

RINGKASAN

Penerapan teknologi *Internet of Things* (IoT) pada proses fermentasi tempe kacang merah (*Phaseolus vulgaris* L.) menjadi salah satu upaya untuk meningkatkan pengendalian kondisi lingkungan selama fermentasi serta menjaga kualitas produk yang dihasilkan. Sistem monitoring dan kontrol berbasis IoT memanfaatkan sensor suhu dan kelembaban yang terhubung dengan aplikasi *smartphone* sehingga kondisi ruang fermentasi dapat dipantau secara *real-time*. Pengujian dilakukan menggunakan metode *Accelerated Shelf Life Testing* (ASLT) dengan tiga perlakuan suhu penyimpanan, yaitu 25–28°C, 29–34°C, dan 35–40°C. Parameter mutu yang diamati meliputi tekstur dan warna (L^* , a^* , dan b^*), kemudian dianalisis menggunakan uji ANOVA dan pendekatan persamaan *Arrhenius* untuk memprediksi umur simpan produk.

Hasil penelitian menunjukkan bahwa sistem *Internet of Things* (IoT) mampu memantau suhu ruang fermentasi pada kisaran 25,9–38,7°C dan kelembaban 50–88% secara *real-time* sehingga mendukung proses fermentasi tempe kacang merah. Perubahan suhu memengaruhi kualitas produk, ditunjukkan oleh penurunan tekstur dari 2,36 menjadi 1,18 serta perubahan warna selama penyimpanan. Analisis *Accelerated Shelf Life Testing* (ASLT) dengan pendekatan *Arrhenius* menghasilkan nilai energi aktivasi (E_a) sebesar 1.118,565 J/mol dan prediksi umur simpan berturut-turut 4,90 hari (25–28°C), 4,69 hari (29–34°C), dan 4,61 hari (35–40°C), yang menunjukkan bahwa semakin tinggi suhu penyimpanan maka umur simpan tempe kacang merah semakin pendek.

Kata kunci: *Accelerated Shelf Life Testing* (ASLT), *Internet of Things* (IoT), kualitas tempe, tempe kacang merah, umur simpan.

SUMMARY

*The application of Internet of Things (IoT) technology in the fermentation process of red kidney bean tempeh (*Phaseolus vulgaris* L.) offers an innovative approach to improving environmental control and maintaining product quality. An IoT-based monitoring and control system equipped with temperature and humidity sensors connected to a smartphone application enables real-time observation of fermentation conditions. Shelf-life prediction was conducted using the Accelerated Shelf Life Testing (ASLT) method under three storage temperature treatments: 25–28°C, 29–34°C, and 35–40°C. The quality parameters observed included texture and color (L^* , a^* , and b^*), which were analyzed using ANOVA and the Arrhenius equation to estimate the product's shelf life.*

The results showed that the Internet of Things (IoT) system was able to monitor the fermentation chamber temperature within a range of 25.9–38.7°C and relative humidity of 50–88% in real time, thereby supporting the fermentation process of red kidney bean tempeh. Temperature changes affected product quality, as indicated by a decrease in texture values from 2.36 to 1.18 and changes in color during storage. Accelerated Shelf Life Testing (ASLT) using the Arrhenius approach produced an activation energy (E_a) of 1,118.565 J/mol and predicted shelf lives of 4.90 days at 25–28°C, 4.69 days at 29–34°C, and 4.61 days at 35–40°C, indicating that higher storage temperatures resulted in a shorter shelf life of red kidney bean tempeh.

Keywords: Accelerated Shelf Life Testing (ASLT), Internet of Things (IoT), red kidney bean tempeh, shelf life, tempe quality.