PENGARUH *NANOSTRUCTURED LIPID CARRIERS* (NLC) EKSTRAK ETANOL SAMBILOTO TERHADAP EKSPRESI mRNA *SUPEROXIDE DISMUTASE-1* (SOD-1) PADA MENCIT YANG DIINDUKSI KARBON TETRAKLORIDA (CCL_4)

ABSTRAK

Latar Belakang: Paparan karbon tetraklorida (CCl_4) dapat menimbulkan cedera hepar akut melalui pembentukan radikal bebas dan stres oksidatif. Sambiloto (*Andrographis paniculata*) memiliki senyawa bioaktif bersifat antioksidan, tetapi kelarutan dan bioavailabilitas yang rendah dapat membatasi efeknya. *Nanostructured lipid carrier* (NLC) berpotensi meningkatkan bioavailabilitas dan stabilitas senyawa aktif. Ekspresi mRNA *superoxide dismutase-1* (SOD-1) digunakan untuk menilai respons pertahanan antioksidan hepar.

Tujuan: Mengetahui pengaruh pemberian NLC berisi ekstrak etanol sambiloto terhadap ekspresi mRNA SOD-1 pada jaringan hepar mencit yang diinduksi karbon tetraklorida (CCl_4).

Metode: Penelitian eksperimental *posttest only with control group* pada 25 mencit yang dibagi menjadi 5 kelompok. K1 kontrol sehat. K2 diberi CCl_4 tanpa terapi. K3 diberi CCl_4 + NLC berisi ekstrak etanol sambiloto 70 mg/kgBB. K4 diberi CCl_4 + ekstrak etanol sambiloto 70 mg/kgBB. K5 diberi CCl_4 + NLC kosong 0,14 mL. Induksi CCl_4 diberikan hari ke-1, perlakuan per oral hari ke-3 dan ke-5, terminasi hari ke-6. Ekspresi mRNA SOD-1 dinilai dengan RT-qPCR menggunakan GAPDH sebagai gen referensi. Analisis bivariat menggunakan *one-way* ANOVA dan uji lanjut Tukey HSD.

Hasil: Rerata ekspresi relatif mRNA SOD-1 (*mean*±SD) berturut-turut K1 0,956±0,3596; K2 1,236±0,2893; K3 1,574±0,5609; K4 1,210±0,2396; K5 0,370±0,4019. *One-way* ANOVA menunjukkan perbedaan bermakna antar kelompok (p=0,0013), dengan perbedaan signifikan hanya pada K5 yang lebih rendah dibanding K2 (p=0,0155), K3 (p=0,0007), dan K4 (p=0,0196).

Kesimpulan: Pemberian NLC ekstrak etanol sambiloto tidak berpengaruh terhadap ekspresi mRNA SOD-1 pada jaringan hepar mencit yang diinduksi CCl_4.

Kata Kunci: *Andrographis paniculata*; cedera hepar akut; *nanostructured lipid carrier*; superoxide dismutase-1.

EFFECT OF NANOSTRUCTURED LIPID CARRIERS (NLC) LOADED WITH ETHANOLIC ANDROGRAPHIS PANICULATA EXTRACT ON SUPEROXIDE DISMUTASE-1 (SOD-1) mRNA EXPRESSION IN CCl_4-INDUCED MICE

ABSTRACT

Background: *Carbon tetrachloride (CCl_4) exposure can induce acute liver injury through free radical formation and oxidative stress. Sambiloto (Andrographis paniculata) contains bioactive compounds with antioxidant properties, but low solubility and bioavailability may limit its effects. Nanostructured lipid carriers (NLC) have the potential to improve bioavailability and stability of active compounds. Hepatic antioxidant defense is assessed by superoxide dismutase-1 (SOD-1) mRNA expression.*

Objective: *This study aimed to evaluate the effect of NLC loaded with ethanolic sambiloto extract on hepatic SOD-1 mRNA expression in CCl_4-induced mice.*

Methods: *An experimental posttest-only control group design was conducted in mice divided into five groups. Group K1 served as a healthy control. Group K2 received CCl_4 without therapy. Group K3 received CCl_4 plus NLC loaded with ethanolic sambiloto extract (70 mg/kgBW). Group K4 received CCl_4 plus ethanolic sambiloto extract (70 mg/kgBW). Group K5 received CCl_4 plus blank NLC (0.14 mL). CCl_4 was administered on day 1. Treatments were given orally on days 3 and 5. Animals were euthanized on day 6. SOD-1 mRNA expression was measured by RT-qPCR using GAPDH as the reference gene. Bivariate analysis was performed using one-way ANOVA followed by Tukey HSD.*

Results: *The mean±SD relative SOD-1 mRNA expression is 0.956±0.3596, 1.236±0.2893, 1.574±0.5609, 1.210±0.2396, and 0.370±0.4019 for K1–K5, respectively. One-way ANOVA shows a significant difference among groups ($p=0.0013$). Tukey HSD indicates significant differences only for K5, which is lower than K2 ($p=0.0155$), K3 ($p=0.0007$), and K4 ($p=0.0196$).*

Conclusion: *NLC-loaded ethanolic Andrographis paniculata extract does not alter hepatic SOD-1 mRNA expression in CCl_4-induced mice.*

Keywords: *Andrographis paniculata; acute liver injury; nanostructured lipid carrier; superoxide dismutase-1.*