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Preliminary Clinical and Mechanistic Evaluation of Traditional Thai Herbal Cream Containing *Cannabis sativa* and *Curcuma longa* for Eczema and Psoriasis

Julalak Chorachoo Ontong [1,2], Chatchai Wattanapiromsakul [3], Charassri Nualsri [4], Sudarshan Singh [5], Popat Mohite [6], Benjaporn Bourchum [7], Meadeena Kobmang [8], Pinyada Subyad [8], Thanyaphon Pusawiro [8], Supatina Khan [8], Nattanon Bunrodchu [8], Narapat Aunruean [8], Apiwat Artkaew [8], Anon Makklay [8] and Thanyaluck Siriyong [8,*]

1 Cosmetic Technology and Dietary Supplement Products, Faculty of Agro- and Bio-Industry, Thaksin University, Phatthalung Campus, Ban Phrao 93210, Thailand; julalak.o@tsu.ac.th
2 High-Value Bioproduct Innovation Research Center, Faculty of Agro and Bio Industry, Thaksin University, Phatthalung Campus, Ban Phrao 93210, Thailand
3 Department of Pharmacognosy and Pharmaceutical Botany, Faculty of Pharmaceutical Sciences, Prince of Songkla University, Songkhla 90110, Thailand; chatchai.w@psu.ac.th
4 Department of Plant Science, Faculty of Natural Resources, Prince of Songkla University, Songkhla 90110, Thailand; charatsri.n@psu.ac.th
5 Office of Research Administration and Faculty of Pharmacy, Chiang Mai University, Chiang Mai 50220, Thailand; sudarshansingh83@hotmail.com
6 AETs St. John Institute of Pharmacy and Research, Palghar 401404, Maharashtra, India; popatm@sjipr.edu.in
7 Khlong Chanuan Health Promoting Hospital, Surat Thani 84190, Thailand; koy.pepper@hotmail.com
8 Traditional Thai Medical Research and Innovation Center, Faculty of Traditional Thai Medicine, Prince of Songkla University, Songkhla 90110, Thailand; 6311410081@email.psu.ac.th (M.K.); 6311410077@email.psu.ac.th (P.S.); 6311410037@email.psu.ac.th (T.P.); 6311410108@email.psu.ac.th (S.K.); 6311410030@email.psu.ac.th (N.B.); 6311410047@email.psu.ac.th (N.A.); 6311410116@email.psu.ac.th (A.A.); 6311410123@email.psu.ac.th (A.M.)
* Correspondence: thanyaluck.s@psu.ac.th

Abstract

Cannabis sativa and *Curcuma longa* have traditionally been used for the management of skin disorders; however, scientific evidence supporting their combined topical use in eczema and psoriasis remains limited. To characterize the phytochemical composition, evaluate the biological activities, investigate potential molecular mechanisms, and assess the preliminary clinical performance of a topical herbal cream containing *C. sativa* and *C. longa* extracts. Ethanolic extracts were analyzed using UHPLC and GC-MS. Antioxidant, antibacterial, cytotoxicity, and nitric oxide inhibition assays were performed. Molecular docking studies were conducted against inflammation-related protein targets. A pilot clinical study evaluated the effects of the herbal cream in patients with eczema and psoriasis over four weeks using EASI, PASI, and DLQI scores. The herbal formulation contained cannabinoids, terpenoids, and curcuminoids with measurable antioxidant activity. The extract exhibited low cytotoxicity and moderate inhibition of nitric oxide production in LPS-stimulated macrophages (0.0001–0.1 mg/mL). Docking analyses suggested favorable interactions between selected phytochemicals and inflammation-associated targets. Preliminary clinical observations indicated improvements in EASI (from 4.11 ± 3.14 to 1.28 ± 1.46), PASI (from 39 to 16.2), and DLQI (from 6.25 ± 5.25 to 1.00 ± 0.82) scores among study completers. The herbal cream demonstrated antioxidant and anti-inflammatory properties and showed preliminary clinical potential in inflammatory skin disorders. Larger controlled clinical studies are required to confirm efficacy and establish therapeutic value.

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Keywords: *Cannabis sativa*; *Curcuma longa*; herbal formulation; Eczema Area and Severity Index (EASI); Psoriasis Area and Severity Index (PASI); Dermatology Life Quality Index (DLQI)

1. Introduction

Eczema and psoriasis are common chronic inflammatory skin diseases that significantly impact the quality of life associated with physical, psychosocial, and mental functioning [1,2]. Eczema and psoriasis are caused by a complex combination of immune dysregulation, skin-barrier disruption, genetic factors, and environmental influences [3,4]. Eczema is characterized by T helper type 2-dominant inflammation, whereas psoriasis is associated with T helper type 1 and/or T helper type 17 immunological response [5]. Eczema tends to appear on the extensor side of extremities and face in infancy and flexure side and hands in adolescents and adults, while psoriasis lesions are most frequently found on the scalp and extensor skin [6]. The current sets of regimens for the treatment of eczema and psoriasis are not completely effective in either curing or controlling their recurrence. Moreover, unavailability of standardized international guidelines considering the internally and topically administered hormone or immune inhibitors and antihistamines may result in side effects. However, recent studies showed that the treatments for eczema and psoriasis using alternative medicinal plants, including traditional Thai medicine, are increasing significantly [7,8].

