Chapter 9

MICROBIAL SYNTHESIS OF VITAMIN B₁ (THIAMINE)

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1 HISTORICAL

Thiamine was discovered in the course of a search for an agent that would cure beriberi. The conquest of beriberi began in 1885 when Takaki (1885) practically eradicated the disease among the Japanese navy by introducing fish, vegetables, meat and barley into the diet. In 1897 Eijkman (1897) showed that an experimental polyneuritis in fowl, which closely resembled the polyneuritic symptoms of beriberi, could be produced by feeding the birds on a diet of polished rice. When they were fed on unpolished rice they did not develop the disease. In 1926 Jansen & Donath (1926) isolated a crystalline hydrochloride of the antineuritic factor from rice bran.

The structure of thiamine, elucidated in the mid-1930s, was established by Williams (1936) as 3-(4-amino-2-methyl-5-pyridimidinylmethyl)-5-(β-hydroxyethyl)-4-methylthiazolium chloride hydrochloride (Fig. 1). The name thiamine derives from the chemical nature of the vitamin, in that it has the thiazole (sulfur-containing) ring attached to a pyrimidine ring with an amine group. Thiamine was first synthesized in 1936 by Williams & Cline (1936) from the pyrimidine and thiazole moieties of thiamine. Within a year, Lohmann & Schuster (1937) isolated thiamine pyrophosphate (TPP) from yeast and showed that it was the cofactor for the decarboxylation of pyruvic acid. In addition to thiamine and TPP, thiamine monophosphate (TMP) and thiamine triphosphate (TTP) have been found in living organisms. These phosphate esters of thiamine are also shown in Fig. 1.

2 CHEMICAL AND PHYSICAL PROPERTIES

The double-salt from thiamine with hydrochloric acid (C₁₂H₁₇N₄OŚCl HCl; molecular weight, 337.28) consists of monoclinic plates in rosette-like clusters
Fig. 1. Structures of thiamine and its related compounds.

Thiamine, as well as other vitamins, is produced by micro-organisms in extremely small amounts. Usually it is not formed in great excess over the