Purification and Properties of Methyl Formate Synthase, a Mitochondrial Enzyme Participating in Formaldehyde Oxidation in Methylotrophic Yeasts

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A novel enzyme, methyl formate synthase, was purified to homogeneity from methanol grown Candida boidinii and Pichia methanolica. Both purified enzymes are tetrameric with identical subunits (molecular mass 42 to 45 kDa, respectively) containing 2 mols of zinc per subunit. The enzyme catalyses NAD-linked dehydrogenation of hydroxyl group of hemiacetal adduct (CH2(OH)CCH3) of methanol and formaldehyde, leading to the formation of stoichiometric amount of methyl formate, and is a new enzyme responsible to ester formation in yeasts. Although methanol or formaldehyde was not used independently, the enzyme showed a simple NAD-linked alcohol dehydrogenase activity with an aliphatic long-chain alcohol like octanol, being refereed to a class III alcohol dehydrogenase. On the basis of the evidence that methyl formate was accumulated in the culture medium1' and the results of this work, the enzyme assumed to use the hemiacetal as the genuine substrate, and function primarily in detoxification of formaldehyde during the growth of yeasts in methanol. Methyl formate synthase was found to be compartemented in mitochondria of C. boidinii, is being the first example of mitochondrial enzyme that participates in methylotrophic metabolism of yeasts. As the oxidation is able to link directly to mitochondrial oxidative phosphorylation, an alternative pathway involving this enzyme is thought to be significant in the energy metabolism of formaldehyde.