ABSTRAK

Hutomo Mandala Putra. 2026. Eksplorasi Mekanisme Molekuler *Solanum nigrum* Terhadap Jalur Laktasi Berbasis *Network Pharmacology* Dan *Molecular Docking*. Program Studi Farmasi, FIKS, Universitas PGRI Madiun. Pembimbing (I) apt. Weka Sidha Bhagawan M. Farm (II) Dra. Arum Suproborini, M. Si

Laktasi merupakan proses fisiologis yang keberlangsungannya dipengaruhi oleh regulasi hormonal dan keterlibatan berbagai jalur molekuler. Oleh karena itu, pemanfaatan bahan alam sebagai kandidat agen laktogenik perlu didukung oleh penjelasan mekanisme kerja yang memadai. Penelitian ini bertujuan menentukan profil senyawa fitokimia dalam ekstrak daun ranti (*Solanum nigrum*), menjelaskan mekanisme kerja senyawa tersebut terhadap target molekuler yang berkaitan dengan aktivitas laktogenik, serta mengevaluasi interaksi antara senyawa kandidat dan protein target melalui pendekatan *in silico*. Penelitian dilaksanakan menggunakan desain kuantitatif berbasis komputasi dengan mengintegrasikan analisis LC-HRMS, *Principal Component Analysis*, penapisan bioaktivitas, prediksi toksisitas dan *drug-likeness*, *network pharmacology*, serta simulasi *molecular docking* menggunakan AutoDock 4.2.6. Analisis LC-HRMS menghasilkan lebih dari 150 sinyal kromatografik yang selanjutnya dianotasi menjadi 29 metabolit teridentifikasi maupun tentatif. Tahap seleksi lanjutan memperoleh enam metabolit yang berpotensi sebagai kandidat laktogenik, yaitu Methionine Sulfoxide, Indole, Scopoletin, Isorhamnetin-3-O-glucoside, Kaempferol, dan Linolenic Acid. Analisis *network pharmacology* menunjukkan adanya 17 *common targets*, dengan JAK2 dan ESR1 sebagai *hub genes* utama. Empat protein prioritas yang dianalisis melalui simulasi *molecular docking* meliputi JAK2, ESR1, PGR, dan EGFR. Isorhamnetin-3-O-glucoside memperlihatkan afinitas ikatan yang paling potensial terhadap JAK2 sebesar -11,3 kcal/mol dan EGFR sebesar -9,8 kcal/mol, serta menghasilkan nilai yang kompetitif terhadap ESR1 sebesar -8,6 kcal/mol. Hasil tersebut mengindikasikan bahwa *Solanum nigrum* berpotensi memodulasi jalur prolaktin dan estrogen melalui mekanisme *multi-target*. Temuan penelitian ini dapat menjadi landasan ilmiah awal bagi pengembangan dan validasi lebih lanjut terhadap kandidat laktogenik berbasis *Solanum nigrum*.

Kata Kunci: *Solanum nigrum*; laktasi; *network pharmacology*; *molecular docking*; Isorhamnetin-3-O-glucoside.

ABSTRACT

Hutomo Mandala Putra. 2026. *Exploration of the Molecular Mechanisms of Solanum nigrum in Lactation Pathways Using Network Pharmacology and Molecular Docking*. *Pharmacy Study Program*, *Faculty of Health and Science*, Universitas PGRI Madiun. Supervisors: (I) apt. Weka Sidha Bhagawan, M.Farm.; (II) Dra. Arum Suproborini, M.Si.

Lactation is a physiological process regulated by hormonal activity and interconnected molecular pathways. Consequently, the investigation of natural products as potential lactogenic agents requires adequate mechanistic evidence. This study aimed to characterize the phytochemical constituents of ranti leaf (Solanum nigrum) extract, elucidate the potential mechanisms through which these compounds interact with molecular targets associated with lactogenic activity, and assess the interactions between selected compounds and target proteins using an in silico approach. A quantitative computational research design was applied by integrating LC-HRMS analysis, Principal Component Analysis, bioactivity screening, toxicity and drug-likeness prediction, network pharmacology, and molecular docking simulations performed with AutoDock 4.2.6. LC-HRMS analysis detected more than 150 chromatographic signals, which were subsequently annotated as 29 identified or tentatively identified metabolites. Further screening selected six metabolites as potential lactogenic candidates, namely Methionine Sulfoxide, Indole, Scopoletin, Isorhamnetin-3-O-glucoside, Kaempferol, and Linolenic Acid. Network pharmacology analysis revealed 17 common targets and identified JAK2 and ESR1 as the principal hub genes. Four priority proteins, comprising JAK2, ESR1, PGR, and EGFR, were then evaluated through molecular docking simulations. Isorhamnetin-3-O-glucoside exhibited the most favorable binding affinity toward JAK2 at -11.3 kcal/mol and EGFR at -9.8 kcal/mol, while also demonstrating a competitive binding value toward ESR1 at -8.6 kcal/mol. These results suggest that Solanum nigrum may modulate prolactin and estrogen signaling pathways through a multi-target mechanism. The findings provide preliminary scientific evidence to support further development and validation of Solanum nigrum-based lactogenic candidates.

Keywords: *Solanum nigrum; lactation; network pharmacology; molecular docking; Isorhamnetin-3-O-glucoside.*