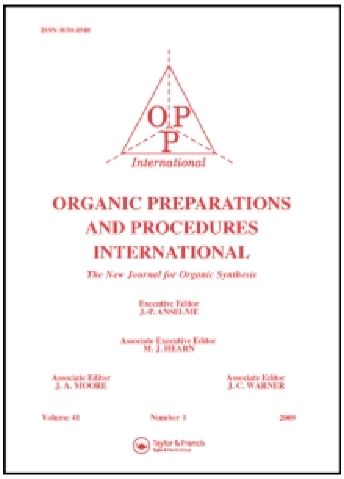
This article was downloaded by:
On: *27 January 2011*
Access details: *Access Details: Free Access*
Publisher *Taylor & Francis*
Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Organic Preparations and Procedures International

Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t902189982

REDUCTIVE ALKYLATION OF ACRYLONITRILES AND ACRYLATES

T. Caronna[a]; A. Citterio[a]; A. Clerici[a]; R. Galli[b]
[a] Istituto di Chemica del Politecnico, Milano, Italy [b] Istituto di Chimica Organica, Parma, Italy

To cite this Article Caronna, T. , Citterio, A. , Clerici, A. and Galli, R.(1974) 'REDUCTIVE ALKYLATION OF ACRYLONITRILES AND ACRYLATES', Organic Preparations and Procedures International, 6: 6, 299 — 303

To link to this Article: DOI: 10.1080/00304947409355124

URL: http://dx.doi.org/10.1080/00304947409355124

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: http://www.informaworld.com/terms-and-conditions-of-access.pdf

This article may be used for research, teaching and private study purposes. Any substantial or systematic reproduction, re-distribution, re-selling, loan or sub-licensing, systematic supply or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

ORGANIC PREPARATIONS AND PROCEDURES INT. 6(6), 299-303 (1974)

REDUCTIVE ALKYLATION OF ACRYLONITRILES AND ACRYLATES

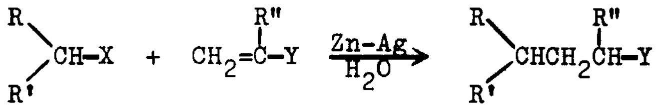
T. Caronna, A. Citterio, A. Clerici

Istituto di Chemica del Politecnico
Piazza L. da Vinci 32, 20133 Milano, Italy

R. Galli*

Istituto di Chimica Organica
Via M. d'Azeglio 85, 43100 Parma, Italy

In the presence of activated metals, secondary alkyl iodides and bromides react with olefins conjugated with electron withdrawing groups, in particular acrylonitriles and acrylates, to give the corresponding products (III) of reductive alkylation.



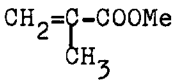
I II III

X = I, Br, (Cl); Y = CN, COOR, etc.

Under the experimental conditions used, alkyl iodides and bromides give the best results as shown in the Table while with alkyl chlorides, the yields are much lower. Among the various metals used, the most effective are zinc dust and copper-activated or preferably silver-activated zinc dust. Satisfactory yields are obtained neither with primary alkyl halides (even though they react with activated metals) nor with the tertiary ones since in this case the zinc halide formed during the reaction favors the Ritter reaction with the nitriles (substrate or solvent).

The reaction mechanism has not yet been thoroughly studied. Recently, it has been observed[1] that the reaction of benzyl and isopropyl halides with metals leads to alkylation of activated substrates, such as protonated heteroaromatic bases *via* free radicals. However, at the present time, we cannot state definitely that radical species are involved. On the other hand, a mechanism involving organometallic compounds is contraindicated since the same reductive alkylation is also obtained in methanol as solvent; in this case, the main product results from the addition of methanol to the acrylic acid derivative.

TABLE

	Alkyl halide	Olefin	Conversion[a] %	Yield[b] %
1.	Cyclohexyl iodide	$CH_2=CH-CN$	54	92
2.	Cyclohexyl iodide	$CH_2=CH-COOMe$	76	90
3.	Cyclohexyl iodide	 $CH_2=C(CH_3)-COOMe$	61	90
4.	Isopropyl iodide	$CH_2=CH-CN$	68	85
5.	Cyclohexyl bromide	$CH_2=CH-CN$	57	70
6.	Cyclohexyl bromide	$CH_2=CH-COOMe$	50	70

---

a) Based on the alkyl halide.
b) Based on converted alkyl halide by glc data.

