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ON THE SYNTHESIS OF C-N-ALKYLPHENYLSUBSTITUTED DERIVATIVES OF BENZIMIDAZOLE

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A synthesis of chloroanhydrides of phenyl-, alkylsubstituted dodecarboxylic acids has been performed and their electrophilic reactions with *o*-phenylenediamine explored. It is established that during the reaction the cyclic compound, C-alkyl derivatives of benzimidazole were produced with high yield. It as a result of formation of the product determined that mono-carboxamide compounds transformed into enol form intramolecular cyclization, C-alkyl derivatives. Due to this mono-carboxamide compounds are obtained with low yield.

Keywords: carboxylic acid, chloroanhydride, carboxamide, benzimidazole.

Introduction

Benzimidazole derivatives are widely used in chemistry, pharmacy and laquer dye industry. Many scientists focus on the research works carried out in this direction. Considering this we synthesized C-functionally substituted cycloalkane derivatives and studied their properties in our previous works [1–3]. In the present work we the obtaining of new N-alkylphenylsubstituted C-derivatives of benzimidazole and research of their properties are reflected. *ortho*-Phenylenediamine is acylated with chloroanhydrides of 5-phenyl, alkylphenyldodeca-

carboxylic acids to produce C-N-alkylphenyl derivatives of benzimidazole. 5-phenyl, alkylphenyldodecarboxylic acids were produced by alkylating benzene and its derivatives with δ -heptyl- δ -valerolactone obtained by the method [4] in Friedel-Crafts reaction using the method [5]. Physical and chemical properties of synthesized acids (*Ia-ch*) are similar to the literature data [6]. Chloroanhydrides of acids were obtained using the method [7] and reactions with *o*-phenylenediamine were studied. The reaction proceeds by the following scheme:

$\text{R}^1 = \text{R}^2 = \text{R}^3 = \text{H}$ (a); $\text{R}^2 = \text{CH}_3$, $\text{R}^1 = \text{R}^3 = \text{H}$ (b); $\text{R}^2 = \text{C}_2\text{H}_5$, $\text{R}^1 = \text{R}^3 = \text{H}$ (c); $\text{R}^1 = \text{R}^3 = \text{CH}_3$, $\text{R}^2 = \text{H}$ (ch).

During the reaction carboxamide (II *a-ch*) compounds are also obtained in small quantities (8–10%) with the main product C-alkyl-

phenyl derivatives (III *a-ch*) of benzimidazole. These derivatives (III *a-ch*) of benzimidazole are probably obtained due to the intramolecular

cyclization of mono-carboxamide compounds (II *a-ch*) by transforming to enol form. Composition and structure of synthesized carboxamide (II *a-ch*) and benzimidazole derivatives (III *a-ch*) were studied by determining their physical and chemical constants and confirmed by the method of IR-spectroscopy and NMR.

Experimental part

Chloroanhydride of 5-phenyldodecarboxylic acid (Ia). 69 g (0.25 mol) of 5-phenyldodecarboxylic acid and 80 ml of benzene mixture are placed into three-necked flask equipped with a mechanical mixer, reverse cooler, thermometer and drop funnel, then 23.37 g (0.17 mol) of PCl_3 is added into the mixture using a drop funnel. After PCl_3 is added completely the reaction mass is heated for 1.5–2 hours at 70–75°C. Chloroanhydride benzene mixture is separated from yellow deposit by decantation and distilled in vacuum. Obtained 66.11 g (89.9%) chloroanhydride (I *a*). $T_{\text{boil.}}$ – 189–191°C/8 mm Hg, n_D^{20} – 1.4826, d_4^{20} – 0.9745. $\text{C}_{18}\text{H}_{27}\text{ClO}$. Calculated MR_D – 86.689. Found MR_D – 86.248.

Chloroanhydride of 5-(4-methylphenyl)dodecarboxylic acid (I b). Using the above-mentioned technique 66.71 g (86.5%) of chloroanhydride (I *b*) was obtained by the interaction of 72.50 g (0.25 mol) of 5-(4-methylphenyl)dodecarboxylic acid with 23.37 g (0.17 mol) of phosphorus trichloride in 80 ml of benzene environment. $T_{\text{boil.}}$ – 194–196°C/7 mm Hg, n_D^{20} – 1.4835, d_4^{20} – 0.9699. $\text{C}_{19}\text{H}_{29}\text{ClO}$. Calculated MR_D 91.307. Found MR_D – 90.875.

Chloroanhydride of 5-(4-ethylphenyl)dodecarboxylic acid (I c). Using the same technique 80.62 g (86.6%) of chloroanhydride (I *c*) was obtained by the interaction of 76.0 g (0.25 mol) of 5-(4-ethylphenyl)dodecarboxylic acid with 23.37 (0.17 mol) of PCl_3 in 80 ml of benzene environment. $T_{\text{boil.}}$ – 236–239°C, 20 mm Hg, n_D^{20} – 1.4785, d_4^{20} – 0.9536, $\text{C}_{20}\text{H}_{31}\text{ClO}$. Found MR_D 96.182, Calculated MR_D – 95.925.

