CHAPTER 7

CONCLUSION

The major goals of this dissertation were to investigate the potential roles of bacteria in the arsenic (As) transformation in As-contaminated soils and accumulation in carrot. Agricultural soils of highland areas of northern Thailand had quite high As concentration (5.45 to 39.48 mg/kg). Only nine out of 40 isolates (22.5%) could tolerate a high level of As at pH 4.5 and 4.7 with the MIC of 40 mM. Four isolates, i.e. BAs8, BAs11, BAs19 and BAs29 performed promising tolerant ability under various pH values. BAs29 exhibited the highest resistant ability with the maximum percentage 64.5% of arsenite transformation. High arsenic resistant isolates increased the pH of the broth medium from 4.7 to around 7.0 to > 8.0

High phosphate (P) solubilizing ability was observed in all the selected isolates (BAs 7, BAs 8, BAs 11, BAs 19 and BAs 29) and the ability was markedly increased when they were exposed to arsenite, particularly sensitive isolate (BAs7), suggesting less arsenic uptake thus higher tolerant ability. It was interesting to note that IAA production was also increased when $NaAsO_2$ was added to the medium. The clear phenomenon of increment in P solubilization and IAA production by the arsenic-resistant isolates in this study seemed to be the first report on simple mechanisms to cope with high arsenic environments.

Phylogenetic analysis based on 16S rRNA gene sequences indicated that the five selected isolates, representing two major bacterial genera; *Bacillus* and *Mycobacterium*. Isolates BAs7 and BAs19 showed 99% similarity to *Bacillus stratosphericus*, BAs8 showed 98% similarity to *Bacillus pumilus*, BAs 29 showed 98% similarity to *Bacillus altitudinis* and BAs11 showed 99% similarity to *Mycobacterium neoauurum*. A qualitative silver nitrate ($AgNO_3$) indicated that isolates BAs11 and BAs29 exhibited both arsenite oxidizing as well as arsenate reducing abilities.

Effects isolates BAs7, BAs11 and BAs29 on arsenic transformation in Pangda soils and arsenic accumulation in the roots and leaves of carrot under un-lime and liming

conditions, were evaluated. The soils treated with BAs29, BAs11+Lime and BAs29+Lime gave the highest As reducing percentage (24.88, 24.61 and 24.29%, respectively). Treatment BAs29 and BAs29+Lime also gave the highest sum values of As(V) for the entire period of incubation (15+75 days) suggesting that this isolate could effectively oxidize As(III) to As(V). Pangda soils treated with BAs29 gave the lowest value of As accumulations in leaves (0.025 mg/kg) while BAs29 + Lime gave the lowest value of As accumulations in the storage roots (0.025 mg/kg). The results of the present study highlighted the several survival mechanisms i.e. pH changes, arsenite oxidation, P solubilization and IAA production) of the arsenic resistant isolates and the close relationship between pH conditions of surrounding medium and As(III) oxidation process.