

**PENGARUH NANOKRISTAL JAHE MERAH TERHADAP
SITOTOKSISITAS SERTA EKSPRESI GEN *NFKB* DAN *CASP3*
PADA LINI SEL MCF-7**

SKRIPSI

diajukan untuk memenuhi sebagian dari syarat untuk memperoleh
gelar Sarjana Sains Program Studi Biologi



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UNIVERSITAS PENDIDIKAN INDONESIA
BANDUNG
2024**

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Sebuah Skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains pada Program Studi Biologi, Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

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Agustus 2024

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**PENGARUH NANOKRISTAL JAHE MERAH TERHADAP
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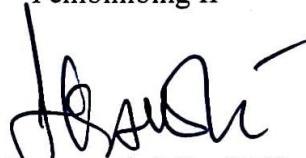
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PERNYATAAN KEASLIAN SKRIPSI

Dengan ini saya menyatakan bahwa skripsi dengan judul “Pengaruh Nanokristal Jahe Merah terhadap Sitotoksitas serta Ekspresi Gen *NFKB* dan *CASP3* pada Lini Sel MCF-7” ini beserta seluruh isinya adalah benar-benar karya saya sendiri. Saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika ilmu yang berlaku dalam masyarakat keilmuan. Atas pernyataan ini, saya siap menanggung sanksi apabila di kemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

Bandung, Agustus 2024
Yang membuat pernyataan,

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ABSTRAK

Kanker payudara adalah penyebab utama kematian pada wanita dengan jumlah kasus tinggi di seluruh dunia, termasuk di Indonesia. Aktivasi jalur molekuler, seperti *NFKB* dan *CASP3*, memainkan peran kunci dalam perkembangan kanker ini. Pengobatan konvensional kanker menghadapi tantangan, seperti resistensi obat dan efek samping. Jahe merah (*Zingiber officinale* var. *Rubrum*), khususnya senyawa 6-gingerol dan 6-shogaol, menunjukkan potensi antikanker. Pemanfaatan ekstrak rimpang jahe merah yang diformulasikan dalam bentuk nanokristal diharapkan dapat meningkatkan efektivitas terapi dengan memperbaiki kelarutan dan ketersediaan hayati. Penelitian ini dilakukan untuk mengetahui pengaruh nanokristal jahe merah (NKJM) terhadap sitotoksitas serta ekspresi gen *NFKB* dan *CASP3* pada sel MCF-7. NKJM dibuat di PT Nanotech Herbal Indonesia dengan metode *top-down* menggunakan *High Energy Milling Machine (HEM-Ellipse 3 Dimension)*. Sitotoksitas MCF-7 dianalisis dengan metode WST-8, sedangkan ekspresi gen *NFKB* dan *CASP3* pada sel MCF-7 diukur menggunakan RT-qPCR. Data dianalisis menggunakan secara statistik menggunakan analisis varian (ANOVA) satu arah, kemudian dilanjutkan dengan *Dunnet T3 Post-Hoc Test* dan *Tukey HSD Post Hoc Test* ($P \leq 0,05$). Hasil penelitian menunjukkan bahwa NKJM secara signifikan meningkatkan efek toksik terhadap sel MCF-7 pada konsentrasi 400 $\mu\text{g/mL}$ dengan nilai IC_{50} sebesar 353,34 $\mu\text{g/mL}$ setelah pemberian NKJM selama 24 jam, menurunkan ekspresi gen *NFKB* pada konsentrasi 125 $\mu\text{g/mL}$, dan meningkatkan ekspresi gen *CASP3* pada konsentrasi 125 $\mu\text{g/mL}$ pada sel MCF-7 dibandingkan dengan kontrol. Selain itu, ekspresi gen *NFKB* memiliki korelasi berbanding terbalik yang sangat kuat dengan ekspresi gen *CASP3* pada sel MCF-7. Dengan demikian, dapat disimpulkan bahwa NKJM berpotensi untuk digunakan sebagai agen terapi kanker payudara.

Kata Kunci: *CASP3*, MCF-7, Nanokristal, *NFKB*, Sitotoksitas, *Zingiber officinale* var. *Rubrum*

EFFECT OF RED GINGER NANOCRYSTALS ON CYTOTOXICITY AND GENE EXPRESSION OF NFKB AND CASP3 IN MCF-7 CELL LINE

ABSTRACT

Breast cancer is the leading cause of death in women with a high number of cases worldwide, including in Indonesia. Activation of molecular pathways, such as NFKB and CASP3, plays a key role in the development of these cancers. Conventional treatments of cancer face challenges, such as drug resistance and side effects. Red ginger (*Zingiber officinale* var. *Rubrum*), particularly the compounds 6-gingerol and 6-shogaol, show anticancer potential. Utilization of red ginger rhizome extract formulated in nanocrystal form is expected to increase therapeutic effectiveness by improving solubility and bioavailability. This study was conducted to determine the effect of red ginger nanocrystals (NKJM) on cytotoxicity and gene expression of NFKB and CASP3 in MCF-7 cells. NKJM was made at PT Nanotech Herbal Indonesia by top-down method using High Energy Milling Machine (HEM-Ellipse 3 Dimension). MCF-7 cytotoxicity was analyzed by WST-8 method, while NFKB and CASP3 gene expression in MCF-7 cells was measured using RT-qPCR. Data were statistically analyzed using one-way analysis of variance (ANOVA), followed by Dunnett T3 Post-Hoc Test and Tukey HSD Post Hoc Test ($P \leq 0.05$). The results showed that NKJM significantly increased the toxic effect on MCF-7 cells at a concentration of 400 $\mu\text{g/mL}$ with an IC_{50} value of 353.34 $\mu\text{g/mL}$ after treatment of NKJM for 24 hours, decreased NFKB gene expression at a concentration of 125 $\mu\text{g/mL}$, and increased CASP3 gene expression at a concentration of 125 $\mu\text{g/mL}$ in MCF-7 cells compared to the control. In addition, NFKB gene expression has a very strong inverse correlation with CASP3 gene expression in MCF-7 cells. Thus, it can be concluded that NKJM has the potential to be used as a potential therapeutic agent for breast cancer.

Keywords: CASP3, MCF-7, Nanocrystals, NFKB, Cytotoxicity, *Zingiber officinale* var. *Rubrum*

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