Synthesis of Isokinetin, 2-N-furfurylaminopurine and its Leaf-growth Activity (Studies of Isokinetin and its Analogs. Part I)

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More than fifty kinetin-analogs which belong to 6-(*N*-substituted)-aminopurine, have been prepared and it was found[1] that some of them have a leaf-growth stimulating activity. During the course of this study, our interest was directed to investigate whether the leaf-growth activity is still retained after the furfurylamino group at 6-position of the purine ring migrates to the 2-position.

After making many unsuccessful attempts to synthesize 2-(*N*-furfuryl)-aminopurine, we succeeded in preparing this new compound by the process outlined in Fig. 1.

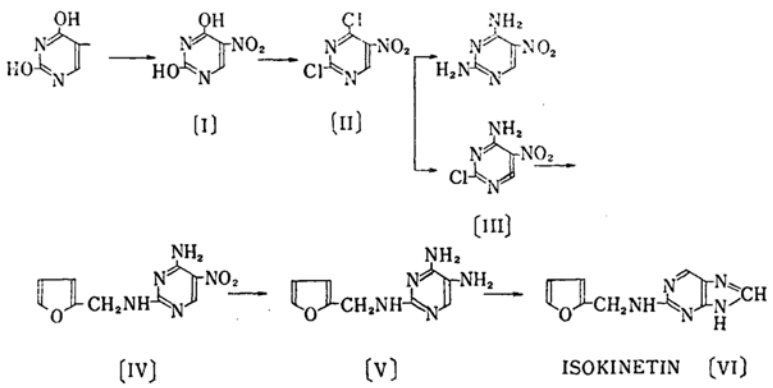
Nitration of uracil with fuming nitric acid gave 2, 6-dihydroxy-5-nitropyrimidine (I) in 90.7% yield, m. p. 294~295°C (Found: N, 26.70. Calcd. for $C_4H_3N_3O_4$: N, 26.75%). This was chlorinated with phosphoroxychloride in the presence of dimethylaniline to give 2, 6-dichloro-5-nitro-pyrimidine (II) in 64% yield.

Amination of II by ammonia in methanol-ether solution gives the mixture of 2, 6-diamino-5-nitro-pyrimidine and 2-chloro-6-amino-5-nitro-pyrimidine (III). However, III can be obtained in 60% yield when amination takes place at low temperature (below 0°C), m. p. of III, 220~221°C, Found: N, 31.95. Calcd. for $C_4H_3N_4O_2Cl$: N, 32.10%. III was then converted into 2-furfurylamino-6-amino-5-nitropyrimidine (IV) in 69.7% yield by refluxing with furfurylamine for 3~4 hr. (m. p, 159~160°C, Found: N, 29.50. Calcd. for $C_9H_9N_5O_3$: N, 29.76%).

IV was finally reduced catalytically with Raney nickel in methanol to give 2-furfuryl-amino-4, 5-diaminopyrimidine (V) which was refluxed with formamide yielding 2-(*N*-furfuryl)-aminopurine (VI) in 24% yield. Tan-colored needle from absolute alcohol, m. p. 195~196°C, (Found: C, 55.88; H, 4.01; N, 32.55. Calcd. for $C_{10}H_9N_5O$: C, 55.55; H, 4.67; N, 32.37%). The ultraviolet spectrum of isokinetin showed almost the same absorption as that of kinetin.

The leaf-growth activity of isokinetin was compared with that of kinetin by using *Rhaphanus cotyledon* by the Takematsu method[2]. The 200 mg./1. solution of kinetin or isokinetin was sprayed by using 0.4 ml. microsprayer on both sides of *Rhaphanus cotyledon*, which was cultured on the sand for 4 days at 15~18°C after coming out the *cotyledon* of *Rhaphanus sativa*. The increase of the leaf-area was measured 5 days after spraying. Isokinetin stimulates leaf-growth, but activity was observed to be about 80% of that of kinetin.

Okumura and Kuraishi[3] observed that kinetin inhibits the growth of the root of *Brassica chinensis L var. amplexicaulis Makino* at the concentration of 10^{-3}mg./l. In the present communication we have observed the same inhibiting action of both kinetin and isokinetin against the growth of roots of *Rhaphanus sativa* and *Brassica juncea*. Kinetin inhibited the growth of roots remarkably, even in the concentration of 5mg./1. but the inhibiting action of isokinetin was observed only at the concentration of 50 mg./1. or higher. As gibberelline and indol acetic acid has no inhibitory



1) F. S. Okumura et al., This Bulletin, 30, 194 (1957); 32, 886, 889, (1959).

2) Method of *Rhaphanus* test and its application, by T. Takematsu (1959).

3) Unpublished work.

effect against the growth of plant roots, this inhibiting action is specific for the kinetin and isokinetin groups.

From the above observation it is clear that there are some interesting relationships between the leaf-growth and root-inhibition among the kinetin and isokinetin groups. Concerning this aspect, further studies are now in progress.

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