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Stereoselectivity of alkylation benzene by (1*R*,2*S*)/(1*S*,2*R*)-cyclohex-4-ene-1,2-dicarboxylic acid and (1*R*,2*S*)/(1*S*,2*R*)-4-methylcyclohex-4-ene-1,2-dicarboxylic acid

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Abstract

The alkylation reaction of benzene by cycloalkane-1,2-dicarboxylic acids in the presence of an aluminum chloride proceeds stereoselectively with the predominant formation of an *anti*-isomer described in the literature. When optimizing the reaction conditions, it was found that if the mixing order of the reagents changes (instead of heating the mixture from benzene and aluminum chloride and then adding the acid, first heating the mixture from acid and benzene to 55 °C and then adding aluminum chloride in small portions), the stereoselectivity of the formation of 4-phenylcyclohexane-1,2-dicarboxylic acid and 4-methyl-4-phenylcyclohexane-1,2-dicarboxylic acid changes from the results described earlier. Using of (1*R*,2*S*)/(1*S*,2*R*)-cyclohex-4-ene-1,2-dicarboxylic acid as an alkylating agent leads to the formation of *syn*- and *anti*-products at 31 and 69%, respectively, and in the case of (1*R*,2*S*)/(1*S*,2*R*)-4-methylcyclohex-4-ene-1,2-dicarboxylic acid was not so high, and was 58 and 42%, respectively.

At the same time, the synthesis of phenylcycloalkanedicarboxylic acids was reproduced, as described in the literature. In the case of the using of (1*R*,2*S*)/(1*S*,2*R*)-cyclohex-4-ene-1,2-dicarboxylic acid, the diastereomeric ratio was found to correspond to the literature data. The authors indicated the predominant product of alkylation of benzene as the *anti*-isomer because of the greatest stability of its carbocation, but according to the obtained data of 2D NMR spectroscopy, in studying the stereochemical composition of the alkylation products, the predominant product is the *syn*-isomer. When (1*R*,2*S*)/(1*S*,2*R*)-4-methylcyclohex-4-ene-1,2-dicarboxylic acid was used as the alkylating agent, it turned out that a mixture of diastereomers with a slight predominance of the anti-product (*syn*- : *anti*- was 38 and 62%, respectively) was obtained.

The product structure was determined using GC-MS, ^{1}H, ^{13}C and ^{1}H-^{13}C HSQC NMR spectroscopy.

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