Preparation of 5α-Cholestan-3z-ol from 5α-Cholestan-3-one with Urushibara Nickel A

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The Urushibara nickel catalysts have been efficiently used for the hydrogenation of numerous organic compounds. Hydrogenation of 5α-cholestan-3-one with Urushibara nickel B (U.-Ni-B) in ethanol at room temperature was reported by Nishimura to give mainly 5α-cholestan-3β-ol.

In the course of our investigation of the catalytic hydrogenation of steroidal ketones with other types of Urushibara catalysts, we found that the hydrogenation of 5α-cholestan-3-one using Urushibara nickel A (U.-Ni-A) in the presence of a small amount of hydrochloric acid affords 5α-cholestan-3α-ol in 66–68% yield and 5α-cholestan-3β-ol in 32–34% yield. Hydrobromic acid also favored the formation of the 3α-ol.

The yield is somewhat lower than those obtained by the previously reported procedures using platinum catalysts. However, our procedure represents another useful route for the preparation of 5α-cholestan-3α-ol because the catalyst is easily prepared and isolation of the product is simple.

Urushibara-Nickel-A Catalyst:

U.-Ni-A was prepared from precipitated nickel (p-p-Ni; prepared from 16 g of nickel chloride and 10 g of zinc dust according to Ref.) by digesting with 13% aqueous acetic acid; the previously reported procedure was modified as follows: to p-p-Ni (10 g) placed in a 50 ml Erlenmeyer flask, 13% aqueous acetic acid (6 ml) was added and the mixture was stirred. After the evolution of gas had subsided, additional 13% acetic acid (6 ml) was added. The procedure was repeated four times and then the supernatant liquid was discarded by decantation. The same procedure was carried out three times using ~ 30 ml of 13% acetic acid each time. The resulting U.-Ni-A was washed with water and then with dioxane by decantation. The catalyst thus obtained was immediately used for hydrogenation.

Hydrogenation:

A mixture of freshly prepared U.-Ni-A (from 10 g of p-p-Ni) and dioxane (30 ml) was stirred under hydrogen at ambient temperature and pressure. After 1.5 hr, 5α-cholestan-3-one (1 g) and a 9:1 mixture of dioxane and conc. hydrochloric acid were added and the hydrogenation was carried out at 72–75 °C. The reaction was complete after 7 hr. G.L.C. analysis of the product (as trimethylsilyl ethers) showed it to consist of 66% of 3α-ol and 34% of 3β-ol. No hydrogenolysis product was found. The catalyst was removed by filtration, the solvent was evaporated, and the residue was chromatographed on silica gel using hexane/ether (9:1) as the eluent; yield: 550 mg (55%) of 5α-cholestan-3α-ol, m.p. 187.5–188.5 °C (Ref., m.p. 186–187 °C), and 320 mg (32%) of 5α-cholestan-3β-ol, m.p. 140–141.5 °C.
The results of several hydrogenations are listed in the Table.

**Table.** Hydrogenation of 5α-Cholestan-3-one using U.-Ni-A Catalyst

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Additive</th>
<th>Products (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3α-ol</td>
</tr>
<tr>
<td>t-Butanol</td>
<td>—</td>
<td>38</td>
</tr>
<tr>
<td>t-Butanol</td>
<td>HCl</td>
<td>56</td>
</tr>
<tr>
<td>t-Butanol</td>
<td>HBr</td>
<td>69</td>
</tr>
<tr>
<td>Ethanol</td>
<td>—</td>
<td>26</td>
</tr>
<tr>
<td>Ethanol</td>
<td>HCl</td>
<td>33</td>
</tr>
<tr>
<td>Dioxane</td>
<td>—</td>
<td>62</td>
</tr>
<tr>
<td>Dioxane</td>
<td>HCl</td>
<td>66</td>
</tr>
</tbody>
</table>

* G.L.C. Analysis: 3 m glass column, 1.5% Silicone OV-17 on silanized Shimalite W, 80/100 mesh; 245–255°; HPID detector.

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4. J.T. Edward, J.M. Ferland, *Can. J. Chem.* 44, 1311 (1966); The hydrogenation in acetic acid in the presence of hydrochloric acid with platinum oxide was reported by these authors to give 95° of the 3α-ol (analyzed by N.M.R.). In our experiments, G.L.C. analysis of the products revealed the composition of the products as follows: 10–14° of 5α-cholestanone, 60–66° of 3α-ol, 11–27° of 3β-ol, and 3–9° of 3β-ol acetate.
10. All the melting points were measured on a hot-plate and are corrected.