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Studies on Thiazoline Derivatives (XVI) Synthesis of N-Alkyl-N′-cyano-N″-(3, 4-dimethyl-4-thiazoline-2-ylidene)guanidine

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N-Alkyl-N′-cyano-N″-(3, 4-dimethyl-4-thiazoline-2-ylidene)guanidine (3a-e) were prepared in two routes as outlined in Scheme 2. The structure of (3) was supported by elemental analysis, mass and NMR data. The IR spectra of (3) showed a characteristic absorption of $\nu_{C\equiv N}$ at *ca.* 2130-2150 cm^{-1}.

Treatment of (3) and (6), respectively, with conc.HCl gave N-(3, 4-dimethyl-4-thiazoline-2-ylidene)biuret (4). The UV spectrum having the absorption maxima in 2-PrOH at 235 nm and 298 nm resembled that of the known compound (8).

Furthermore, (3) in HCl-EtOH soln. was heated at 80-90° for 2-4 hr to give colourless crystals after neutralization. The products were identified as N-Alkyl-N′-ethoxycarbonyl-N″-(3, 4-dimethyl-4-thiazoline-2-ylidene)guanidine (5a, c) on the basis of NMR data and elemental analysis.

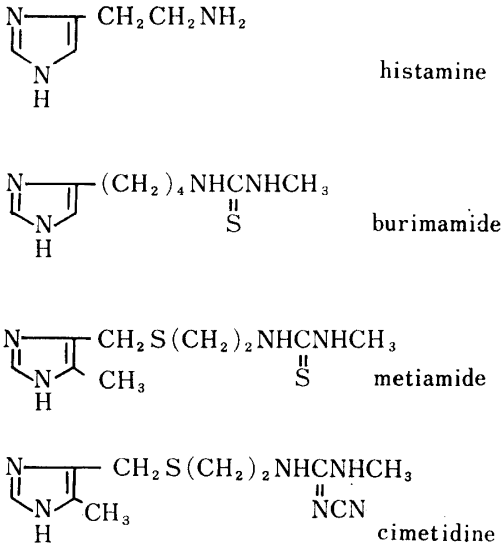
The discovery of the selective antagonist burimamide permitted the characterization of histamine H_2-receptor and furnished a class of drug with a completely novel pharmacological action. Burimamide has a side chain so selected that it may show great potency as a histamine H_2-receptor antagonist.

G.J.Durant *et al.*[1] chemically modified burimamide into another antagonist metiamide, and found kidney damage and agranulccytosis in high dosage chronic toxicity tests with metiamide. They considered that these effects might be attributable to the presence of a thiourea group in the drug molecule, which led to the synthesis of cimetidine possessing a cyanoimino group (=N−C≡N) instead of the thione sulfur (=S) of metiamide. Cimetidine is slightly more active than metiamide *in vivo* as an inhibitor of histamine-stimulated gastric acid secretion. (Scheme 1)

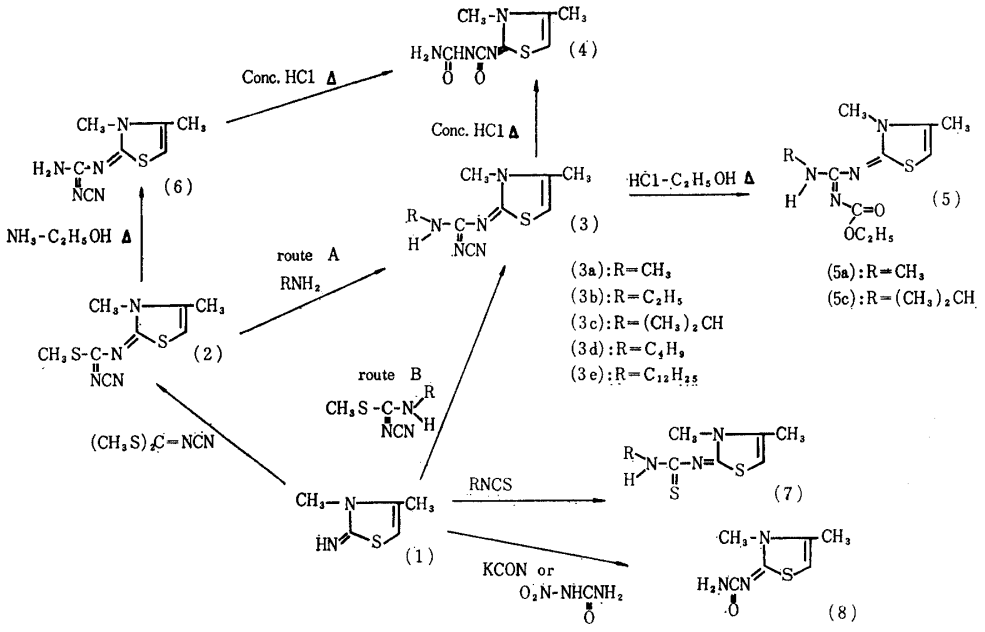
1) G.J.Durant, J.C.Emmett and C.R.Ganellin, Deutsches patentant, offen legungsschrift 2, 344, 779. G.J.Durant, J.C.Emmett, C.R.Ganellin, P.D.Miles, M.E.Parsons, H.D.Prain and G.R.White, J.Med. Chem. 20, 901 (1977). K.Watanabe, Farumashia, 12, 140 (1976), S.Okabe and A.Nosaka, Nichiyaku pharmacist, (1977). may 30.

