Study on isolation, characterization, and application of new functional bacteria from composts

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論文題目　：Study on isolation, characterization, and application of new functional bacteria from composts
（コンポストからの新奇機能性細菌の分離、性質解明及び応用に関する研究）

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論　文　内　容　の　要　旨

Composting has become increasingly importance for the managing and recycling of organic wastes. Compost inhabiting bacteria (CIB) play key roles in the biotransformation processes because of their metabolic versatility in assimilation and dissimilation of organic substances under a wide range of physicochemical conditions during composting. Application of functional compost can improve soil fertility, soil microbial activity, and plant growth for sustainable crop production. In soil, CIB play important roles in degrading organic matter, solubilizing insoluble minerals, producing growth stimulating substances, and protecting plant against biotic and abiotic stresses. In this study, the potential function of CIB from the palm oil industry waste co-compost, and marine animal resources (MAR) compost were investigated.

In chapter I, recent topics on the physicochemical and biological changes during composting process by CIB were introduced to emphasize their importance role in the wastes biotransformation process and in production of functional compost. The potential functions of CIB in term of plant growth promotion (PGP), plant protection (biocontrolling), biodegradation (composting), bioremediation, novel strain isolation, and its application were summarized. In chapter II, isolation of the multifunctional CIB from co-compost of palm oil industry waste was investigated. Out of 100 isolated CIB strains, 25 were selected for identification based on their moderate to strong or multifunctional activities in PGP, biocontrolling against the oil palm basal stem rot disease causal fungus *Ganoderma boninense*, or composting traits. Three novel multifunctional strains were obtained and identified as *Citrobacter sedlakii* CESi7 (PBP and composting), *E. cloacae* subsp. *dissolvens* B3 (PGP and biocontrolling), and *B. tequilensis* CE4 (biocontrolling and composting). In chapter III, novel PGP activity of eight *C. sedlakii* strains, including the type strain, and co-compost mixed communities was investigated. When komatsuna was cultivated in pot with zero fertilizer condition, 2 isolated *C. sedlakii* strains (CESi7 and TSASi10) significantly promoted some growth parameters of komatsuna compared to non-inoculation control. On the other hand, when soil was supplemented with half recommended fertilizers rate (N:P:K, 25:25:25, mg/pot), only co-compost

mixed communities showed significance komatsuna shoot growth. In chapter IV, two bacterial isolates (MTB37-1 and CORY-14) previously obtained from MAR compost was investigated for its taxonomic novelty. Results revealed strain MTB37-1 was closely related to *Lysinibacillus fusiformis* (99.8%), but showed some physiological and phenotypic variation from the type strain. On the other hand, strain CORY-14, was found to be a co-culture of two bacteria, and was renamed as CORY-14AB and CORY-14C. Strain CORY-14AB is found closely related to *Paenibacillus ehimensis* (97.45%), whereas the closet strain related to CORY-14C is *Paenibacillus mucilaginosus* (97.39%). Results suggested CORY-14AB and CORY-14C potentially represent two novel species in the genus *Paenibacillus*.

In chapter V as general conclusion and future prospective, three novel multifunctional bacteria originally isolated from co-compost of the palm oil industry waste has been proposed for used in the integration of pest management and crop production systems in the oil palm plantation industry. In addition, co-compost mixed communities showed promising results in promoting plant growth under zero or reduced fertilizing conditions. These new findings would be helpful for sustainable utilization of waste generated from palm oil industry to value-added co-compost.