ADDITION OF CARBENES TO 4-METHYL-5,6-DIHYDRO-2H- AND 4-METHYLENETETRAHYDROPYRANS

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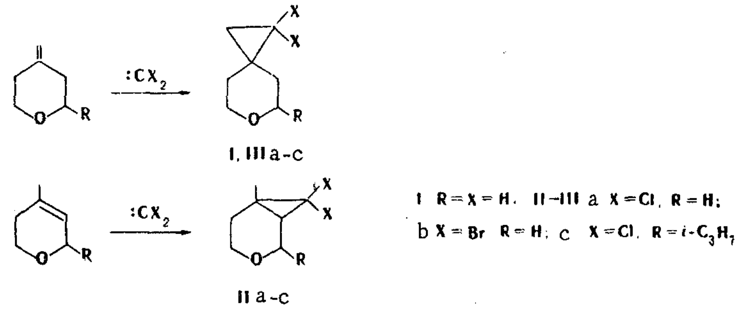
It is shown that 4-methylenetetrahydropyran adds a methylene group under the conditions of the Simmons—Smith reaction to give 4,4-dimethylenetetrahydropyran. 4-Methyldihydro-2H-pyran and 4-methylenetetrahydropyran add dichlorocarbene in the presence of a catalyst, viz., triethylbenzylammonium chloride, to give two-ring adducts. It is shown that the adducts can be converted to ketals by refluxing for many hours with alcoholic alkali. The structures of the compounds obtained were established by gas—liquid chromatography and PMR and IR spectroscopy.

In a continuation of our research (see [1] and the literature cited therein) on the synthesis and chemical transformations of di- and tetrahydropyrans, in the present communication we present the results of investigations of the addition of carbenes.

We have shown that 4-methyl-5,6-dihydro-2H-pyran readily adds methylene to the double bond under the conditions of the Simmons—Smith reaction [2] to give 4,4-dimethylenetetrahydropyran. From a preparative point of view, the addition of dihalocarbenes proceeds even more readily. Dihalocarbenes generated by the method in [3] add to 4-methyl-5,6-dihydro-2H-pyran and 4-methylenetetrahydropyran to give two-ring adducts in high yields (Table 1).



In the absence of a catalyst, viz., triethylbenzylammonium chloride, the yields of adducts are reduced to 10%. The halogen atoms of the synthesized cyclopropane derivatives are distinguished by their considerable inertness; however, under severe conditions, as in [4], they can be replaced by alkoxy groups. For example, 4-methyl-3,4-(dipropoxymethylene)tetrahydropyran can be obtained in 48% yield by refluxing 4-methyl-3,4-(dichloromethylene)tetrahydropyran with alcoholic alkali for many hours.

The structures of the compounds obtained were confirmed by PMR spectroscopy (Table 2).

EXPERIMENTAL

The PMR spectra of solutions of the compounds in CCl_4 were obtained with a Perkin—Elmer R-12 spectrometer (60 MHz) with tetramethylsilane as the internal standard. The starting isomeric di- and tetrahydropyrans were separated with a preparative chromatograph with 3.3 m × 5 mm columns containing 15% PEG-20M on Chromaton N-AW-HMDS as the stationary phase; the carrier gas (helium) flow rate was 80-90 ml/min at 100-120°C. The 4-methylenetetrahydropyran and 4-methyl-5,6-dihydro-2H-pyran were identical to genuine samples [5]. 4-Methyl-2-

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TABLE 1. Tetrahydropyran Derivatives

Compound	bp, °C (mm)	n_D^{20}	d_4^{20}	Found, %			Empirical formula	Calc., %			Yield, %
				C	H	halogen		C	H	halogen	
IIa	60—61 (1)	1,5013	1,2674	46,5	5,6	39,5	$C_7H_{10}Cl_2O$	46,4	5,5	39,2	89
IIb	89—90 (1)	1,5510	1,7950	30,8	4,0	59,6	$C_7H_{10}Br_2O$	31,1	3,7	59,3	74
IIc	77 (1)	1,4838	1,1297	54,0	7,7	31,4	$C_{10}H_{16}Cl_2O$	53,8	7,2	31,8	83
IIIa	90—91 (11)[a]	—	—	46,2	5,8	38,6	$C_7H_{10}Br_2O$	46,4	5,5	39,2	71
IIIb	93—94 (3)[b]	—	—	31,1	4,0	59,8	$C_7H_{10}Br_2O$	31,1	3,7	59,3	74
IIIc	63—64 (1)	1,4950	1,1371	53,6	6,8	31,7	$C_{10}H_{16}Cl_2O$	53,8	7,2	31,8	78

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[a] This compound had mp 27°C. [b] This compound had mp 29°C.

