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SHORT COMMUNICATIONS

Preparative Procedure for the Synthesis of 4-Allyloxypyridine-2,6-dicarboxylic Acid

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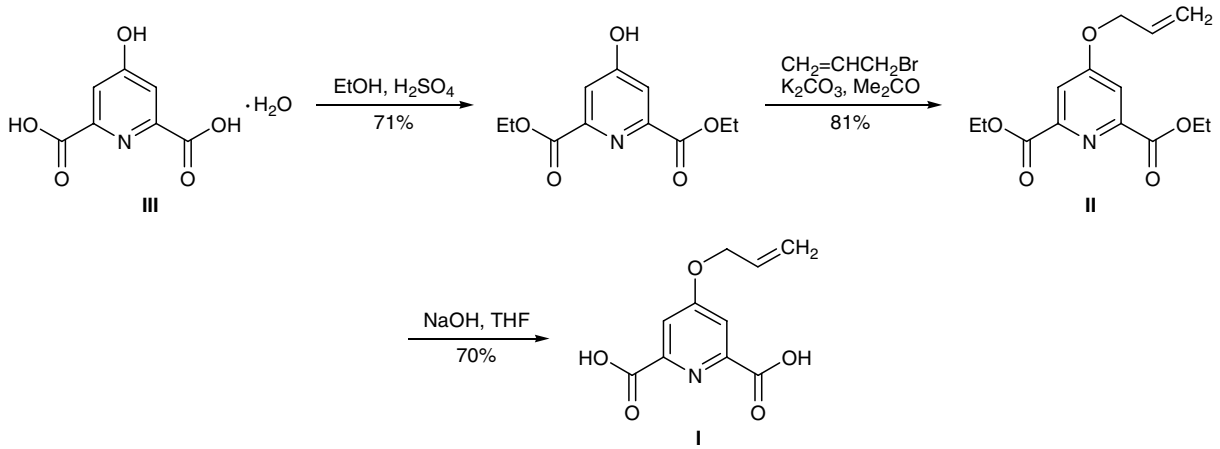
4-Allyloxypyridine-2,6-dicarboxylic acid (**I**) is used as starting compound in the synthesis of 4-allyloxy-2,6-diacetylpyridine; *N*-arylimines derived from the latter at both carbonyl groups attract considerable interest as ligands for immobilized iron(II) complexes as highly efficient catalysts in the polymerization of ethylene [1, 2]. Kim et al. [1] described a procedure for the synthesis of dicarboxylic acid **I** starting from 4-hydroxypyridine-2,6-dicarboxylic acid monohydrate (**III**) in three steps including esterification with ethanol, O-alkylation with allyl bromide at the 4-hydroxy group, and hydrolysis of the ester moieties in diethyl 4-allyloxypyridine-2,6-dicarboxylate (**II**); the overall yield of acid **I** was about 40% (Scheme 1).

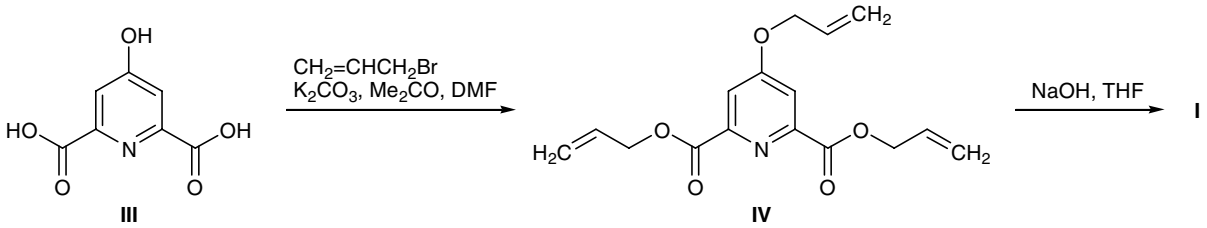
While preparing acid **I** on an enlarged scale according to [1], we revealed some uncertainty in the described procedure: in the hydrolysis stage, no organic layer containing acid **I** was formed after acidification of the hydrolyzate, and we failed to isolate the target acid by extraction with an organic solvent (chloroform, benzene, and diethyl ether were tried). Moreover, a considerable amount of mesityl oxide (4-methylpent-3-en-2-one) was formed at the alkylation stage.