2) Y.Yamamoto, R.Yoda and M.Matsumura, Chem. Pharm. Bull. (Tokyo) 23, 2134 (1975); C.A. 84 17207e (1976). Y.Yamamoto, R.Yoda, S.Kouda, M.Matsumura, K.Sekine and Y.Yoshida, Kyoritsu Yakka Daigaku Nempo, 20, 57 (1975).

During past several years, we have synthesized carbamoylamino and thiocarbamoylamino derivatives of thiazole, 2-thiazoline and thiazolidine in order to study structure-activity relationship[2]. Among these compounds, N,N′-dimethyl-N′-(4-methylthiazole-2-yl)thiourea and N-Alkyl-N′-(3, 4-dimethyl-4-thiazoline-2-ylidene)thiourea (7) exhibited strong antiinflammatory and analgetic activities, but showed an oral toxity in rat. We wish to report here the synthesis of 2-guanidino-3, 4-dimethyl-4-thiazoline derivatives, in which the thiourea sulfur atom of (7) is replaced by a cyanoimino group (=N−C≡N) as chemical modification of metiamide by G.J.Durant *et al.*[1].



Scheme 1



Scheme 2

As shown in Scheme 2, the title compounds were synthesized mainly by route A and identified by elemental analysis, UV, IR, NMR and Mass spectral data. Furthermore, in order to confirm their structures, synthesis through route B was carried out. The IR and MS spectra of (3a, b, c) were identical with those of compounds through route A. Route A is as follows. Intermediate N-cyano-N′-(3, 4-dimethyl-4-thiazoline-2-ylidene)-S-methylisothiourea (2) was synthesized from a mixture of 2-imino-3, 4-dimethyl-4-thiazoline (1) and dimethylcyanodithioimidocarbonate[3] in EtOH. Then, to a hot solution of crude compound (2) in DMSO, an excess of alkylamine was added. For alkylamines with smaller number of carbons the mixture was stirred overnight at room temperature to give N-Alkyl-N′-cyano-N″-(3, 4-dimethyl-4-thiazoline-2-ylidene)guanidine (3) as colourless crystals. On the contrary, for alkylamines with greater number of carbons the mixture was heated in a sealed-tube at 105° for 24 hr to give (3) in good yield. On the other hand route B is as follows. An equimolar amount of (1) and S-methyl-N-alkyl-N′-cyanoisothiourea[4] in acetonitrile or pyridine was heated in a 100 ml sealed-tube at 105° for overnight to give (3). As shown in Table 1 and 2, compounds (3) gave satisfactory analytical results and spectral data. The IR spectra of (3) showed ν_{NH} absorptions at 3255-3260 cm^{-1} and 3075-3080 cm^{-1}, and a characteristic absorption of $\nu_{C\equiv N}$ at *ca.* 2130-2150 cm^{-1}. The UV spectra of (3a) showed absorption maxima at 233 nm, 260 nm and 313 nm. (Fig. 1) Each of the MS spectra of compounds (3a-e) showed a very intense molecular ion peak (M^+), a peak at m/e 179 corresponding to [M^+-RNH], a very intense peak or base peak at m/e 154 corresponding to loss of CN and gain of proton, and a characteristic peak of [M^+-(RNH+=N-CN)] at m/e 139. (Scheme 3)

