Tetrahedron Letters No. 3, pp. 93-95, 1962. Pergamon Press Ltd. Printed in Great Britain.

SYNTHESIS OF (+)-ETHYL p-TOLYL SULFOXIDE FROM (-)-MENTHYL (-)-p-TOLUENESULFINATE

Kenneth K. Andersen
Department of Chemistry,
University of New Hampshire, Durham, New Hampshire

(Received 20 December 1961)

OPTICALLY active sulfoxides owing their activity to the asymmetric sulfur atom have been prepared by resolution techniques[1] and by the asymmetric oxidation of sulfides using optically active peracids.[2,3] The first method requires that the sulfoxide have an acidic or basic group as part of its structure in order to form a salt with an optically active acid or base. The second method has the disadvantage of producing sulfoxides of very low optical purity. This report describes a new method for the synthesis of optically active sulfoxides of high purity from the reaction of an optically active sulfinate ester with an organomagnesium halide.

Addition of ethylmagnesium iodide to an equimolar amount of (-)-menthyl (-)-p-toluenesulfinate (I), $[\alpha]_D^{21}$ -201° (C = 2.000 in acetone), in ether followed by hydrolysis with aqueous ammonium chloride gave a mixture of (-)-menthol and (+)-ethyl p-tolyl sulfoxide (II). A 62% yield of II, b.p. 123-126° (1.5 mm), $[\alpha]_D^{25}$ +186 (C = 1.997 in acetone), was obtained from the menthol-sulfoxide mixture by distillation. The infrared spectrum of II

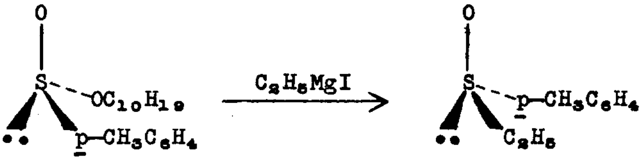
---

[1] P.W.B. Harrison, J. Kenyon and H. Phillips, J. Chem. Soc. 2079 (1926).

[2] R. Maccioni, F. Montanari, M. Secci and M. Tramontini, Tetrahedron Letters No. 17, 607 (1961).

[3] K. Balenovic, I. Bregovec, D. Francetic, I. Monkovic and V. Tomasic, Chem. & Ind. 469 (1961).

was identical with that of an authentic sample of the racemic sulfoxide. Oxidation of II with chromic oxide gave ethyl p-tolyl sulfone, m.p. 56-57°, which did not depress the m.p. of an authentic sample. The infrared spectra were also identical.



I S FORM

II R FORM

The sulfinate ester, I, gave a strongly negative Cotton effect. R.D. in ethanol (C = 0.125), 25°: $[\phi]_{695}-495^\circ$, $[\phi]_{589}-754^\circ$, $[\phi]_{276}-14{,}400^\circ$, $[\phi]_{270}-3630^\circ$. A sample of II, $[\alpha]_D^{25}+172^\circ$ (C = 2.635 in acetone), contaminated with some (-)-menthol, gave a strongly positive Cotton effect. R.D. in ethanol [C = 2.57 (695-300mμ), C = 0.857 (below 300mμ)], 25°: $[\phi]_{695}+216^\circ$, $[\phi]_{589}+301^\circ$, $[\phi]_{286}+7030^\circ$, $[\phi]_{281}+4300^\circ$.

Evidence has been presented that sulfinate esters undergo nucleophilic substitution reactions on sulfur with inversion of configuration at the sulfur atom.[4,5] Since ethylmagnesium iodide is a nucleophilic reagent, the configuration of the sulfur of II must be opposite to that of I. It is interesting that I and II have opposite signs of rotation and give opposing Cotton effects. Herbrandson[5] has assigned the S[6] configuration to the groups around the sulfur atom in (-)-menthyl (-)-p-iodobenzenesulfinate on the basis of kinetic and thermodynamic data. One may then assume that I

---

[4] H. Phillips, J. Chem. Soc. **127**, 2552 (1927).

[5] H.F. Herbrandson and C.M. Cusano, J. Amer. Chem. Soc. **83**, 2124 (1961).

[6] R.S. Cahn and C.K. Ingold, J. Chem. Soc. 612 (1951); R.S. Cahn, C.K. Ingold and V. Prelog, Experientia **12**, 81 (1956).

also has the S configuration at the asymmetric sulfur center. Para methyl and iodo groups would not be expected to change the sign of rotation of the powerfully rotating sulfinate ester group. It follows, then, that II must have the R configuration if II were formed by a nucleophilic attack of ethylmagnesium iodide on I with consequent inversion of the sulfur configuration.

Balenovic and coworkers[3] have assumed a geometry of the transition state for the oxidation of sulfides by optically active alpha substituted monoperglutaric acids and by (+)-cis-monopercamphoric acid (III). Their transition state predicts predominant formation of II when ethyl p-tolyl sulfide is oxidized by either III or by alpha-methylmonoperglutaric acid having the S configuration and the peracid group on the gamma carbon. Montanari and coworkers[7] found that oxidation of ethyl phenyl sulfide by III gave (+)-ethyl phenyl sulfoxide of low optical purity.

More recently Montanari and coworkers[2] presented evidence that alkyl aryl sulfoxides which are dextrorotatory have the R configuration.

Thus, there are two independent lines of evidence which assign the R configuration, II, to (+)-ethyl p-tolyl sulfoxide. The first is its synthesis from I[5] and the second is Montanari's[2,7] work on the absolute configuration of aryl alkyl sulfoxides. Considered in another manner, it seems likely that Herbrandson on one hand and Montanari and Balenovic on the other are both correct in their assignments of the absolute configuration to sulfur in their respective cases. The synthesis of II from I has served to tie together these workers' results and make their assignments of the absolute configuration to sulfur less tentative.

I wish to thank Professor G.G. Lyle for running the optical rotatory dispersion curves of I and II and for helpful discussions.

---

[7] A. Mayr, F. Montanari and M. Tramontini, Gazz. Chim. Ital. **90**, 739 (1960).