Thai herbal medicine provides a theoretical basis for the treatment of eczema and psoriasis with considerable benefits and biocompatibility [7,8]. Topical application of *Cannabis sativa* and *Curcuma longa* has been used traditionally for centuries for wound care and treatment of skin diseases. Major phytocannabinoids, including tetrahydrocannabinol (THC), cannabinol (CBD), cannabigerol (CBG), cannabichromene (CBC), cannabinol (CBN), cannabinodiol (CBND), cannabielsoin (CBE), cannabicyclol (CBL), and cannabitriol (CBT) derived from *C. sativa* exhibit anti-inflammatory properties, immunological activity, and anti-proliferative effects on keratinocytes for treatment of eczema and psoriasis [9–11], whereas curcumin, the main active ingredient extracted from *C. longa*, displayed potent anti-inflammatory effects with potential mechanisms of action identified, such as suppression of pro-inflammatory cytokines, inhibition of iNOS, cyclooxygenase-2, prostaglandin E2, and NO production, and downregulation of the MAPK pathway [12–14]. However, there is currently a lack of scientific data regarding the therapeutic effects of a traditional Thai herbal formulation of *C. sativa* and *C. longa* for the treatment of eczema and psoriasis. Therefore, this study was conducted to characterize the phytochemical composition, evaluate the biological activities, investigate potential molecular mechanisms, and assess the preliminary clinical performance of a topical herbal cream containing *C. sativa* and *C. longa* extracts in participants with eczema or psoriasis.

2. Materials and Methods

2.1. Preparation of Herbal Extract

Medicinal plants including *C. sativa* (leaf) and *C. longa* (rhizome) from Songkhla Province, Thailand, were obtained during January 2025. The plant materials were washed and oven-dried at 45 °C overnight. The plants were coarsely ground using a grinder. The botanical identities of the plant materials were verified and authenticated by matching with the reference voucher specimens at the Forest Herbarium (BKF), Department of National Parks, Wildlife and Plant Conservation, Bangkok, Thailand, under the reference numbers BKF No. 009254 (for *C. sativa*) and BKF No. 128478 (for *C. longa*). The authenticated plant

powders were stored in air-tight bottles for further studies. Briefly, a sample (50 g) of both plants was added to a round-bottom flask containing 100 mL of 95% ethanol. Then, the extract was filtered using Whatman filter paper, and the filtrate was concentrated using a rotary evaporator. The extracts were stored at 4 °C until used.

2.2. Ultra-High-Performance Liquid Chromatography (UHPLC)

The chromatographic quantification of THC and CBD in the herbal formulation was performed using an ultra high-performance liquid chromatography system (UHPLC, Ultimate 3000, Thermo Fisher Scientific, Germering, Germany), Infinity Lab Poroshell 120 EC-C18 (4.6 × 100 mm, 4 µm) as reported previously [15]. The mobile phase consisted of methanol:water (85:15 v/v) at a flow rate of 1.0 mL/min. The detector was set at 220 nm, and a sample injection volume of 10 µL for a 10 min run was injected and tested. Briefly, a standard stock of THC and CBD was prepared in the concentration range of 5 to 100 µg/mL and 2.5 to 100 µg/mL by dissolving them in methanol and tested for accuracy of the method through determination of relative standard deviation (RSD) (%). Furthermore, the quantification of THC/CBD in the herbal formulation was determined by dissolving the samples in methanol, followed by sonication for 15 min using a sonicator and centrifugation for 5 min at 4500× g. The supernatant obtained after centrifugation was filtered using a 0.22 micron nylon membrane filter and transferred into a 1.5 mL HPLC vial, and 10 µL was injected into the UHPLC in five replicates. The THC and CBD were quantified using straight line equations Y = 0.5228x + 0.0719 (R^2 = 0.9999) and Y = 0.6593x − 0.1872 (R^2 = 0.9995), respectively, as presented in Figure 1.

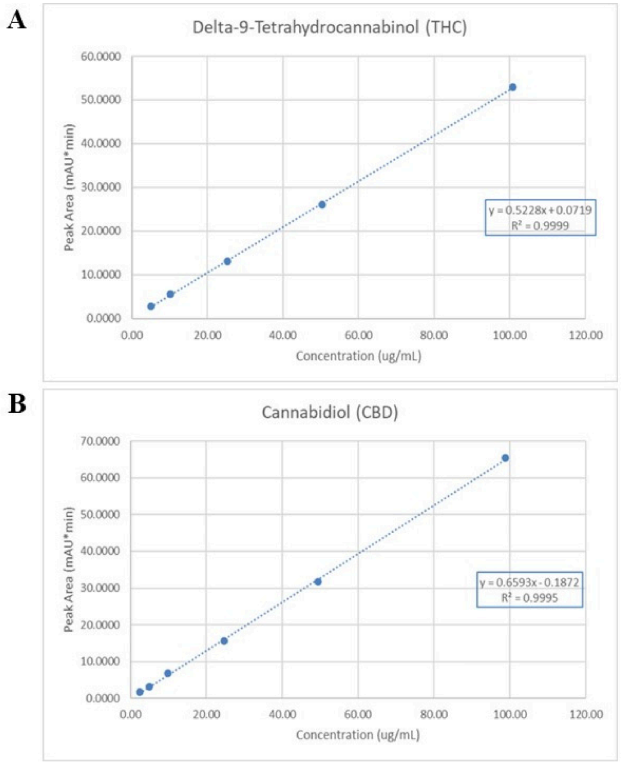


Figure 1. Standard calibration curve from HPLC chromatogram of tetrahydrocannabinol (**A**) and cannabinol (**B**). The y-axis indicates peak area obtained from UHPLC chromatogram, and x-axis indicates quantified bioactive content in mg/mL.