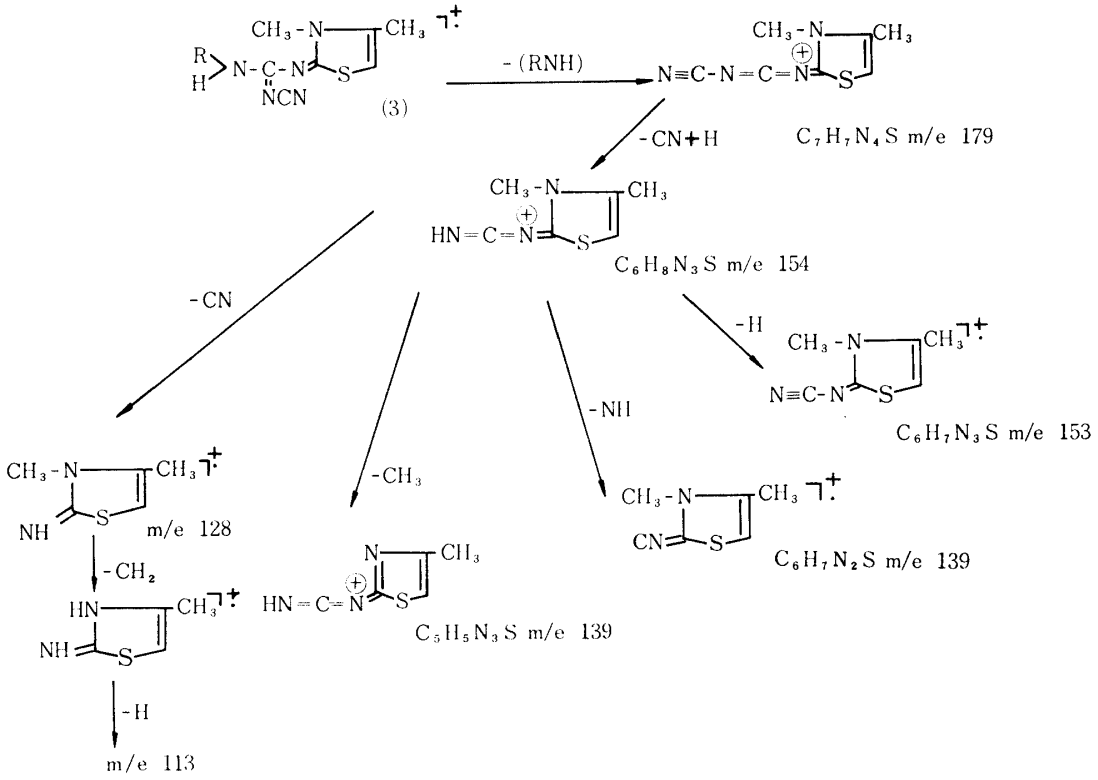
The compounds (3a, b) were very slightly soluble in $CDCl_3$ and DMSO-d_6, but (3c) was readily soluble in above solvents. The NMR spectrum ($CDCl_3$) of (3c) exhibited a doublet at δ 2.28 (3H, J=1.0Hz) due to C4-$\underline{CH_3}$ with a long-range coupling to C5-$\underline{CH}$ in the 4-thiazoline ring appearing at δ 6.25 (1H,d, J=1.0Hz), a singlet at δ 3.57 (3H) due to N-$\underline{CH_3}$ in the 4-thiazoline ring, and two singlets at δ 1.19 (s, 3H) and 1.25 (s, 3H) attributable to isopropyl group. A broad peak at δ 5.20-5.50 (1H) disappeared completely by the addition of D_2O, which indicated the presence of $\underline{NH}$.

On the other hand, the reaction of (2) with ethanolic NH_3 in a sealed-tube gave crystals (mp 247°) of a molecular formula of $C_7H_9N_5S$. The MS spectrum of this compound showed a very intense molecular ion peak at m/e 195, and a peak at m/e 179 (Rel. Intensity: 20%) corresponding to [M^+-NH_2]. The absorption at 3280 cm^{-1}, 3180 cm^{-1} and 3210 cm^{-1} are attributed to ν_{NH} and those at 2160 cm^{-1} to $\nu_{C\equiv N}$. Hydrolysis of the compound (6) (mp 247°) with conc. HCl gave (4) as reported below. The NMR spec-

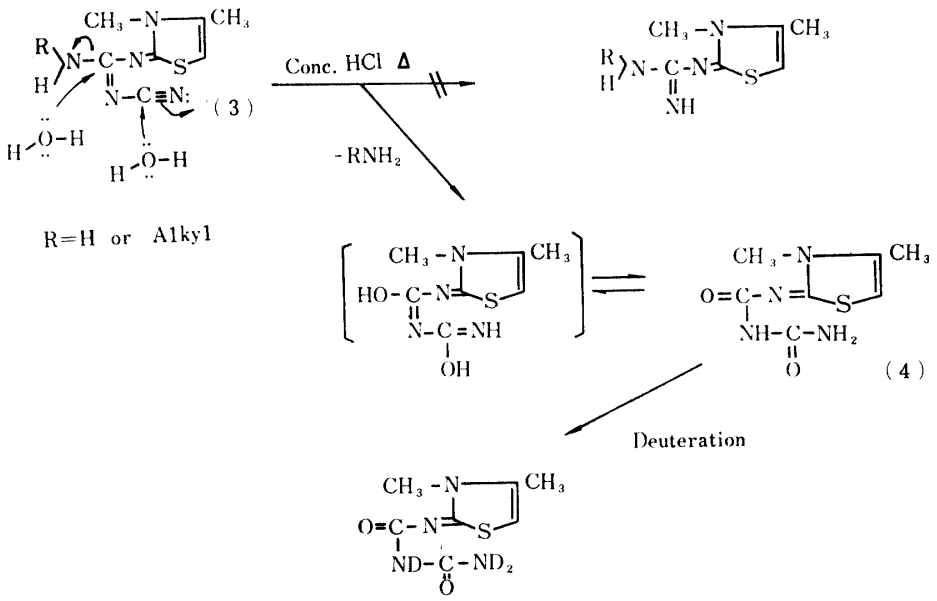
3) A.Hantzch and M.Wolvekamp, Justus Lieigs Ann. Chem., 331, 265 (1904).
4) F.H.S.Curd *et al.*, J.Chem. Soc. 1630 (1948); C.A. 43, 2947c (1949).

trum of (6) obtained in DMSO-d_6 showed a chemical shift for $\underline{NH_2}$ at δ 7.04 which disappeared after D_2O exchange. From above results it was confirmed that the reaction product (6) (mp 247°) by elimination of CH_3S and addition of NH_2 was N-cyano-N'-(3, 4-dimethyl-4-thiazoline-2-ylidene)guanidine (6).

