CHEMISTRY LETTERS, pp. 131-132, 1981.

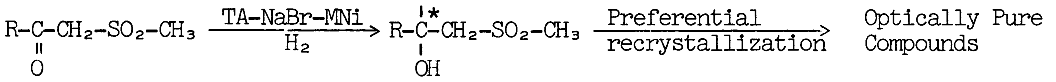
Enantioface Differentiating Hydrogenation of β-Ketosulfone

Yuji HIRAKI, Kazuhisa ITO, Tadao HARADA, and Akira TAI*

Institute for Protein Research, Osaka University, Yamadakami, Suita, Osaka 565

The enantioface-differentiating hydrogenation of β-ketosulfone (I) over (R,R)-tartaric acid-NaBr-modified Raney nickel ((R,R)-TA-NaBr-MRNi) gave β-hydroxysulfone (II) in quantitative chemical yield and 70% optical yield. The optically pure II was obtained from the hydrogenation product by the preferential recrystallization method.

It has been reported that the asymmetric modification of Raney nickel with an aqueous solution of tartaric acid and NaBr gave an excellent catalyst (TA-NaBr-MRNi) for the enantioface-differentiating hydrogenation of methyl acetoacetate (MAA)1) and acetylacetone (AA).2) Now we found that the catalyst was also effective for the enantioface-differentiating hydrogenation of β-ketosulfone. In this communication, we wish to report the facile preparative method of optically pure β-hydroxysulfone (II) from β-ketosulfone (I). The method consisted of the enantioface-differentiating hydrogenation of I over TA-NaBr-MRNi and the preferential recrystallization to the optically pure II from the hydrogenation product (eq. 1).



$$R\text{-}\underset{\overset{\|}{O}}{C}\text{-}CH_2\text{-}SO_2\text{-}CH_3 \xrightarrow[H_2]{\text{TA-NaBr-MNi}} R\text{-}\overset{H}{\underset{OH}{\overset{*}{C}}}\text{-}CH_2\text{-}SO_2\text{-}CH_3 \xrightarrow[\text{recrystallization}]{\text{Preferential}} \text{Optically Pure Compounds} \qquad (1)$$

R=$-CH_2CH_3$	Ia	IIa
R=$-(CH_2)_4CH_3$	Ib	IIb
R=$-(CH_2)_7CH_3$	Ic	IIc

The β-ketosulfones (Ia-Ic) were prepared from dimethylsulfone and esters by the published method.3) The yields were 70-83%. The TA-NaBr-MRNi was prepared by the method reported before.1) The hydrogenation of I (100 g) was carried out with TA-NaBr-MRNi (12 g) in THF (230 ml) and acetic acid (2 ml) under 100kg/cm^2 of hydrogen pressure at 100°C. The reaction readily proceeded and completed in 16 h to afford II in quantitative chemical yield. The representative results were summarized in Table 1. The high optical yields were obtained in all cases. The stereochemistry of the reaction, that is, the use of (R,R)-TA-MRNi gave (R)-II in excess, was in good agreement with the one in the hydrogenation of MAA or AA.

Table 1 Hydrogenation of I to II over TA-NaBr-MRNi

Substrate	TA-NaBr-MRNi Configuration of TA	Product		
		e.e (%)4)	$[\alpha]_D^{20}$ (c 5, EtOH)	Configuration
Ia	R,R	68	-22.9°	(R)6)
	S,S	71	+24.0°	(S)6)
Ib	R,R	69	-13.7°	(R)6)
Ic	R,R	67	-10.5°	R5)
	S,S	67	+10.4°	S5)

When the structural similarity of I and MAA or AA was taken into consideration, the enantioface-differentiation of I was expected to take place by the same mechanism as that of MAA or AA.[7]

The product of hydrogenation, IIa-c was found to be purified to the optical pure state by the preferential recrystallization method. As shown in Table 2, three successive crystallization from ethyl acetate or ether gave an optically pure II in yields of 20-40%. To apply the preferential recrystallization method in purification of II, it was necessary to use the starting material with at least 60% optical purity as far as examined.

Table 2 The Preparation of Optically Pure β-Hydroxysulfone (II)[8]

	Preferential recrystallization		$[\alpha]_D^{20}$ max	Yield(%)[d]	mp		Anal.		
	Solvent	Times	(c 5, EtOH)		(°C)		C(%)	H(%)	S(%)
IIa	ethyl acetate[a]	3	-33.9°	30	64.5	Found	39.47	8.16	20.78
						Calc.	39.45	7.94	21.06
IIb	ether[b]	3	-19.9°	20	70.0	Found	49.36	9.54	16.50
						Calc.	49.45	9.34	16.50
IIc	ethyl acetate[c]	3	-15.6°	40	85.6	Found	55.69	10.28	13.36
						Calc.	55.89	10.23	13.56

a) IIa (2 g) was dissolved in the solvent (10 ml), and was recrystallized at -20°C.

b) IIb (3.5 g) was dissolved in the solvent (15 ml), and was recrystallized at 0°C.

c) IIc (10 g) was dissolved in the solvent (50 ml), and was recrystallized at -5°C.

d) Overall yield based on I.

The authors would like to thank Professor Yoshiharu Izumi for his helpful suggestions and encouragement. Thanks are also due to Mr. Yoshimi Imachi for his assistance.

References and notes

1) T. Harada and Y. Izumi, Chem. Lett., 1978, 1195.
2) K. Ito, T. Harada, and A. Tai, Bull. Chem. Soc. Jpn., 53, 1179 (1980).
3) H.O. House and J.K. Larson, J. Org. Chem., 33, 61 (1968). E.J. Corey and M. Chaykovsky, J. Am. Chem. Soc., 87, 1345 (1965).
4) The enantiomer excess of the product was determined by NMR measurement. The singlet peat due to sulfonylmethyl group of (R)-IIc was appeared in higher field by 4-10 Hz than that of (S)-IIc, on addition of $Eu(hfmc)_3$ (15 mg into the $CDCl_3$ solution (0.4 ml) of IIc (10 mg)).
5) The configuration was correlated to that of 2-decanol derived from IIc by the reductive removal of sulfonyl group with $Li\text{-}EtNH_2$; L.F. Fieser and M. Fieser, "Reagents for Organic Synthesis," John Wiley & Sons, Inc., Vol. 1. New York (1967), p. 580.
6) The absolute configurations of these β-hydroxysulfones have not yet been determined except IIc. However the configuration of (-)-isomers is expected to be (R) from the following reasons:
1) The lanthanide induced sifts of all (-)-isomers in NMR showed the same tendency as that of (-)-(R)-IIc. 2) All substrates were expected to be hydrogenated in the same enantioface-differentiating mechanism over TA-NaBr-MRNi.
7) T. Harada, A. Tai, M. Yamamoto, H. Ozaki, and Y. Izumi, 7th Int. Congr. Catal., Tokyo 1980. A-24.
8) The optical rotation of sample reached steady value unchanged by further recrystallization. The optical purity was also checked by NMR with $Eu(hfmc)_3$.

(Received November 17, 1980)