aqueous samples. overall mean recoveries±standard deviations of 100.3±1.0% (dog, n=10) and 99.5±0.7% (man, n=12) had been obtained.

It may be concluded from the results of these data that this method is successfully applied to absorption studies in laboratory animal and man. Details of the experiment including the application to biological materials will be reported in the near future.

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The Reaction of Ethyl 3-Chloropropionimidate with Amino Heterocycles

Only few of pyrido[1,2-*a*]pyrimidinium compounds have been pronounced to date,[1] whereas many compounds of pyrido[1,2-*a*]pyrimidine type have been reported.[2] We now wish to report a new synthesis of 3,4-dihydro-1*H*-2-oxo-pyrido[1,2-*a*]pyrimidinium compounds, since we have recently obtained them in good yields by the condensation of 2-aminopyridine with ethyl 3-chloropropionimidate hydrochloride (I).

When ethyl 3-chloropropionimidate I was dissolved in anhydrous ethanolic solution of 2-aminopyridine, ammonium chloride was soon deposited in the reaction-mixture. After it was filtrated off, the filtrate was evaporated to a small volume and allowed to stand at room temperature overnight. The yellow oil was converted to crystalline mass. After recrystallized from methanol–ethanol (2:1), this substance was characterized to be 3,4-dihydro-1*H*-2-oxo-pyrido[1,2-*a*]pyrimidin-5-ium chloride (II: R=H) by the elementary analysis (Calcd. for $C_8H_9ON_2Cl$: C, 52.04; H, 4.91; N, 15.17. Found: C, 52.05; H, 4.82; N, 15.17), the infrared spectrum (IR cm^{-1}: C=O 1726 (KBr) indicating the existence of the positively charged nitrogen of amide),[3] and NMR spectrum (the difference of the chemical shift between α and γ-proton in the pyridine ring was 0.3 ppm which indicates that the ring nitrogen of the pyridine charged positively).[4] Hereupon, it was found that the concentrated filtrate was immediately crystallized into the compound II (R=H) by the addition of a few drops of concentrated hydrochloric acid.

On the other hand, it was found that the cyclic amidine derivative, 3,4-dihydro-1*H*-2-imino-pyrido[1,2-*a*]pyrimidin-5-ium chloride (III: R=H), was produced, when the above

1) A.N. Nesmeyanov, M.I. Rybinskaya and N.K. Bel'skii, *Doklady Akad. Nauk. S.S.S.R.*, **113**, 343 (1957) [*C.A.*, 51, 14712 g (1957)]. A.N. Nesmeyanov and M.I. Rybinskaya, *ibid.*, **118**, 297 (1958) [*C.A.*, **52**, 10080f (1958)].
2) A.E. Tschitschibabin, *Chem. Ber.*, **57**, 1168 (1924). G.R. Lappin, *J. Am. Chem. Soc.*, **70**, 3348 (1948). M. Shur and S.S Islaelstam, *J. Org. Chem.*, **33**, 3015 (1968).
3) R.C. Gore, R.B. Barnes and E. Peterson, *Anal. Chem.*, **21**, 382 (1949).
4) N. Nakagawa, "Interpretation of NMR Spectra," Kyoritsu Shuppan Co., Ltd., 1966, p. 91. (Pyridine: α,β and γ-protons, at 7.09, 5.75 and 6.16 ppm respectively in 5% CCl_4 solution, and at 7.55, 6.73 and 7.18 ppm respectively in 5% CF_3COOH solution, using cyclohexane as internal standard).

concentrated filtrate was treated with anhydrous ether and dried the resulting oily mass on the clay plate. The structure of the compound III (R=H) was characterized by the NMR determination (a ethylene group, two triplets at 3.00 and 4.61 ppm; α,β and γ-protons of the pyridine ring, at 8.45, 7.33 and 8.15 ppm, respectively; amidine group, a broad doublet at 9.30 ppm in 8% $DMSO_{d-6}$ solution using TMS as the internal standard). 8-Methyl-3,4-dihydro-1*H*-2-imino-pyrido[1,2-*a*]pyrimidin-5-ium chloride was obtained from 2-amino-4-methylpyridine by the same method but not 9-methyl-3,4-dihydro-1*H*-2-imino-pyrido[1,2-*a*]-pyrimidin-5-ium chloride from 2-amino-3-methylpyridine (this compound is a very hygroscopic).

2-Aminopyridine was reacted in acetonitrile in lieu of ethanol with ethyl 3-chloropropionimidate, the compound III (R=H) with ammonium chloride was precipitated from the reaction-mixture, and then the fine crystals II (R=H) deposited from the filtrate after the filtration of the precipitates. Moreover, it was shown that the compound III (R=H) was converted to the compound II (R=H) by the addition with diluted hydrochloric acid. On the contrary, any amount of the compound II (R=H) was not detected in the reaction of 2-

