# PENGGUNAAN DESKRIPTOR MUATAN BERSIH ATOM HASIL PERHITUNGAN METODE PENYETARAAN ELEKTRONEGATIVITAS PADA ANALISIS HUBUNGAN KUANTITATIF STRUKTUR-AKTIVITAS SENYAWA *ANTICYANOBACTERIA* TURUNAN MALEIMIDA

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## INTISARI

Penggunaan deskriptor muatan bersih atom hasil perhitungan metode penyetaraan elektronegativitas atau *Electronegativity Equalization Method* (EEM) telah dilakukan pada analisis hubungan kuantitatif struktur-aktivitas (HKSA) senyawa *anticyanobacteria* turunan maleimida. Penelitian ini bertujuan untuk menguji penggunaan EEM dalam melakukan perhitungan deskriptor pada metode HKSA melalui analisis regresi multilinier (MLR) untuk desain senyawa *anticyanobacteria* baru. Optimasi molekul dilakukan dengan menggunakan metode semiempirik AM1 untuk memodelkan struktur senyawa turunan maleimida. Perhitungan deskriptor muatan bersih atom dilakukan dengan metode analisis populasi Mulliken (APM) dan EEM terhadap struktur senyawa hasil optimasi AM1. Model HKSA didapatkan dari analisis MLR dengan menggunakan metode *backward.*

Hasil analisis HKSA dari metode statistik sebagai berikut:

Metode APM hasil optimasi semiempirik AM1:

$\text{Log } (1/IC_{50}) = (14{,}326 \times qC1) + (-4{,}946 \times qC2) + (-3{,}766 \times qC3) + (-3{,}252 \times qC4) + (38{,}635 \times qC6) + (300{,}015 \times qC7) + (34{,}772 \times qO8) + (109{,}028 \times qN9) + (-32{,}292 \times qC11) + (22{,}474 \times qC12) + (-56{,}899 \times qO16) - 51{,}493$

$n = 16$; $r = 0{,}968$; $r^2 = 0{,}937$; $SEE = 0{,}158$; $F_{hit}/F_{tab} = 4{,}633$; $PRESS = 0{,}251$

EEM hasil optimasi semiempirik AM1:

$\text{Log } (1/IC_{50}) = (-20{,}261 \times qC1) + (-3{,}367 \times qC2) + (0{,}859 \times qC3) + (18{,}159 \times qO8) + (-104{,}695 \times qN9) + (767{,}161 \times qN10) + (-135{,}810 \times qC11) + (-13{,}496 \times qC12) + (-64{,}143 \times qC14) + (-118{,}921 \times qO16) + 230{,}879$

$n = 16$; $r = 0{,}973$; $r^2 = 0{,}946$; $SEE = 0{,}140$; $F_{hit}/F_{tab} = 6{,}770$; $PRESS = 0{,}214$

Desain senyawa turunan maleimida baru dengan prediksi aktivitas terbaik adalah senyawa 2-Metil-N-(2,5-diokso-2H-pirol-1(5H)-il)benzamida dengan nilai $IC_{50}$ prediksi 0,13 $\mu M$ menggunakan deskriptor hasil APM dan 0,85 $\mu M$ dengan deskriptor hasil perhitungan EEM.

Kata kunci: HKSA, *anticyanobacteria*, APM, EEM, regresi multilinier

# APPLICATION OF ATOMIC CHARGE DESCRIPTORS CALCULATED BY ELECTRONEGATIVITY EQUALIZATION METHOD ON QUANTITATIVE STRUCTURE-ACTIVITY RELATIONSHIP ANALYSIS OF ANTICYANOBACTERIA MALEIMIDE DERIVATIVE COMPOUNDS

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## ABSTRACT

Application of atomic charge descriptors calculated by electronegativity equalization method (EEM) had been conducted on QSAR analysis of anticyanobacteria maleimide derivative compounds. This research aimed to examine application of EEM in descriptor calculations performed on the QSAR method using multiple linear regression (MLR) analysis for the new design of anticyanobacteria compounds. Molecular optimization was conducted using AM1 semiempirical method applied to the maleimide derivative compounds. The atomic charge descriptor calculated by Mulliken population analysis method and EEM using compounds structure optimized by AM1. The QSAR model were derived from MLR analysis by using backward method.

The result of QSAR analysis from the statistical method was:

Mulliken population analysis method using structure optimized by AM1:

$\text{Log } (1/IC_{50}) = (14.326 \times qC1) + (-4.946 \times qC2) + (-3.766 \times qC3) + (-3.252 \times qC4) + (38.635 \times qC6) + (300.015 \times qC7) + (34.772 \times qO8) + (109.028 \times qN9) + (-32.292 \times qC11) + (22.474 \times qC12) + (-56.899 \times qO16) - 51.493$

$n = 16$; $r = 0.968$; $r^2 = 0.937$; SEE = 0.158; $F_{cal}/F_{tab} = 4.633$; PRESS = 0.251

EEM using structure optimized by AM1:

$\text{Log } (1/IC_{50}) = (-20.261 \times qC1) + (-3.367 \times qC2) + (0.859 \times qC3) + (18.159 \times qO8) + (-104.695 \times qN9) + (767.161 \times qN10) + (-135.810 \times qC11) + (-13.496 \times qC12) + (-64.143 \times qC14) + (-118.921 \times qO16) + 230.879$

$n = 16$; $r = 0.973$; $r^2 = 0.946$; SEE = 0.140; $F_{cal}/F_{tab} = 6.770$; PRESS = 0.214

The new design of maleimide derivative compounds with the best activity prediction was 2-Methyl-N-(2,5-dioxo-2H-pyrrol-1(5H)-yl)benzamide with predicted $IC_{50}$ value 0.13 μM using descriptors calculated by Mulliken population analysis and 0.85 μM using descriptor calculated by EEM.

Keywords: QSAR, anticyanobacteria, Mulliken population analysis, EEM, MLR