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SYNTHESIS OF (1*R*,2*R*)-1,2-BIS-(5-(4-HYDROXYNAPHTHALEN-1-YLAZO)-[1,3,4]THIADIAZOL-2-YL)-ETHANE-1,2-DIOL

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*In this study, (1*R*,2*R*)-1,2-bis-(5-amino-1,3,4-thiadiazol-2-yl)ethane-1,2-diol (**2**), was synthesized by using (2*R*,3*R*)-(+)-Tartaric acid (**1**) as starting compound. Then the diazo component **3** was obtained from **2** and 1-naphthol. In addition, the structures of the synthesized compounds **2** and **3** were confirmed by elemental analyses, IR, ^{1}H-NMR, and ^{13}C-NMR spectra.*

Key words: tartaric acid, thiadiazole, dye compounds.

The 1,3,4-thiadiazole ring is associated with diverse biological activities probably by virtue of incorporating a toxophoric –N=C-S- linkage, the importance of which has been well stressed in many pesticides [1–4]. Various 2-amino/substituted-amino-1,3,4-thiadiazoles and their Schiff bases have recently received significant importance because of their diverse biological properties [5a–d].

Enantiomerically pure 1,2-diols are valuable intermediates in the organic synthesis of biologically active compounds and natural products [6]. They are readily transformed into chiral epoxides [7a], aziridines, and amino alcohols [7b,c]. Moreover, the 1,2-diol functionality is found in a number of synthetic [8a] and pharmaceutical intermediates [8b].

Some azo compounds synthesized by Jolly and coworkers have shown good antibacterial activity [9]. Azo compounds are important structures in the medicinal and pharmaceutical fields [10].

Heterocycles have been put to much use in disperse dye chemistry, which it has been claimed was the first area to foster the industrial exploitation of heteroaromatic amines [11]. Numerous heterocyclic dyes are now marketed to the extend that no manufacturer can profess to produce a full range of disperse dyestuff without handling colorants based on heteroaromatic diazo or coupling components. In addition, just as new applications have emerged for "conventional" textile-oriented heterocyclic dyes, such as their utilization in photodynamic therapy and lasers of thiazines and oxazines [11], nontextile uses of hetarylazo disperse dye types have increasingly been explored, for example, in reprographic technology, functional dye applications, and nonlinear optical systems [11].

Dyes derived from 2- amino-1,3,4-thiadiazoles are of technical interest for the production of brilliant red shades [11]. Relatively little has been published regarding this class compared to the other categories of dyes derived from five-membered sulfur-containing heterocycles. In addition, the level of recent patent activity has been low, although papers focusing exclusively on dyes derived from 1,3,4-thiadiazole have appeared.

Compounds that have optical activity can change to another compound that has optical activity without breaking of covalent bonds, which is connected with asymmetric carbon atoms. In this change, the configuration stays unchanged. So, our synthesized compound configuration is the same as that of our starting compound (the reactions are shown in Scheme 1). The proposed mechanism for compound **2** is shown in Scheme 2. However, this reaction mechanism shows that the stereochemisty of the products is unchanged, and the synthesized compound **2** is enantiomerically pure.

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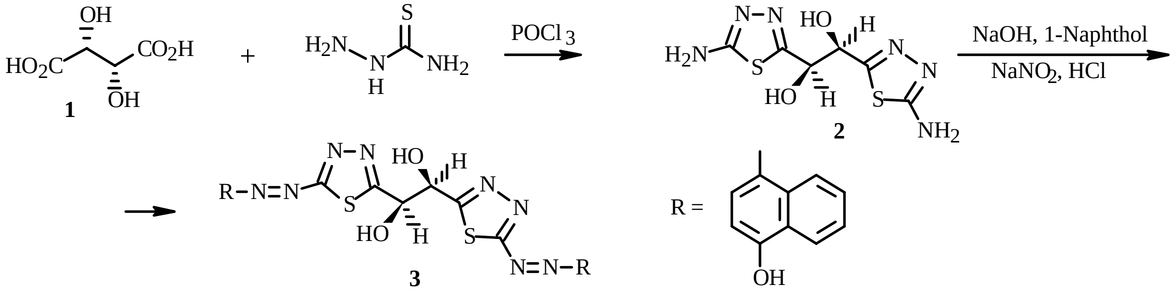
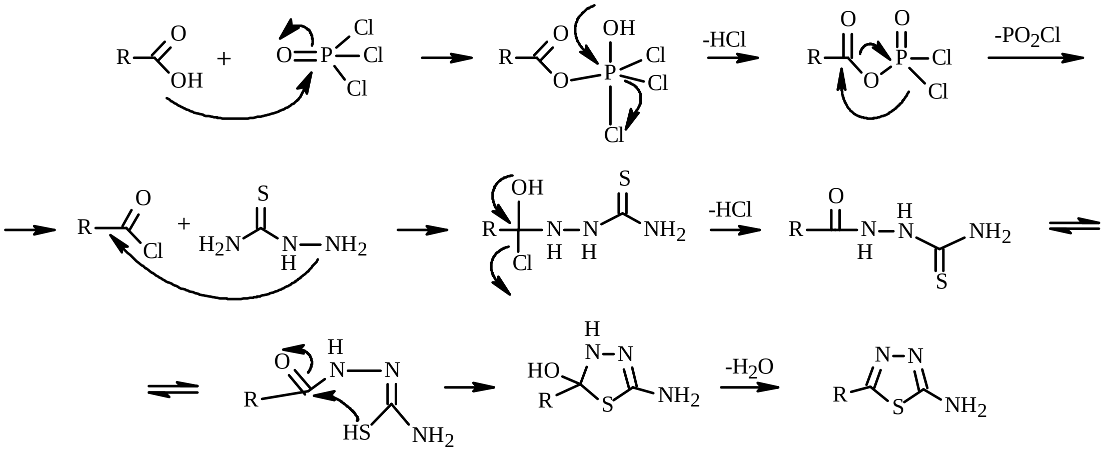


