

Acetylation with Isopropenyl Acetate¹

ED F. DEGERING¹ and H. H. CHEN, Purdue University

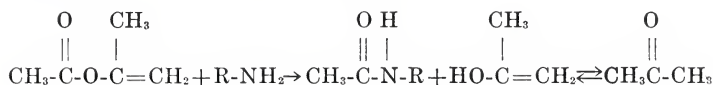
In 1936, Hardy (3) suggested the conversion of esters directly into the corresponding anilides by treatment with anilino magnesium bromide, which was readily obtained from any simple Grignard reagent and aniline. By replacement of the latter with other aromatic amines, substituted anilides also may be obtained. Koelsch and Tenenbaum, (6) in a similar manner, obtained *p*-toluides. Conversely, a solid derivative of the alcohol portion of a simple ester may be obtained by effecting an interchange reaction between 3,5-dinitrobenzoic acid and the ester in the presence of concentrated sulfuric acid. (7) This method is applicable to a large number of simple esters but may not be used if either the alkyl group of the ester reacts with concentrated sulfuric acid. High-molecular-weight esters ($\rightarrow$ 250) also fail to react.

For the identification of the acyl group in esters, Dermer and King (2) prepared the N-benzylamides according to a modified method by Buehler and Mackenzie. (1) The ester was refluxed with benzylamine in the presence of a small amount of ammonium chloride. The cooled mixture was washed with water, if necessary acidified with hydrochloric acid, and the solid amide filtered, dried, washed with ligroin, and recrystallized from aqueous acetone or ethyl alcohol. In 1940, Sah (8) obtained acid hydrazides by treating hydrazines with methyl and ethyl esters. Jacobs and Heidelberger (5) obtained a yield of seventy-eight to eighty-four percent of the theoretical amount of the chloroacetamide by treating a mixture of ethyl chloroacetate and chilled aqueous ammonia at a temperature maintained at 0-5°C. At higher temperatures there was more replacement of the chlorine and the yields were considerably lower. Henry, (4) in a similar way, prepared chloroacetamide by the treatment of methyl chloroacetate with cold aqueous ammonia.

All these processes, however, proceed well only when the esters used are of methyl and ethyl alcohols. Esters of higher alcohols should be subjected to a preliminary methanolysis. The purpose of the present investigation is to acetylate a number of amines with a special ester, isopropenyl acetate. By the use of this compound, results the formation of a by-product, acetone, which may be easily distilled from the reaction mixture. The isopropenyl acetate is also a low-boiling ester, which, if

¹ An abstract of a thesis submitted to the faculty of Purdue University by H. H. Chen in partial fulfillment of the requirement for the degree of Master of Science.

unused in the course of reaction, may be distilled simultaneously with the acetone. The reaction proceeds as follows:



In the course of the present investigation, several acetylations were conducted. The physical constants of the major acetylated products and those of the derivatives prepared from the by-product, acetone, agree very well with the data from the literature. The general procedures adopted are as follows:

An equi-mole mixture of the amine and the isopropenyl acetate is refluxed from one to four hours, depending on the different amines used. The acetone formed from the reaction and the isopropenyl acetate unused are distilled. The residue is a mixture of the acetyl derivative of the present amine and the unreacted amine. The acetyl derivative is isolated by one of the following processes:

(a) The residue from the distillation is poured into a large quantity of distilled water, then dilute hydrochloric acid is added with stirring. The precipitate is filtered, washed and dried.

(b) The residue from distillation is dissolved in acetone. This solution is added to a large quantity of dilute hydrochloric acid solution. The precipitate formed is washed with more dilute hydrochloric acid solution, then with water, filtered and dried.

(c) The residue from the distillation is dissolved in ether. This solution is extracted with several portions of dilute hydrochloric acid solution. The ether layer is separated, evaporated, and the residue is recrystallized from suitable solvents.

(d) The residue from the distillation is treated with a suitable solvent which will dissolve one of the two compounds, followed by either evaporation of the solvent or washing the residue with the same solvent. The residue obtained by either way is recrystallized from the same or another suitable solvent.

In the identification of the by-product, acetone, the following procedure is used:

A solution of 2,4-dinitrophenylhydrazine is prepared by adding to 0.4 g. of 2,4-dinitrophenylhydrazine, in a 25 ml. Erlenmeyer flask, 2 ml. of concentrated sulfuric acid. Water (3 ml.) is then added dropwise. To this warm solution is added 10 ml. of 95% ethanol.

A solution of the distillate in ethanol is prepared by dissolving 0.5 g. of the distillate in 20 ml. of 95% ethanol. The freshly prepared 2,4-dinitrophenylhydrazine solution is then added, and the resulting mixture is allowed to stand at room temperature. Crystallization of the 2,4-dinitrophenylhydrazone occurs within five to ten minutes. The 2,4-dinitrophenylhydrazone is filtered, dried, and its melting point determined.

Literature Cited

1. BUEHLER, C. A. and MACKENZIE, C. A. 1937. The action of benzylamine on aliphatic esters. *J. Am. Chem. Soc.*, **59**:421.
2. DERMER, O. C. and KING, J. 1943. N-benzylamides as derivatives for identifying the acyl group in esters. *J. Org. Chem.*, **8**:168-73.
3. HARDY, V. N. 1936. Identification of acids and esters. *J. Chem. Soc.*, 1936, 398.
4. HENRY, M. L. 1905. Sur quelques derives du nitrile glycolique $\text{NC-CH}_2(\text{OH})$. *Rec. Trav. Chim.*, **24**:165.
5. JACOBS, W. A. and HEIDELBERGER, M. 1941. Chloroacetamide. *Org. Syn. Col. Vol. I*, pp. 153-4.
6. KOELSCH, C. F. and TENENBAUM, D. 1933. A method for the identification of the acyl group in certain esters. *J. Am. Chem. Soc.*, **55**:3049.
7. RENFROW, W. B. and CHANEY, A. 1946. Identification of the Alcohol components of simple esters. *J. Am. Chem. Soc.*, **68**:150.
8. SAH, P. T. 1940. Hydrazides as characteristic derivatives for the identification of esters, acids, salts, acid halides, and anhydrides, acid amides, ureas and nitriles. *Rev. trav. chim.*, **59**:1036.