The curcumin was determined in the herbal formulation using a mobile phase of acetonitrile (50%) in water with acetic acid (2%) using a column (ACE Generix 5C-18, Agilent Technologies, Inc., Santa Clara, CA, USA), flow rate of 1 mL/min, quantified

at 425 nm with an injection volume of 10 µL, as reported with slight modification [14]. Briefly, 1000 µg/mL of standard curcumin was dissolved in the mobile phase and injected into the HPLC after passing it through a filter in five replicates with suitable dilution to check the accuracy of the method through determination of RSD (%). Furthermore, the herbal formulation was dissolved in the mobile phase at a concentration of 10 µg/mL and filtered through a 0.22 micron nylon filter. Later, the filtrate was transferred into a 1.5 mL HPLC vial, and 10 µL was injected into the HPLC in five replicates to quantify its curcumin content. The curcumin was quantified using straight line equation Y = 9E + 07x (R^2 = 0.9994), as presented in Figure 2.

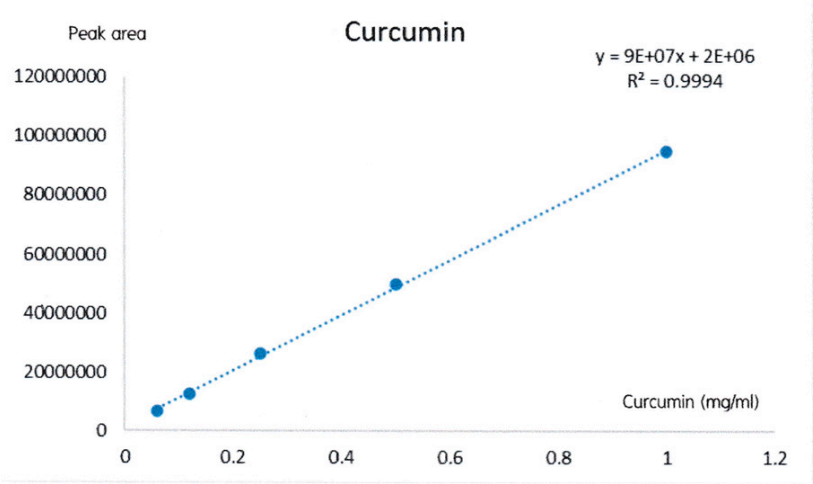


Figure 2. Standard calibration curve from HPLC chromatogram of curcumin.

2.3. Gas Chromatography and Mass Spectroscopy (GC-MS) Analysis

The GC/GC-MS analysis was performed to identify the bioactive compounds present within the herbal extract using Agilent Technologies, Inc., CA, USA. Gas Chromatography-Electron Ionization/Mass Spectrometry (GC-EI/MS; 7890 B GC–5977B MSD) following NIST standard data [16]. A GC with a capillary column (30 m × 0.25 mm id, film thickness of 0.25 µm) and HP-5 MS (Agilent Technologies) at a helium flow rate of 1.0 mL/min were operated with source temperature maintained at 230 °C, quad temperature at 150 °C, electron energy fixed at 70 (eV), and solvent delay of 5 min to 650 min at a scan speed of 1562 s. Briefly, 24.0 mg of extract was added to 200 µL of 70% ethanol and mixed thoroughly for 1 min using a vortex mixer (WF2, Janke & Kunkel, Staufen, Germany). Then, 800 µL of ethanol was added, and the mixture was sonicated for 5 min, followed by centrifugation at 10,000 rpm at 20 °C for 10 min. Subsequently, the clear solution was aspirated and filtered through a 0.22-micron nylon membrane (Agilent technologies). A 1 µL volume of the sample was dissolved in solvent and injected using a 10 µL syringe (Agilent technologies), and the obtained GC spectra were transferred to MS in electron ionization mode. The identified compound was matched with the inbuilt reference library (Agilent MassHunter Qualitative Analysis Software Ver. 10.0). Later, the identified compound was reported with a percentage match.

2.4. Determination of Total Polyphenol and Flavonoid Contents

Total phenolic content and total flavonoid content of the herbal mixture were determined using the Folin–Ciocalteu method and aluminum chloride calorimetric method as previously described [17], respectively. The total phenolic content and total flavonoid content of the herbal mixture were expressed as milligrams of gallic acid equivalent (GAE)

per milligram of extract and milligrams of quercetin equivalents (QEs) per milligram of extract, respectively.