Scheme 1



Scheme 2

Natural chiral compounds (from the chiral pool) often offer an alternative to the synthesis of enantiomerically pure products. (2*R*,3*R*)-(+)-Tartaric acid (**1**) is one chiral carboxylic acid isolated from natural sources. In this study, we aimed to synthesize a new (1*R*,2*R*)-1,2-bis-(5-amino-1,3,4-thiadiazol-2-yl)ethane-1,2-diol (**2**) by using (2*R*,3*R*)-(+)-tartaric acid (**1**) as starting compound. Then the diazo component **3** was obtained from **2** and 1-naphthol.

In the IR spectrum of **2**, the most characteristic absorptions are at 3413-3195 cm^{-1} (NH_2 and OH), 1621 cm^{-1} (C=N) and 685 cm^{-1} (C–S–C). Since there are no C=O bands in the IR spectra, these peaks indicate the formation of the expected compound. The data of two compounds are given in the experimental section.

EXPERIMENTAL

(2*R*,3*R*)-(+)-Tartaric acid, thiosemicarbazide, and phosphorus oxychloride from Merck were used as received. Melting points were determined on a Thomas Hovver melting point apparatus and are uncorrected but checked by differential scanning calorimeter. Specific rotations were recorded on a POLS-1 high-sensitivity polarimeter, with a fixed sodium lamp of wavelength 589 nm. The IR spectra were measured with a Mattson 1000 FT-IR spectrophotometer. Elemental analyses were done on a LECO-CHNS-938. The NMR spectra were recorded on a Bruker WM-400 MHz spectrometer and are reported in ppm (δ) relative to the spectrometer in $CDCl_3$+DMSO-d_6, D_2O with DSS, TMS as an internal standard and ^{13}C NMR (100 MHz).

Synthesis of (1*R*,2*R*)-1,2-Bis-(5-amino-1,3,4-thiadiazol-2-yl)ethane-1,2-diol (2). A mixture of acid **1** (0.01 mol), thiosemicarbazide (0.023 mol), and phosphorus oxychloride (0.023 mol) was warmed at 60°C for 1 h and the temperature was raised to 95°C for an additional 2 h. The contents were then poured onto the least amount of crushed ice needed, cooled to 10°C, and pH adjusted to 9–10 with 10 M NaOH. The resulting solid was crystallized from DMF-alcohol to give **2**. Yield: 77%; mp 138–139°C; –173° (*c* 4, water), $C_6H_8N_6SO_2$.

^{1}H NMR (400 MHz, D_2O): δ 4.16 (s, 2H, 2×CH), 4.65 (s, 6H, HDO from $2\times NH_2$ and 2×OH).

^{13}C NMR (100 MHz, D_2O): δ 178.69, 165.04; 74.05, IR (KBr, cm^{-1}): 3413, 3195, 1621, 1412, 1380, 1210, 1075, 980, 875, 721, 685.

(1*R*,2*R*)-1,2-Bis-(5-(4-hydroxynaphthalen-1-ylazo)-[1,3,4]thiadiazol-2-yl)-ethane-1,2-diol (3). The (1*R*,2*R*)-1,2-bis-(5-amino-[1,3,4]thiadiazol-2-yl)-ethane-1,2-diol (**2**, 7 mmol) was stirred into water (7.5 mL), concentrated HCl (2 mL), and ice (5 g). Then $NaNO_2$ (prepared from 8 mmol $NaNO_2$ and water (2 mL)) was slowly added to this solution. Then this coupling component was stirred into the R-OH (14 mmol), which was stirred into 10% NaOH (10 mmol) with ice (5 g) for 2 h at 7–10°C. The product was filtered and washed with water. Recrystallization from ethanol gave **3**. Yield: 81%; mp 160–161°C; $[\alpha]_D^{20}$ –3.862° (*c* 1, ethanol), $C_{26}H_{18}N_8S_2O_4$.

^{1}H NMR (400 MHz, $CDCl_3$, J/Hz) : δ 6.67 (d, 2H, 2×$\underline{CH}$-OH, J = 10, 14), 6.89–6.97 (br, 4H, $\underline{OH}$), 7.22 (d, 2H, $J_{1,2}$ = 8.05, H-1, H-1′), 7.54–7.74 (m, 4H, H-4, H-4′; H-5, H-5′), 8.02 (d, $J_{2,1}$ = 10.53, 2H, H-2, H-2′), 8.18 (dd, 2H, $J_{6,5}$ = 7.80, $J_{6,4}$ = 1.17, H-6, H-6′), 8.36 (dd, 2H, $J_{3,4}$ = 6.63, $J_{3,5}$ = 1.17, H-3, H-3′).

^{13}C NMR (100 MHz, $CDCl_3$): δ 178.64, 165.07; 153.41, 144.38, 127.99, 127.80, 127.44, 126.99, 119.41, 115.97, 113.51, 74.02.

IR (KBr, cm^{-1}): 3450, 3040, 1625,1575, 1525, 1450, 1383, 1211, 1070, 981, 872, 719, 685.

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