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学 位 論 文 要 旨
Dissertation Abstract

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学位論文題目：
Title of Dissertation

Study and development of biological activity from edible mushrooms and *Citrus macroptera*
(食用キノコと *Citrus macroptera* の生物活性の研究と開発)

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Diabetes mellitus is a serious metabolic disease and has been viewed as major risk of health. Inhibition of carbohydrate hydrolyzing enzymes like *α*-glucosidase in the digestive tract is one of the therapeutic strategies used to treat diabetes by preventing the digestion of oligosaccharides and disaccharides and slowing the absorption of glucose. Furthermore, diabetes mellitus is also responsible for generating reactive oxygen species (ROS), which causes an increase in free radical production and reduces antioxidant defense. Antioxidants are bioactive agents capable of preventing harmful effects of reactive oxygen species (ROS) and other free radicals. On the other hand, antibiotics have proven to be an important tool to fight against bacterial infections and have significantly improved health-related qualities of human life. However, in the past few decades, misuse of antibacterial agents has led to the development of microbial resistant. In clinical practice, various synthetic agents are used to control diabetes, oxidative damages and bacterial infections. Therefore, it is very important to find active substances that will lead to the development of antidiabetic, antioxidant, and antibacterial drugs with minimal side effects and relatively low cost in the clinic. For this reason, the use of biomolecules of natural resources is the best option. Edible mushrooms and *Citrus macroptera* have been recognized as a source of natural phytochemicals with promising biological activities that can protect us from different chronic diseases. This research, therefore, has focused to study and development of biological activity from edible mushrooms and *Citrus macroptera* fruit.

This study consisted of three chapters. The second chapter was carried out to examine the antioxidant activity and *α*-glucosidase inhibitory activity of the seven species of edible mushroom species. Seven species of edible mushrooms are commercially available in Japan, namely, Enokitake (*Flammulina velutipes*), Hiratake (*Pleurotus ostreatus*), Aragekikurage (*Auricularia polytricha*), Maitake (*Grifola*

frondosa), Porcini (Yamadoritake) (*Boletus edulis*), Mannentake (*Ganoderma lucidum*), and Shiitake (*Lentinula edodes*). Methanol and water extracts were prepared from these edible mushrooms and their antioxidant activity and *α*-glucosidase inhibitory activity were studied. The water extract of *B. edulis* had the highest total phenolic content (30.8 mg GAE/g sample extract) and the highest DPPH scavenging activity (IC_{50}: 0.33 mg/mL). Likewise, the methanolic extract of *B. edulis* showed the highest *α*-glucosidase (from *Saccharomyces cerevisiae*) inhibitory activity (IC_{50}: 1.27 mg/mL). Furthermore, methanolic extract of *B. edulis* was analyzed to determine the *α*-glucosidase inhibitory active compounds, and palmitic acid, stearic acid, oleic acid, and linoleic acid were identified. Among them, stearic acid exhibited the highest activity (IC_{50}: 6.13 μg/mL), which was stronger than that of (-)-epicatechin. Related fatty acids, arachidic acid, behenic acid, and *α*-linolenic acid, were also assayed, and among them, behenic acid showed the strongest inhibitory activity (IC_{50}: 0.99 ± 0.03 μg/mL). The outcomes suggested that *B. edulis* can be utilized for the development of *α*-glucosidase (*S. cerevisiae*) inhibitory activity and antioxidant activity.

The third chapter was carried out to explore the antibacterial activity of the seven species of edible mushroom species. With the increase in antibiotic resistance, the development of new antibacterial agents is essential. Mushrooms could be an alternative source of new antibacterial agents among the potential sources of new drugs. In this study, the mushrooms and extracts used were the same as above and their antibacterial activity was assayed, using a resazurin-based 96-well plate microdilution method. The MeOH extract of *G. lucidum* showed the highest activity with minimum inhibitory concentrations (0.31 mg/mL) and minimum bactericidal concentrations (0.625 mg/mL) values against *Escherichia coli*. Likewise, it showed the highest activity with minimum inhibitory concentrations (0.16 mg/mL) and minimum bactericidal concentrations (0.31 mg/mL) values against *Staphylococcus aureus*.

The fourth chapter was carried out to isolate and identify the compounds from the whole fruit of *Citrus macroptera* and investigate their antioxidant activities. *Citrus macroptera* (family Rutaceae), locally known as Satkara in Bangladesh, is a pharmacologically diverse medicinal plant. The whole fruit was extracted with methanol to obtain the extract. Fractionation and purification of the extract led to the isolation of xanthotoxol (**1**), isomeranzin (**2**), limonin (**3**), scopoletin (**4**), scoparone (**5**), 5-[(6',7'-dihydroxy-3',7'-dimethyl-2'-octenyl)oxy]psoralen (**6**), and meranzin hydrate (**7**). These six compounds **1**, **2**, **4**, **5**, **6**, and **7** are coumarins, and limonin (**3**) is a furanolactone-type tetranortriterpene. Although all of the compounds are known, **1**, **2**, **4**, **5**, and **7** were first identified from this plant. The 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay of the identified compounds demonstrated that xanthotoxol (**1**) possessed the highest antioxidant activity (IC_{50}: 53 nmol/mL) followed by isomeranzin (**2**) (290 nmol/mL) and scopoletin (**4**) (590 nmol/mL) among the isolated seven compounds.