

POTENSI PEPTIDA BIOAKTIF DALAM SOSIS AYAM FERMENTASI SEBAGAI  
KANDIDAT SENYAWA ANTIHIPERTENSI: PENDEKATAN *IN VITRO*,  
*IN SILICO*, DAN *IN VIVO*

INTISARI

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Penelitian ini bertujuan untuk menghasilkan peptida bioaktif sosis ayam fermentasi yang memiliki potensi aktivitas penghambatan *Angiotensin Converting Enzyme* (ACE) untuk mendukung terapi antihipertensi. Tiga jenis starter komersial digunakan yaitu ragi tempe, *Aspergillus niger*, dan *Lactobacillus plantarum*, dengan variasi bahan pengikat yang berbeda yaitu isolat protein kedelai, tepung gelatin, dan susu skim bubuk dengan lama fermentasi 0, 24, 48, dan 72 jam. Penelitian tahap I yaitu karakteristik sosis ayam fermentasi, potensi aktivitas ACE dan penentuan masa simpan sosis fermentasi. Nilai pH,  $a_w$ , *hardness*, *cohesiveness*, *springiness*, *gumminess*, *chewiness*, kadar air, kadar protein, dan kadar lemak menunjukkan penurunan, sedangkan nilai *adhesiveness* mengalami peningkatan. Nilai angka kapang khamir sosis ayam fermentasi dengan starter ragi tempe dan *L. plantarum* mengalami penurunan sedangkan sosis ayam fermentasi dengan starter *A. niger* cenderung mengalami sedikit kenaikan. Berdasarkan uji hedonik, starter ragi tempe dan *L. plantarum* terdapat kecenderungan peningkatan terhadap tingkat kesukaan warna, aroma, tekstur, dan rasa. Hasil mikrostruktur sosis ayam fermentasi menunjukkan adanya sel kapang starter berupa bulatan kecil menonjol menempel pada struktur, droplet lemak matriks sosis, dan granula butiran putih padat dari protein bahan pengikat. Hasil perlakuan terbaik adalah penggunaan bahan pengikat isolat protein kedelai yang difermentasi selama 24 jam. Profil protein dari sosis dengan starter ragi tempe, *A. niger* dan *L. plantarum* berturut-turut yang dihasilkan memiliki berat molekul terendah, yaitu 10-12 kDa, 9-10 kDa, dan 10-12.5 kDa. Aktivitas penghambatan ACE terbaik pada sosis ayam fermentasi starter ragi tempe, bahan pengikat isolat protein kedelai dengan fermentasi selama 24 jam yaitu sebesar 79,03% dengan  $IC_{50}$  0,05 mg/ml. Hasil perhitungan daya simpan sosis ayam fermentasi yaitu selama 14 hari dalam suhu refrigerator. Penelitian tahap II yaitu evaluasi aktivitas antihipertensi peptida bioaktif sosis ayam fermentasi melalui pendekatan *docking* molekuler dan uji *in vivo* pada tikus hipertensi. Hasil *docking* molekuler menunjukkan sekuens peptida EAFLLFDR memiliki afinitas pengikatan yang lebih kuat dengan nilai -12,6 kcal/mol. Hasil uji *in vivo* menunjukkan bahwa pemberian sosis ayam fermentasi sebesar 1000 mg/kgBB, 2000 mg/kgBB, 3000 mg/kgBB, dan kontrol positif (kaptopril) secara signifikan lebih baik menurunkan tekanan darah sistolik sebesar 25,95%; 21,53%; 27,31; dan 32,62% dibandingkan kontrol negatif sebesar 2,07%. Pemberian sosis ayam fermentasi ragi tempe 2000 mg/kgBB memberikan efek penurunan tekanan darah diastolik tertinggi sebesar 33,5% dibandingkan penggunaan kaptopril sebesar 32,09%. Dapat disimpulkan bahwa fermentasi sosis ayam dengan starter ragi tempe selama 24 jam menghasilkan peptida bioaktif yang mampu menghambat ACE dan menurunkan tekanan darah secara efektif.

Kata kunci: Sosis ayam fermentasi, Peptida bioaktif, Antihipertensi, *Angiotensin Converting Enzyme* (ACE)

## POTENTIAL OF BIOACTIVE PEPTIDES IN FERMENTED CHICKEN SAUSAGE AS ANTIHYPERTENSIVE CANDIDATES: IN VITRO, IN SILICO, AND IN VIVO APPROACHES

### ABSTRACT

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This study aimed to produce bioactive peptides from fermented chicken sausage with potential Angiotensin-Converting Enzyme (ACE) inhibitory activity to support antihypertensive therapy. Three commercial starters were used: ragi tempeh, *Aspergillus niger*, and *Lactobacillus plantarum*, with different binding agents including soy protein isolate, gelatin flour, and skim milk powder, and fermentation durations of 0, 24, 48, and 72 hours. Phase I of the study focused on characterizing the fermented chicken sausages, evaluating ACE inhibitory potential, and determining shelf life. The values of pH, water activity ( $a_w$ ), hardness, cohesiveness, springiness, gumminess, chewiness, moisture, protein, and fat decreased, while adhesiveness increased. Sausages fermented with ragi tempeh and *L. plantarum* showed a decrease in mold and yeast counts, while sausages with *A. niger* showed a slight increase. Based on hedonic testing, sausages with ragi tempeh and *L. plantarum* showed increased preference in color, aroma, texture, and flavor. Microstructural observations revealed the presence of mold cells as small protruding spheres attached to the matrix, fat droplets, and dense white granules from the binding proteins. The best treatment was the use of soy protein isolate fermented for 24 hours. Protein profiles from sausages with ragi tempeh, *A. niger*, and *L. plantarum* showed the lowest molecular weights at 10–12 kDa, 9–10 kDa, and 10–12.5 kDa, respectively. The highest ACE inhibition was achieved in sausages with ragi tempeh and soy protein isolate fermented for 24 hours, reaching 79.03% inhibition with an  $IC_{50}$  of 0.05 mg/ml. The shelf life of fermented chicken sausage was calculated as 14 days under refrigerated conditions. Phase II involved evaluation of antihypertensive activity using molecular docking and *in vivo* tests on hypertensive rats. Docking results showed that the peptide sequence EAFLLFDR had strong binding affinity with a score of  $-12.6$  kcal/mol. *In vivo* tests revealed that fermented sausage doses of 1000, 2000, and 3000 mg/kg body weight, as well as captopril (positive control), significantly reduced systolic blood pressure by 25.95%, 21.53%, 27.31%, and 32.62%, respectively, compared to 2.07% in the negative control. The 2000 mg/kg dose of ragi tempeh sausage produced the highest diastolic pressure reduction at 33.5%, slightly higher than captopril at 32.09%. It was concluded that 24-hour fermentation of chicken sausage using ragi tempeh successfully produced bioactive peptides capable of inhibiting ACE and effectively lowering blood pressure.

**Keywords:** Fermented chicken sausage, Bioactive peptides, Antihypertensive, Angiotensin-Converting Enzyme (ACE)