G.J.Durant *et al.*[1] reported also the reaction of cyanoimino compounds with conc. HCl to give imino compounds. The compound (3) or (6) in conc.HCl was heated on a steam-bath for 2-3 hr to give yellow crystals, mp 200-225° (HCl salt). Neutralization of the HCl salt with $NaHCO_3$ soln. gave a free base (4) (mp 246°) (from DMF). The IR spectrum of (4) showed no absorption for $\nu_{C\equiv N}$ in the region of 2100 cm^{-1}, but new absorptions for amide I at 1680-1690 cm^{-1}. The MS spectrum of (4) showed a molecular ion peak at m/e 214 with very strong relative intensity and a peak at m/e 155 corresponding to 2-carbonylimino-3, 4-dimethyl-4-thiazoline cation. The compound (4) (mp 246°) evolved NH_3 gas when heated with 1N-NaOH soln. but the biuret test was negative. Then its deuterated derivative had a peak at m/e 217 (RI, 39%) which was m/e 3 more than the molecular ion peak of the undeuterated compound. The additional peaks at m/e 173 and m/e 155 corresponded to [M^+-NDCO] and 2-carbonylimino-3, 4-dimethyl-4-thiazoline cation, respectively. The UV spectrum of (4) showed absorption maxima at 235 nm 298 nm. The spectral pattern and MS fragmentation of (4) resembled those of known compound, 2-(N-carbamoyl)imino-3, 4-dimethyl-4-thia-



Scheme 3 Mass fragmention pattern of (3).



Scheme 4 Hydrolysis of (3)

zoline (8). As shown in Scheme 4, the product (4) was identified as N-(3, 4-dimethyl-4-thiazoline-2-ylidene)biuret.

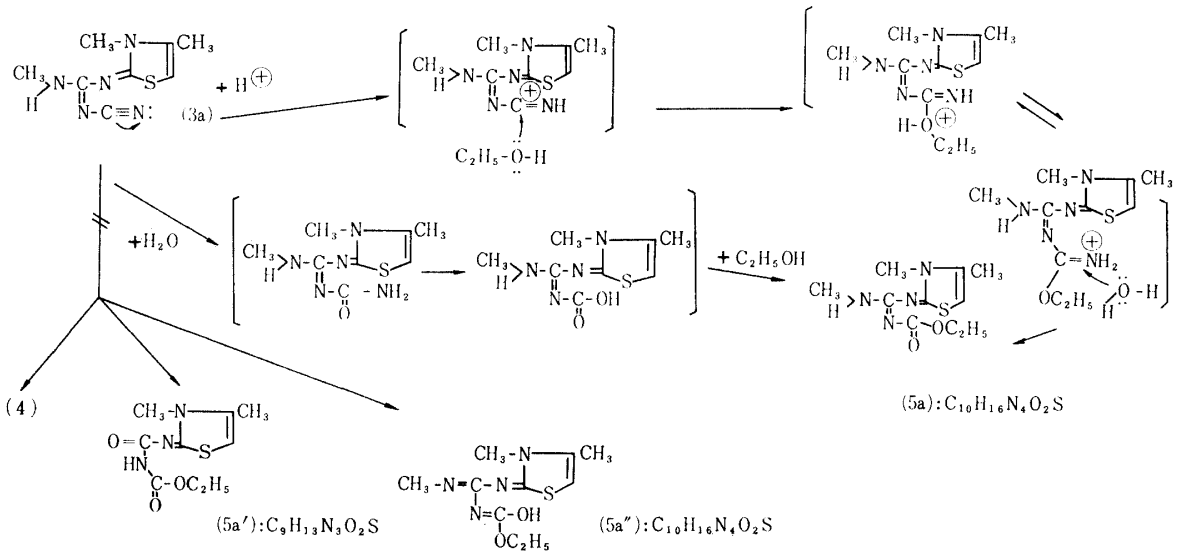
W.K.Detweiler *et al.*[5] reported that 2-amino-heterocyclic compounds reacted with nitrobiuret to give heterocyclic biurets and biuret test gave a colour.

The compound (3a) in ethanolic HCl was heated at 80–90° for 4 hr, and then neutralized with $NaHCO_3$ soln. to give colourless crystals which melted at 148° after recrystallization from EtOH. The elemental analysis gave a molecular formula of $C_{10}H_{16}N_4O_2S$. The MS spectrum of this compound showed a molecular ion peak at m/e 256 (base) and a very intense ion peak at m/e 211 for $[M^+-OC_2H_5]$. The IR spectrum showed strong absorptions for ν_{NH} at 3315 cm^{-1} and 3075 cm^{-1}, no absorption for $\nu_{C\equiv N}$ in the region of 2100 cm^{-1} and a new absorption for amide I at 1630 cm^{-1}. The NMR spectrum ($CDCl_3$) of (5a) exhibited a triplet at δ 1.32 (3H, J=7.0Hz), a quartet at δ 4.17 (2H, J=7.0Hz) and a doublet at δ 3.04. The first two of these indicated the presence of $\underline{OCH_2CH_3}$. The last due to $\underline{CH_3}$-NH showed a singlet after D_2O exchange.

