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論文要旨

THESIS SUMMARY

専攻 : Bioengineering 専攻
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Student's Name

申請学位 (専攻分野) : 博士 (工学)
Academic Degree Requested Doctor of
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要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words)

This doctoral dissertation is titled -Seasonal changes in microbial consortia and fate of human intestinal bacteria in Tonle Sap Lake- and consists of six chapters.

Chapter 1, The general introduction. More than 1.7 million people who live and depend on the Tonle Sap Lake, which located in Cambodia and the largest lake in Southeast Asia, have no choice but to discard their household and human wastes into the lake. Villagers exposed to several waterborne diseases, mainly diarrhea, since they used the lake water for their daily life activity. Moreover, sewage from the cities usually release into the water sources such as Tonle Sap River, Mekong River, and Tonle Sap Lake without the proper treatment. The discharge of the untreated sewage into the water sources may influence not only their chemical and biological water quality but also pose a potential risk to human health. However, their biological water quality and the microbial consortia shifting are not well studied. This research is aiming to quantify the biological water quality of the sewage, Tonle Sap River, and Mekong River in Phnom Penh capital city of Cambodia, to study on the spatiotemporal changes in the microbial consortia in the water and sediment of the Tonle Sap Lake, and to trace the fate of human intestinal bacteria in the Tonle Sap Lake.

Chapter 2, Biological water quality of sewage, Mekong River, and Tonle Sap River. The wastewater produced by 2.2 million people in Phnom Penh city was collected into the sewage system and discharged into the water environment. The concentration of *E. coli* measured in the sewage was 100 and 1000 times higher than that measured in the Tonle Sap River and Mekong River, respectively. The total 16S rRNA gene copy number was determined as the highest in the sewage and the lowest in the Mekong River. Moreover, the microbial consortia found in the Tonle Sap River and sewage in Phnom Penh city was similar. The results from this study demonstrated that Tonle Sap River and Mekong River are contaminated from the high concentration of human intestinal bacteria. For improving water quality, the sewage should be treated before discharging into the rivers.

Chapter 3, Seasonal changes in the microbial consortia in the Tonle Sap Lake. The water cycle in the Tonle Sap Lake between dry and rainy season is unique. I determined the different of microbial consortia structure between the lake water and sediment and its abundance showed spatiotemporal variation. As affected from the fecal waste, the microbial consortia in the floating villages was different from those measured at the place with non-point sources. Microbial diversity and total gene copy number in the sediment was higher than that in the water. In a transition period from the dry to rainy season, the microbial diversity was increased in the deep water. Consortia members present in high abundance in the lake water were correlated with pH and

dissolved oxygen.

Chapter 4, Fate of *Escherichia coli* in the sewage influent and activated sludge. I investigated the survival of *Escherichia coli* K-12 (*E. coli*) in the sewage influent and activated sludge using a novel approach that involves the application of a biologically stable dialysis device. The ions and nutrients were able to penetrate the membrane easily. Without the contamination of indigenous microorganisms, *E. coli* was able to survive in the sewage influent or activated sludge. The reduction of *E. coli*, higher in the activated sludge compared to in the sewage influent, revealed by next-generation sequencing and culture-based analysis. Bacteriophage infection on *E. coli* was highlighted in the filtrated sewage influent and activated sludge.

Chapter 5, Fate of human intestinal bacteria in the floating village at Tonle Sap Lake. The method developed in the chapter 4 was used to trace the fate of representative human intestinal bacteria in the Tonle Sap Lake. Without interaction with the environmental microbes, the *Escherichia* group was well persisted than *Staphylococcus* group in the lake water. However, the bacterial strains were dramatically reduced when they interacted with the microbial consortia in the lake water. *Staphylococcus* group was more tolerant in the lake water than *Escherichia* group in which their presence was still detected after one-week incubation.

Chapter 6, Conclusions and Perspectives. Tonle Sap River and Mekong River are affected by the inflow of untreated sewage. High concentration of *E. coli* was detected in the monthly sampling. The structure of the microbial consortia showed spatiotemporal variation in the Tonle Sap Lake. The bacterial concentration condensed in the sediment and in the dry season in the Tonle Sap Lake. The lake's microbial consortia influenced by villager fecal waste in a limited area. The lifelong of bacteria derived from human in the lake water is not so long. Further understanding on bacterial removal mechanism in the lake water and sediment is needed. Moreover, proposing an alternative drinking water treatment is necessary for villagers.

備考：論文要旨は、和文2000字と英文300語を1部ずつ提出するか、もしくは英文800語を1部提出してください。

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