SYNTHESIS OF N-BENZYLLEPIDINIUM SALTS FROM N-BENZYLARYLAMINES

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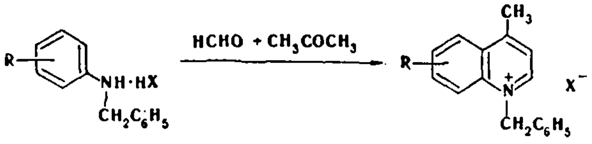
Quaternary N-benzyllepidinium salts are usually synthesized by reaction of benzyl halides with lepidine and its derivatives, which are prepared by the multistep Knorr synthesis from primary aromatic amines [1-4].

Pilyugin and Gutsulyak found [5, 6] that reaction of diarylamines and alipathic aromatic amines with formaldehyde and acetone in the presence of a mineral acid forms N-aryl- and N-alkyllepidinium salts in one stage. Here we report a study of the related cyclization of N-benzyl derivatives of aniline, p-toluidine, p-anisidine, p-phenetidine, and 1- and 2-naphthylamines to N-benzyllepidinium salts.



I–XVII

Use of nitrobenzene as a mild dehydrogenating agent increases the yield and purity of the quaternary salts. Better yields can be obtained by using hydrochloric, hydrobromic, or perchloric acid, when the compounds are isolated as the chlorides, bromides, or perchlorates. Exchange reaction of the chlorides with potassium iodide gives the iodides. We verified the structures of salts (III) and (IV) by independent synthesis [7].

The UV spectra of salts (I)-(XV) have two clear absorption bands (Table 1); the long-wavelength band is hardly susceptible to substituent effects and correlates with the known spectra of N-alkyl and N-aryllepidinium salts [8]. The similarity between the UV spectra of salts (XVI) and (XVII) and that of N-phenylbenzo[f]lepidinium perchlorate support their structures.

The IR spectra of all the salts lacked the characteristic N–H stretching bands, implying that they were not contaminated by the protonated starting amines. The 1650-1300 cm^{-1} region contains the stretching bands of the charged quinolinium ring [7].

The IR spectra of the individual groups of salts differ most obviously in the region of the out-of-plane CH deformation modes (γCH). All the salts have two bands due to the five adjacent hydrogen atoms in the N-benzyl radical (760-733 and 710-690 cm^{-1}). The spectra of the 6-unsubstituted salts (I)-(IV) have strong bands due to four (777-772) and two (864-850 cm^{-1}) adjacent hydrogen atoms. The 6-substituted quaternary salts (V)-(XV) have a band of the isolated hydrogen atom (888-849 cm^{-1}) and two strong bands of two adjacent hydrogen atoms (843-821, 824-805 cm^{-1}). The spectra of the benzo[f]- and benzo[h]lepidinium salts (XVI) and (XVII) contain bands due to two (819, 849, 821 cm^{-1}) and four (757, 760 cm^{-1}) adjacent hydrogen atoms. The absence of bands due to isolated hydrogen atoms should imply the angular fusion of the benzene and lepidine nuclei.

EXPERIMENTAL

Spectra were recorded on: UV: an SF-4A spectrophotometer, in ethanol; IR: an IKS-14 with NaCl prisms, in Vaseline oil.

1-Benzyllepidinium Chlorides (I), (V), and (XII). To a mixture of the appropriate N-benzylarylamine (0.1 mole), acetone (2 mole), concentrated HCl (0.4 mole), and nitrobenzene (0.6 mole) heated to 80°C was added in small portions the solution derived by heating paraformaldehyde (0.1 mole) in butyl alcohol (0.55 mole) in the presence of catalytic amounts

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TABLE 1. Quaternary N-Benzyllepidinium Salts