2.5. Antioxidant Activity

2.5.1. DPPH (2,2-Diphenyl-1-picrylhydrazyl) Radical Scavenging Assay

The free radical scavenging capability of herbal extract solutions on DPPH radical was determined as described previously with modifications [18]. Briefly, 20 µL of each sample at different concentrations (8–1024 µg/mL) was added to 180 µL of 80 µM DPPH solution. The reaction mixtures were incubated for 30 min in the dark at room temperature, and the reduction of DPPH· radical was measured at 517 nm using a microplate reader (Agilent Technologies, CA, USA). Trolox, a standard antioxidant, was used as a positive control. Percentage inhibition of DPPH oxidation was calculated according to the following formula: DPPH scavenging effect (%) = $(A_{control} - A_{sample})/A_{control} \times 100$. The antioxidant ability of the sample was expressed as IC_{50}.

2.5.2. ABTS (2,2′-Azino-bis(3-ethylbenzothiazoline-6-sulfonic acid)) Radical Scavenging Assay

ABTS radical-scavenging activity of the herbal mixture was assessed as previously described with modifications [19]. Briefly, ABTS solution was prepared by dissolving 2 mM ABTS and 2.45 mM potassium persulfate. After storing in the dark for 12 h at room temperature, the mixture was diluted with ethanol to an absorbance recorded at 734 nm. Subsequently, 10 µL of each sample at concentrations ranging from 8 to 1024 µg/mL was mixed with 990 µL of the ABTS radical solution, and the absorbance was measured. Trolox, a standard antioxidant, was used as a positive control. Percentage inhibition of ABTS oxidation was calculated using the following formula: ABTS scavenging effect (%) = $(A_{control} - A_{sample})/A_{control} \times 100$. The antioxidant ability of the sample was expressed as IC_{50}.

2.5.3. FRAP (Ferric Reducing Antioxidant Power) Assay

The ability of the herbal mixture to reduce ferric ions was measured using the FRAP assay as described with modifications [20]. FRAP reagent was prepared by mixing 300 mM sodium acetate buffer (pH 3.6), 10 mM ferric-tripyridyl triazine solution, and 20 mM ferric chloride solution in a ratio of 10:1:1. All samples were diluted in ethanol at a concentration of 1024 µg/mL. An aliquot of 150 µL of the sample was mixed with 1.35 mL of the FRAP reagent and then incubated at 37 °C for 30 min in the dark. The reaction was measured at an absorbance of 593 nm, and a standard curve was prepared using different concentrations of ferrous solution. The reducing capacity of each sample was expressed as micromoles of ferrous equivalent per microgram of extract.

2.6. Anti-Microbial Activity

Bacterial strains including *E. coli* ATCC 25922, *S. aureus* ATCC 25923, *S. pyogenes* DMST 17202, and *P. aeruginosa* ATCC 27853 were obtained from the Division of Biological Science, Faculty of Science, Prince of Songkla University, Thailand.

All the bacterial cultures were stored in tryptic soy broth supplemented with 40% glycerol and kept at −80 °C.

Minimum inhibitory concentrations (MICs) of herbal mixture and antibiotics (ceftazidime, erythromycin, levofloxacin, vancomycin) were determined using the standard broth microdilution method [21]. The herbal formulations (16–1024 mg/L) and antibiotics (0.0625–4 mg/L) were evaluated against bacterial strains. MIC values were defined as the lowest concentration that inhibited the visible growth of bacteria, and minimum bactericidal concentration (MBC) values as the lowest concentrations that showed no growth on tryptic soy agar plates after incubation for 24 h. Each experiment was performed at least twice.

2.7. Anti-Inflammatory Activity

2.7.1. Cell Culture and Cell Viability Assay

RAW 264.7 cells, a mouse macrophage cell line, were obtained from the Division of Biological Science, Faculty of Science, Prince of Songkla University, Thailand. Macrophages were cultured in Dulbecco's modified Eagle's medium (DMEM) supplemented with 10% fetal bovine serum (FBS), 100 U/mL penicillin, and 100 µg/mL streptomycin in a 5% CO_2 atmosphere at 37 °C.

Biocompatibility of herbal mixture against macrophage cells was evaluated by 3-[4,5-dimethylthiazole-2-yl]-2,5-diphenyltetrazolium bromide (MTT) bioassay, a mitochondrial-based assay. Approximately 2×10^4 cells were seeded in 96-well plates (100 µL/well) and incubated at 37 °C in an incubator humidified with 5% CO_2 at 37 °C. After 24 h incubation, the culture medium was replaced with fresh DMEM medium. The herbal formulation was two-fold diluted in the plates containing DMEM to yield a final concentration of 4–2048 µg/mL. Cells without the added herbal formulation were tested as a negative control. After 24 h incubation, the cells were treated with 100 µL of fresh medium along with 50 µL of MTT solution (5 mg/mL) and further incubated at 37 °C for 4 h. The medium containing MTT was removed, and 100 µL of dimethyl sulfoxide (DMSO) was added. The absorbance of the dissolved formazan dye was determined at a wavelength of 570 nm using a microplate reader. Percentage cell viability was calculated and compared with the that of the negative control [22].

