Tetrahedron Letters,Vol.29,No.31,pp 3797-3798,1988 0040-4039/88 $3.00 + .00
Printed in Great Britain Pergamon Press plc

REDUCTION OF ALLENIC ALCOHOLS BY SACCHAROMYCES CEREVISIAE

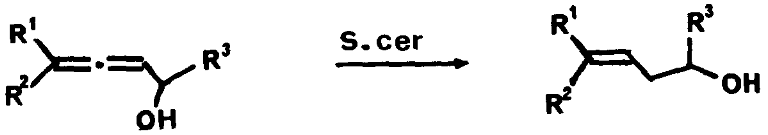
Gérard GIL[1], Elisée FERRE[1], Michel BARRE[1], and Jean LE PETIT[2]

1 - Unité Associée au C.N.R.S. n°109 ; 2 - Laboratoire de Microbiologie
Faculté des Sciences et Techniques - Avenue Escadrille Normandie-Niemen - 13397 MARSEILLE CEDEX 13

Abstract : α-Allenic alcohols are reduced by Saccharomyces cerevisiae into the corresponding β-ethylenic alcohols, whereas β-allenic alcohols undergo an isomerization leading to their γ-acetylenic counterparts.

Yeast-effected reactions (1) are generally easy to use by organic chemists, particularly with respect to the experimental techniques involved. In this context, S. cerevisiae has proved very useful in decarboxylations (2), condensations (3), hydrolyses (4) or reductions (5,6).

We observed that primary and secondary α-allenic alcohols are reduced into the β-ethylenic compounds with proliferating S. cerevisiae cells (7).



Whereas baker's yeast reduces α-unsaturated alcohols and aldehydes into the corresponding saturated alcohols (8), no reaction takes place in the case of allenic alcohols using the described conditions (8).

The chemical reduction of α-allenic alcohols gives only in a few cases the β-ethylenic alcohols ; instead, it is a good synthetic route to 1,3-butadienes (9 and ref. therein).

By contrast, even using nonoptimized conditions, we obtained the desired ethylenic alcohols along with some unreacted allenic substrates.

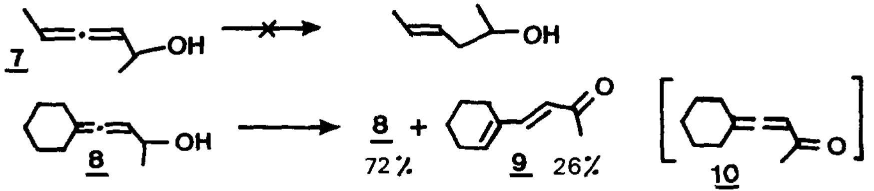
As can be seen in the Table, primary allenic alcohols are more easily reduced than secondary ones. Indeed, the latter necessitate a greater contact time between cells and substrates.

SUBSTRATES	R^1	CH_3		CH_3		CH_3	C_5H_{10}	CH_3	CH_3
	R^2	C_2H_5		CH_3		H		C_2H_5	CH_3
	R^3	H 1		H 2		H 3	H 6	CH_3 4	CH_3 5
CONTACT TIME (DAYS)		1	2	1	2	2	2	3	5,5
ALLENIC ALCOHOL %		30	2	40	25	20	30	20	35
ETHYLENIC ALCOHOL %		50	80	40	65	70	55	55	50

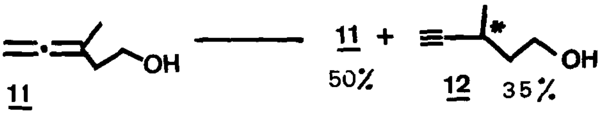
TABLE

The residual allenic alcohol 1 is recovered in the (+) S form after the biological oxidation with an optical purity of 5 % (10) and a 30 % yield.

No reduction takes place with alcohols 7 and 8. We only observed the formation of the dienic ketone 9 when starting from 8. This fact can be accounted for by a biological oxidation of 8 into the corresponding allenic ketone 10 followed by isomerization of the allenic moiety.



In the same conditions, the β-allenic alcohol 11 is isomerized by *Saccharomyces cerevisiae* into the optically active acetylenic alcohol 12.



$[\alpha]_{20}^{D} = +3°$, C = 2

These results are reminiscent of those of SCHWAB and LINN (11) who studied allene-acetylene isomerizations catalyzed by an allene-acetylene isomerase.

The reduction and isomerization reactions of allenic alcohols mediated by other yeast strains are currently in progress in our laboratory.

REFERENCES AND NOTES

1 - K. KIESLICH, Microbial Transformations, G. Thieme Publi. Stuttgart (1976).

2 - P. MANITTO, P. GRAMATICA and B.M. RANZI, J. Chem. Soc. Chem. Commun., 442 (1975).

3 - C. FUGANTI, P. GRASSELLI and S. SERVI, J. Chem. Soc. Perkin Trans. I, 241 (1983).

4 - F. VAN MIDDLESWORTH, Y. F. WANG, B. ZHOU, D. DITULLIO and C.J. SIH, Tetrahedron Letters, **26**, 961 (1985).

5 - D.W. BROOKS, H. MAZDIYASNI and P. SALLAY, J. Org. Chem., **50**, 3411 (1985).

6 - K. NAKAMURA, M. HIGAKI, K. USHIO, S. OKA and A. OHNO, Tetrahedron Letters, **26**, 4213 (1985)

7 - General procedure . Strain · *Saccharomyces cerevisiae* (Institut Pasteur, Paris, B 219) ; Culture medium : glucose 10g/l, yeast extract 10g/l.

3 liters baffled flasks containing 800 ml sterile medium were inoculated with early stationary phase cells and incubated at 30°C. After 24 h, the allenic alcohol was added in 0.5 % concentration. At the end of the transformation, the culture medium was continuously extracted with ethyl ether for 48 h. The organic layer was analyzed and purified by gaz chromatography. All spectral data were in accord with assigned structure and in full agreement with (9a)

8 - P. GRAMATICA, M. MANITTO and L. POLI, J. Org. Chem., **50**, 4625 (1985).

9 - a. R. BAUDOY and J. GORE, Tetrahedon, **31**, 383 (1975).

b. K.K. WANG, S.S. NIKAM and M.M. MARCANO, Tetrahedron Letters, **27**, 1123 (1986).

10 - M. BERTRAND, G. GIL and A. KUMAR, Nouv. J. Chim., **4**, 69 (1980).

11 - J.M. SCHWAB and D.C.T. LINN, J. Amer. Chem. Soc., **107**, 6046 (1985).

(Received in France 7 November 1987)