Sintesis Derivat Senyawa Quinoline-4-carboxylic acid Berbasis Ramah Lingkungan MCR dan MAOS menggunakan Katalis Reusable Fe(OTf)3 dan Uji Aktivitasnya sebagai Antioksidan dan Antimikroba = Synthesis of Quinoline-4-carboxylic acid Derivative Compounds Based on Environmentally Friendly MCR and MAOS using Reusable Fe(OTf)3 Catalyst and Test its Activity as Antioxidant and Antimicrobial

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Abstrak

Quinoline merupakan senyawa heterosiklik yang mengandung nitrogen pada cincin heterosikliknya. Derivat quinoline telah dilaporkan memiliki berbagai aktivitas biologis, seperti antioksidan, antibakteri, antifungi, antimalaria, dan anti-inflamatory. Banyaknya aktivitas biologis penting yang dimiliki oleh senyawa quinoline sehingga pada penelitian ini dilakukan sintesis derivat quinoline-4-carboxylic acid menggunakan metode Doebner dengan komponen asam piruvat, derivat anilin, dan derivat aldehid. Tujuan penelitian ini yaitu sintesis turunan quinoline-4-carboxylic acid berbasis ramah lingkungan dengan menggunakan metode Multicomponent Reaction (MCR), Microwave-Assisted Organic Synthesis (MAOS) dan menggunakan katalis reusable Fe(OTf)3 serta melakukan uji aktivitas antioksidan dan antimikroba. Penelitian dilakukan dalam beberapa tahap. Tahap pertama adalah pembuatan katalis Fe(OTf)3 disertai karakterisasi menggunakan FT-IR dan TEM. Tahap kedua adalah skrining kondisi optimum reaksi pada sintesis turunan quinoline-4-carboxylic dengan komponen prekursor benzaldehid, anilin dan asam piruvat dengan variasi kondisi jenis pelarut, waktu reaksi dan jumlah katalis. Hasil reaksi diamati menggunakan TLC, produk yang dihasilkan direkritalisasi dan yield yang diperoleh dihitung. Tahap ketiga adalah investigasi ruang lingkup metode dengan memvariasikan prekursor derivat benzaldehid (4-hidroksibenzaldehid, 4-metoksibenzaldehid), anilin (kloroanilin), dan asam piruvat. Senyawa hasil sintesis yang diperoleh dikarakterisasi dengan menggunakan melting point, FT-IR, spektrofotometer UV-Vis, LC-MS. Tahap keempat adalah uji aktivitas antioksidan produk yang dihasilkan menggunakan metode DPPH dan uji aktivitas antibakteri menggunakan metode difusi agar. Kondisi Optimum yang diperoleh pada sintesis senyawa 1 yang menunjukkan yield paling tinggi (96%) adalah penggunaan 5% katalis Fe(OTF)3 selama 90 detik dan tanpa penggunaan pelarut. Kondisi optimum yang diperoleh pada sintesis senyawa 1 diterapkan pada sintesis senyawa 2,3 dan 4 dan menghasilkan yield senyawa 2(74%), senyawa 3(91%) dan senyawa 4 (68%). Adapun senyawa yang menunjukkan aktivitas antioksidan paling tinggi yaitu senyawa 2 (IC50 6,76 ppm). Senyawa 3 menunjukkan aktivitas antimikroba paling tinggi, kategori kuat melawat bakteri Gram negatif E.Coli, dan kategori sedang melawan bakteri Gram positif S.Aureus.

.....Quinoline is a heterocyclic compound that contains nitrogen in its heterocyclic ring. Quinoline derivatives have been reported showing a wide range of biological activities such as antioxidant, antibacterial, antifungal, antimalarial, and anti-inflammatory. The number of important biological activities possessed by quinoline compounds so that in this study the synthesis of quinoline-4-carboxylic acid derivatives was carried out using the Doebner method with pyruvic acid components, aniline derivatives, and aldehyde derivatives. The purpose of this research is the synthesis of environmentally friendly

quinoline-4-carboxylic acid derivatives using the Multicomponent Reaction (MCR) method, Microwave-Assisted Organic Synthesis (MAOS) and using a reusable Fe(OTf)3 catalyst as well as conducting antioxidant and antimicrobial activity tests. This research was carried out in four stages. The first stage was the synthesis and evaluation of catalytic activity of Fe(OTF)3 catalyst as well as its characterization using FT-IR and TEM. The second stage was the screening of optimum reaction condition of the synthesis of quinoline derivatives using substrates of benzaldehyde, aniline, and pyruvic acid, in a condition of different types of solvents, reaction time, and the amount of catalyst. The reaction was observed using TLC, the obtained products were recrystallized, and yield products were calculated. The third stage was to investigate the scope of the method by varying the substrate of aromatic aldehyde (4-hydroxy benzaldehyde, 4-metoxy benzaldehyde), aniline (chloroaniline), and pyruvic acid. The results of reactions were characterized by melting point, FT-IR, UV-Vis spectrophotometer, and LC-MS. The fourth stage is to evaluate the activity of the obtained product of quinoline-4-carboxylic acid derivatives as antioxidant by DPPH method and antibacterial by agar difusion method. The optimum conditions of compound 1 that show the highest yield (96%) is to use 5% of catalyst Fe(OTF)3 for 90 second in solvent-free. This optimum conditions also applied on synthesis of compounds 2, 3, and 4 producing poducts of compound 2(74%), compound 3 (91%) and compound 4 (68%). Compound 2 showed the strongest antioxidant activity (IC50: 6.76 ppm). Compound 3 showed a strong antibacterial activity against Gram-negative bacteria, E.Coli (13 mm); a moderate antibacterial activity against Gram-positive bacteria, S.Aureus (10 mm).