2.7.2. Inhibition of Nitric Oxide Production

Nitric oxide (NO) production due to enhanced expression of inducible nitric oxide synthase (iNOS) in lipopolysaccharide (LPS)-activated macrophages was measured by a colorimetric method based on Griess reagent. Briefly, after incubation of RAW 264.7 cells with the herbal formulations or triamcinolone acetonide (TA) for 24 h, 100 µL of supernatant from each well was mixed with 100 µL Griess reagent in 96-well plates. After an incubation for 15 min at room temperature, optical density was determined at 540 nm using a microplate reader [22].

2.8. Preparation of a Traditional Topical Thai Herbal Cream

The emulsion-based cream was formulated by mixing the oil phase, aqueous phase, and active components, as shown in Table 1, without incorporation of herbal extract [23]. Briefly, the oil-phase ingredients were weighed in a beaker, whereas the ingredients of the aqueous phase were weighed in a separate beaker. Later, both beakers were heated to 75 °C in a water bath. Then, the aqueous phase was slowly added to the oil phase with continuous stirring. The herbal extract was weighed and incorporated into the cream bases by geometric dilution. Geometric dilution was continued until a uniform cream was obtained. The herbal cream was packaged into a plastic container and kept at room temperature for further analysis.

2.8.1. Freeze–Thaw Stability

A total of 2 g of the herbal cream was weighed and filled into several vials before being subjected to the freeze–thaw cycle [24]. The herbal cream was studied under two conditions, including 4 °C for 24 h and 45 °C for another 24 h. The freeze–thaw was repeated for six cycles. Physical stability, pH, and spreadability of the cream were observed initially and after the completion of each freeze–thaw cycle.

2.8.2. Physical Stability Testing

The herbal formulated cream was observed for physical appearance, color, texture, phase separation, homogeneity and odor [25]. A required quantity of cream was pressed

between the thumb and index finger to determine the consistency and presence of coarse particles. Moreover, the stiffness, grittiness and greasiness of the creams upon application were evaluated [26].

Table 1. Formulation of a novel topical Thai herbal cream.

Ingredients	Quantity for 100 g (%)
Active	
Herbal ethanolic extract	10
Oil Phase	
Liquid paraffin	10
White soft paraffin	10
Cetyl alcohol	10
BHT	0.1
Cottonseed oil	5
Aqueous Phase	
Propylene glycol	5
Paraben concentrate	1
Cetomacrogol 1000	3
Purified water	Up to 100%

2.8.3. pH Determination

The pH meter was calibrated with pH 4, 7 and 10 standard buffers before use. A total of 10% *w*/*v* of the herbal cream suspension was prepared for pH measurement at room temperature. The pH measurement was repeated in triplicate to obtain the representative data of the cream suspension [27,28].

2.8.4. Viscosity

Viscosity of the herbal cream formulation was determined by Brookfield Viscometer at 200 rpm, using spindle no 7.

2.9. Preliminary Clinical Evaluation of a Traditional Topical Thai Herbal Cream for Eczema and Psoriasis Treatment

2.9.1. Study Design and Patient Recruitment

A pretest–posttest clinical trial was performed at the Faculty of Traditional Thai Medicine, Prince of Songkla University, Thailand. The study protocol was approved by the Ethics Committee of the Faculty of Traditional Thai Medicine, Prince of Songkla University (reference number: EC.65/TTM.01-006 and EC.65/TTM.01-007, approved on 1 December 2022) and was also registered in the Thai Clinical Trials Registry (registration ID: TCTR20240902001, approval on 29 August 2024). The patient who agreed to participate signed a written informed consent prior to commencement of the study and was enrolled for 4 weeks.

The inclusion criteria were as follows: (1) aged 18–55 years; (2) patients with a clinical diagnosis of eczema or psoriasis; (3) patients who voluntarily participated in the study and signed the informed consent form. Meanwhile, the exclusion criteria were as follows: (1) patients with uncontrolled systemic illness or life-threatening infection; (2) patients who had already undergone treatment for any chronic skin disease, substance abuse and/or dependence, or were pregnant or lactating women; (3) patients with psychiatric diseases and self-reported immune-compromised states; (4) patients who had history of allergy to any Thai herbal medicines [7,8].

2.9.2. Treatment Interventions

The therapeutic effects of a traditional topical Thai herbal cream containing *C. sativa* and *C. longa* were assessed for the treatment of patients with eczema or psoriasis by application three times daily for 4 weeks.

2.9.3. Outcome Measures

Primary outcome measurements included Eczema Area and Severity Index (EASI) [29] and Psoriasis Area Severity Index (PASI) score [30]. Secondary outcome measurement was the Dermatology Life Quality Index (DLQI) score [31]. Additionally, during the study, any adverse effects were also recorded. All outcome measures were assessed at baseline and follow-up.

The EASI [29] is a scale used in clinical trials to assess the severity and extent of eczema. Clinical parameters including erythema, infiltration and/or papulation, excoriations, and lichenification were assessed for severity by the investigator on a scale of 0 (absent) to 3 (severe). The total EASI score ranges from 0 to 72 points, with the highest score indicating the worst severity of AD. It is suggested that the severity of AD based on EASI can be categorized as follows: 0 = clear; 0.1 to 1.0 = almost clear; 1.1 to 7.0 = mild; 7.1 to 21.0 = moderate; 21.1 to 50.0 = severe; 50.1 to 72.0 = very severe.