As shown in Scheme 5, treatment of (3a) with ethanolic HCl have a possibility to give compounds (5a′) or (5a″). From above results the product (mp 148°) was uneqivocally identified as N-ethoxycarbonyl-N′-methyl-N″-(3, 4-dimethyl-4-thiazoline-2-ylidene)guanidine (5a). The formation of (5a) in the above reaction may be explained by pathway either *via* iminoester or carboxylic acid. In the former, C_2H_5OH may add to the nitril group of (3a) in the presence of acid catalyst to afford the iminoester derivative, which then the imino moiety is hydrolyzed to give oxo-derivative (5a). In the latter, H_2O may add to nitril group of (3a) to form amido-derivative. It is

5) W.K.Detweiler and E.D.Amstutz, J.Am.Chem.Soc. 73, 5451 (1951).

converted to the carboxilic acid derivative, whose carboxylic acid moiety is easily esterified to (5a). The compound (5c) was also prepared by the same procedure as (5a) from (3c) and it was characterized satisfactorily by elemental and spectral analysis.



Scheme 5 Hydrolysis of (3a) in HCl-EtOH

To our knowledge, the compounds (2-6) were new derivatives. Toxicity of the compound (3) was reduced relative to previously reported compounds, however antiinflammatory and analgetic effects were also reduced. Recently, American Cyanamide Co. reported that thiazolyl phenyl guanidines were useful against rhinovirus *in vitro*[6].

We are grateful to Miss Tomoko Takahashi, Tomoko Aida, Machiko Uiro, Estuko Ousumi for their assistance in experimental works. We also wish to acknowledge the staff of Department of Physical Chemistry for elemental analyses and the staff of Department of Pharmacology for screening tests, the Central Research Laboratories, Sankyo CO., Ltd..

Experimental

Melting points were taken on a Yanako micro melting point apparatus and are uncorrected. Infrared spectra were obtained with a Hitachi EPI-G3 spectrometer, ultraviolet spectra with a Shimadzu double beam spectro photometer UV-200s and nuclear magnetic resonance spectra with a Nihon Denshi JNM-NH 100 (100 MHz) with tetramethylsilane (TMS) as internal standard. Chemical shift are expressed in δ (ppm). The coupling constants (J) is expressed in Hz. Abbreviation : s: singlet, d: doublet, q: quartet, m: multiplet, b: broad.

6) American Cyanamid Co., Beg, 850, 148; C.A. 88, 170131c (1978), A.R.Bruceand and L.H.Lee, S.African 7607, 539; C.A. 88, 190813e (1978).

dimethylcyanodithioimidocarbonate

To a stirred mixture of crude NH_2CN (0.41 mole) and CS_2 (0.41 mole) was added KOH (30 g) in EtOH (120 ml). After stirring for several hours, the crude product was collected on a filter, dried *in vacuo* over KOH to give 22 g of $(KS)_2C=NCN$. Then, to an excess of CH_3I (100 ml) was added $(KS)_2CN=CN$ with vigorous stirring at room temperature. After stirring for overnight, the reaction mixture was filtered, the filtrate was concentrated *in vacuo* to dryness and the residue was treated with activated charcoal in EtOH–H_2O to give 10 g of $(CH_3S)_2C=NCN$. $\nu_{C\equiv N}$ 2160 cm^{-1}, NMR (δ in $CDCl_3$) 2.62 (s. $\underline{CH_3}$).

S-methyl-N-alkyl-N′-cyano-isothiourea

Alkylisothiocyanate (0.05 mole) in EtOH (100 ml) was stirred for 18 hr at room temperature. The filtrate was treated with CH_3I (0.05 mole) and the mixture was refluxed for 0.5 hr and kept at room temperature. After the solvent was evaporated *in vacuo* to dryness, the crude product was recrystallized from EtOH to give S-methyl-N-alkyl-N′-cyano-isothiourea. (Alkyl, CH_3, mp 187°, C_2H_5, mp 163°, $(CH_3)_2CH$, mp 107°)

N-cyano-N′-(3, 4-dimethyl-4-thiazoline-2-ylidene)-S-methylisothiourea (2)

Equimolar amounts of (1) (0.0137 mole) and dimethylcyanodithioimidocarbonate in EtOH (25 ml) was stirred at room temperature. The resulting white precipitate was collected on a filter and recrystallized from dimethylsulfoxide (or acetonitrile). MS: m/e 226 (M^+, 40%), 179 (M^+–SCH_3, base), 154(7), 125(10), 99(8), 72(13), 56(10).

N-Alkyl-N′-cyano-N″-(3, 4-dimethyl-4-thiazoline-2-ylidene)guanidine (3)

method A

(3a): To a hot solution of (2) (0.0089 mole) in DMSO (40 ml), a commercial 40% CH_3NH_2 in MeOH (10 g) was added. After stirring at room temperature for 24 hr, the crystallized precipitate was collected on a filter, washed with water, and dried to give 1.52 g of (3a). Compound (3a) is nearly insoluble in all common solvents.

(3b): To a hot solution of (2) (0.0044 mole) in DMSO (20 ml), a commercial 70% $C_2H_5NH_2$ aq. soln. (3 g) was added. The mixture was worked up by the same procedure as (3a) to give 0.25 g of (3b). NMR (δ in DMSO-d_6, very sparingly soluble) 1.14 (t, J=7.0Hz, 3H, $\underline{CH_3}CH_2$), 3.20–3.48 (m, 2H, $CH_3\underline{CH_2}$), 3.55 (s, 3H, $\underline{CH_3}N$–), 2.26 (d, J=1.0Hz, 3H, C4-$\underline{CH_3}$), 6.49 (b, 1H, C5-$\underline{CH}$), NH (not appear).