TABLE 2. Parameters of the PMR Spectra of II and III

Compound	δ, ppm (J, Hz)						Compound	δ, ppm (J, Hz)			
	2-H	3-H	5-H	6-H_2	CH_3 (*i*-Pr)	4-CH_3		2-H and 6-H	5-H and 3-H	CH_2 (cyclopropane)	CH_3 (*i*-Pr)
IIa	3,87 (3,0) 3,89 (4,9)	1,28 dd (3,0, 4,9)	1,50—2,27 m	2,95—3,69m	—	1,47 s	IIIa	3,37—4,00	1,47—2,08	1,27 s	—
IIb	3,84 d (2,3) 3,88 d (4,9)	1,41 dd	1,60—2,28 m	2,92—3,76m	—	1,52 s	IIIb	3,35—4,05 m	1,53—2,09 m	1,47 s	—
IIc	2,64 dd (5,3, 10,0)	— —	1,40—2,10 m	3,3—4,5 m	0,86 d (5,9)	1,45 s	IIIc	2,82—4,22 m	1,30—2,10	1,23 s	0,89 and 0,92 (6,0)

isopropyl-5,6-dihydro-2H-pyran had bp 63°C (12 mm), n_D^{20} 1.4510, and d_4^{20} 0.8876. IR spectrum: 1654 cm^{-1} (C=C). Found: C 77.3; H 11.2%. $C_9H_{16}O$. Calculated: C 77.1; H 11.4%. 4-Methylene-2-isopropyl-5,6-dihydro-2H-pyran had bp 58-59°C (12 mm), n_D^{20} 1.4500, and d_4^{20} 0.8768. IR spectrum: 3090 cm^{-1} (=CH_2). Found: C 77.3; H 11.2%. $C_9H_{16}O$. Calculated: C 77.1; H 11.4%.

The individuality of the synthesized adducts was determined by means of GLC with an LKhM-8MD chromatograph with a catharometer and a column filled with 15% PEG-20M on Chromaton N-AW-HMDS; the carrier-gas (helium) flow rate was 40-60 ml/min, and the temperature was 150-180°C.

Reaction of Dihalocarbenes with Di- and Tetrahydropyrans. An 8-ml (100 mole) sample of chloroform or bromoform was added dropwise with stirring at 25-30°C in the course of 2 h to a mixture of 50 mmole of the pyran derivative, 24 g of a 50% solution of sodium hydroxide, and triethylbenzylammonium chloride (0.5% of the weight of the starting pyran). The mixture was then stirred for another 3 h, after which it was cooled and extracted with ether. The extract was dried with magnesium sulfate, the solvent was evaporated, and the pyran derivatives were isolated by vacuum distillation (Table 1).

4,4-Dimethylenetetrahydropyran (I). A mixture of 7.8 g (120 mmole) of a zinc—copper couple [6], 50 ml of ether, and a small crystal of iodine was stirred until the brown coloration vanished, after which a mixture of 9.8 g (100 mmole) of 4-methylenetetrahydropyran and 9.4 ml (116 mmole) of methylene iodide was added, and the mixture was stirred at 45-50°C for 20 h. It was then filtered, and the residue on the filter was washed successively with a saturated solution of ammonium chloride, a saturated solution of sodium bicarbonate, and water and dried with magnesium sulfate. The ether was evaporated, and the residue was distilled with collection of the fraction with bp 100-145°C (680 mm), which (according to GLC) was a mixture of the starting 4-methylenetetrahydropyran (51%) and 4,4-dimethylenetetrahydropyran (49%). The mixture was separated by means of preparative chromatography with a 3.3 m × 5 mm column with 15% PEG-20M on Chromaton N-AW-HMDS as the stationary phase; the carrier-gas (helium) flow rate was 100 ml/min at 90°. This procedure gave 2.7 g (33% based on the converted 4-methylenetetrahydropyran) of 4,4-dimethylenetetrahydropyran with bp 126-128°C (680 mm), n_D^{20} 1.4540, and d_4^{20} 0.9694. Found: C 75.1; H 10.6%. $C_7H_{12}O$. Calculated: C 75.0; H 10.7%.