The PASI [30] is a widely used instrument in psoriasis trials that assesses and grades the severity of psoriatic lesions and the patient's response to treatment. The PASI assesses the degree of erythema, scaling, and induration of the patient's lesion. Psoriasis severity is assessed based on a combined evaluation and interpretation of PASI and DLQI. Psoriasis severity of mild, moderate, and severe is defined according to PASI and DLQI as follows: (a) mild psoriasis if PASI < 7 and DLQI < 5; (b) moderate psoriasis if PASI < 7 and DLQI ≥ 5; (c) severe psoriasis if PASI > 15 with any DLQI value.

The DLQI [31] is a widely used dermatology-specific quality-of-life instrument. The 10-item DLQI questionnaires include symptoms and feelings, daily activities, leisure, work and school performance, personal relationships, and treatment. Each of the 10 questions is scored from 0 (not at all) to 3 (very much), and the overall DLQI is calculated by summing the scores of each question, resulting in a numeric score between 0 and 30. The higher the score, the more the quality of life is impaired. The meaning of the DLQI scores for a patient's life is as follows: 0 to 1 = no effect; 2 to 5 = small effect; 6 to 10 = moderate effect; 11 to 20 = very large effect; 21 to 30 = extremely large effect.

2.10. Preliminary Mechanistic Investigation of a Traditional Topical Thai Herbal Cream for Eczema and Psoriasis treatment

2.10.1. In Silico Molecular Docking

Seven phytochemicals—1,8-cineole (eucalyptol), αR-turmerone, turmerone, α-bisabolol, curcumenol, cannabidiol, and vitamin E—were selected for molecular docking based on their well-documented anti-inflammatory, antioxidant, immunomodulatory, and skin-protective properties, which are highly relevant to the treatment of psoriasis and eczema. Psoriasis and eczema are multifactorial disorders involving chronic inflammation, oxidative damage, immune dysregulation, and impaired skin barrier function; hence, compounds capable of targeting multiple pathological mechanisms were prioritized.

1,8-Cineole is known for its anti-inflammatory and soothing effects on irritated skin, making it useful in reducing erythema and pruritus. αR-Turmerone and turmerone, derived from *C. longa*, possess potent anti-inflammatory and immunomodulatory activities that help suppress pro-inflammatory cytokines involved in psoriatic lesions. α-Bisabolol exhibits strong anti-irritant, anti-inflammatory, and wound-healing properties, which are particularly beneficial in eczema management. Curcumenol demonstrates antioxidant and

anti-inflammatory effects, aiding in the reduction of oxidative stress-mediated skin damage. Cannabidiol is known to regulate keratinocyte proliferation, inhibit inflammatory cytokine release, and alleviate itching, addressing key pathological features of both diseases. Vitamin E, a powerful antioxidant, plays a critical role in protecting the skin from oxidative damage, improving barrier function, and reducing inflammation.

2.10.2. Procedure for Docking

The molecular docking study was carried out using PyRx software (version 0.8) to predict the binding affinity and interaction pattern of selected phytochemicals with target proteins relevant to inflammatory skin disorders. Initially, the ligands were selected based on their reported anti-inflammatory, antioxidant, and dermatological relevance. The three-dimensional structures of the selected ligands were downloaded from the PubChem database in SDF format. These ligand files were imported into PyRx, where they were energy-minimized using the Open Babel tool integrated within the software to obtain stable conformations. During ligand preparation, hydrogen atoms were added, torsions were assigned, and the structures were converted into PDBQT format, which is required for docking.

The target proteins involved in psoriasis- and eczema-associated inflammatory pathways were downloaded from the Protein Data Bank (PDB) in PDB format using their respective PDB IDs (PDB: 5E1E or 6N7A). Protein preparation was performed using Discovery Studio. This step involved removal of co-crystallized ligands, water molecules, and heteroatoms that could interfere with ligand binding. Polar hydrogen atoms were added to the protein structure, and Kollman charges were assigned to ensure accurate electrostatic interactions. The prepared protein was then saved in PDBQT format for docking analysis.

Molecular docking was performed with the AutoDock Vina engine integrated in PyRx version 0.8. The prepared protein was loaded as a macromolecule, and the optimized ligands were selected as docking molecules. A grid box was defined to cover the active site or binding pocket of the protein, ensuring sufficient space for ligand flexibility and interaction. Docking parameters were set to default values, and the docking simulation was executed to predict the most favorable binding poses and binding energies. The resulting docked conformations were ranked based on their binding affinity (kcal/mol), with lower energy values indicating stronger and more stable interactions. To validate the docking protocol, the co-crystallized native ligand was redocked into the active site, yielding an RMSD value within the acceptable range (<2.0 Å), confirming the reliability of the docking procedure. The grid coordinates used for docking for selecting the active-site binding pocket were (X: 25.4283, Y: 44.5478, Z: 1.6584).

Post-docking analysis was performed using Discovery Studio Visualizer to examine ligand–protein interactions. The best docked complexes were analyzed for hydrogen bonds, hydrophobic interactions, π-alkyl, and other non-covalent interactions. Two-dimensional and three-dimensional interaction maps were generated to identify key amino acid residues involved in binding. These analyses provided insights into the potential interactions of selected phytochemicals with inflammatory targets associated with psoriasis and eczema.

