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DEHALOGENATION OF α-HALOKETONES AND VIC-DIBROMIDES WITH NICKEL BORIDE

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Summary : α-Haloketones and vic-dibromides are converted to the corresponding ketones and alkenes respectively with nickel boride generated *in situ* from sodium borohydride and nickel chloride.

During the course of our studies on *in situ* generated nickel boride[1], it was observed that a carbonyl group remains unaffected under appropriate reaction conditions.[2] It was therefore argued that since reductive removal of a halogen in α-haloketones can sometimes be achieved through hydrogenation[3], nickel boride whose generation from sodium borohydride and nickel chloride is accompanied by a sufficient amount of hydrogen evolution[4], could be an effective catalyst in this transformation. The reaction of nickel boride with a variety of α-haloketones was studied and the results are reported in Table 1.

It was found that the reductive removal of a halogen in α-haloketones was highly solvent dependant. Although DMF proved to be the best solvent but comparable yields of the parent ketones were also obtained in HMPT, diglyme and ethylene glycol monomethylether. From Table 1 it is evident that bromoketones are more efficiently reduced than the corresponding chloroketones and this behaviour is reminiscent of the reduction of alkyl halides with organotin hydrides.[5] However α-bromocamphor was recovered unchanged under the reaction conditions.[6]

Table 1 : Reduction of α-Haloketones with Nickel Boride[a–e]

Entry	α-Haloketone Reduced	% Yield of Parent Ketone
1	2-Chlorocyclohexanone	75
2	2-Bromocyclohexanone	90
3	2α-Bromocholestan-3-one	95
4	3β-Acetoxy-7α-bromocholestan-6-one	95
5	p-Bromophenacyl bromide	98
6	Phenacyl bromide	98
7	α-Bromocamphor	No reaction
8	2α-Chlorocholest-4-en-3-one	70
9	(9)	85
10	(10)	90
11	(11)	95
12	(12)	50

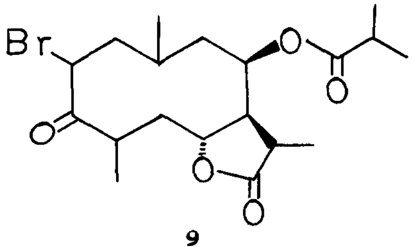
(a) All compounds were characterized by direct comparison (tlc, ir, nmr and ms) with the authentic samples.

(b) Yields refer to the isolated products of > 90% purity.

(c) Nickel chloride refers to the hexahydrate.

(d) The rest of the material in case of entry 8 & 12 was the unreacted starting α-haloketone.

(e) Substrates at entry 9, 10, 11 and 12 were prepared from the natural products available in our laboratory.



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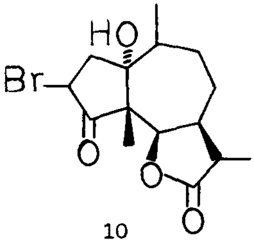

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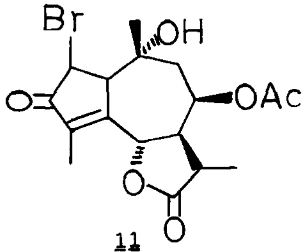

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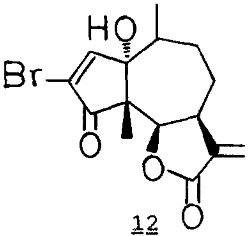

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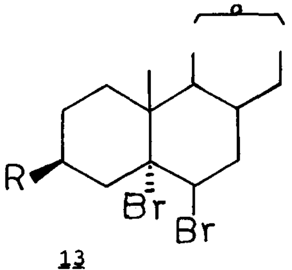
Typical Procedure : To a solution of nickel chloride (1.25 m mol) in 4 ml DMF is added slowly sodium borohydride (2.0 m mol) with stirring at r.t. Immediate formation of the black precipitate of nickel boride is observed with the evolution of hydrogen and the reaction is exothermic. After 2 min. , a solution of α-haloketone (0.5 m mol) in 1.0 ml DMF is added and the reaction mixture stirred till tlc indicated that no further reaction is taking place. In all cases mentioned in Table 1, 80% of the product is formed within 10-15 min. The reaction mixture after dilution with water is extracted with a suitable solvent (Pet ether, b.p. 60-80° for non polar compounds & CH_2Cl_2 for polar compounds) and purified by preparative tlc.

It is pertinent to note that an exomethylene group conjugated with the lactone moiety (or isolated[1]) is not reduced.[7]

Synthetic utility of the conversion of α-haloketones into the parent ketones has been amply demonstrated[8] and literature enumerates numerous methods to achieve this transformation; each one is compatible with a particular set of functionalities.[9] The present method employing mild reaction conditions in an easy to carry out operation and able to sustain various functionalities will be a useful addendum to them.[10]

Reaction of *vic*-dibromides **13**a, **13**b (cholestane series), **14** and **15** with nickel boride using the same procedure as described for α-haloketones furnished the corresponding alkenes in 80-90% yield.[11] We have observed that alkyl chlorides are not reduced with nickel boride whereas alkyl bromides and iodides have been found to be reduced albeit in a poor yield.

The results described above appear to warrant mechanistic study of this reaction which is being undertaken.



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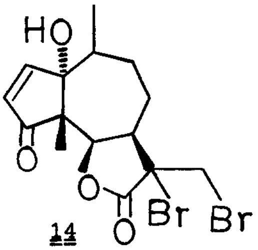
a) R = OH
b) R = Cl



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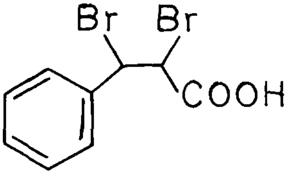

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