ABSTRACT

Bacterial morphogenesis and cell division are closely regulated processes that are influenced by a large number of external and internal factors. Different environmental conditions serve as external factors that regulate bacterial cell shape such as temperature, pH, salt and nutrient availability. Numerous studies have been carried out in different bacteria to see the effect of varying environmental conditions on bacterial morphology. However, these studies are limited to some bacteria only and very few reports are present for cell shape switching in Actinomycetes. To understand the various environmental factors which may affect the morphology in Actinomycetes, one of its members *Rhodococcus erythropolis* PR4 was studied. *R. erythropolis* PR4 is a non-pathogenic bacterium with high bioremediation activity.

The present study also focuses on determining the role of prokaryotic cytoskeleton elements and cell division associated proteins on morphological adaptation in *R. erythropolis* PR4.

R. erythropolis PR4 was grown in different environmental conditions with varying nutrient availability, pH and salt concentration. An altered short rod morphology was observed under nutrient deprived conditions, acidic pH and high salt concentrations.

There are several proteins which modulate the cell wall structure and regulate cell shape. During cell division process, peptidoglycan layer acts as the scaffold for shaping bacterial morphology in which CHAP domain containing proteins play a significant role. CHAP domain containing proteins modify the peptidoglycan layer by mediating their muramidase and peptidase activity during cell division. Deletion of *chap* gene resulted in elongated morphology due to delayed cell division and mislocalisation of the septa ring. The prokaryotic cytoskeleton proteins such as orphan ParA, orphan ParB, RodA and DivIVA play key role in cell shape maintenance. Morphological studies of the deletion mutants of orphan *parA1, parA2, parA3*

and *divIVA-2* genes resulted in elongated rod-shaped morphology due to delayed cell division process. The disruption of *rodA, divIVA-1* and *divIVA-3* genes resulted in short rod-shaped morphology.

The study suggests that *R. erythropolis* PR4 exhibits morphological adaptation in varying environmental conditions. It has multiple copies of *chap*, orphan *parA*, orphan *parB* and *divIVA* genes that are likely to perform unique biological functions. To date there has been no report showing the multiple copies of these genes present in any of the class of Actinomycetes phylum. This research investigation provides deeper insights into the close association between cytoskeleton and cell division proteins which in turn will be useful to develop effective drugs against the pathogenic strain of *R. erythropolis* in future.