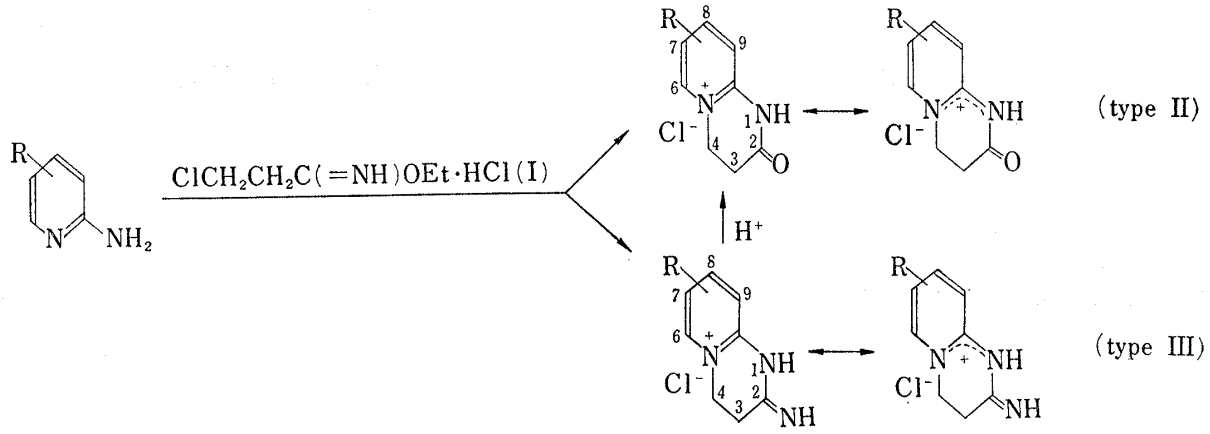


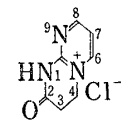
Chart 1

Table I. Compounds of Type III

R	Yield (%)	Appearance (Recryst. solvt.)	mp (°C)	Reaction solvent	Conditions[a] time
H	10—20	needles (EtOH)	213 (decomp.)	EtOH	30 min
				CH_3CN	5 min
8-CH_3	10—20	needles (EtOH)	202—203	EtOH	24 hr

a) at room temperature

Table II. Compounds of Type II

R	Yield (%)	Appearance (Recryst. solvt.)	mp (°C)	Reaction solvent	Conditions[a] time
H	86	prisms (EtOH+MeOH)	265 (decomp.)	EtOH	30 min
8-CH_3	87	prisms (EtOH+MeOH)	260 (decomp.)	EtOH	30 min
9-CH_3	87	prisms (EtOH+MeOH)	235 (decomp.)	EtOH	30 min
	63	plates (MeOH)	263	EtOH	10 hr

a) at room temperature

aminopyridine with ethyl 3-chloropropionate in lieu of the imidate I under the same conditions described above.

Several compounds of the type II were synthesized under similar reaction conditions to those as for the compound II (R=H). The results are listed in Table I and II. All of these compounds are novel in literature to date. It, however, was found that the substitution of a methyl group at 6-position on 2-aminopyridine hindered the production of the objective compound but afforded only a hydrochloride salt of 2-amino-6-methylpyridine. This exception seems to be due to a steric hindrance of a methyl group.[5]

The study on the reaction of the imidate I with amino heterocycles of other types, which the structure are similar to that of 2-aminopyridine (for example, when 2-aminopyrimidine was used in lieu of 2-aminopyridine in this reaction, 3,4-dihydro-1*H*-2-oxo-pyrimido[1,2-*a*]-pyrimidin-5-ium chloride was obtained, see Table II.), is now being in progress.

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5) H.C. Brown, D. Gintis and H. Podall, *J. Am. Chem. Soc.*, **78**, 5376 (1956).

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A New Iridoid Glycoside from *Gardenia jasminoides* Genipin-1-β-gentiobioside

The fruits of *Gardenia jasminoides* Ellis f. *grandiflora* (Lour.) Makino (Rubiaceae) are being used as an antiphlogistic under the name Shan-zhi-i (山梔子).

The occurrence of gardenoside and geniposide in this plant was already reported.[1] We have now isolated a new iridoid glycoside from the methanol extracts of the fruits of the same plant and elucidated its structure as genipin-1-β-gentiobioside (I).

I, $C_{23}H_{34}O_{15}\cdot 1/2\ H_2O$, mp 193—195°, was obtained as a white powder[2] from ethanol, $[\alpha]_D \simeq 0°$, $[\alpha]_{405} +33.5°$ (c=1.0, MeOH), UV λ_{max}^{EtOH}: 238 mμ (log ε 4.11), IR ν_{max}^{KBr} cm^{-1}:1710, 1690, 1640, NMR $\delta_{DSS}^{D_2O}$: 2.50—3.00 (2H, m, H-5,9), 3.78 (3H, s, $-OCH_3$), 4.32 (2H, m, H-10), 5.33 (1H, d, J=7 cps, H-1), 5.95 (1H, m, H-7), 7.66 (1H, d, J=1.5 cps, H-3), 4.53 (1H, d, J=7 cps) and 4.88 (1H, d, J=7 cps) (anomeric protons of sugar moiety).

On acetylation with acetic anhydride and pyridine I gave octaacetate(II) $C_{39}H_{50}O_{23}$, mp 167—169° as colorless needles, $[\alpha]_D \simeq 0°$ (c=0.5, MeOH), IR ν_{max}^{KBr} cm^{-1}: 1760, 1720, 1640, NMR $\delta_{TMS}^{CDCl_3}$: 2.00—2.22 ($-COCH_3\times 8$), 3.75 (3H, s, $-OCH_3$), 4.77 (2H, s-like, H-10), 5.31 (1H, d, J=5.5 cps, H-1), 5.91 (1H, m, H-7), 7.46 (1H, s, H-3).

1) H. Inouye, S. Saito, H. Taguchi and T. Endo, *Tetrahedron Letters*, **1969**, 2347.
2) Carefull recrystallization from acetone gave fine needles mp 227—229°.