

## **PEMODELAN MATEMATIS UMUR SIMPAN DAN PERUBAHAN MUTU FISIK BERAS INPARI 32 PADA BERBAGAI SUHU DAN KELEMBABAN RELATIF**

### **INTISARI**

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**24/551449/PTP/02147**

Beras merupakan komoditas pangan higroskopis yang mutu fisik dan umur simpannya sangat dipengaruhi oleh suhu dan kelembaban relatif (RH) selama penyimpanan. Penelitian ini bertujuan mengembangkan model prediksi perubahan mutu fisik dan umur simpan beras varietas Inpari 32 selama penyimpanan dalam kemasan pada berbagai kondisi suhu dan RH.

Penelitian dilakukan selama 90 hari menggunakan rancangan faktorial pada suhu 20, 30, dan 40°C serta RH 50, 70, dan 90%. Parameter yang diamati meliputi kadar air, aktivitas air (aw), densitas, tekstur, whiteness, butir kepala, butir patah, butir menir, dan butir rusak. Perubahan kadar air dimodelkan menggunakan pendekatan kesetimbangan massa, sedangkan perubahan mutu fisik dianalisis menggunakan model kinetika orde satu. Umur simpan diprediksi menggunakan Accelerated Shelf-Life Testing (ASLT) berbasis persamaan Arrhenius.

Hasil menunjukkan bahwa suhu, RH, dan interaksinya berpengaruh signifikan ( $p < 0,05$ ) terhadap seluruh parameter mutu fisik, dengan RH sebagai faktor yang paling dominan. Model kesetimbangan massa dan model kinetika orde satu menunjukkan akurasi tinggi dengan nilai  $R^2$  masing-masing sebesar 0,9840–0,9982 dan 0,9829–0,9999. Peningkatan RH hingga 90% mempercepat adsorpsi air, menyebabkan kadar air meningkat hingga 15,63–18,89%, melampaui batas maksimum SNI 6128:2020 (14%), serta menurunkan persentase butir kepala hingga 76,4%. Prediksi umur simpan menunjukkan nilai terpanjang pada kondisi 20°C/RH 50% sebesar 258–261 hari dan terpendek pada kondisi 40°C/RH 90% sebesar 2,8–8,8 hari. Model yang dikembangkan mampu memprediksi perubahan mutu fisik dan umur simpan beras secara akurat serta berpotensi diterapkan dalam pengelolaan penyimpanan dan rotasi stok beras.

**Kata kunci:** beras Inpari 32, umur simpan, mutu fisik, kesetimbangan massa, kinetika deteriorasi.

## MATHEMATICAL MODELLING OF SHELF LIFE AND PHYSICAL QUALITY CHANGES OF INPARI 32 RICE UNDER VARIOUS TEMPERATURES AND RELATIVE HUMIDITIES

### ABSTRACT

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Rice is a hygroscopic food commodity whose physical quality and shelf life are strongly influenced by temperature and relative humidity (RH) during storage. This study aimed to develop a predictive model for changes in physical quality and shelf life of Inpari 32 rice variety during packaged storage under various temperature and RH conditions.

The study was conducted over 90 days using a factorial design at temperatures of 20, 30, and 40°C and RH levels of 50, 70, and 90%. Parameters observed included moisture content, water activity ( $a_w$ ), density, texture, whiteness, head rice, broken rice, brewers' rice, and damaged rice. Changes in moisture content were modeled using a mass equilibrium approach, while changes in physical quality were analyzed using first-order kinetic models. Shelf life was predicted using Accelerated Shelf-Life Testing (ASLT) based on the Arrhenius equation.

The results demonstrated that temperature, RH, and their interaction had a significant effect ( $p < 0.05$ ) on all physical quality parameters, with RH being the most dominant factor. The mass equilibrium model and first-order kinetic model exhibited high accuracy, with  $R^2$  values of 0.9840–0.9982 and 0.9829–0.9999, respectively. Increasing RH up to 90% accelerated moisture adsorption, causing moisture content to rise to 15.63–18.89%, exceeding the maximum threshold established by SNI 6128:2020 (14%), and reducing the percentage of head rice to as low as 76.4%. Shelf life predictions indicated the longest duration under conditions of 20°C/RH 50%, at 258–261 days, and the shortest under conditions of 40°C/RH 90%, at 2.8–8.8 days. The developed models demonstrated high accuracy in predicting changes in physical quality and shelf life of rice, and show strong potential for application in rice storage management and stock rotation systems.

**Keywords:** Inpari 32 rice, shelf life, physical quality, mass equilibrium, deterioration kinetics.