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Isobornanyl sulfoxides and isobornanyl sulfone: Physicochemical characteristics and the features of crystal structure

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ABSTRACT

The physico-chemical characteristics and crystal structure of newly synthesized isobornanyl sulfoxides and sulfone are presented. After purification, diastereomeric sulfoxides were obtained in a 2:1 eutectic ratio, which did not allow either separation or enrichment of the mixture. Based on thermochemical data, the form of the phase diagram of the system was reconstructed, showing that diastereomers have significantly different melting points. According to the X-ray data, the same supramolecular open-chain S=O···H–O synthon is built up in the crystals of diastereomeric sulfoxides. The isobornanyl sulfone crystal is formed in a complex way – two crystallographically independent molecules playing different roles in the formation of H-bonds. The IR spectra of a diastereomeric sulfoxides mixture demonstrate the averaging of the synthon-forming functional groups bands. In a counterbalance, the IR spectrum of isobornanyl sulfone shows a doubling of the key bands of synthon-forming functional groups belonging to homochirally homogeneous but crystallographically nonequivalent molecules.

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1. Introduction

Terpenoids have long been recognized to be attractive tools in organic synthesis as chiral auxiliaries or ligands for catalysis. In other respects, their biological activity has been exploited in the pharmaceutical industry. In this regard, thiofunctionalized bicyclic monoterpenoids hold particular interest, due to the potential combined asymmetry induction of the terpene backbone and sulfur-centered functions, e.g. sulfoxides. We have previously developed a series of sulfur-containing terpenoids of varied structures involving a large set of functional groups [1]. In other respects, the e.g. anti-fungal, anti-inflammatory, antibacterial, antimicrobial activities of the thioterpenoids studied were highlighted [2–7]. Additionally, their impact on coagulation has also been reported by us [8–12].

In previous works [13–16], we synthesized pinane-based β-hydroxysulfoxides and -sulfone, discovering an unusual "racemic compound-like" behavior of the diastereomeric mixture of sulfoxides, as well as a phenomenon of "crystallization-induced diastereomerization" of the related sulfone (Scheme 1).

Earlier, those sulfoxides were shown to have high antiaggregatory and anticoagulant properties [10]. It was found that the procoagulative activity was due to the ability of the sulfoxides to prevent platelet activation through inhibition of the catalytic activity of the phospholipid surface involved in the formation of coagulation clotting factor complexes.

With a view to continuing our studies on the crystallization of chiral β-hydroxysulfoxides and -sulfones, we now report the synthesis, physicochemical characteristics and crystal structures of new terpenoid sulfoxides and sulfone built on an isobornane framework. From a structural point of view, the obtained compounds are built according to the type of "rigid terpene framework – conformationally mobile sulfur-containing substituent". The relationship between one or another configuration of the sulfur atom with respect to the terpene backbone and the conformation of the

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