2.11. Statistical Analysis

Data were expressed as mean ± SD. The normality of the differences between baseline and post-treatment values was assessed using the Shapiro–Wilk test. Since the data met the normality assumption ($p > 0.05$), comparisons were performed using the paired *t*-test. Statistical significance was set at $p < 0.05$. All statistical analyses were performed using R software (version 4.4.3).

3. Results and Discussion

3.1. UHPLC Analysis

A consistent degree of ionization and polarity of the analytes with sensitive resolution and a short processing time was achieved by optimizing the chromatographic system utilizing a C18 column. Calibration curves in the range of 2.5 to 100 µg/mL through HPLC analysis of CBD demonstrated retention times (Rt) of 2.845 ± 0.002 min and 5.883 ± 0.001 min, correspondingly (Figure 3). Moreover, RSD (%) values of 2.29 and 2.76 were observed for CBD and THC, respectively. The quantification of CBD (0.15% *w*/*w*) and THC (0.99% *w*/*w*) within the herbal formulation, which appeared at Rt of 2.818 ± 0.004 min and 5.803 ± 0.01 min, respectively, confirmed the accuracy of the method. The calibration curve for curcumin in the range of 200 to 1000 µg/mL indicated a linear range with a straight line equation of $y = 9 \times 10^7 x$ and R^2 of 0.994. The chromatogram showed retention time at 15.870 ± 0.455 min with quantification of 1.1829 ± 0.1856 mg (%) in THF (Figure 4).

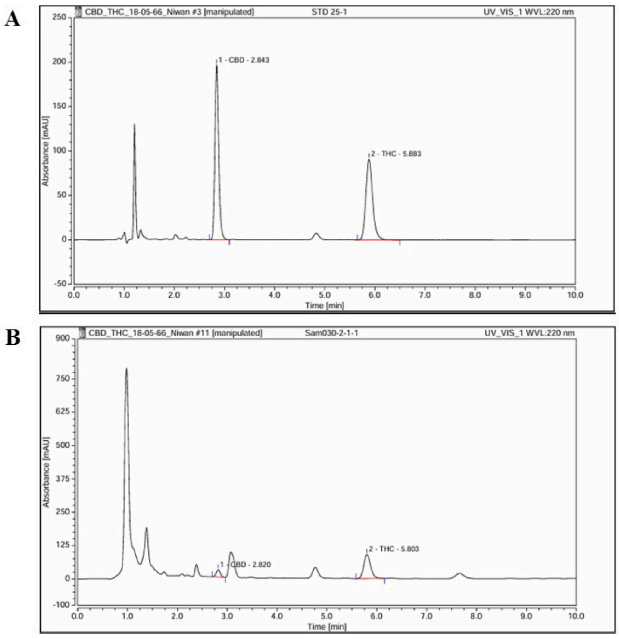


Figure 3. Representative chromatograms of CBD and THC by UHPLC. (**A**) Standard solution; (**B**) Thai herbal formulation.

3.2. GC-MS Analysis

Qualitative profiling with GC-MS analysis was used to identify the major phytopharmaceuticals contained in the herbal formulation, exhibiting high accuracy and sensitive mass identification (Table 2). The GC-MS profiling of the herbal formulation incorporating *C. sativa* and *C. longa* showed the presence of 95 compounds targeting primarily terpenoids and cannabinoids. Terpenoids, or terpenes, are the most abundant and structurally varied naturally occurring bioactive compounds present in a wide range of flora, whereas cannabinoids, originating from cannabis and known for excellent pharmacological activity, are approved in the treatment of chemotherapy-induced gastrointestinal symptoms, multiple sclerosis, and epilepsy. The GC-MS-based chemical profiling of the herbal formulation indicated presence of 27 major compounds with match percentages of more than 90%, such as Eucalyptol (1,8-cineole) (93.5%), α-Santalene (96.6%), cis-α-Bergamotene (94.8%), Bicyclo[2.2.1]heptane, 2-methyl-3-methylene-2-(4-methyl-3-pentenyl)-,(1S-endo) (92.0%), cis-β-Farnesene (94.4%), Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl (96.7%), 1,3-Cyclohexadiene, 5-(1,5-dimethyl-4-hexenyl)-2-methyl (97.9%), β-Bisabolene (97.4%), Cyclo-

hexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene (98.0%), 7-epi-cis-Sesquisabinene hydrate (90.5%), aR-Turmerone (96.4%), Tumerone (94.0%), α-Bisabolol (94.8%), 3,7-Cyclodecadien-1-one,3,7-dimethyl-10-(1-methylethylidene) (96.8%), 2-Methyl-6-(4-methylenecyclohex-2-en-1-yl) hept-2-en-4-one (96.7%), (E)-Atlantone (97.6%), Hexadecanoic acid, ethyl ester (98.3%), Phytol (97.4%), Linoleic acid ethyl ester (96.5%), 9,12,15-Octadecatrienoic acid, ethyl ester (98.2%), δ-9-Tetrahydrocannabivarin (93.1%), 1H-4-Oxabenzo(f)cyclobut(cd)inden-8-ol, 1a-α,2,3,3a,8b-α,8c-α.-hexahydro-1,1,3a-trimethyl-6-pentyl (90.0%), Cannabidiol (97.9%), Cannabichromene (96.2%), Dronabinol (98.4%), Cannabinol (97.0%), and γ-Sitosterol (90.6%) (Figures 5 and 6).

