

Characteristics of Mix Grain Tempe from Soybean (*Glycine max* (L.) Merr.) and Jack Bean (*Canavalia ensiformis* L.) as Precursor of Angiotensin Converting Enzyme (ACE) Inhibitor

ABSTRACT

Angiotensin-Converting Enzyme (ACE) Inhibitor is a bioactive peptide that inhibits ACE in hypertension mechanism. ACE-inhibitory bioactive peptide mostly consists of hydrophobic amino acids and negative charge amino acids. Tempe is Indonesian traditional food, high protein content, and potent to produce ACE-inhibitory bioactive peptides. The commonly tempe ingredients are soybeans, but the amino acid composition is low in hydrophobic amino acids. Jack beans have a high content of hydrophobic amino acid, so that can be a potent as Mix Grain ingredient in making tempe to produce the higher ACE inhibitor activity. The purpose of this research is to characterize Mix Grain tempe from soybeans and jack beans as precursor ACE inhibitor. Mix Grain tempe had made with variations in the comparison of jack bean : soybeans (1:0, 0:1, 1:1, 1:2, and 2:1) and fermentation time variations (24, 36, 48 and 60 h). The best Mix Grain tempe was based on the highest water-soluble protein levels and supporting parameters including hardness, color (L, a, b), pH value, and sensory test. The experimental design was using factorial design, data were analyzed using Two way ANOVA then tested with Duncan (SPSS ver.22), and analyzed using Principal Component Analysis (PCA) Plots. The best Mix Grain tempe was characterized in proximate test and functional properties test were the degree of hydrolysis: without pepsin, incubation with pepsin enzyme (0 and 2 h), and ACE inhibitor activity. The results showed that the best Mix Grain tempe was tempe with ingredients of jack bean : soybeans were 1:1, with 48 h fermentation time. The water-soluble protein content was 24,10 +- 4,71 mg/g; 6.48 +- 0.16 of pH value; 0,61 +- 0,07mm/s of hardness; the values of L, a, b, respectively were 70.16 +- 7.66; 4.91 +- 0.41; 8.08 +- 0.44; and hedonic scores (texture, aroma, taste, color, and overall) were 3 (liked). PCA plot grouped mix grain tempeh into 4 clusters. The Mix Grain tempeh proximate were consisting 62.82 +- 1.18% (wb) of water content, 2.71 +- 0.39% (db) of ash, 16.93 +- 1.66% (db) of fat; 30.39 +- 4.12% (db) of crude protein; 3,96+-0,93% (db) of crude fiber; and 22,58 +-1,89% (db) of carbohydrates. Degree of hydrolysis: without pepsin, 0 h pepsin, and 2 h pepsin respectively were 3.85 +- 0.71%; 2.36 +- 1.03%; 2.89 +- 0.69%. Raw Mix Grain tempe and hydrolyzed Mix Grain tempe by 2 h of pepsin had ACE inhibitor activity: 41.19 +- 2.19% and 59.80 +- 2.54%. The highest hydrophobic amino acids of Mix Grain tempe consisted of Leucine (Leu), Valine (Val), and Phenylalanine (Phe). Amino acid with negative charges consisted of Glutamic Acid (Glu), Aspartic Acid (Asp), Arginine (Arg), Histidine (His), Lysine (Lys), as precursors of the formation of bioactive peptide that had ACE inhibitor activity.

Keywords: tempeh, soybean, jack bean, characterization, ACE inhibitors.

Karakteristik Tempe Mix Grain dari Kedelai (*Glycine max* (L.) Merr.) dan Koro Pedang (*Canavalia ensiformis* L.) sebagai Prekursor Angiotensin Converting Enzyme (ACE) Inhibitor

INTISARI

Angiotensin Converting Enzyme (ACE) *Inhibitor* adalah peptida bioaktif yang berperan dalam menghambat ACE dalam mekanisme hipertensi. Peptida bioaktif ACE *inhibitor* terdiri dari asam amino hidrofob dan bermuatan negatif. Tempe adalah makanan tradisional Indonesia tinggi protein dan berpotensi menghasilkan peptida bioaktif ACE *inhibitor*. Bahan pembuatan tempe secara umum adalah kedelai namun komposisi asam amino hidrofob rendah. Koro pedang putih memiliki komposisi asam amino hidrofob yang tinggi dapat berpotensi untuk dijadikan bahan campuran pembuatan tempe sehingga potensi aktivitas ACE *Inhibitor* tinggi. Tujuan penelitian ini adalah untuk mengkarakterisasi tempe *Mix Grain* dari kedelai dan koro pedang putih sebagai prekursor ACE *Inhibitor*. Pembuatan tempe *Mix Grain* dengan variasi formulasi perbandingan kacang koro pedang putih : kedelai (1:0, 0:1, 1:1, 1:2, dan 2:1) dan waktu fermentasi (24, 36, 48, dan 60 jam). Tempe terbaik didasarkan pada kadar protein terlarut tertinggi dan parameter pendukung diantaranya nilai pH, kekerasan, warna, dan uji sensoris. Rancangan percobaan menggunakan RAL faktorial dan data dianalisa menggunakan Two-way ANOVA kemudian diuji Duncan (SPSS ver.22) serta *Principal Component Analysis* (PCA) Plot. Tempe *Mix Grain* terbaik diuji proksimat dan sifat fungsional dengan mengukur derajat hidrolisis tanpa pepsin, dengan pepsin (0 dan 2 jam) serta uji aktivitas ACE *inhibitor*. Hasil penelitian menunjukkan bahwa tempe *Mix Grain* yang memiliki kadar protein terlarut tertinggi dan memiliki karakteristik sesuai dengan tempe kedelai yaitu tempe dengan formula bahan koro pedang : kedelai adalah 1 : 1 dengan lama waktu fermentasi 48 jam. Kadar protein terlarut yaitu 24,10 ± 4,71 mg/g; nilai pH 6,48 ± 0,16; kekerasan 0,61±0,07 mm/s; nilai L, a, b, c, adalah 70,16±7,66; 4,91±0,41; 8,08±0,44; skor hedonik adalah 3 (suka). PCA plot mengkategorikan tempe mixgrain menjadi 4 kelompok. Proksimat tempe *Mix Grain* terdiri dari kadar air 62,82±1,18% (bb), kadar abu 2,71±0,39% (bk), kadar lemak 16,93±1,66% (bk); kadar protein 30,39±4,12% (bk); serat kasar 3,96±0,93% (bk); dan karbohidrat 22,58±1,89% (bk). Derajat hidrolisis tempe *Mix Grain* tanpa pepsin yaitu 3,85±0,71%; dihidrolisis pepsin 0 jam yaitu 2,36±1,03%; dan dihidrolisis pepsin 2 jam yaitu 2,89±0,69%. Tempe *Mix Grain* tanpa dihidrolisis pepsin dan dihidrolisis pepsin 2 jam memiliki aktivitas ACE *inhibitor* 41,19±2,19% dan 59,80±2,54%. Asam amino hidrofobik tinggi pada tempe *Mix Grain* yaitu Leusin (Leu), Valin (Val), dan Fenilalanin (Phe). Asam amino bermuatan negatif yang tinggi yaitu Asam Glutamat (Glu), Asam Aspartat (Asp), Arginin (Arg), Histidin (His), Lisin (Lys) sebagai prekursor peptida bioaktif ACE *inhibitor*.

Kata kunci : tempe, kedelai, koro pedang, karakterisasi, ACE inhibitor