We have found that acid **I** can be synthesized in two steps and that its yield can be raised to 89% by carrying out alkylation of anhydrous dicarboxylic acid **III** with allyl bromide in the presence of anhydrous potassium carbonate in a mixture of acetone with DMF. The subsequent alkaline hydrolysis of diallyl 4-allyloxypyridine-2,6-dicarboxylate (**IV**) gives the target product. The alkylation of **III** in DMF almost does not occur, while the reaction in acetone is accompanied by

Scheme 1.



Scheme 2.



side formation of diallyl carbonate and a large amount of mesityl oxide. The system acetone–DMF at a ratio of 3:2 ensured complete conversion of **III** into ester **IV** (yield 98%), and no mesityl oxide was formed (Scheme 2).

The hydrolysis of diallyl 4-allyloxypyridine-2,6-dicarboxylate (**IV**) was performed in a mixture of aqueous sodium hydroxide and THF, i.e., under the conditions similar to those reported in [1] for the hydrolysis of diethyl ester **II**, but the hydrolyzate was then treated in a different way. The organic phase containing tarry impurities was separated, the residue was concentrated under reduced pressure and acidified, and the precipitate of **I** was filtered off (yield 91%).

Anhydrous chelidamic acid (**III**) was prepared by heating its monohydrate (synthesized as described in [3]) until constant weight at 150–175°C under reduced pressure (water-jet pump). Allyl bromide was synthesized by the procedure reported in [4].

Diallyl 4-allyloxypyridine-2,6-dicarboxylate (IV). A suspension of 15 g (0.11 mol) of anhydrous potassium carbonate in a mixture of 115 ml of DMF and 75 ml of acetone was stirred for 4 h at room temperature, 7.5 g (0.041 mol) of anhydrous chelidamic acid (**III**) was added, and the mixture was stirred for 1 h, gradually raising the temperature to 80°C. Allyl bromide, 40 ml (49.5 g, 0.41 mol), was then added, and the mixture was heated for 15 h under reflux with stirring. An additional portion of anhydrous potassium carbonate, 10.5 g (0.076 mol), was added, and the mixture was heated for 15 h under reflux. Acetone and excess allyl bromide were distilled off, the residue was diluted with 120 ml of water, and the mixture was extracted with ethyl acetate (4×30 ml). The organic extract was dried over anhydrous magnesium sulfate, and the solvent was distilled off under reduced pressure (water-jet pump, 28–30 mm, bath temperature 80–100°C). Yield 12.17 g (98%), light brown thick liquid. The product was subjected to hydrolysis without additional purification. Found, %: C 63.49; H 5.43; N 4.71. M^+ 303. $C_{16}H_{17}NO_5$. Calculated, %: C 63.37; H 5.61; N 4.62. *M* 303.

4-Allyloxypyridine-2,6-dicarboxylic acid (I). Ester **IV**, 12.17 g (0.04 mol), was dissolved in 100 ml of THF, 105 ml of 4 N aqueous sodium hydroxide was added under stirring, and the mixture was stirred for 4 h at 90°C. It was then cooled to room temperature, the organic phase was separated, THF and most water were distilled off from the aqueous phase, and the residue was cooled with ice and acidified with 30 ml of concentrated hydrochloric acid to pH <1. The colorless precipitate was filtered off, washed with 5 ml of cold water, and dried first in air and then in a drying box at 140°C. Yield 8.12 g (91%), mp 161–163°C. ^{1}H NMR spectrum (DMSO-d_6–CCl_4), δ, ppm: 4.80 d (2H, OCH_2, *J* = 4 Hz), 5.31 d (1H, CH=C**H**$_2$, *J* = 8 Hz), 5.37 d (1H, CH=C**H**$_2$, *J* = 13 Hz), 5.96–6.05 m (1H, C**H**=CH_2), 7.70 s (2H, 3-H, 5-H). The ^{1}H NMR spectrum was identical to that given in [1].

The ^{1}H NMR spectrum was recorded on a Bruker WP-200 SY spectrometer at 200 MHz relative to HMDS as internal reference. The progress of reactions and the purity of products were monitored by TLC on Silufol UV-254 plates using chloroform as eluent. The elemental analysis was obtained on a Carlo Erba 1106 CHN analyzer. The melting point was determined by heating a sample placed between glass plates at a rate of 1 deg/min.

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