

ABSTRAK

EVALUASI AKTIVITAS ANTIFUNGI EKSTRAK DAUN KELOR (*Moringa oleifera* Lamk.) TERHADAP PENYAKIT ANTRAKNOSA CABAI RAWIT (*Capsicum frutescens* L.) SECARA *IN SILICO*, *IN VITRO* DAN *IN VIVO*

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Penelitian ini bertujuan untuk mengevaluasi aktivitas antijamur ekstrak daun kelor (*Moringa oleifera* Lamk.) terhadap penyakit antraknosa pada cabai rawit (*Capsicum frutescens* L.) melalui pendekatan *in silico*, *in vitro*, dan *in vivo*. Uji *in silico* dilakukan dengan menyaring senyawa bioaktif hasil GC-MS, menganalisis kemiripan dengan pestisida, memprediksi toksisitas, serta memodelkan interaksi ligan-protein menggunakan *molecular docking* terhadap dua protein target patogen, yaitu cutinase (PDB ID: 3DEA) dan CDC42. Hasil *docking* menunjukkan bahwa senyawa 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)-, cis- memiliki nilai afinitas tertinggi dengan nilai *binding affinity* sebesar -5,8 kcal/mol terhadap cutinase dan senyawa 1-Acetoxy-p-menth-3-one memiliki nilai ΔG_{bind} sebesar -5,7 kcal/mol terhadap CDC42, serta membentuk interaksi ikatan hidrogen dan hidrofobik yang kuat pada situs aktif protein target. Uji *in vitro* menggunakan metode eksperimen RAL dengan perlakuan konsentrasi 1%, 2%, 3%, 4%, dan 5% menunjukkan bahwa ekstrak daun kelor mampu menghambat pertumbuhan *Colletotrichum* sp. secara signifikan, dengan daya hambat tertinggi diperoleh pada konsentrasi 5%. Sedangkan uji *in vivo* dilakukan dengan metode eksperimen RAL dengan konsentrasi 5%, 10%, 15%, 20%, dan 25% menunjukkan bahwa konsentrasi 15% merupakan konsentrasi terbaik dalam menekan intensitas serangan dan memperpanjang masa inkubasi penyakit antraknosa pada buah cabai rawit.

Kata kunci: Cabai rawit, *Colletotrichum* sp., Daun kelor, *Molecular docking*,

ABSTRACT

EVALUATION OF THE ANTIFUNGAL ACTIVITY OF MORINGA (*Moringa oleifera* Lamk.) LEAF EXTRACT AGAINST ANTHRACNOSE DISEASE IN CHILI PEPPER (*Capsicum frutescens* L.) THROUGH *IN SILICO*, *IN VITRO*, AND *IN VIVO* APPROACHES

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This study aimed to evaluate the antifungal activity of moringa leaf extract (*Moringa oleifera* Lamk.) against anthracnose disease in chili pepper (*Capsicum frutescens* L.) through *in silico*, *in vitro*, and *in vivo* approaches. The *in silico* test was conducted by screening bioactive compounds identified from GC-MS analysis, evaluating their pesticide-likeness, predicting toxicity, and modeling ligand–protein interactions using molecular docking against two target pathogenic proteins, namely cutinase (PDB ID: 3DEA) and CDC42. The docking results showed that the compound 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)-, cis- had the highest binding affinity to cutinase with a ΔG_{bind} value of -5.8 kcal/mol, while the compound 1-Acetoxy-p-menth-3-one exhibited a ΔG_{bind} value of -5.7 kcal/mol against CDC42, forming strong hydrogen and hydrophobic interactions at the active sites of the target proteins. The *in vitro* test, conducted using a Completely Randomized Design (CRD) with treatment concentrations of 1%, 2%, 3%, 4%, and 5%, demonstrated that moringa leaf extract significantly inhibited the growth of *Colletotrichum* sp., with the highest inhibition observed at a 5% concentration. Meanwhile, the *in vivo* test using CRD with concentrations of 5%, 10%, 15%, 20%, and 25% revealed that a 15% concentration was the most effective in reducing disease severity and extending the incubation period of anthracnose symptoms on chili pepper fruits.

Keyword: Chili pepper, *Colletotrichum* sp., Molecular docking, Moringa leaf