(3c): The mixture of (2) (0.0044 mole) in DMSO (24 ml) and isopropylamine (2 g) was heated in a 100 ml sealed-tube at 105° for 24 hr. After standing for 1 hr at room temperature, H_2O was added. Then the precipitated crystals were collected on a filter and dried to give crude 0.72 g of (3c). NMR (δ in DMSO-d_6) 3.56 (s, 3H, $\underline{CH_3}N$–),

2.27 (d, J=1.0Hz, 3H, C4-$\underline{CH_3}$) 6.53 (d, J=1.0Hz, 1H, C5-$\underline{CH}$) 1.24 and 1.17 (s, 6H, $(\underline{CH_3})_2CH$), 4.00-4.50 (m, 1H, $(CH_3)_2\underline{CH}$), 6.60-6.80 (b, 1H, $\underline{NH}$, This signal disappeared by the addition of D_2O.).

(**3d**) : To a 100 ml sealed-tube was added (2) (0.0177 mole) and n-butylamine (6.5 g) in DMSO (20 ml). The solution was heated at 105° for 48 hr. After standing at room temperature for several hours, the crude product were collected on a filter, washed with DMSO, dried, and recrystallized from EtOH to give 1.9 g of (3d). NMR (δ in $CDCl_3$) 2.28 (d, J=1.0Hz, 3H, C4-$\underline{CH_3}$), 3.58 (s, 3H, $\underline{CH_3}$-N-), 6.26 (d, J=1.0Hz, 1H, C5-$\underline{CH}$), 0.94 (t, 3H, $\underline{CH_3}(CH_2)_3$), 3.36-3.60 (m, 2H, $CH_3\underline{CH_2}(CH_2)_2$). 1.20-1.70 (m, 4H, $CH_3CH_2(\underline{CH_2})_2$), 5.40-5.70 (b, 1H, NH, This signal disappeared by the addition of D_2O.)

(**3e**) : This was prepared by the same procedures as (3d) from (2).

method B

(**3a**) : The mixture of (1) (0.005 mole) in acetonitrile (5 ml) and N-cyano-N′, S-dimethylisothiourea (0.005 mole) was heated in a sealed-tube at 105° for 15 hr. The crystallized precipitate was collected on a filter and treated with an activated charcoal in pyridine. MS: m/e 209 (base), 179 (58), 154 (24).

(**3b**) **and** (**3c**) : These were prepared by the same procedures as (3a) from N-cyano-N′, S-dimethylisothiourea. (3b) MS: m/e 223 (base), 179 (53), 170 (29), 154 (80).

Acid hydrolysis of (3).

(3a) (0.0096 mole) in conc.HCl (30 ml) was heated on a steam-bath for 2-3 hr. The pale-yellow solution was condensed *in vacuo*. The crude product (HCl salt) was dissolved in H_2O and neutralized with a saturated $NaHCO_3$aq. soln.. After stirring for 0.5 hr the free-base was collected on a filter and recrystalized from DMF to give N-(3, 4-dimethyl-4-thiazoline-2-ylidene)biuret (4). The HCl salt: mp. 220-225° (from EtOH). Anal. calcd. for $C_7H_{11}N_4OSCl$ MW. 250.708: C, 33.54%; H, 4.42; N, 22.35. found C, 33.82%; H, 4.55; N, 21.99. MS: m/e 214 (39%, M^+), 171(21), 155 (base), 128(8), 100(4), 86(7), 71(6), 56(20). Each of (3a, b, c) or (6) derived from route A and B was hydrolized by the same procedures as described above. The infrared spectra of these products were identical with that of (4).

Deuteration of (4)

(4) (50 mg) in DMSO-d_6 (1.5 ml) and D_2O was heated on a steam-bath for 5 hr. The hot solution was filtered. After standing at room temperature for several minutes, the crystalized precipitate was collected on a filter, and dried. mp 249°. MS: m/e 217 (38%), 185(8), 173(17), 155(base), 129(7), 128(7), 114(4), 100(6), 86(9), 71(12), 56(30).

Ethanolic HCl hydrolysis of (3)

(3a) (0.005 mole) in ethanolic hydrochloride (20 ml) was heated at 80° for 4 hr and then concentrated *in vacuo*. The crude product was dissolved in H_2O, filtered, neutrized with saturated sodium bicarbonate aq. soln. After standing for 0.5 hr the crystals were collected on a filter and recrystallized from EtOH or EtOH-H_2O to give 0.3 g of N-ethoxycarbonyl-N'-methyl-N''-(3, 4-dimethyl-4-thiazoline-2-ylidene)guanidine (5a). NMR (δ in $CDCl_3$) 3.04 (d, J=5.0Hz, 3H, $\underline{CH_3}NH$, This signal changed to a singlet by the addition of D_2O), 1.32 (t, J=7.0, 3H, $\underline{CH_3}CH_2O$), 4.17 (q, J=7.0, 3H, $CH_3\underline{CH_2}O$), 3.56 (s, 3H, $\underline{CH_3}$-N-), 2.24 (d, J=1.0, 3H, C4-CH_3), 6.12 (d, J=1.0, 1H, C5-$\underline{CH}$), 8.65 -9.08 (b, 1H, $\underline{NH}$. This signal disappeared by the addition of D_2O.) MS: m/e 256 (base), 223(8), 211(87), 210(66), 185(67), 178(24), 168(44), 155(61), 154(86), 153(19), 151 (31), 149(13), 139(14), 128(70), 113(19), 106(16), 86(18), 83(77).

