{t}ONa" benzalacetone enolate condenses with bromobenzene to give tetralone 3 (R = Ph, $R^1 = R^2 = H$) with a good yield. In fact, a side product is formed which was identified as the indanone 4 (R = Ph, $R^1 = R^2 = H$), so that the most general condensation encountered with this kind of ketones should be written as follows (Scheme I).



Scheme I

[‡] Part XI cf. reference (1)

In Table I we have summarized our main results. It must be noted that minor quantities of side products are formed simultanously with 3 and 4 ; for the present time we have discarded them.

Table I

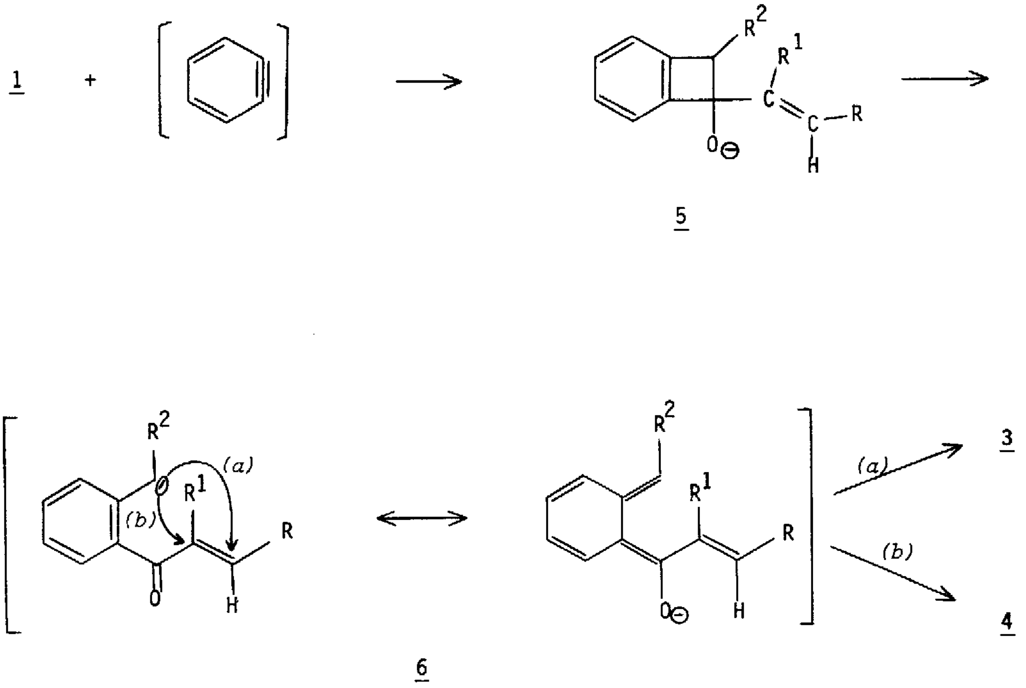
Runs	R	R^1	R^2	3 % (a)	4 % (a)
1	C_6H_5 (b)	H	H	60	10
2	$4\text{-}(MeO)C_6H_4$	H	H	45	-
3	$3,4\text{-}(MeO)_2C_6H_3$	H	H	50	-
4	2-Furyl	H	H	45	-
5	$i\text{-}C_3H_7$	H	H	60	-
6	C_6H_5	H	CH_3	-	60
7	$4\text{-}(MeO)C_6H_4$	H	CH_3	20	40
8	$3,4\text{-}(MeO)_2C_6H_3$	H	CH_3	-	50
9	C_6H_5	$(CH_2)_3$		-	85
10	C_6H_5	$(CH_2)_4$		-	80

(a) Yield based on bromobenzene. The excess of ketone necessary to the reaction (see the general procedure) is recovered in about 60-90 % yield

(b) From our preceding paper (3)

The properties of the isolated ketones in run 1 are identical to those described in the literature (4, 5, 6). The products obtained from the other runs have been identified by their analysis and spectroscopic properties (IR, NMR, UV).

Taking into account what we know about the mechanism of these types of reactions (1, 3), we propose the Scheme II to explain the observed condensations.



Scheme II

The alcoholate 5 may be formed by one or two-step mechanisms (3, 7). We think that structural effects on R^2 which destabilize the negative charge in the benzylic position should favour the attack *(b)*. Thus making $R^2 = CH_3$ or alkyl instead of $R^2 = H$ leads to the formation of 4. On the other hand, the structural effects on R which promote the delocalization of the ethylenic unsaturation towards the carbonyl group should favour the attack *(a)*. Comparison of runs 6, 7 and 8 shows that with $R = 4\text{-}(MeO)C_6H_4$ instead of $R = C_6H_5$ the tetralone 3 reappears. On the contrary in run 8 where a methoxy in position three counterbalances the effect of the one in position four, only the indanone 4 is formed.

It is clear that, if our hypothesis is true, it should be possible to manage, at least partially, the reactions towards 3 or 4 by means of solvent or cations effects. We are now working on this point.

GENERAL PROCEDURE

A solution of Bu^tOH (25 mM) in THF (10 ml) was added to sodamide (100 mM) in THF (20 ml), and stirred for 1,5 h. at 40-45°C under dry nitrogen ; then the ketone (25 mM) in THF (20 ml) was added dropwise at 25-30°C. The mixture was stirred at this temperature for 5-10 min., and bromobenzene (12,5 mM) in THF (10 ml) was added. The reaction was continued for 4 h. at 30°C and 40-45°C for $R^2 \neq H$ and $R^1 = R^2 = H$ respectively.

After cooling to room temperature, the mixture was poured into ice, acidified with HCl 20 %, extracted with ether (3 x 100 ml), and dried over magnesium sulfate. The solvent was removed under reduced pressure and the residual oil was chromatographed on a silica gel column using ether - petroleum ether 2-5 % as eluent.

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