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学位論文内容の要旨

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学位論文題名

Cyclic aminals from aldehydes and “roofed” mono-*N*-sulfonyl *cis*-diamines

（アルデヒドと屋根付きモノ-*N*-スルホニル シス型ジアミンとの環状アミナール）

Most popular strategy for optical resolution (resolution of enantiomers) is based on the different physical properties of diastereomers. New mono-*N*-sulfonyl *cis*-diamine reagents were created as chiral derivatizing reagents for racemic aldehydes in this research. Racemic aldehydes are converted into mixture of diastereomers by using the new roofed *cis*-diamine reagents. Most of resulting five-membered diastereomeric aminals are stable on silica-gel TLC plate and separated by silica-gel chromatography very easily. The absolute configuration of aldehyde moiety in each separated diastereomer is determined by two-dimensional NMR analyses. The new reagents react smoothly with aldehydes under mild and neutral or a little acidic condition.

1. New synthetic process for roofed *cis*-diamine skeleton

The roofed *cis*-diamine skeleton (*rel*-(11*R*,12*S*)-9,10-dihydro-9,10-ethanoanthracene-11, 12-diamine hydrochloride (1:2) **1**) was synthesized conventionally by Diels–Alder reaction of anthracene and cyclic urea (1,3-diacetyl-2-imidazolone) as the first step. The bicyclic imidazolidinone was converted to the roofed *cis*-diamine hydrochloride **1** through five serial reactions.

The cyclic urea was replaced to a cyclic aminal derivative (1,3-diacetyl-2,3-dihydro-1*H*-Imidazole) in this research. By Diels–Alder reaction of anthracene and the cyclic aminal derivative to afford a new intermediate (roofed 1,3-diacetyl-2-imidazolidine), which was hydrolyzed under refluxing in conc. HCl/MeOH solution to give the same roofed *cis*-diamine hydrochloride **1** in high yield (94 %).

２．Preparation of mono-*N*-sulfonyl *cis*-diamine reagents and diastereomeric aminals from aldehydes and the reagents

The mono-*N*-sulfonyl *cis*-diamine reagents (**2**: Ms, **3**: Ts, **4**: 1-naphthylsulfonyl, **5**: 2-naphthylsulfonyl) were prepared from cis-diamine hydrochloride **1** and corresponding

sulfonyl chlorides.

Those mono-*N*-sulfonyl *cis*-diamine reagents were reacted with isobutyraldehyde to form cyclic aminals (**2'** from **2**, **3'** from **3**, **4'** from **4**, and **5'** from **5**). The chemical shifts of geminal proton and carbon signals in aminals are as follows.

^{1}H NMR (δ); **2'**: -0.01, 0.82 (Δδ=0.83), **3'**: 003, 0.79 (Δδ=0.76), **4'**: 0.02, 0.82 (Δδ=0.80), **5'**: 0.05, 0.81 (Δδ=0.76).

^{13}C NMR (δ); **2'**: 11.18, 19.44 (Δδ=8.26), **3'**: 11.73, 19.50 (Δδ=8.13), **4'**: 11.29, 19.60 (Δδ=8.31), **5'**: 11.41, 19.53 (Δδ=8.21).

One methyl proton signal in each aminal is apt to shift upfield. The chmical shift differences of geminal carbon signals in 4 aminals are more than 8 ppm. In the stable conformation of aminals, the methine proton (the smallest substitution group) is face to sulfonyl moiety. As the result, one methyl group will get closer to one benzene ring of the reagent. Due to the diamagnetic effect of the benzene ring, the methyl proton signal should appear upfield. NOE experimental data supports the conformation.

3. Prepration of chiral reagents (2-5) and diastereomeric aminals from chiral and racemic aldehydes

Aldehydes **6-9** (**6**; (1*R*)-(-)-myrtenal, **7**; (±)-2-methylbutanal, **8**; (±)-2-phenylpropanal, **9**; (±)-2-Methyl-3-(4-*tert*-butylphenyl)propanal) were reacted with reagents (**2**-**5**) to afford diastereomeric aminals. These diastereomers were well separated on silica-gel TLC plates. Chiral reagents were obtained by acidic hydrolysis of aminals which were prepared from (1*R*)-(-)-myrtenal **6** and racemic reagents. The whole structures of aminals with **6** were determined by two-dimensional NMR analyses.

The developing pattern of a pair of diastereomeric aminals can be explained by the steric and electronic interactions between aminals and silica-gel stationary phase. Hydrogen bonds will predominantly occur between silica-gel particle (Si-OH) and the -SO_2- and –NH- sites of aminal. As a result, the substrate adsorbs silica-gel particle at one side. When the substitution group (**A**) of aldehyde moieties is near side of the silica-gel particle, the properties of **A** like bulkiness and polarity affect the strength of adsorption. The other diastereomer will interact with silica-gel particle on the other substitution group (**B**). So, by comparison with the chemical property of **A** and that of **B**, the developing pattern will be predicted.