N. A. Buntyakova, K. A. Taraskin, and V. G. Kharchenko UDC 547.879'233'281.1.07;543.422

N,N,N-Trifurylalkylperhydro-1,3,5-triazines were synthesized by the reaction of primary furan amines with formal dehyde. 1-(2-Furyl)-3-methylaminobutane and 1-(2-furyl)-3-methyl-3-hydroxymethylaminobutane were isolated as intermediates in the case of stepwise reductive alkylation of 1-(2-furyl)-3-aminobutane.

We have previously obtained [1-3] a series of tertiary furan amines by direct reductive alkylation. The aim of the present research was to study the nature of the intermediates and to ascertain the mechanism of this reaction. It is known [4] that primary amines react with ketones and aldehydes to give methylol derivatives or Schiff bases. One might have expected that the same compounds would be intermediates in the reductive alkylation of amines with formaldehyde. We found that products with the following structures (V-VIII) are formed even when alcohol solutions of the primary amines (I-IV) are mixed with formalin:



I R=R'=H; II R=H,  $R'=CH_3$ ; III  $R=CH_3$ , R'=H; IV R=H,  $R'=C_6H_5$ ; V R=R'=H; VI R=H,  $R'=CH_3$ ; VII  $R=CH_3$ ; R'=H; VIII R=H,  $R'=C_6H_5$ ; IX R=R'=H; X R=H,  $R'=CH_3$ ; XI R=H,  $R'=CH_3$ ; XII R =H,  $R'=CH_3$ ; XII R =H

Absorption bands associated with the vibrations of the furan ring appear distinctly in the IR spectra of triazines V-VIII at 1010, 1510, and 1600 cm<sup>-1</sup>. The spectra do not contain absorption bands of stretching vibrations of the NH and OH bonds at 3300-3600 cm<sup>-1</sup> and of an azomethine C=N group at 1640-1690 cm<sup>-1</sup>, and this provides a basis for exclusion of the possibility of the formation of methylol derivatives or Schiff bases.

Compounds V-VI were subjected to reductive alkylation with formaldehyde in the presence of NiR (Raney nickel), and tertiary amines IX and X were obtained. The reaction of amine II in an autoclave in the presence of hydrogen and the NiR catalyst at room temperature led to secondary amine XI, whereas unstable methylol derivative XII was obtained by its reaction with formalin. Secondary amine XI is readily alkylated to give tertiary amine X by further reduction with hydrogen in the presence of formaldehyde on the NiR catalyst.

The structures of IX-XII were confirmed by the results of elementary analysis and the IR spectra.

N. G. Chernyshevskii Saratov State University, Saratov 410026. Translated from Khimiya Geterotsiklicheskikh Soedinenii, No. 2, pp. 175-177, February, 1983. Original article submitted February 1, 1982.

TABLE 1. N,N,N-Trifurylalkylperhydro-1,3,5-triazines (V-VIII)

Com- pound	R	R′	bp, °C (mm)	n <sub>D</sub> <sup>20</sup>	М		Found, %			Empirical	Calc.,			1, %
					found	calc,	С	н	N	formula	С	н	N	Yield
VI VI VII VIII	H H CH₃ H	H CH₃ H C6H₅	130 (8) 85 (2) 190 (3)	1,5190 1,5160 1,5150 1,5625	372 480 468 571	375 453 453 558	69,9 71,4 71,2 78,5	8,1 8,8 8,7 7,2	9,9 9,2 9,4 6,4	$(C_8H_{11}NO)_3$ $(C_9H_{13}NO)_3$ $(C_9H_{13}NO)_3$ $(C_{14}H_{15}NO)_3$	70,0 71,5 71,5 78,9	8,0 8,7 8,7 7,0	10,2 9,3 9,3 6,6	84 85 50 80

It is apparent that the first step in this reaction is monomethylation with the subsequent formation of triazines and their conversion to monoalkylation products. The latter are methylolated to give compunds that do not give triazine structures and are reduced to dialkylamines on NiR. It is quite possible that the formation of triazines and monomethylation of the amines are parallel processes.

