Phytochemical Constituents and Biological Effects of *Derris elliptica* (Wall.) Benth.: A Review

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**ABSTRACT**

*Derris elliptica* (Wall.) Benth. is one of the wild plants found in farmland of Southeast Asia. The root of the tuba plant was traditionally used as the fish poison and crop pest insecticide. It has many kinds of toxic chemical compounds as rotenone, toxicarol, elliptone, sumatrol, tephrosin, and deguelin. Recently, root extract has developed in various bioactive compounds exploration not only for the agricultural field but also public health intervention, especially in Dengue control programs. *Derris elliptica* (Wall.) Benth. root extract have larvacidal potential to control the temephos-resistant *Aedes aegypti* larvae.

**Keywords:** *Derris elliptica* (Wall.) Benth., Biological effect, Chemical compounds, Bioactivities.
INTRODUCTION

Plants have chemical compounds with bioactive ability to prevent bugs and diseases from its environment. In addition, specific kinds of the plant can be used to replace the synthetic pesticide in protecting plantation as well. There are a number of plants known to exhibit secondary metabolic compounds in Indonesia, particularly Gorontalo. One of these examples is *Derris elliptica* root or known as Tuba. *Derris elliptica* (Wall.) Benth. is a wild plant or weed in agricultural fields that was traditionally used for poisoning fish and plant pests. A number of studies have been carried out to reveal the secret within *Derris elliptica* (Roxb (Benth)) plant. In a study by Dardenne, 2,5-dihydroxymethyl-3,4-di-hydroxy-methyl had been isolated successfully [1]. Furthermore, Wu et al. was able to isolate nine flavonoid compounds from the *Derris* plants. Lu succeeded isolating two new retinoid compounds from the same plant with the results 4', 5'-dihydroxy-6a, 12a-dehydrodeguelin (Adharini, 2004), II, 4', 5'-trihydroxy-6a, 12a-dehydrodeguelin (Clifford et al. 2005). The plant containedrotenone for its main active compounds. The other active ingredients are deguelin, elliptone, and toxicarol.

It contained compounds such as: 6,4'-dihydroxy-7,5'-dimethoxy-cumarochromone , 7,4'-dihydroxy-5'-methoxy-cumarochromone, 7-hydroxy-4,5'-methylenedioxy-petrokarpan , 3-hidroxy-8,9-methylenedioxy-petrokarpan-6a-ene , flemikapparin-B , gene stein, prune tin, formononietin, apegeni, lutiolin, apegenin 7-0-B-D glucoside and 5'R-6a,12a-dehidrotoenone. Some of these compounds have harness toxic characteristic for the agent Spodopteralitura (SL) and Trichoplusia Ni BTI Tn 5BI-4 (Hi-5) have rotenone as its controller (Dardenne & Marlier, 1975). This review gave the previous chemical compounds and bioactivities from *Derris elliptica*.

Chemical compounds and Biological activities

A new coumaronochromone, 6,4'-dihydroxy-7,5'-dimethoxy-coumaronochromone, together with eleven known flavonoids were isolated from the ethanol extract of the aerial part of *Derris elliptica* (Wall.) Benth. Their structures were elucidated on the basis of spectroscopic analysis. Some of these compounds showed moderate insecticidal activities against larvae of *Aedes albopictus*. All compounds showed strong cytotoxic activities against *Spodoptera litura* (SL) and Trichoplusiani BTI Tn 5BI-4 (Hi-5) cells comparison to positive control of rotenone (Xinzhout al. 2012).

Two new rotenoids, 2-hydroxy-5-aminorotenonon and ellipticoic acid, were isolated from the roots of *Derris elliptica* (Wall.) Benth. collected in Guangdong Province, China. Their structures were established by extensive spectral analysis. Compound 1 is the first N-containing rotenoid and compound 2 is the third rotenoid with the cleavage of C(12)-C(12a) (Hai Ying et al. 2009).

Operationally simple, stereocontrolled semisynthesis of the anticancer rotenoidselliptone and 12aβ-hydroxyelliptone, isolated from *Derris elliptica* and *Derris trifoliata*, respectively, are described. Inspired by the work of Singhal, elliptone was prepared from rotenone via a dihydroxylation-oxidative cleavage, chemoselective Baeyer-Villiger oxidation, and acid-catalyzed elimination sequence. Elaboration of elliptone to 12aβ-hydroxyelliptone was achieved via a diastereoselective chromium-mediated Étard-like hydroxylation. The semisynthesis of elliptone constitutes an improvement over previous methods in terms of safety, scalability, and yield, while the first synthesis of 12aβ-hydroxyelliptone is also described (Russell et al. 2017).

