SHORT COMMUNICATIONS

The Catalytic Hydrolysis of Esters by Amidines

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(Received December 20, 1965)

It has been well recongnized that α-chymotrypsine catalyzes the hydrolyses of esters and that its esteratic activity is due to the imidazolyl group of the histidine residue in α-chymotrypsine. In fact, imidazoles effectively hydrolyze many kinds of esters.

We have now found that amidines, which are considered to be a part of the imidazole ring, catalyze the hydrolyses of esters more effectively than do imidazole and its derivatives. For example, ethyl acetate and γ-butyrolactone were hydrolyzed very easily with benzamidine or acetamidine, but they were not hydrolyzed with imidazole. When a solution of an ester in ethanol-water was mixed with a solution of an amidine in the same solvent at room temperature, the ester was quickly hydrolyzed to the corresponding acid and the acid did form the salt with free amidine, although the salts of amidines do not catalyze the reaction. The kinetics of the reaction were followed by measuring the amount of the residual amidine, which was determined by titration with hydrochloric acid, using phenolphthalein as an indicator. Kinetic studies were carried out starting with about 0.02 mol. solutions of both amidines and esters in a 85% ethanol-water solvent. The reactions were of the second order; the initial second-order rate constants, which were determined from the data for the first 40% of the reaction, are summarized in Table I.

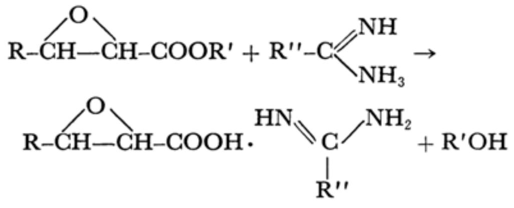
TABLE I. RATE CONSTANTS FOR HYDROLYSIS OF VARIOUS ESTERS BY FORMAIDINE, ACETAMIDINE, BENZAMIDINE AND GUANIDINE IN 85% ETHANOL-WATER AT 30°C

Ester	Catalyst	Second order rate constant $1\ \mathrm{mol^{-1}\ sec^{-1}}$
Ethyl acetate	Formamidine	1.82×10^{-2}*
	Acetamidine	2.82×10^{-3}*
	Guanidine	3.75×10^{-3}
	Hydroxide ion	1.09×10^{-2}
γ-Butyrolactone	Formamidine	very fast
	Acetamidine	5.42×10^{-3}*
	Benzamidine	1.43×10^{-3}
	Guanidine	2.90×10^{-2}
Phenyl acetate	Formamidine	very fast
	Acetamidine	3.40×10^{-2}
	Benzamidine	2.37×10^{-2}
	Imidazole	1.80×10^{-3}**
p-Cresyl acetate	Benzamidine	2.44×10^{-2}
	Imidazole	8.83×10^{-3}**

* These values include the rate of the self-decomposition of amidines.

** Determined in a 60% acetone-water solvent at 25°C by T. C. Bruice and G. L. Schmir, *J. Am. Chem. Soc.*, **79**, 1663 (1957).

N-Substituted amidines seem to be very weak catalysts. The relations between the reactivities and the structures of amidines and of esters will be reported on later. However, it must be noted here that the glycidic esters are hydrolyzed without opening the epoxide ring to form the amidinium salts of the glycidic acids.



Further study is now in progress.