

Pengaruh Konsentrasi Enzim Bromelin terhadap Rendemen, Derajat Hidrolisis, Daya Cerna, dan Profil Asam Amino Hidrolisat Protein *Mealworm* (*T. molitor*)

Ninda Ainiatuzahwa^{1,*}, Fitriyono Ayustaningwarno¹, Nurmasari Widyastuti¹, Lilis Wijayanti¹

ABSTRAK

Latar Belakang: Kebutuhan protein global yang terus meningkat mendorong pencarian sumber protein alternatif yang berkelanjutan. Mealworm (*Tenebrio molitor*) berpotensi sebagai sumber protein berkualitas tinggi, namun keterbatasan pencernaan akibat kitin dan struktur protein kompleks menjadi tantangan.

Tujuan: Mengevaluasi efektivitas hidrolisis protein mealworm menggunakan enzim bromelin, menentukan formula terbaik melalui metode *Multi-Attribute Decision Making – Simple Additive Weighting* (MADM–SAW), serta menilai kualitas proteinnya berdasarkan *Digestible Indispensable Amino Acid Score* (DIAAS).

Metode: Penelitian menggunakan Rancangan Acak Lengkap satu faktor (0%, 4%, 5%, 6% bromelin). Parameter yang dianalisis meliputi rendemen, derajat hidrolisis (metode Kjeldahl), dan daya cerna *in vitro*. Perlakuan terbaik dipilih menggunakan MADM–SAW, kemudian dianalisis profil asam aminonya dengan UPLC–PDA, LC–MS/MS, dan HPLC–PDA.

Hasil: Penambahan konsentrasi bromelin meningkatkan rendemen (12,27–16,40%), DH (62,30–85,38%), dan daya cerna protein (69,61–88,60%). Formula terbaik diperoleh pada perlakuan 6% bromelin (B6). Analisis asam amino menunjukkan kandungan lengkap dengan dominasi BCAA dan glutamin. Nilai DIAAS sebesar 75% dengan metionin + sistin sebagai asam amino pembatas, menandakan mealworm hidrolisat termasuk protein berkualitas sedang.

Simpulan: Tepung hidrolisat protein mealworm (THPM) berpotensi dikembangkan sebagai suplemen protein fungsional berkelanjutan, khususnya bagi atlet dan masyarakat dengan kebutuhan protein tinggi. Upaya peningkatan mutu, misalnya melalui kombinasi dengan protein pelengkap atau optimasi proses, diperlukan untuk memperbaiki skor DIAAS.

Kata kunci: bromelin, daya cerna, derajat hidrolisis, DIAAS, hidrolisat protein, *mealworm*

¹Departemen Gizi, Fakultas Kedokteran, Universitas Diponegoro, Semarang

*email: nindaainiatuzahwa9@gmail.com

Impact of Bromelain Concentration on Yield, Hydrolysis Degree, Digestibility, and Amino Acid Profile of *Tenebrio molitor* Protein Hydrolysate

Ninda Ainiatuzahwa^{1,*}, Fitriyono Ayustaningwarno¹, Nurmasari Widyastuti¹, Lilis Wijayanti¹

ABSTRACT

Background: The increasing global demand for protein highlights the need for sustainable alternative sources. Mealworm (*Tenebrio molitor*) is a promising candidate due to its high protein content, but its digestibility is limited by chitin and complex protein structures.

Objective: This study aimed to evaluate the effectiveness of mealworm protein hydrolysis using bromelain, determine the optimal treatment through the Multi-Attribute Decision Making–Simple Additive Weighting (MADM–SAW) method, and assess protein quality based on the Digestible Indispensable Amino Acid Score (DIAAS).

Methods: A completely randomized design with one factor (0%, 4%, 5%, 6% bromelain) was applied. Parameters analyzed included yield, degree of hydrolysis (Kjeldahl method), and in vitro protein digestibility. The best treatment was selected using MADM–SAW, followed by amino acid profiling with UPLC-PDA, LC-MS/MS, and HPLC-PDA.

Results: Bromelain addition significantly increased yield (12.27–16.40%), DH (62.30–85.38%), and digestibility (69.61–88.60%). The 6% bromelain treatment (B6) was identified as optimal. Amino acid analysis revealed a complete profile dominated by BCAAs and glutamine. The DIAAS value was 75%, with methionine + cystine as limiting amino acids, indicating a medium-quality protein.

Conclusion: Mealworm protein hydrolysate shows potential as a sustainable functional protein supplement, particularly for athletes and individuals with high protein requirements. Further improvement, such as combining with complementary proteins or optimizing processing, is needed to enhance DIAAS.

Keywords: bromelain, digestibility, degree of hydrolysis, DIAAS, protein hydrolysate, *Tenebrio molitor*

¹Department of Nutrition, Faculty of Medicine, Diponegoro University, Semarang

*email: nindaainiatuzahwa9@gmail.com