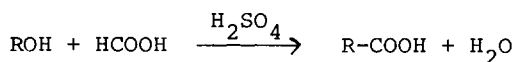


SYNTHESIS OF $^{13}\text{C}=\text{O}$ -LABELLED TERTIARY ALKANOIC ACIDS BY THE
KOCH-HAAF-REACTION*

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Summary: Good yields of tertiary alkanolic acids are obtained from the Koch-Haaf-synthesis even when only stoichiometric amounts of carbinol and HCOOH are used. This offers a new approach to ^{13}C -labelled tertiary alkanolic acids. - An excess of HCOOH is generally used in the Koch-Haaf-synthesis¹⁾ of carboxylic acids from carbinols and HCOOH in conc. H_2SO_4 .



For this reason this reaction has not been previously used for the synthesis of ^{13}C -labelled acids. Because ^{13}C -labelled 1-adamantane carboxylic acid was required for related work²⁾ we have developed a variation of the Koch-Haaf-reaction using only a stoichiometric amount of HCOOH:

2.0 g (13.2 mmol) 1-hydroxyadamantane are mixed with 0.61 g (13.2 mmol) HCOOH (99%) and added with stirring to 23.2 g conc. H_2SO_4 at 10°C . Stirring is continued for 2h and the mixture is then kept at 10°C for an additional 27h without stirring, before it is added to 150 g crushed ice. The precipitated acid is purified in the usual way³⁾. Yield: 2.0 g (84.4%). The lit. procedure³⁾ using ROH:HCOOH in the molar ratio 1:12 yields 96%. Even when 1 mol hydroxyadamantane is reacted with only 0.7 mol HCOOH a 51% yield is obtained. The ^{13}C -labelled acid was also successfully prepared by this procedure using H^{13}COOH ²⁾.

The success of the reaction is somewhat dependent on the rate of stirring⁴⁾ and is illustrated with the examples listed in Table 1.

Table 1 Koch-Haaf Synthesis of Tertiary Alkanoic Acids.

| ROH | stirring rate ^{a)} | T °C | reagent ratio ^{b)} | yield % | RCOOH ^{c)} |
|---------------------------|--------------------------------|----------------|--------------------------------|----------------|---|
| 2-methyl- cyclohexanol | slow fast | 25-30 15-20 | 1:1:24 1:1:24 | 66 44 | 1-methylcyclo- hexanecarboxylic acid ⁵⁾ |
| 1-pentanol | medium | 20-25 | 1:1:10 | 46 | 2,2-dimethyl- butyric acid ^{1a)} |
| 1-hydroxy- adamantane | fast fast fast | 10 10 10 | 1:1:24 1:1:12 1:0.7:18 | 84 80 51 | 1-adamantane- carboxylic acid ³⁾ |
| 1-adamantyl- methanol | fast | -15 | 1:1:24 | 28 | 3-homoadamantane- carboxylic acid ⁶⁾ |

a) slow: 200, medium: 500, fast: 1200 revs. per minute.

b) molal ratio ROH:HCOOH:H₂SO₄

c) Lit. refers to publications, where these acids have been prepared using excess HCOOH.

*) Dedicated to Prof.Dr.Siegfried Hünig on the occasion of his 60th birthday

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