## EXPERIMENTAL

<u>N,N,N-Trifurylalkylperhydro-1,3,5-triazines (V-VIII)</u>. A total of 3.6 g (0.12 mole) of formaldehyde in the form of a 38% aqueous solution was added to 0.12 mole of the primary furan amine I-IV [5-7] dissolved in 30 ml of ethanol. The reaction was accompanied by the liberation of heat. After 15 min, the lower layer was separated, and the upper layer was extracted with ether (two 20-ml portions). The ether extracts were added to the oil, and the mixture was dried with  $K_2CO_3$ . The ether was removed by distillation, and the product was distilled in vacuo or dried in vacuo at room temperature.

<u>1-(2-Furyl)-3-methylaminobutane (XI).</u> A 250-ml rotating autoclave was charged with 12.5 g (0.1 mole) of 1-(2-furyl)-3-aminobutane [6], 9 g (0.3 mole) of formaldehyde ( $\sim$ 24 ml of formalin), 1.25 g of sodium acetate in 100 ml of ethanol, and 2.5 g of Raney nickel, and reduction was carried out at room temperature and an initial hydrogen pressure of 10 mhPa. After 0.1 mole of hydrogen has been absorbed, the catalyst was removed by filtration, and the alcohol was removed by distillation at reduced pressure. The amine was separated from the aqueous layer, and the aqueous layer was extracted with ether (three 50-ml portions). The ether extracts were added to the amine, and the mixture was dried with calcined potassium carbonate. The ether was then removed by distillation, and the amine was distilled in vacuo to give 9.9 g (72%) of 1-(2-furyl)-3-methylaminobutane (XI) with bp 95-97°C (18 mm) and n<sup>20</sup><sub>D</sub> 1.4720, IR spectrum: 3425 cm<sup>-1</sup> (NH). Found: C 70.5; H 9.8; H 9.2%. C<sub>9</sub>H<sub>15</sub>NO. Calculated: C 70.5; H 9.9; N 9.1%.

<u>1-(2-Furyl)-3-methyl-3-hydroxymethylaminobutane (XII)</u>. This compound was obtained by the general method for V-VIII on the basis of 2 g of IX and 15 ml of formalin in 20 ml of ethanol. Workup gave 1 g (44%) of a product with bp 105°C (5 mm) and  $n_D^{20}$  1.4640. Found: N 7.2%. C<sub>10</sub>H<sub>17</sub>NO<sub>2</sub>. Calculated: N 7.6%.

<u>1-(2-Furyl)-3-dimethylaminopropane (IX).</u> A 250-ml rotating autoclave was charged with 5 g (0.012 mole) of N,N,N-tris[1-(2-furyl)propyl]perhydro-1,3,5-triazine (V), 8.2 g (0.072 mole) of 38% aqueous formaldehyde solution, 15 ml of ethanol, and 1.5 g of NiR, and hydro-genation was carried out at 30°C and an initial hydrogen pressure of 10 mhPa. After the calculated amount of hydrogen had been absorbed, the catalyst was removed by filtration, and the alcohol was removed by distillation at reduced pressure. The amine was extracted from the aqueous layer with ether, and the ether extracts were dried with calcined potassium carbonate. The ether was removed by distillation, and the amine was distilled in vacuo to give 3.6 g (65%) of a product with bp 72-73°C (15 mm) and  $n_D^{2°}$  1.4618 [bp 59°C (5 mm) and  $n_D^{2°}$  1.4620 [1]].

<u>l-(2-Furyl)-3-dimethylaminobutane (X)</u>. This compound was synthesized in 60% yield from triazine VI and in 70% yield from XI by a method similar to that used to prepare IX. The product had bp 82°C (9 mm) and  $n_D^{20}$  1.4670 [bp 81-81.5°C (9 mm) and  $n_D^{20}$  1.4668 [1]].

