9. Yu. A. Kokotov and V. A. Pasechnin, Equilibrium and Kinetics of Ion Exchange [in Russian], Leningrad (1970).
10. A. V. Lykov, Theory of Heat Conductivity [in Russian], Moscow (1967).
11. Ting Chia-Huang and Ku Yeu-Zi, Industr. Eng. Chem. Fundam., 12, No. 1, 50-53 (1973).

PERCHLORIC ACID CATALYZED ACYLATION OF ANISOLE

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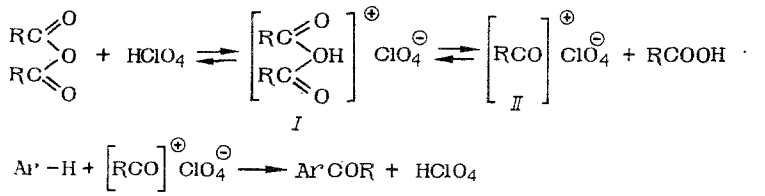
UDC 615.277.3:547.829].
012.1:542.951.1

The C-acylation reaction, which is used for the synthesis of various carbonyl compounds, is widely used in laboratory practice and industry. Thus, in the manufacture of benzestrol (a preparaton for the treatment of inadequacy of ovarian functions), p-methoxybutyrophenone is prepared by acylation of anisole with butyryl chloride in 70% yield; and in the manufacture of chlortrianizen (a preparation for treating cancer of the prostate gland), ω-chloro-p-methoxyacetophenone is prepared by acylation of anisole with monochloroacetyl chloride in 24% yield.

These processes take place by the Friedel—Crafts reaction in the presence of anhydrous aluminum chloride or other such catalysts [1, 2]. The use of these catalysts has a number of defects: resinification of the starting components, considerable catalyst consumption (two to three moles per mole of substance acylated), and difficulty in separating the desired compound.

There are indications in the literature [3] of the possibility of acylating various organic compounds with acid anhydrides in the presence of perchloric acid. According to existing concepts, the mechanism of C-acylation can be represented by the following scheme:



Perchloric acid reacts with the acid anhydride, forming an oxonium ion (I) which dissociates to form the acylium ion (II). Acylium cations (II) are the acylating agents.

The acylation can also be performed with acid chlorides in the presence of perchloric acid. In this case acylium cations are also formed and the acylation proceeds by the scheme given, but, as certain authors have indicated, with lower yields.

In all cases the separation and purification of the acylating agents are necessary.

In our experiments, in the acylation of anisole by butyric acid and a half-molar amount of thionyl chloride, the butyric anhydride formed, without isolation or purification, gave p-methoxybutyrophenone in 66% yield in the presence of catalytic amounts (0.1 mole) of 60% perchloric acid.

We have obtained p-methoxybutyrophenone in higher yield upon use of equimolar ratios of butyric acid and thionyl chloride. In this case butyryl chloride is formed, which reacts further by the known scheme.

Khar'kov Endocrine Preparations Plant. Translated from Khimiko-Farmatsevticheskii Zhurnal, Vol. 10, No. 3, pp. 90-91, March, 1976. Original article submitted March 11, 1975.

Our attempts to effect an acylation of anisole with a mixture of monochloroacetic acid and a half-molar amount of thionyl chloride did not work out. This may be explained by the difficulty of forming oxonium ion I due to the presence of two electrophilic chlorine atoms in the monochloroacetic anhydride; by virtue of their inductive effect these significantly reduce the electron density on the oxygen atom which undergoes protonation in the process of forming oxonium ion I.

An increase in time or reaction temperature did not show up on the yield of the desired product.

The practical use of perchloric acid causes no hazards, since solutions containing less than 55% perchloric acid by volume do not have the ability to detonate or explode [4].

EXPERIMENTAL

p-Methoxybutyrophenone. A mixture of 792 g (9 moles) of butyric acid and 1071 g (9 moles) of thionyl chloride was heated on a boiling water bath for 1 h. Then 486 g (4.5 moles) of anisole was added, plus 35 drops of 60% perchloric acid, and heating was continued for another hour. The reaction mixture was poured into 3 liters of water and the organic layer was separated; this was washed with water to a neutral reaction. Then 80-90 g of anisole was distilled off, which could be used again. The residue was distilled at 135-139° (2-4 mm). There was obtained 486 g of p-methoxybutyrophenone (84% of the theoretical yield calculated on anisole which reacted), b.p. 272-275°; lit.: b.p. 275°.

LITERATURE CITED

1. I. M. Kharag, B. M. Savin, and L. N. Volovel'skii, Med. Prom. SSSR, No. 11, 31-32 (1966).
2. Organic Reactions [in Russian], Coll. 3, pp. 7-8 (1951).
3. M. Nencki, Ber., Dtsch. Chem. Ges., 1766 (1897).
4. N. Dorofeenko, Yu. A. Zhdanov, V. I. Dulenko, et al., Perchloric Acid and Its Compounds in Organic Synthesis [in Russian], Rostov on the Don (1965), p. 55.

USE OF MULTIFACTOR EXPERIMENT PLANNING IN CHOOSING A CATALYTIC SYSTEM AND HYDROGENATION CONDITIONS FOR A C_{20} ACETYLENIC GLYCOL

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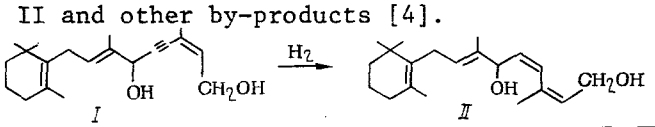
UDC 615.356:577.161.11].
0.12.1.002.62

Performing the selective and stereo-regulated hydrogenation of the acetylenic C_{20} glycol — 9,13-dimethyl-7-(1,1,5-trimethyl-5-cyclohexen-6-yl)-8,13-nonadien-11-yne-10,15-diol (I) into the 11-cis isomer of the ethylenic C_{20} glycol — 9,13-dimethyl-7-(1,1,5-trimethyl-5-cyclohexen-6-yl)-8,11,13-nonatriene-10,15-diol (II) is a very complex process in the synthesis of vitamin A. In the known patents [1-3], this process is carried out on a catalytic system (palladium on a support) which has been deactivated to increase its selectivity by treatment with salts of heavy metals or with organic bases. Various conditions have been proposed thereupon, plus, as a rule, wide ranges in their variation. The absence of specific conditions for selective hydrogenation of compound I has not made it possible to prepare preferentially the 11-cis isomer of II with good reproducibility as compared with the 11-trans isomer of II and other by-products [4].



I II

All-Union Scientific-Research Vitamin Institute, Belgorod Division. Translated from Khimiko-Farmatsevticheskii Zhurnal, Vol. 10, No. 3, pp. 92-96, March, 1976. Original article submitted January 29, 1975.