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学 位 論 文 要 旨
Dissertation Abstract

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学位論文題目： Study on Improvement of agricultural productivity using biotic and abiotic factors
Title of Dissertation （生物的･非生物的要素による農業生産性の向上に関する研究）

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Agricultural productivity is influenced by many factors, biotic and abiotic. In this study, I tried to improve productivity with two biotic factors, seaweed polysaccharide ulvan and bacteria utilizing Yuzu waste, and one abiotic material, slightly acidic electrolyzed water (SAEW).

Seaweed or macroalgae *Ulva* species contain a sulfated polysaccharide ulvan. While ulvan can be used as a fertilizer, degraded oligo-ulvan could be used in the agricultural field. Several marine bacteria use ulvan as a carbon source by degrading ulvan into oligo-ulvan. Draft genome sequences of ulvan-degrading strains belonging to genera *Alteromonas* and *Tenacibaculum* were determined. The first enzyme in the degradation pathway of ulvan, an ulvan lyase, was detected in the polysaccharide utilizing loci (PULs) in all ulvan-degrading strains.

Yuzu is one of the important fruits in Kochi. Large amounts of waste are produced in the process of squeezing Yuzu. The post-squeezing Yuzu waste is thought to be unused biomass resources. One of the useful applications of Yuzu waste is decomposing by bacteria. The squeezed Yuzu waste was homogenized and used as a sole carbon source for bacterial enrichment at neutral and acidic conditions. Enriched and isolated bacteria at neutral conditions belonged to the genus *Bacillus*. Isolated bacteria at acidic conditions belonged to the genus *Burkholderia*. Species in the genus *Burkholderia* are known to be acid tolerant. For making compost with Yuzu waste, the

acidic-tolerant feature of *Burkholderia* is highly advantageous. Seven *Burkholderia* strains, YK2014, YK2015, YK2022, YK2025, YK2051, YK2052, and YK2054 were used. Besides YK2051, which was classified into group A including several plant-associated and saprophytic species, 6 other strains belonged to group B, which includes human, animal, and plant pathogens. YK2015 and YK2051 grew well even at pH 4.0. Interestingly, YK2054 grew slower at pH 7.0 than at lower pH.

The Yuzu waste contained three carbon sources, fructose, glucose, and sucrose. The *Bacillus* strain YK1110 isolated at neutral conditions could not consume any sugars, which is consistent with no growth at acidic conditions. When homogenized Yuzu waste was added at different levels, 10%, 20%, and 50%, to the minimal media, the pH of the growth media became 4.00, 3.83, and 3.77, respectively. The 7 *Burkholderia* strains consumed all three sugars at a 10% level. Only glucose was consumed by 7 strains at a 20% level. At a 50% level, only YK2054 consumed glucose. YK2054 was most tolerant to acidic pH and could be used for composting.

SAEW has strong bactericidal activity and is relatively safe compared to other disinfectants. In vitro exposure of *Escherichia coli* and *Bacillus subtilis* to SAEW at more than 25 mg/L chlorine concentration for 3 min completely killed bacterial cells. When SAEW was sprayed in the greenhouse at around 30 mg/L chlorine concentration, the viability of airborne microorganisms was significantly reduced. On the other hand, SAEW spray did not affect the growth of eggplant and cucumber plants in the greenhouse. SAEW spray did not influence microorganisms in the soil or the plant leaf surface. SAEW could be used as a substitute for tap water to increase the relative humidity during the daytime, which is expected to increase photosynthesis. SAEW spraying reduces airborne microorganisms and improves the environmental conditions in the greenhouse.