Chloroanhydride of 5-(2,5-dimethylphenyl)dodecarboxylic acid (I ch). Using the same technique 69.17 g (85.8%) of chloroa-

nhydride (I *ch*) was obtained by the interaction of 76.0 g (0.25 mol) of 5-(2,5-dimethylphenyl)dodecarboxylic acid with 23.17 (0.17 mol) of PCl_3 in 80 ml of benzene environment. $T_{\text{boil.}}$ – 241–243°C, 20 mm Hg, n_D^{20} – 1.4796, d_4^{20} – 0.9576, $\text{C}_{20}\text{H}_{31}\text{ClO}$. Found MR_D – 95.347. Calculated MR_D – 95.925.

Reaction of chloroanhydride (I a) of 5-phenyldodecarboxylic acid with *o*-phenylenediamine. 5.4 g (0.05 mol) of *o*-phenylenediamine and 70 ml of *p*-xylene mixture is placed into a three-necked flask equipped with a reflux condenser, thermometer and mixer and 14.7 g (0.05 mol) of chloroanhydride (I *a*) is added drop by drop. The temperature of a reaction mass rises up to 40°C when chloroanhydride is added. Then the reaction mass is heated for 2 hours at 75–80°C. After cooling a crystal substance is filtered and separated from a liquid part. When crystal substance is crystallized in a water–alcohol mixture two fractions are obtained. 1) 1.7 g (9.3%) N-(2-aminephenyl)-5-phenyldodecarboxamide (II *a*). $T_{\text{melt.}}$ – 135–136°C (EtOH–H₂O). IR spectra (ν , cm^{-1}): 3380 (NH_2), 3350 (NH), 1650 ($-\text{CO}-\text{NH}$), 1600–1500 ($\text{C}=\text{C}_{\text{ar.}}$), 770, 755, 740 ($\text{C}=\text{C}_{\text{ar.}}$, 1,2-substituted), 730, 710, 700 ($\text{C}=\text{C}_{\text{ar.}}$, mono-substituted). 2) [(4-phenyl)undecyl]-1H-benzimidazole (III *a*), $T_{\text{melt.}}$ – 71–72°C (EtOH–H₂O). IR-spectrum (ν , cm^{-1}): 3180 ($-\text{NH}$, bonded), 1660 ($\text{C}=\text{N}$, valence vibrations of a bond in a cycle), 1600, 1580, 1510, ($\text{C}=\text{C}_{\text{ar.}}$), 730, 710, 700 ($\text{C}=\text{C}_{\text{ar.}}$, mono-substituted). Spectrum NMR (δ , ppm): 0.88 s (3H, CH_3), 1.30 s (2H, CH_2), 1.36÷1.84 m (16H, 5 CH_2), 2.64 s (1H, Ar–CH), 6.70–6.82 m (5H, C_6H_5), 7.30–7.65 m (4H, C_6H_4).

Reaction of chloroanhydride of 5-(4-methylphenyl)dodecarboxylic acid (I b) with *o*-phenylenediamine. Two substances are obtained by the interaction of 15.32 g (0.05 mol) of chloroanhydride (I *b*) with 5.4 g (0.05 mol) of *o*-phenylenediamine in 70 ml of *p*-xylene environment using the same method: 1) 1.63 g (8.6%) N-(2-aminephenyl)-5-(4-methylphenyl)dodecarboxamide (II *b*). $T_{\text{melt.}}$ – 128–129°C (EtOH–H₂O).

Fig. 1. N-(2-aminephenyl)-5-phenyldodecarboxamide (II a).

Fig. 2. 2-[4-(2,5-dimethyl-phenyl)undecyl]-1H-benzimidazole.

2) 14.49 g (80.5%) 2-[4-(4-methylphenyl)undecyl]-1H-benzimidazole (II *b*). $T_{\text{melt.}}$ – 61–62°C (EtOH–H₂O). IR spectra (ν , cm^{-1}): 3280 (NH, valence bond), 1690 (C=N–), 600, 540, 500 (C=C_{ar.}), 860, 830 (C=C_{ar.}, 1,4-substituted), 775, 770, 700 (C=C_{ar.}, 1,2-substituted).