## LITERATURE CITED

- 1. A. A. Ponomarev, I. M. Skvortsov, N. A. Buntyakova, A. A. Stolyarchuk, and N. I. Ivanova, Khim.-farm. Zh., No. 11, 5 (1969).
- I. M. Skvortsov, N. A. Buntyakova, A. A. Stolyarchuk, and N. I. Ivanova, Khim.-farm. Zh., No. 8, 14 (1972).

- I. M. Skvortsov, N. A. Buntyakova, A. A. Stolyarchuk, and N. I. Ivanova, Khim.-farm. Zh., No. 5, 66 (1977).
- 4. V. Emerson, in: Organic Reactions [Russian translation], No. 5, Inostr. Lit., Moscow (1951), p. 347.
- 5. A. P. Terent'ev, R. A. Gracheva, and O. P. Shkurko, Zh. Obshch. Khim., 30, 3711 (1960).
- A. A. Ponomarev, N. P. Maslennikova, and A. P. Kriven'ko, Zh. Obshch. Khim., <u>31</u>, 958 (1961).
- 7. I. F. Bel'skii, Izv. Akad. Nauk SSSR, Ser. Khim., No. 3, 493 (1962).

SYNTHESIS AND TRANSFORMATIONS OF 2-BROMOMETHYL-3-BENZOYL-5-ACETOXYBENZOFURAN

A. N. Grinev, S. A. Zotova,

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O. S. Anisimova, and T. M. Gololobova

2-Bromomethyl-3-benzoyl-5-acetoxybenzofuran was synthesized, and its reaction with nucleophilic reagents was studied. Various benzofuran derivatives, as well as condensed systems that include a benzofuran ring, were obtained. The structures of the synthesized compounds were proved by PMR and mass spectrometry.

We have previously shown that when electrophilic substitution reactions with 5- and 6hydroxybenzofurans are carried out, the substituents are incorporated primarily in the benzene ring, whereas substitution in the benzene ring is excluded in the action of electrophilic agents on the corresponding acetoxy derivatives of benzofurans, and the substituent is incorporated only in the furan ring or in the side chain of the benzofuran derivative [1-3]. These investigations, which create new prospects from the point of view of the synthesis of various benzofuran derivatives, have undergone further development in the present research.

We have found that 2-methyl-3-benzoyl-5-acetoxybenzofuran (I) is converted to 2-bromomethyl-3-benzoyl-5-acetoxybenzofuran (II) by bromination in nonaqueous solutions with N-bromosuccinimide (NBS) in the presence of benzoyl peroxide and with illumination. We also showed that II is a convenient starting compound for the synthesis of both benzofuran derivatives and condensed systems that include a benzofuran ring. The bromine atom is replaced by a hydroxy group by the action of water on II. The resulting hydroxymethyl-3-benzoyl-5-hydroxybenzofuran (III) was oxidized with the chromium trioxide-pyridine complex to 2-formyl-3-benzoyl-5hydroxybenzofuran (IV). Bromomethyl derivative II is converted to ethyl 3-benzoyl-5-hydroxybenzofuranyl-2-methylthioglycolate (V) in 61% yield by the action of ethyl trioglycolate. Compound II reacts with N-phenylhydrazine to give 1,3-diphenyl-4H-8-acetoxypyridazino[5,4-b]benzofuran (VI), whereas 1-phenyl-7-hydroxythieno[3,4-b]benzofuran (VII) is formed when it is treated with thioacetamide. We established that in the case of aminomethylation of VII the



S. Ordzhonikidze All-Union Scientific-Research Institute of Pharmaceutical Chemistry, Moscow 119021. Translated from Khimiya Geterotsiklicheskikh Soedinenii, No. 2, pp. 178-180, February, 1983. Original article submitted April 28, 1982.