(5c): This was prepared by the same procedures as (5a) from (3c). MS: 284(50%, M^+), 269(11, M^+-CH_3), 251(13), 239(26, $M^+-OC_2H_5$), 227(30), 155(34), 154(base), 138(9), 129(20), 128(21), 114(17), 113(21). Anal. calcd. for $C_{12}H_{20}N_4O_2S$ (see Table 1) S: 11.27 %, found, S: 11.43%.

N-cyano-N'-(3, 4-dimethyl-4-thiazoline-2-ylidene)guanidine (6)

The mixture of (2) (0.0265 mole) in ethanolic NH_3 in a 100 ml sealed-tube was heated at 105° for 48 hr. After standing for room temperature, the crystallized precipitate was collected on a filter and recrystallized from DMF-H_2O to give 3.2 g of (6). NMR (δ in DMSO-d_6) 2.26 (d, J=1.0Hz, 3H, C4-$\underline{CH_3}$), 3.54 (s, 3H, $\underline{CH_3}$-N-), 6.47 (d, J=1.0, 1H, C5-$\underline{CH}$) 7.04 (b, 2H, $\underline{NH}$. This signal disappeared by the addition of D_2O.)

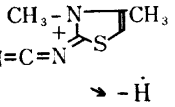
Table 1 Physical properties

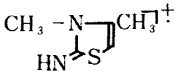
Compd. No.	Formula MW	mp °C (recrys. solvent)	UV λ 2-PrOH max nm (ε)	Analysis(%) Calcd. (found) C	H	N	IR KBr disk max >3000	−2900	−2000	−1600	−1500	−1400 cm^{-1}
(6)	$C_7H_9N_5S$ 195.248	247 (DMF-H_2O)	234(7900) 310(19900)	43.06 (43.05	4.65 4.56	35.87 35.76)	3380sh 3280m 3180 s 3120m	2900sh	2160vs 2125 s	1655sh 1638 s 1605sh	1560sh 1555sh 1530sh	1500−1450br 1410 s
(3 a)	$C_8H_{11}N_5S$ 209.275	>300 (pyridine)	233(5200) 260(5600) 313(21500)	45.91 (45.87	5.30 5.37	33.47 33.23)	3250vs 3075 s	2910m	2140vs	1600sh	1580sh 1575 s 1510br	
(3 b)	$C_9H_{13}N_5S$ 223.302	268 (pyridine)	236(5800) 260(6600) 313(23300)	48.41 (48.29	5.87 5.78	31.36 31.26)	3260vs 3085 s	2975m 2925m	2140vs		1570m 1525br	1487m 1460w
(3 c)	$C_{10}H_{15}N_5S$ 237.329	208 (EtOH)	235(5800) 260(6600) 313(23500)	50.61 (50.64	6 37 6.34	29.51 29.59)	3250sh 3213m 3080m	2950m 2900m	2140vs	1600sh	1580sh 1570m 1520br	1475br 1440br 1400m
(3 d)	$C_{11}H_{17}N_5S$ 251.356	233 (EtOH)	235(5900) 263(6700) 313(23600)	52.56 (52.52	6.82 6.63	27.86 27.74)	3255vs 3080 s	2940m 2910m 2840sh	2140vs	1600sh	1578sh 1570 s 1560sh 1510 s	1490 s 1460sh 1420br
(3 e)	$C_{19}H_{33}N_5S$ 363.572	148 (EtOH)	235(5600) 262(6600) 313(23200)	62.77 (63.08	9.15 9.06	19.26 19.28)	3400br 3240vs 3075sh	2940sh 2905vs 2840vs	2150vs	1600m	1580vs 1515 s 1508sh	1490 s 1455sh 1420vs
(4)	$C_7H_{10}N_4O_2S$ 214.247	246 (DMF)	235(900) 298(8100)	39.24 (39.19	4.71 4.74	26.15 25.58)	3300m 3140br			1690sh 1680m 1615br	1585br 1505sh	1490m 1455sh 1440m
(5 a)	$C_{10}H_{16}N_4O_2S$ 256.328	148 (EtOH)	245(8000) 313.5(21300)	46.86 (46.89	6.29 6.23	21.86 21.87)	3315vs 3075 s	2975m 2940m 2885w		1640sh 1630vs 1600sh	1585vs 1550sh 1520br 1510sh	1480m 1450br 1418w

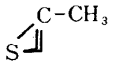
(5c)	$C_{12}H_{20}N_4O_2S$	116	248(8700)	50.68	7.09	19.70	3575m	2955m		1650sh	1590sh	1470br
	284.382	(EtOH–H_2O)	314(21700)	(50.63	6.90	19.56)	3500m	2925m		1630vs	1580br	1430 s
							3440 s	2900m		1615m	1535br	1405vs
							3325 s					
							3125m					
							3005 s					
(2)	$C_8H_{10}N_4S_2$	224–7	290(6400)	42.46	4.45	24.76	3425br	2910m	2160sh		1586m	1495sh
	226.324	(DMSO)	336(23600)	(42.85	4.49	24.78)	3088m		2140vs		1550sh	1480m
											1525sh	1465m
											1515sh	

abbreviation
sh : shoulder, w : weak, br : broad, m : medium,s : strong, vs : very strong.