The complete absence of polymerization coupled with the very simple experimental conditions recommends this reaction as a convenient method for the preparation of compounds not always readily accessible by other routes, from commonly available starting materials.

EXPERIMENTAL

Preparation of the Silver-Zinc Couple.

CAUTION.- It is advisable to carry out the filtration and the washings as rapidly as possible, preferably under nitrogen and to avoid paper filters since the dust may catch fire.

The directions of the literature[2] were modified as follows: Zinc dust (21 g) was stirred with 10% aq. HCl (100 ml) for 15 min. with a magnetic stirrer. The supernatant liquid was decanted and the zinc washed with acetone (2x50 ml) and ethyl ether (50 ml), then dried (mechanical pump). In a 250 ml flask, a suspension of commercial silver acetate (1 g) in glacial acetic acid (100 ml) was boiled to reflux with stirring for 10 min. The heating bath was removed and immediately thereafter, the activated zinc (10 g) was added in one portion to the suspension and with vigorous stirring. Vigorous and spontaneous boiling which started again, without external heating was allowed to continue for an additional 5 min. with continued stirring. The mixture was rapidly cooled with an ice-bath to at least 50°, filtered on a sintered glass funnel and the zinc dust washed first with acetic acid (30 ml) then abundantly with acetone and finally with ethyl ether (2x100 ml). It was kept in a vacuum desiccator (mechanical pump) for 5 hr. over P_2O_5; 9.5-9.8 g of zinc-silver couple were obtained.

Reaction between Alkyl halides and Activated Olefins. General Procedure.- In a four-necked 250 ml flask, equipped with a mechanical stirrer, a thermometer, a reflux condenser and a dropping funnel, the olefin (~0.22 mole) was dissolved in commercial acetonitrile (70 ml) and the Zn-Ag couple (6 g) added to the solution. The stirred mixture was heated to boiling (~70°) and the alkyl halide (0.11 mole) was added over a period of about 1 hr. Before the end of the addition, the previously clear suspension had become cloudy and gray-green in color; the blackish surface of the metallic dust was covered by a gray-green coating. The suspension was refluxed with stirring for 4-6 hr. (with alkyl iodides, 4 hr. is sufficient; with bromides 6 hr. is preferable). The reaction mixture was cooled to room temperature and poured into 1 l. of water slowly with stirring; in this way, the resulting flakes were thin and well dispersed (otherwise bulky lumps are formed which are difficult to filter and extract). After filtration, the liquid was extracted with ethyl ether (2x200 ml); the solid was stirred with aq. 10% HCl at room temperature for 15 min. when practically all the solid had dissolved (if little lumps remained, they were removed by filtration). This solution was also extracted with ethyl ether (2x100 ml) and the combined ethereal extracts were washed with aq. $NaHCO_3$ solution (150 ml) and water (2x200 ml), dried over Na_2SO_4 and evaporated. The residue was distilled in vacuo to give most of the unreacted halide as the first fraction followed by the product, contaminated with a little of the starting halide, as shown by the glc analysis. It is readily purified by a careful redistillation.

The products obtained are all known compounds, except III (R, R' = $(CH_2)_5$, R' = CH_3, X = CO_2CH_3) and were identified by comparison with authentic samples and by their spectra (IR, NMR, MA).

The gas-chromatographic analyses were carried out on a Hewlett-Packard instrument, model 5750 G, using a 6 ft x 1/8" steel column packed with DEGS 10% on Chrmosorb W.

Methyl 3-cyclohexyl-2-methylpropionate.- Bp., 232-233°; NMR ($CDCl_3$, from TMS): 1.12 (d, 3H, $-CH-\underline{CH_3}$); 0.90-1.90 (broad, 11H, cyclohexyl); 2.56 (sextet, 1H, $-\underline{CH}-COOMe$); 3.64 (s, 3H, $-OCH_3$). M.S.: m/e 184 (M^+); major peaks at m/e 153 (m-OMe), 141 ($M-C_3H_7$), 125, 110, 101, 88.

Acknowledgement.- We wish to thank Prof. F. Minisci for encouragement and helpful discussions.

REFERENCES

1.- F. Bertini, T. Caronna, A. Citterio, L. Grossi and F. Minisci, Chimica e Industria (Milan), 56, 272 (1974).

2.- R. D. Clark and C. H. Heathcock, J. Org. Chem. 38, 3658 (1973)

(Received October 30, 1974; in revised form December 20, 1974)