Reaction of chloroanhydride of 5-(4-ethylphenyl)dodecarboxylic acid (I *c*) with *o*-phenylenediamine. Using the same technique two substances are obtained by the reaction of 16.03 g (0.05 mol) of chloroanhydride (I *c*) with 5.4 g (0.05 mol) of *o*-phenylenediamine in 70 ml *p*-xylene. 1) 1.52 g (7.8%) N-(2-aminephenyl)-5-(4-ethylphenyl)dodecarboxamide (II *c*). $T_{\text{melt.}}$ – 120–121°C (EtOH–H₂O). IR spectra (ν , cm^{-1}): 3380 (NH₂), 3350 (–NH), 1670 (–CO–NH), 1600–1480 (C=C_{ar.}), 850, 810 (C=C_{ar.}, 1,4-substituted), 750, 730 (C=C_{ar.}, 1,2-substituted). 2) 14.75 g (78.9%) 2-[4-(4-ethylphenyl)undecyl]-1H-benzimidazole (II *c*). $T_{\text{melt.}}$ – 54–55°C (EtOH–H₂O). IR spectra (ν , cm^{-1}): 3300 (–NH, valence bond), 1680 (C=N–), 600–480 (C=C_{ar.}), 860, 840, 810 (C=C_{ar.}, 1,4-substituted), 770, 750, 710 (C=C_{ar.}, 1,2-substituted).

Reaction of chloroanhydride of 5-(2,5-dimethylphenyl)dodecarboxylic (II *ch*). Using the same method two substances are obtained by the interaction of 16.03 g (0.05 mol) of chloroanhydride (I *ch*) with 5.4 g (0.05 mol) of *o*-phenylenediamine. 1) 1.99 g (10.2%) N-(2-aminephenyl)-5-(2,5-dimethylphenyl) dodecarboxamide (II *c*). $T_{\text{melt.}}$ – 123–124°C (EtOH–H₂O). IR spectra (ν , cm^{-1}): 3380 (NH₂, free), 3350 (–NH), 1680 (CO–NH), 1600–1500 (C=C_{ar.}), 870, 860 (C=C_{ar.}, 1,2,5-substituted), 750, 710, 700 (C=C_{ar.}, 1,2-substituted). 2) 15.67 g (83.8%) 2-[4-(2,5-dimethyl-phenyl)undecyl]-1H-benzimidazole (II *c*). $T_{\text{melt.}}$ – 56–57°C (EtOH–H₂O). IR spectra (ν , cm^{-1}): 3180 (–NH, connected), 1660 valence vibrations of (C=N–) bond in cycle, 1605, 1580 (C=C_{ar.}), 860–840 (C=C_{ar.}, 1,2,5-substituted), 760–700 (C=C_{ar.}, 1,2-substituted). NMR spectra (δ , ppm): 0.935 s

(3H, CH₃), 1.30 s (2H, CH₂), 1.28 – 1.55 m (10H, 5CH₂), 1.58–1.62 m (CH, 3CH₂), 2.32 s (6H, Ar– (CH₃)₂), 2.72 s (1H, Ar–CH–), 6.70–6.80 d (3H, 3ArH), 7.76 s (1H, N–H) absorption bands and signals confirm its structure.

IR spectrum of synthesized substances was recorded on Nicolet 10 spectrometer in suspension state on a thin film or in paraffinic oil.

Spectrum NMR was measured on Bruker 300 spectrometer (operating frequency – 300 MHz), internal standard – hexamethylenedicyclohexane, chemical shift was measured in a scale δ .

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**BENZİMİDAZOLUN C-N-ALKİL FENİLƏVƏZLİ TÖRƏMƏLƏRİNİN
SİNTEZİ HAQQINDA****M.Ə.Rüstəmov, G.Ə.Mirzəyeva, Ş.M.Eyvazova**

Fenil-, alkilfeniləvəzli dodekakarbon turşularının xloranhidridləri sintez edilərək, onların *o*-fenilendiaminlə elektrofil reaksiyası tədqiq edilmişdir. Tədqiqat nəticəsində müəyyən edilmişdir ki, reaksiya zamanı yüksək çıxımla tsiklik birləşmə, benzimidazolun C-alkil törəmələri alınır. Sonuncunun, reaksiya zamanı alınan mono-karboksiamid birləşməsinin reaksiya şəraitində enol-formaya keçərək molekul daxili tsiklləşməsi nəticəsində əmələ gəlməsi müəyyən edilmişdir. Bunun nəticəsidir ki, mono-karboksiamid birləşmələri az çıxımla alınır.

Açar sözlər: karbon turşusu, xloranhidrid, karboksiamid, benzimidazol.

СИНТЕЗ БЕНЗИМИДАЗОЛА С С-N-АЛКИЛЗАМЕЩЕННЫМИ ПРОИЗВОДНЫМИ**М.А.Рустамов, Г.А.Мирзоева, Ш.М.Эйвазова**

Синтезированы хлорангидриды фенил-, алкилфенилзамещенных додекакарбоновых кислот и изучены их электрофильные реакции с *o*-фенилендиамином. Установлено, что в результате реакции с большим выходом получены циклические производные С-N-алкилбензимидазола. Показано, что образование продукта внутримолекулярной циклизации С-N-алкилпроизводных связано с переходом моно-карбоксиамидных соединений в ходе реакции в энольную форму. В связи с этим моно-карбоксиамидные соединения получены с низким выходом.

Ключевые слова: карбоновая кислота, хлорангидрид, карбоксиамид, бензимидазол.