Table 2 Mass spectral data m/e (Relative Intensity : %)







frag. pattern / compd.No.	M^+	M^+-CH_3	$M^+-(CH_3+(CH_2)_n)$			M^+-RNH																		
	↓	↓		↓					↓					↓	↓			↓						
(6)	195								179	176	170	168	155	154	153	139	129	128	127	113	86	82	72	56
	(base)								(20)	(–)	(–)	(3)	(10)	(47)	(41)	(8)	(2)	(6)	(16)	(18)	(14)	(4)	(14)	(34)
(3a)	209								179	176	170	168	155	154	153	139	129	128	127	113	86	82	72	56
	(base)								(50)	(19)	(–)	(19)	(17)	(35)	(29)	(24)	(–)	(28)	(16)	(27)	(16)	(23)	(20)	(34)
(3b)	223	208						182	179	176	170	168	155	154	153	139	129	128	127	113	86	82	72	56
	(base)	(7)						(6)	(77)	(–)	(39)	(–)	(42)	(87)	(35)	(55)	(15)	(43)	(8)	(47)	(13)	(7)	(21)	(42)
(3c)	237	222					204	197	179	176	170	168	155	154	153	139	129	128	127	113	86	82	72	56
	(54)	(7)					(7)	(11)	(96)	(–)	(61)	(–)	(35)	(base)	(52)	(59)	(9)	(34)	(7)	(24)	(7)	(3)	(14)	(21)
(3d)	251	236				222	210	209	179	176	170	168	155	154	153	139	129	128	127	113	86	82	72	56
	(57)	(9)				(41)	(20)	(43)	(96)	(12)	(22)	(3)	(18)	(base)	(23)	(19)	(15)	(37)	(6)	(17)	(8)	(3)	(16)	(33)
(3e)	363	348	334(19)	320(23)	306(21)	222		209	179	176	170	168	155	154	153	139	129	128	127	113	86	82	72	56
	(62)	(10)	292(19)	280(27)	278(18)	(base)		(92)	(92)	(17)	(11)	(3)	(18)	(92)	(22)	(13)	(50)	(33)	(7)	(13)	(7)	(4)	(11)	(30)
			264(33)	250(31)	237(30)	236(25)																		

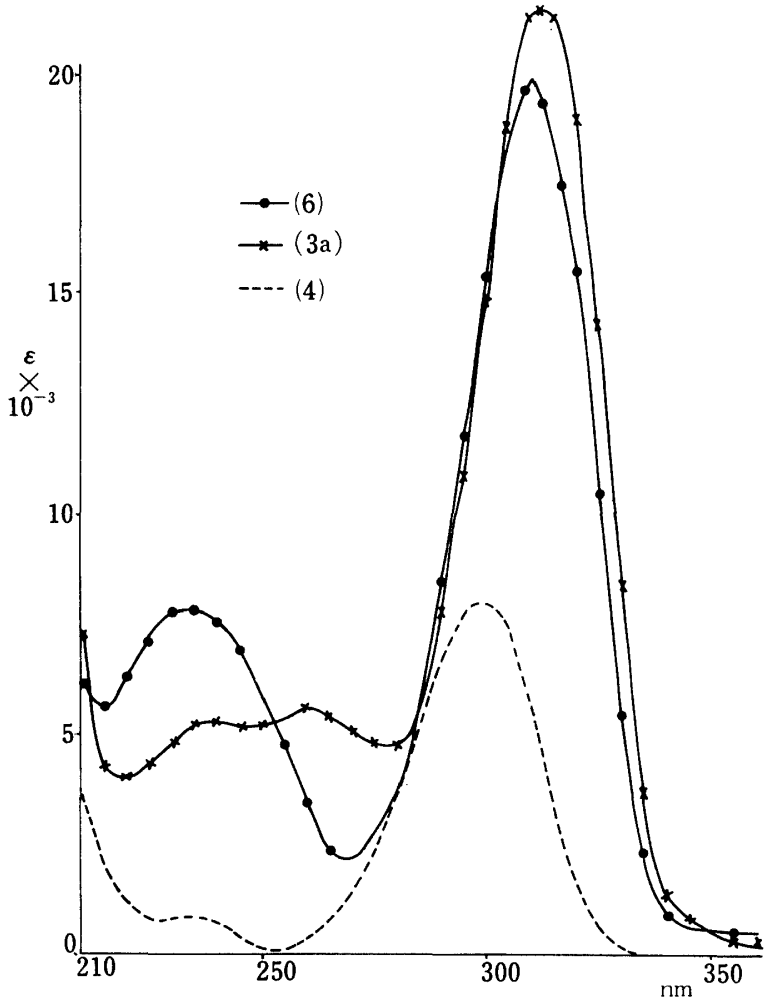


Fig. 1 UV absorption spectra of (6), (3a), and (4) in 2-PrOH (Merck).