

INTISARI

KARAKTERISASI KINERJA SISTEM CITRA MIKROSKOPI FOTOAKUSTIK DAN APLIKASINYA UNTUK DETEKSI DAGING SAPI BERPENGAWET BORAKS

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Telah dilakukan penelitian mengenai karakterisasi kinerja sistem citra mikroskopi fotoakustik serta aplikasinya dalam mendeteksi daging sapi yang mengandung boraks. Sistem ini menggunakan laser dioda hijau 532 nm sebagai sumber radiasi dan mikrofon kondenser sebagai penerima sinyal akustik yang dihasilkan dari penyerapan cahaya oleh sampel. Tahapan awal mencakup karakterisasi laser, mikrofon kondenser, dan motor stepper guna menjamin kestabilan serta ketelitian sistem. Frekuensi modulasi yang digunakan sebesar 15.000 Hz dengan duty cycle optimum 90% berdasarkan hasil karakterisasi. Sampel daging sapi diuji dengan dua variasi, yaitu konsentrasi boraks sebesar 10% hingga 90% dengan lama perendaman tetap 24 jam, serta variasi waktu perendaman selama 12 hingga 72 jam pada konsentrasi tetap 30%. Hasil citra menunjukkan bahwa secara visual tidak terdapat perbedaan mencolok antar sampel, namun analisis kuantitatif menunjukkan bahwa peningkatan konsentrasi boraks maupun waktu perendaman cenderung meningkatkan intensitas akustik yang dihasilkan. Nilai kuantitatif menunjukkan adanya peningkatan intensitas sebesar 5 dB antara konsentrasi boraks 0% (-92 ± 5 dB) dan 90% (-87 ± 6 dB), serta peningkatan serupa sebesar 5 dB antara waktu perendaman 0 jam (-92 ± 5 dB) dan 48 jam (-87 ± 5 dB). Meskipun selisihnya sama, pola kenaikan akibat peningkatan konsentrasi bersifat stabil hingga konsentrasi tertinggi, sedangkan pola akibat waktu perendaman bersifat sementara karena intensitas menurun kembali setelah 48 jam. Temuan ini menunjukkan bahwa sistem mikroskopi fotoakustik yang dikembangkan mampu membedakan kandungan boraks dalam daging secara efektif melalui pendekatan kuantitatif, meskipun tidak tampak perbedaan secara kasatmata.

Kata kunci : boraks, daging sapi, fotoakustik ,intensitas akustik, dan mikroskopi

ABSTRACT

PERFORMANCE CHARACTERIZATION OF PHOTOACOUSTIC MICROSCOPY IMAGE SYSTEM AND ITS APPLICATION FOR BORAX- PRESERVED BEEF DETECTION

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Research has been conducted on the performance characterization of a photoacoustic microscopy imaging system and its application in detecting borax-preserved beef. The system employs a 532 nm green laser diode as the radiation source and a condenser microphone to detect the acoustic signals generated from light absorption by the sample. The initial stage included the characterization of the laser, condenser microphone, and stepper motor to ensure system stability and precision. A modulation frequency of 15,000 Hz was used, with an optimum duty cycle of 90% based on the characterization results. Beef samples were tested under two conditions: varying borax concentrations from 10% to 90% with a fixed immersion time of 24 hours, and varying immersion durations from 12 to 72 hours at a fixed concentration of 30%. The resulting images showed no significant visual differences between samples; however, quantitative analysis revealed that both higher borax concentrations and longer immersion times tended to increase the acoustic intensity. Quantitatively, an increase of 5 dB was observed between borax concentrations of 0% (-92 ± 5 dB) and 90% (-87 ± 6 dB), as well as between immersion times of 0 hours (-92 ± 5 dB) and 48 hours (-87 ± 5 dB). Although the difference in intensity is similar, the trend caused by increasing concentration was stable up to the highest concentration tested, whereas the increase due to immersion time was temporary, with intensity decreasing again after 48 hours. These findings indicate that the developed photoacoustic microscopy system is capable of effectively distinguishing borax content in beef through quantitative analysis, even in the absence of visible differences.

Keywords : borax, beef, photoacoustic, acoustic intensity and microscopy