Antimicrobial Activity

Various parts of *Derris elliptica*, *Derris indica* and *Derris trifoliata* on fractionation with a number of solvents (petrol, dichloromethane, ethyl acetate, butanol and methanol) gave fractions which demonstrated a varied level of broad spectrum antibacterial activity. Good activity was exhibited by the methanol fractions of the leaves and root heart-wood, petrol, butanol and methanol fractions of the root bark of *D. indica* and petrol and ethyl acetate fractions of *D. trifoliata*. None of the plants showed antifungal activity (Khan et al. 2007).

*Derris elliptica* (Wall.) Benth. as a bio-pesticide

Bio-pesticide has an increasing importance in both commercial agriculture and small plot subsistence farming. One of the sources of bio-pesticide is ‘Tuba’ plant, also known as *Derris elliptica* (Wall.) Benth. Rotenone (C21H22O6) is one of the bio-active compounds from the extract of *Derris elliptica* known to be harmless to plants, but highly toxic to many insects and relatively innocuous to mammals. From the preliminary results (of previous study), the optimization process was employed using central composite design (CCD) to study the effects of two processing parameters on mortality (LC50) of Artemiasalina. The processing parameters studied were the types of solvent (acetone and ethanol), solvent-to-solid ratio (10 ml /g and 2 ml/g) and raw material particle size (0.5 mm and 5 mm). The biological activity (LC50) was
evaluated for all treatment conditions generated from the Design Expert software. Various concentrations of rotenoids resin were prepared and exposed to brine shrimps for 6, 12 and 24 hrs. Next, the mortality of Artemiasalina was evaluated using probit analysis. The results showed that rotenoids resin extracted from local plant species of Derris was very active (level of toxicity) whereby all treatments produced LC50 less than 1 ppm irrespective of different processing parameters used. For that reason, rotenone and other toxic constituents available in the resin were considered the most important toxic constituents of Derris root and proved to exhibit strong ‘knock off effect to the aquatic organisms (Zubairi & Sarmidi, 2009).

Effect of Derris elliptica (Wall.) Benth. against Temephos-resistant Aedes aegypti Larvae

Several studies showed the low lethal concentration of Derris elliptica root extract to control the laboratory strain Aedes aegypti larvae. This study aimed to evaluate the effectiveness of Derris elliptica (Wall.) Benth. root extract against the temephos-resistant Aedes aegypti larvae from the Dengue endemic areas. This experimental study used post-test only control group design with five different concentrations of methanolic Derris elliptica root extract, namely 0.09, 0.13, 0.17, 0.21, and 0.25, respectively. Twenty-five of F1 temephos-resistant of wild-caught Aedes aegypti larvae were subjected to each group of the five different concentrations, and two control groups with aquadest. The temephos-resistant strain of Aedes aegypti larvae was determined by bioassay test with temephos -0.02 ppm compound. Mortality rate and lethal concentration (LC50 and LC90) of the larvae were calculated after 24-h contact. Average of mortality rate in each concentration after 24-h contact with Derris elliptica root extract were 32.8%, 49.6%, 72.0%, 95.2%, and 100% with LC50 and LC90 were 1,600 and 2,040 ppm, respectively. The methanolic Derris elliptica (Wall.) Benth. root extract have larvadicidal potential to control the temephos-resistant Aedes aegypti larvae (Sayono & Sumanto, 2019).

Antioxidant properties

In this study, the antioxidant activities of the decoction, crude ethanol and 50:50 ethanol-water extracts from the leaves of Cassia sophera Linn., Derris elliptica (Wall.) Benth, Ficus minahassea Tesym. & De Vr., Leeca aculeata Blume and Leucosyke capitellata Wedd. were determined. The results obtained from the in vitro antioxidant screening of the plant leaf extracts using 1,1-Diphenyl-2-picrylhydrazyl (DPPH) radical scavenging method, total phenolic contents by Folin-Ciocalteu method and phosphomolybdenum method provide good correlation coefficient (r = 0.83288). The highly ranked plant species in all methods used are from the decoction, crude ethanol and 50:50 ethanol-water extracts of the plant L. capitellata and L. aculeate with interestingly comparable antioxidant profiles with those of the reference standards ascorbic acid and butylatedhydroxytoluene (BHT) (Mylene, et al. 2015).

CONCLUSION

This review confirmed the chemical compounds and pharmacological effects of Derris elliptica (Wall.) Benth.

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