

## **EFFECT OF SPIRULINA ADDITION AND FERMENTATION TIME ON NUTRITIONAL VALUES AND FUNCTIONAL PROPERTIES OF SPIRULINA TEMPE**

### **ABSTRACT**

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Spirulina tempe has been commercially sold in Indonesia as one of the potential functional food that is rich in antioxidant. However, there is still a limited research to support the claim of spirulina tempe. Therefore, this research aims to study the effect of spirulina addition and fermentation time to the nutritional value and its functional properties. In this study, spirulina tempe with different spirulina concentration (0%; 0.5%; 1%; 2%; 4%) and fermentation time (24 h; 36h; 48 h; 60 h; 72 h) were assayed to determine its nutritional values, antioxidant activity, and its potential in inhibiting key enzymes responsible for type-2 diabetes and hypertension. The nutritional values analysis of moisture, ash, fat, protein, and carbohydrate were conducted by AOAC methods, the antioxidant activities were assayed using DPPH (1,1-Diphenyl-2-picryl-hydrazyl) radical scavenging activity, the  $\alpha$ -amylase inhibitory activities were measured by  $\alpha$ -amylase inhibitory activities, and the antihypertensive activities were measured by ACE inhibitory activities. The significance was tested by  $p=0.05$ , followed by *Post-hoc* test (Duncan's test). In proximate analysis, there are no significant change in moisture, ash, fat, protein, and carbohydrate content of tempe in the addition of spirulina of different concentration. In studying the different fermentation time, similar results were observed in its nutritional values. However, the fat content of spirulina tempe significantly decreases with longer fermentation time. In the measuring antioxidant activities, expected results were obtained which the DPPH scavenging activity increases as the increasing concentration of spirulina and longer fermentation time in spirulina tempe. In the  $\alpha$ -amylase inhibition assay, as the concentration of spirulina increases with longer fermentation time, the  $\alpha$ -amylase inhibition activities increase. The antihypertension activity is shown by angiotensin-converting enzyme (ACE) inhibitory activity which display a significant increase of ACE inhibitory activities in spirulina tempe compared to control (0%). These current findings indicate that spirulina addition and fermentation time play a significant role in the health benefits of spirulina tempe, especially with the presence of bioactive peptides and phenolic compounds. Therefore, spirulina tempe has a great potential in diabetes and hypertension management in Indonesia.

**Keywords:** Spirulina tempe; Nutritional values; Antioxidants;  $\alpha$ -Amylase inhibitor; Angiotensin-converting enzyme inhibitor

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## **PENGARUH PENAMBAHAN SPIRULINA DAN WAKTU FERMENTASI TERHADAP NILAI GIZI DAN SIFAT FUNGSIONAL TEMPE SPIRULINA**

### **ABSTRAK**

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Tempe spirulina merupakan salah satu produk varian tempe yang kaya akan antioksidan dan telah dikomersialisasikan di Indonesia. Akan tetapi, belum banyak penelitian yang mendukung klaim dari tempe spirulina tersebut. Oleh sebab itu, penelitian ini bertujuan untuk menganalisis pengaruh penambahan spirulina dan waktu fermentasi terhadap nilai gizi dan sifat fungsional tempe spirulina. Dalam penelitian ini, spirulina ditambahkan dalam konsentrasi yang berbeda (0%; 0,5%; 1%; 2%; 4%) dan difermentasi dengan waktu yang berbeda (24 jam; 36 jam; 48 jam; 60 jam; 72 jam) untuk menganalisis pengaruhnya terhadap nilai gizi, aktivitas antioksidan, dan potensi menghambat aktivitas enzim yang relevan terhadap diabetes dan hipertensi. Nilai gizi dari tempe spirulina terlihat dari kadar air, abu, protein, lemak, dan karbohidrat yang didapat melalui analisis proksimat dengan metode AOAC. Analisis sifat fungsional diukur dengan aktivitas antioksidan melalui metode inhibisi DPPH (1,1-Diphenyl-2-picryl-hydrazyl), aktivitas antidiabetes melalui metode  $\alpha$ -amilase inhibitor, dan aktivitas antihipertensi dengan metode ACE (angiotensin-converting enzyme) inhibitor dan dilakukan analisis statistik dengan  $p=0.05$  dan uji lanjutan dengan metode *Duncan*. Dalam analisis proksimat, protein, lemak, dan karbohidrat dari tempe spirulina. Hasil yang serupa didapatkan dari tempe spirulina dengan waktu fermentasi yang berbeda, tetapi kadar lemak menunjukkan penurunan yang signifikan semakin lama waktu fermentasinya. Pada analisis aktivitas antioksidan, didapat bahwa semakin tinggi konsentrasi spirulina dan lama fermentasinya, semakin tinggi aktivitas antioksidannya. Pada analisis aktivitas  $\alpha$ -amilase inhibitorynya, didapat bahwa semakin tinggi konsentrasi spirulina dan lama fermentasinya, semakin tinggi aktivitas  $\alpha$ -amilase inhibitorynya. Pada uji ACE inhibitor, didapatkan hasil aktivitas ACE inhibitor pada tempe spirulina lebih tinggi dibandingkan kontrol (konsentrasi 0%). Hasil ini menunjukkan bahwa penambahan spirulina dan lama fermentasi berpengaruh signifikan terhadap sifat fungsional tempe spirulina, terutama dengan adanya peptida bioaktif dan senyawa fenolik yang ada. Dari penelitian ini, tempe spirulina mempunyai potensi yang baik dalam mengatasi diabetes dan hipertensi di Indonesia.

**Kata kunci:** Tempe spirulina; Nilai gizi; Antioksidan;  $\alpha$ -Amilase inhibitor; Angiotensin-converting enzyme inhibitor

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