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Abstract of Thesis/Dissertation

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Title : Bioactivity of prebiotics from commonly consumed vegetables and root crops under simulated gastrointestinal conditions.
(野菜や根菜のプレバイオティクス効果について)

Abstract

Introduction and Objective

The growing interest in polyphenols has led many researchers to study and confirmed its potential health attributes. Studies have reported that polyphenols are strong antioxidants, which means that they (polyphenols) can counteract oxidative stress caused by reactive oxygen species (ROS). Besides, polyphenols can alleviate the risk factors associated with heart diseases such as lowering of blood pressure and low-density lipoprotein (LDL)-bad cholesterol level. Polyphenols are very low (less than 5%) in terms of absorption in the upper gastrointestinal tract, while more than 90% exited the upper gastrointestinal tract into the large intestine and become a substrate for microbial fermentation. Speculation surrounding the non-absorbable polyphenols could be attributed to a certain role in the large intestine which requires a thorough investigation. Therefore, the main objective of the study was to investigate the biological activity polyphenols, particularly the fermentation characteristics of purple sweet potato to elucidate its potential as a healthy substrate for colonic microbiota,

and thus, might be developed into functional food with health attributes associated with the host.

Materials & Methods

In Chapter 2, *in vitro* fermentation study was conducted by using a small-scale laboratory fermenter. Fermentation materials used were polyphenol extracts prepared from purple sweet potato. The samples were collected at 0, 6, 12, 24, and 48 h time points for the analysis of SCFA (HPLC), putrefactive products (assay kit), intestinal immunity-related substances (assay kit), and bacterial abundance (plate count and 16S rRNA gene sequencing). In chapter 3, in vivo study was conducted using Fischer 344 male rats (6 rats/ group) aiming to investigate the fermentation characteristics of polyphenols. The rats were fed the experimental diets (5% cellulose (CEL), 5% CEL + 0.2% purple sweet potato polyphenol extract (CELP), 5% CEL + 1% purple sweet potato polyphenol extract (CEHP), 5% inulin (INU), 5% INU + 0.2% purple sweet potato polyphenol extract (INLP), and 5% INU + 1% purple sweet potato polyphenol extract (INHP)) based on a modified AIN-93G diet. Organ weights, serum, and cecal digesta were collected for biochemical, cecal biomarkers, and microbiological analyses.

Results & Discussion

Chapter 2: The in vitro fermentation study using sweet potato polyphenols (PSP) displayed the modulatory effect on the colonic microbiota in this study. The differential beneficial bacterial growth and the reduction of pathogenic bacteria were depended on the fermentability of dietary fiber, which was more effective with cellulose and could be a potential material conducive for improving the fermentation characteristics of less-fermentable dietary fiber. PSP also reduces the level of putrefactive product (*p*-cresol). Thus, PSP might be a potential material for functional food ingredients that will confer health benefits to the host.

Chapter 3: Purple sweet potato polyphenol extract (PSPP) increased the serum triglyceride (TG) and HDL-C level while reducing the NH3 level. Additionally, the β-diversity of bacterial species for inulin groups (IN, INLP, and INHP) were similar to the previous study in chapter 2 by clustering together while that of cellulose groups (CE, CELP,and CEHP) were not distinctively separated as seen in the previous study

in chapter 2. Besides, PSPP reduces the relative abundance of *Oscillospira* and *Bacteroidetes* while increasing the relative abundance of *Dorea*. The production of acetate and succinate were increased particularly with lower PSPP concentration, while iso-butyrate was reduced. Further, the level of pH was reduced by PSPP while mucin was increased by PSPP in the CELP group. In this chapter, it seems PSPP was more effective with the less fermentable dietary fiber (cellulose) as seen in the previous study in chapter 2. Finally, the fermentation characteristics of PSPP may have different effects on the microbiota depending on the fermentability of dietary fiber associated with it. Therefore, this study demonstrated that dietary inclusion of polyphenol/anthocyanin from the purple sweet potato might confer positive health attributes to the host gut.