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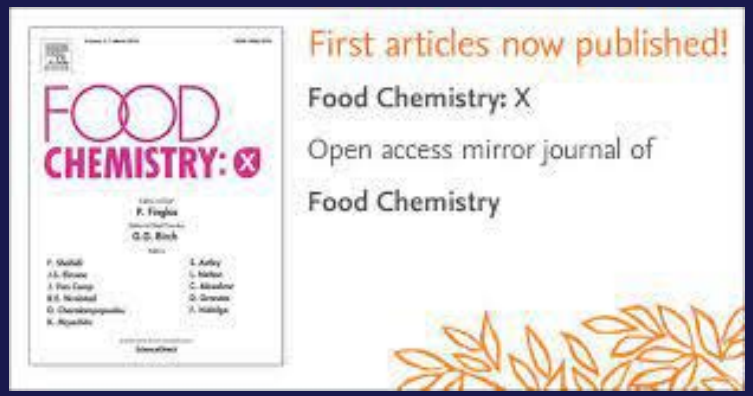
Structural, physicochemical, and immune-enhancing properties of edible insect protein isolates from *Protaetia brevitarsis* larvae



Protaetia brevitarsis

Protaetia brevitarsis

- ด้วงดอกไม้ชนิดหนึ่ง
- พบกว้างขวางทั้งในเอเชียตะวันออก อินเดียและเอเชียตะวันออกเฉียงใต้
- กินอาหารได้หลายชนิด เช่น ขี้เลื่อยไม้โอ๊ค ก้อนเชื้อเห็ด เศษผักและผลไม้ ใบไม้ เปลือกไม้ เนื้อไม้
- ตัวอ่อน (หนอน) เป็นแหล่งโปรตีนและสารออกฤทธิ์ทางชีวภาพ

1. Introduction

The United Nations has announced that by 2050 the world population will reach 9.7 billion (Borges, da Costa, Trombete, & Câmara, 2022). Thus, sustainable development requires solutions to cope with the exploding global population. As the population increases, food security has become a global concern, with studies being actively conducted to solve issues regarding this topic (Dickie, Miyamoto, & Collins, 2019; Cruz-López et al., 2022). Traditional food sources are not sufficient to meet the needs of the growing global population. Thus, research on new, more efficient, sustainable, and nutritionally superior alternative food sources is highly needed (Mariutti et al., 2021). Research on edible insects is attracting considerable attention (Kim, et al., 2021; Lee, Cha, Kim, Choi, & Jang, 2021) owing to their several advantages as alternative protein sources over conventional protein sources (Lee et al., 2023). Edible insects reduce ammonia generation, have good feed conversion ratios, and reduce the amount of water required for breeding animal sources (Lee et al., 2021a). In addition, it is expected that they will play an important role in achieving the global environmental goal of carbon neutrality because of their significantly lower CO_2 production, a representative greenhouse gas, compared to that of the existing livestock industry (Vauterin, Steiner, Sillman, & Kahiluoto, 2021).

Protaetia brevitarsis (PB, white-spotted flower chafer) is a representative edible insect (Lee et al., 2021a) containing 58% protein as the major component, 17% lipid, 5% fiber, and 8% ash (Noh et al., 2018). PB is attracting attention as an alternative protein source owing to its high protein and essential amino acid contents (Kim et al., 2021). Lee, Jo, Yong, Choi, and Jung (2021) reported that PB larvae protein showed higher digestibility compared to beef loin protein; therefore, they suggested that PB larvae protein could be used as an alternative protein source for the elderly (Ham et al., 2021). Moreover, Kim et al. (2021) studied the changes in protein properties according to the organic solvent used for defatting PB larvae protein; changes in the functional properties (emulsion capacity, emulsion stability, foam capacity, and foam stability) of proteins according to solvent treatment were determined to verify the applicability of PB larvae as a protein source. In addition, in a previous study, defatting PB larvae protein reduced its off-flavor and increased its pleasant flavor (Lee et al., 2021a), therefore reducing consumers' prejudice against edible insects. Such a feature is important for increasing their prospect as an alternative protein source.

4. Conclusion

Edible insect protein isolates (*EPI*-W and *EPI*-S) were obtained from defatted PB larvae. Moreover, the structural and physicochemical properties as well as the immune-enhancing properties of EPIs were investigated. EPIs showed a high content ratio of total essential amino acids, and the secondary structure analysis of EPIs revealed that the β-sheet was the major secondary structure. In addition, the particle size of the dispersion was low in the protein solution state; thus, the solubility of the protein was high. In terms of bio-functional properties, EPIs have been confirmed to exhibit immune-enhancing properties through the activation of macrophages. EPIs promoted the production of NO by increasing the expression of the iNOS protein in RAW 264.7 macrophages. EPIs have also been shown to stimulate the production of the pro-inflammatory cytokines TNF-α and IL-1β. It has been confirmed that the effect on the production of these pro-inflammatory mediators is through the MAPK and NF-κB cell signaling pathways of macrophages. Regarding the immune-enhancing properties, it was confirmed that *EPI*-S showed higher activity than *EPI*-W. Our results suggest that edible insect protein isolated from *P. brevitarsis* larvae can be used as a food source in the future as well as a functional food material that strengthens the immune system of immune-deficient patients and the elderly.