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Phosphatase Activities in the Life Cycle of *Myxococcus coralloides* D

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The effect of phosphate on the different stages of the life cycle of *Myxococcus coralloides* D has been examined. A high concentration of phosphate inhibited the process of fructification, but glycerol-induced myxospore formation and germination were independent of phosphate concentration. Acid and alkaline phosphatases were detected and both were released into liquid medium during the exponential growth phase. On solid medium, phosphatase activities showed different patterns according to the stage of the life cycle. The increase of these two activities was transient during glycerol-induced myxospore formation. Differences in phosphatase activities during germination of glycerol-induced myxospores and fruiting-body myxospores were found.

INTRODUCTION

The myxobacteria have a complex life cycle consisting of vegetative growth, aggregation, fruiting body formation, myxospore formation and germination. Myxospore formation can also be induced by the addition of glycerol to a vegetative culture (Dworkin & Gibson, 1964). Two distinct cell types exist in this life cycle: myxospores and vegetative cells.

Myxospores are physiologically different from vegetative cells, having a very low metabolic rate and being more resistant to desiccation (Sudo & Dworkin, 1969). Various enzymes have been observed to increase in activity during myxospore induction (Orlowski *et al.*, 1972; Filer *et al.*, 1977). At high cell densities an increased alkaline phosphatase activity and the release of phosphate by myxospores has been observed (Dworkin, 1973). It has been speculated that orthophosphate is a natural signal necessary to ensure synchronous germination within the community. However, myxospores from fruiting bodies do not seem to respond to the phosphate signal (White, 1975).

Another property of myxobacteria is the ability to produce a wide variety of exoenzymes. The proteins secreted by *Myxococcus xanthus* are not accumulated in its periplasm, but are released into the growth medium (Kaiser *et al.*, 1979; Nicaud *et al.*, 1984).

In this paper we report on acid and alkaline phosphatase activities during the life cycle of *Myxococcus coralloides* D, and the effect of phosphate on this life cycle.

METHODS

Organism and culture conditions. Myxococcus coralloides (*Corallococcus coralloides* according to Reichenbach, 1981) strain D, obtained in our laboratory (Arias & Montoya, 1978), was grown in CT liquid medium containing 10 mM-potassium phosphate (Arias *et al.*, 1983). CTA solid medium (Muñoz *et al.*, 1984) was used for vegetative colony formation, and yeast agar (YA) medium (Muñoz *et al.*, 1984) for fruiting body formation. Growth was measured by following optical density at 650 nm.

Myxospores. Myxospore formation was induced in liquid culture with gyratory shaking (250 r.p.m.) by the addition of glycerol (0·5 M final concentration) to exponentially growing cultures. To prepare fruiting-body myxospores the fruiting bodies were scraped from the surface of the YA medium and suspended in 0·1% SDS: this treatment lysed the remaining vegetative cells but left myxospores intact. Myxospores were washed once with 10 mM-potassium phosphate buffer pH 6·5. After washing, both types of myxospores were centrifuged and