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Efektivitas Ekstrak Etanolik Daun Pepaya (Carica papaya L.) sebagai Pengawet Alami terhadap Karakteristik Fisikokimiawi dan Mikrobiologis Patty Daging Sapi selama Penyimpanan
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EFEKTIVITAS EKSTRAK ETANOLIK DAUN PEPAYA (*Carica papaya* L.) SEBAGAI PENGAWET ALAMI TERHADAP KARAKTERISTIK FISIKOKIMIAWI DAN MIKROBIOLOGIS *PATTY* DAGING SAPI SELAMA PENYIMPANAN

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INTISARI

Kerusakan daging sapi akibat pertumbuhan mikroorganisme patogen dan oksidasi menjadi masalah utama dalam industri pangan. Penggunaan pengawet sintetis seperti asam nitrit dan sorbat menimbulkan kekhawatiran kesehatan, sehingga diperlukan alternatif alami yang lebih aman. Daun pepaya (*Carica papaya* L.) mengandung senyawa bioaktif seperti flavonoid, tanin, alkaloid, saponin, dan terpenoid yang bersifat antioksidan dan antibakteri. Penelitian ini bertujuan menganalisis potensi ekstrak etanolik daun pepaya sebagai pengawet alami terhadap karakteristik fisikokimiawi dan mikrobiologis *patty* daging sapi selama penyimpanan. Penelitian dilakukan di Laboratorium Mikrobiologi Fakultas Biologi Universitas Gadjah Mada menggunakan metode maserasi. Analisis meliputi rendemen, deteksi fitokimia kualitatif (*foam test*, $FeCl_3$, Salkowski, $AlCl_3$, dan Wagner), aktivitas antibakteri metode difusi sumuran, oksidasi lipid metode *Thiobarbituric Acid Reactive Substances* (TBARS), *Gas Chromatography–Mass Spectrometry* (GC-MS), serta total Bakteri Asam Laktat (BAL) dan total koloni bakteri mesofilik aerobik metode *Total Plate Count* (TPC). Data dianalisis menggunakan *Analysis of Variance* (ANOVA) dan *Duncan's Multiple Range Test* (DMRT) ($p \leq 0,05$). Hasil menunjukkan rendemen ekstrak sebesar 4,43% dengan kandungan senyawa bioaktif meliputi flavonoid, tanin, saponin, alkaloid, dan terpenoid. Aktivitas antibakteri ekstrak etanolik daun *C. papaya* L. meningkat seiring konsentrasi, dengan zona hambat tertinggi pada 1 g/mL terhadap *Staphylococcus aureus* (14,45 mm), *Escherichia coli* (16,55 mm), dan *Salmonella typhi* (6,65 mm). GC-MS mengidentifikasi senyawa mayor seperti 4-ethylbenzoic acid, 4-nitrophenyl ester (30,13%), α-tocopherol-β-D-mannoside (13,67%), dan neophytadiene (10,20%). Nilai malondialdehida (MDA) lebih rendah pada perlakuan ekstrak (0,395 µmol/g NaCl; 1,105 µmol/g natrium benzoat; 1,830 µmol/g dimetil sulfoksida), menunjukkan penghambatan oksidasi lipid. Hingga H_6, nilai TPC (6×10^8 CFU/g) dan BAL ($5,25 \times 10^8$ CFU/g) perlakuan ekstrak etanolik daun pepaya melebihi batas aman *Aerobic Plate Count* ($\leq 10^5$ CFU/g). Namun demikian, ekstrak tetap menunjukkan potensi sebagai biopreservatif alami karena dapat menekan laju pertumbuhan bakteri dan oksidasi lipid, sehingga berkontribusi dalam memperlambat penurunan kualitas *patty* daging sapi selama penyimpanan.

Kata Kunci: antibakteri, biopreservatif, *Carica papaya* L., daging, sapi

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EFFECTIVENESS OF ETHANOLIC EXTRACT OF PAPAYA LEAVES (*Carica papaya* L.) AS A NATURAL PRESERVATIVE ON THE PHYSICOCHEMICAL AND MICROBIOLOGICAL CHARACTERISTICS OF BEEF PATTIES DURING STORAGE

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ABSTRACT

Beef spoilage caused by the growth of pathogenic microorganisms and oxidation is a major problem in the food industry. The use of synthetic preservatives such as nitrite and sorbic acid raises health concerns, making safer natural alternatives necessary. Papaya leaves (*Carica papaya* L.) contain bioactive compounds such as flavonoids, tannins, alkaloids, saponins, and terpenoids, which possess antioxidant and antibacterial properties. This study aims to analyze the potential of the ethanolic extract of papaya leaves as a natural preservative on the physicochemical and microbiological characteristics of beef patties during storage. The study was conducted at the Microbiology Laboratory, Faculty of Biology, Gadjah Mada University, using the maceration method. The analysis included yield, qualitative phytochemical tests (foam test, $FeCl_3$, Salkowski, $AlCl_3$, and Wagner), antibacterial activity using the well diffusion method, lipid oxidation using the Thiobarbituric Acid Reactive Substances (TBARS) method, Gas Chromatography–Mass Spectrometry (GC-MS), as well as total Lactic Acid Bacteria (LAB) and total aerobic mesophilic bacterial colonies using the Total Plate Count (TPC) method. Data were analyzed using Analysis of Variance (ANOVA) and the Duncan's Multiple Range Test (DMRT) ($p \leq 0.05$). The results showed an extract yield of 4.43% with bioactive compound content including flavonoids, tannins, saponins, alkaloids, and terpenoids. The antibacterial activity of the ethanolic leaves extract of *C. papaya* L. increased with concentration, with the highest inhibition zones at 1 g/mL against *Staphylococcus aureus* (14.45 mm), *Escherichia coli* (16.55 mm), and *Salmonella typhi* (6.65 mm). GC-MS identified major compounds such as 4-ethylbenzoic acid, 4-nitrophenyl ester (30.13%), α-tocopherol-β-D-mannoside (13.67%), and neophytadiene (10.20%). Malondialdehyde (MDA) levels were lower in the extract treatments (0.395 µmol/g NaCl; 1.105 µmol/g sodium benzoate; 1.830 µmol/g dimethyl sulfoxide), indicating inhibition of lipid oxidation. Through Day 6, the TPC (6×10^8 CFU/g) and BAL (5.25×10^8 CFU/g) values for the ethanolic extract of papaya leaves treatment exceeded the safe Aerobic Plate Count limit ($\leq 10^5$ CFU/g). Nevertheless, the extract still demonstrated potential as a natural biopreservative because it could inhibit bacterial growth and lipid oxidation, thereby helping to slow the deterioration of beef patty quality during storage.

Keywords: antibacterial, biopreservative, *Carica papaya* L., beef, cow