

# Sintesis senyawa turunan 4-Metil Kumarin dengan variasi dihidroksibenzena menggunakan metode Microwave-Assisted Organic Synthesis (MAOS) dan ulasan potensi antibakterinya = Synthesis of 4-Methyl Coumarin Derivatives from various dihydroxybenzenes using Microwave-Assisted Organic Synthesis (MAOS) and review of its antibacterial activities

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## Abstrak

Kumarin merupakan kelompok senyawa heterosiklik yang secara alami terdapat pada tanaman. Senyawa turunan kumarin telah banyak disintesis dan beberapa di antaranya memiliki aktivitas antibakteri. Di sisi lain, resistensi bakteri terhadap antibiotik mendesak agar penelitian tentang senyawa yang berpotensi sebagai antibakteri terus dikembangkan. Oleh karena itu, pada penelitian ini disintesis senyawa turunan 4-metil kumarin dan dianalisis aktivitas antibakterinya terhadap *Escherichia coli* dan *Staphylococcus aureus* berdasarkan studi literatur. Bakteri *E. coli* dan *S. aureus* merupakan dua bakteri paling umum yang memiliki resistensi terhadap antibiotik. Senyawa turunan 4-metil kumarin yang berhasil disintesis adalah 7-hidroksi-4-metil kumarin dari reaksi kondensasi Pechmann antara resorsinol dan etil asetoasetat dengan katalis  $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$  menggunakan metode Microwave Assisted Organic Synthesis (MAOS) dengan persentase yield optimum sebesar  $49,85 \pm 5,4\%$  dengan kondisi reaksi rasio mol resorsinol/etil asetoasetat 1:1, 10% mol katalis terhadap resorsinol, waktu reaksi 260 detik, dan tanpa pelarut. Senyawa hasil sintesis telah diidentifikasi dengan KLT dan uji titik leleh, serta dikarakterisasi dengan menggunakan FTIR, UV-Vis, dan NMR (1D dan 2D). Sintesis senyawa turunan 4-metil kumarin lainnya dari katekol dan hidrokuinon sebagai pengganti resorsinol tidak berhasil dilakukan yang menunjukkan kereaktifan kedua senyawa dihidroksibenzena tersebut lebih rendah dibandingkan dengan resorsinol. Berdasarkan studi literatur, senyawa turunan 4-metil kumarin, 6-hidroksi- dan 7-hidroksi-4-metil kumarin, memiliki aktivitas antibakteri terhadap bakteri *E. coli*. Senyawa 7-hidroksi-4-metil kumarin juga dilaporkan memiliki aktivitas antibakteri terhadap *S. aureus*. Oleh karena itu, senyawa turunan 4-metil kumarin yang disintesis pada penelitian ini diharapkan memiliki potensi sebagai agen antibakteri.

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<b>ABSTRACT</b><br>

Coumarin is classified as a group of heterocyclic compounds naturally found in plants. Coumarin and its derivatives have been widely synthesized and shown antibacterial activities. On the other hand, antibiotic resistance of some bacterial strains has urged the research development related to the new antibacterial agents. Accordingly, in this study, 4-methyl coumarin derivatives were synthesized and its antibacterial activities were also evaluated against *Escherichia coli* and *Staphylococcus aureus* based on literary study. Both bacteria are the most common multidrug-resistant bacteria. 7-Hydroxy-4-methyl coumarin was successfully synthesized via Pechmann condensation between resorcinol and ethyl acetoacetate with  $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$  as catalyst using MAOS method. The synthesized compound was obtained with an optimum yield of  $49,85 \pm 5,4\%$  under solvent free reaction with resorcinol/ethyl acetoacetate molar ratio of 1:1 (mol/mol), 10 mol% catalyst, and 260s reaction time. The synthesized product was identified by TLC and

melting point apparatus, and further characterized by using FTIR, UV-Vis, and NMR (1D and 2D) instruments. However, other 4-methyl coumarin derivatives from catechol and hydroquinone to substitute resorcinol were failed to synthesize revealing that they have low reactivity compared to resorcinol in Pechmann condensation. Based on literary studies regarding its antibacterial activities, 4-methyl coumarin derivatives, i.e. 6-hydroxy- and 7-hydroxy-4-methyl coumarin showed good activity towards *E. coli*. In addition, 7-hydroxy-4-methyl coumarin was also reported having antibacterial activity against *S. aureus*. Therefore, 4-methyl coumarin derivatives may have potency as antibacterial agent.

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