4-Methyl-3,4-(dipropoxymethylene)tetrahydropyran (IV). A 1-g sample of triethylbenzylammonium chloride was added to a heated (to 120°C) mixture of 5.6 g (100 mmole) of potassium hydroxide and 6 g (100 mmole) of propyl alcohol, after which 4.6 g (25 mmole) of IIIa was added dropwise in the course of 15 min. Heating was continued for another 10 h, after which the reaction product was extracted with ether. The extract was washed with water, dried with sodium sulfate, and vacuum distilled to give 2.7 g (48%) of dipropoxy derivative IV with bp 82-85°C (1 mm), n_D^{20} 1.4720, and d_4^{20} 0.9778. Found: C 64.5; H 11.8%. $C_{13}H_{14}O_3$. Calculated: C 64.8; H 11.8%.

LITERATURE CITED

1. A. A. Gevorkyan, S. M. Kosyan, and Dzh. I. Gezalyan, Arm. Khim. Zh., 31, 430 (1978).
2. H. E. Simmons and R. D. Smith, J. Am. Chem. Soc., 80, 5223 (1958).
3. M. Makosha, Usp. Khim., 46, 2183 (1977).
4. V. D. Novokreshchennykh, S. S. Mochalov, and Yu. S. Shabarov, Zh. Org. Khim., 14, 546 (1978).
5. S. K. Ogorodnikov and G. S. Idlis, The Manufacture of Isoprene [in Russian], Khimiya, Leningrad (1973).
6. R. S. Shank and H. Shechter, J. Org. Chem., 24, 1825 (1959).

ONE-STEP SYNTHESIS OF 4-ETHOXY-6-BROMO-7-HYDROXYFLAVYLIUM SALTS AND THE CORRESPONDING FLAVONES

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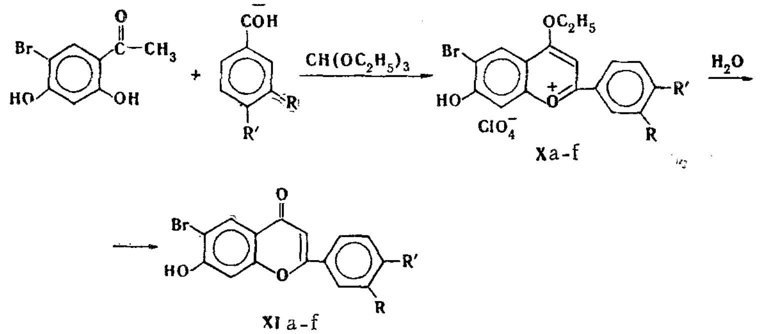
The boundaries of application of the one-step synthesis of flavylium salts on the basis of bromoresacetophenone were extended, and the conditions for heterocyclization of 2',4'-dihydroxy-5'-bromochalcones to 4-ethoxyflavylium salts were studied simultaneously. It was noted that similar reaction products were obtained in these two variants of the synthesis of the salts. The presence of electronegative substituents and a hydroxy group in the starting aldehydes hinders the formation of flavylium salts.

Benzoypyrlium salts are of interest for the preparation of some biologically active substances, viz., chromones, flavones, and isoflavones [1-3]. One of the most convenient methods for the preparation of 4-ethoxyflavylium salts is one-step acid condensation of o-hydroxyacetophenone and its derivatives with aromatic aldehydes and ethyl orthoformate in the presence of 70% perchloric acid [2, 3] or by cyclodehydration of o-hydroxychalcones with ethyl orthoformate and perchloric acid [4].



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