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Genomic investigation of the lipid accumulating filamentous bacterium Candidatus ‘Microthrix parvicella’

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Introduction

Candidatus ‘Microthrix parvicella’ is a Gram positive, filamentous member of the Actinobacteria (Fig. 1). It is observed in activated sludge wastewater treatment plants (WWTP) where it is often associated with the poor sludge separation problems known as ‘bulking’ and ‘foaming’. Despite the importance of ‘M. parvicella’ little is known about its physiology and why it thrives in these treatment plants; an improved understanding is likely to provide the key to improving control strategies.

Aims & Approach

• The aims were to develop a putative metabolic model for ‘M. parvicella’ in activated sludge treatment plants (Fig. 3) and to make genomic comparisons between pure culture isolates and in situ strains.

• To achieve these aims we sequenced and annotated ‘M. parvicella’ strain RN1 and compared the genome with strains present in two metagenomes from full scale WWTPs.

Genetic diversity

• RN1 is remarkably similar to in situ strains (Fig. 2).

• Identifiable genetic differences between strains are mainly associated with mobile genetic elements and exopolysaccharide synthesis.

• Other differences include genes involved in fructose metabolism and mercury resistance.

Metabolic model

Anaerobic conditions:

Utilisation of polyphosphate, trehalose and long chain fatty acids may provide energy and reducing equivalents for lipid uptake and storage as triacylglycerols (TAGs).

Aerobic/anoxic conditions:

Stored TAGs are utilised providing energy and carbon for growth and cell maintenance.

Closing remarks

The annotated genome provides the foundation for future studies, such as transcriptomics and proteomics, that will validate the proposed model and provide further insight into the in situ physiology of ‘M. parvicella’. Such advances in our understanding will likely lead to improved control strategies for this problematic organism.