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NON-ENZYMATIC ATP SYNTHESIS BY THE PHOSPHORYLATION OF ADP
WITH THE ASSISTANCE OF CYANATE AND MAGNESIUM ION

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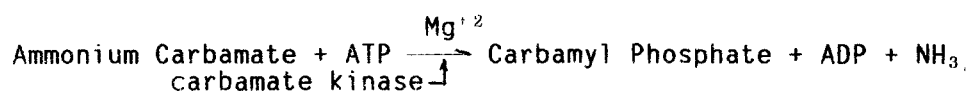
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The formation of ATP by the phosphorylation of ADP in the prebiotic conditions has been studied. A mixed aqueous solution of adenosine diphosphate ($\text{ADP}\cdot\text{K}\cdot 2\text{H}_2\text{O}$), potassium dihydrogen phosphate (KH_2PO_4), sodium cyanate (NaNCO) and magnesium chloride ($\text{MgCl}_2\cdot 6\text{H}_2\text{O}$) was prepared to contain 0.5 M of each. The solution was incubated at 20°C at a pH around neutral with a control sample of magnesium ion free. The analysis of the solution with an anion-exchange column HPLC showed the formation of ATP in the yield of about 2.2 %, 3.1 % and 3.3 % after the incubation for one, two and three days, respectively. In the magnesium free control solution the formation of ATP was not observed. The results reveal another example of the specific effect of magnesium ion in the prebiotic chemical reaction, which was found in the formation of 2',3'-cyclic AMP from adenosine and trimetaphosphate (Yamagata et al., 1995) and in the condensation of glycyglycine with trimetaphosphate (Yamagata and Inomata, to be published).

The similar experiments carried out using other dehydration condensing reagents, cyanamide and dicyandiamide in the same conditions showed no production of ATP in both cases. Yamagata et al.(1979, 1981) demonstrated the phosphorylation of adenosine in aqueous solution by electric discharges of a primitive gas mixture over the solution, and Yamagata and Mohri (1982) showed the formation of cyanate in the experimental system. The present results suggest the uniqueness of cyanate among the condensing agents and of its combination with magnesium ion in the prebiotic chemistry.

It is interesting fact that the present reaction correspond to the reverse reaction of the reaction catalyzed

by carbamate kinase (Conn and Stumpf, 1976) which Lipmann and Jones found:



Conn, E.E. and Stumpf, P.K.: 1976, *Outlines of Biochemistry*, 4th ed., John Wiley and Sons, inc., New York, Chap. 17.

Yamagata, Y. et al.: 1979, *Nature* 282, 284-286.

Yamagata, Y. et al.: 1981, *Origins of Life* 11, 233-235.

Yamagata, Y. and Mohri, T.: 1982, *Origins of Life* 12, 41-44.