Compound	R	X	mp, °C	UV spectra, λ_{max}, nm (log ε)	Found N, %	Formula	Calculated N, %	Yield, %
I	H	Cl	201–202	236 (4,75), 314 (4,02)	5,0	$C_{17}H_{16}ClN$	5,2	43
II	H	Br	181–182	236 (4,69), 316 (4,01)	4,5	$C_{17}H_{16}BrN$	4,5	32
III	H	I	160–161	234 (4,79), 315 (4,15)	3.7	$C_{17}H_{16}IN$	3,9	51
IV	H	ClO_4	170–171	238 (4,68), 318 (4,02)	4,2	$C_{17}H_{16}ClNO_4$	4,2	50
V	6-CH_3	Cl	220–222	242 (4,80), 320 (4,16)	4,8	$C_{18}H_{18}ClN$	4,9	73
VI	6-CH_3	Br	237–238	241 (4,60), 317 (3,85)	4,2	$C_{18}H_{18}BrN$	4,3	32
VII	6-CH_3	I	183–185	240 (4,85), 318 (4,05)	3,7	$C_{18}H_{18}IN$	3,7	60
VIII	6-CH_3	ClO_4	146–147	241 (4,72), 318 (4.02)	4,2	$C_{18}H_{18}ClNO_4$	4,0	45
IX	6-OCH_3	Br	198–200	251 (4,70), 318 (4.90)	4,1	$C_{16}H_{18}BrNO$	4,1	28
X	6-OCH_3	I	164–165	251 (4,70), 312 (4.02)	3,7	$C_{18}H_{18}INO$	3,6	55
XI	6-OCH_3	ClO_4	164–165	252 (4,68), 315 (4,02)	3,8	$C_{18}H_{18}ClNO_5$	3,9	63
XII	6-OC_2H_5	Cl	162–163	254 (4,71), 315 (4,08)	4,4	$C_{19}H_{20}ClNO$	4,5	65
XIII	6-OC_2H_5	Br	98–100	252 (4,64), 313 (4,06)	3,9	$C_{19}H_{20}BrNO$	3,9	30
XIV	6-OC_2H_5	I	123–125	252 (4,76), 314 (4,06)	3,5	$C_{19}H_{20}INO$	3,5	49
XV	6-OC_2H_5	ClO_4	128–129	254 (4,82), 317 (4,27)	3,9	$C_{19}H_{20}CNO_5$	3,7	39
XVI	5,6-$(CH{=}CH)_2$	ClO_4	238–239	226 (4,80), 275 (4,40) 365 (3,85)	3,8	$C_{21}H_{18}ClNO_4$	3,6	27
XVII	7,8-$(CH{=}CH)_2$	ClO_4	203–204	229 (4,76), 282 (4,74) 370 (3,12)	3,3	$C_{21}H_{18}ClNO_4$	3,6	9

of HCl. The reaction mixture was heated at 80°C for another 7 h 30 min and then steam distilled. The residual aqueous solution was evaporated to dryness. The residue was treated several times with boiling acetone and crystallized from water until the protonated starting amine was absent from the reaction product [9].

1-Benzyllepidinium bromides (II), (VI), (IX), and (XIII) were prepared in the same way as the chlorides, except that the hydrochloric acid was replaced by concentrated HBr (0.14 mole). The aqueous solution left in the flask after steam distillation was cooled. The resulting crystals were filtered off and crystallized from water [9].

1-Benzyllepidinium perchlorates (IV), (VIII), (XI), (XV), (XVI), and (XVII) were prepared in the same way as the chlorides, except that the hydrochloric acid was replaced by 42% $HClO_4$ (0.11 mole) [the mixture was heated for 48 h in the case of compound (XVII)]. The precipitated mass was treated several times with ether and crystallized from alcohol [9] [compounds (XVI) and (XVII) were crystallized from DMF].

1-Benzyllepidinium Iodides (III), (VII), (X), and (XIV). Concentrated aqueous KI solution was added in small portions to a saturated aqueous solution of the chloride or bromide until precipitation ceased. The crystals were filtered off and crystallized from water.

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