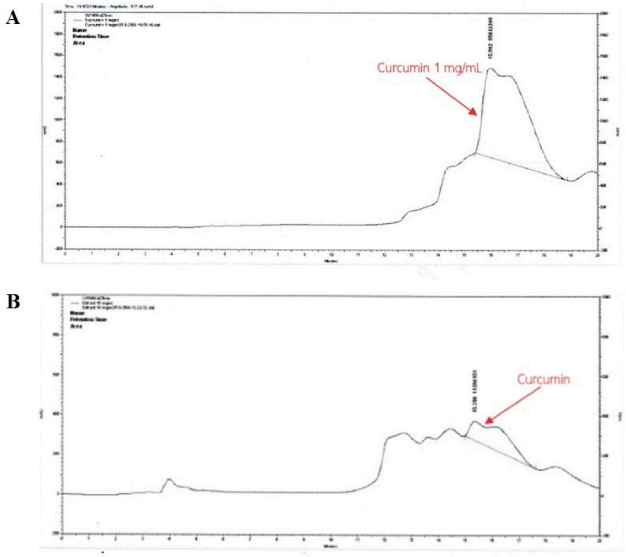


Figure 4. Representative chromatograms of curcumin by HPLC. (**A**) Standard solution; (**B**) Thai herbal formulation.

Table 2. Phytochemical profiling of Thai herbal formulation using GC-MS.

Retention Time (min)	Compound Name	Molecular Formula	Match Percentage	Category and Pharmacological Action
7.9	Eucalyptol (1,8-cineole)	$C_{10}H_{18}O$	93.5	Monoterpenoid, anti-inflammatory, antioxidant
19.6	α-Santalene	$C_{15}H_{24}$	96.6	Sesquiterpenoids, anti-inflammatory, antioxidant, antimicrobial, antidiabetic
20.0	cis-α-Bergamotene	$C_{15}H_{24}$	94.8	Bicyclic sesquiterpenes, astringent, analgesic
20.2	Bicyclo[2.2.1]heptane, 2-methyl-3-methylene-2-(4-methyl-3-pentenyl)-, (1S-endo)-	$C_{15}H_{24}$	92	Polycyclic sesquiterpenes, antimalarial, antifungal, antibacterial, anti-inflammatory
20.5	cis-β-Farnesene	$C_{15}H_{24}$	94.4	Sesquiterpenoids, skin infections

Table 2. *Cont.*

Retention Time (min)	Compound Name	Molecular Formula	Match Percentage	Category and Pharmacological Action
21.1	Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl-	$C_{15}H_{22}$	96.7	Aromatic monoterpenoids, antioxidant
21.5	1,3-Cyclohexadiene, 5-(1,5-dimethyl-4-hexenyl)-2-methyl-,[S-(R*,S*)]-	$C_{15}H_{24}$	97.9	Sesquiterpenoids, skin infections
21.8	β-Bisabolene	$C_{15}H_{24}$	97.4	Sesquiterpenoids, anti-cancer
21.9	(Z)-1-Methyl-4-(6-methylhept-5-en-2-ylidene) cyclohex-1-ene	$C_{15}H_{24}$	83.7	Sesquiterpenes, anti-inflammatory, anti-tumor, antimicrobial
22.0	Benzenemethanol, 4-methyl-α-(1-methyl-2-propenyl)-, (R@,R@)-	$C_{12}H_{16}O$	83.6	-
22.1	Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene-,[S-(R*,S*)]	$C_{15}H_{24}$	98	Sesquiterpenoids, skin infections
22.2	(R,Z)-2-Methyl-6-(4-methylcyclohexa-1,4-dien-1-yl)hept-2-en-1-ol	$C_{15}H_{24}O$	77.8	-
22.3	(E)-1-Methyl-4-(6-methylhept-5-en-2-ylidene) cyclohex-1-ene	$C_{15}H_{24}$	89.4	Monocyclic sesquiterpenes, anti-tumor, anti-inflammatory, antibacterial, antivirus, antiparasitic, anti-ulcer
22.6	α-Humulene	$C_{15}H_{24}$	82.6	Sesquiterpenes, anti-inflammatory, antimicrobial, antileishmanial, antiparasitic
22.9	7-epi-cis-sesquisabinene hydrate	$C_{15}H_{26}O$	90.5	Sesquiterpenes; anticancer
23.1	1,6,10-Dodecatrien-3-ol, 3,7,11-trimethyl-	$C_{15}H_{26}O$	82.6	Sesquiterpenes, anti-inflammatory
23.4	Santalol	$C_{15}H_{24}O$	75.7	Sesquiterpenes, anticancer
23.7	(E)-γ-Atlantone	$C_{15}H_{22}O$	82.7	Sesquiterpenes, antiviral
24.0	1H-3a,7-Methanoazulene, octahydro-3,6,8,8-tetramethyl-,[3R-(3-α,3a-β,6-α,7-β,8a-α)]-	$C_{15}H_{26}$	79.4	-

Table 2. *Cont.*

Retention Time (min)	Compound Name	Molecular Formula	Match Percentage	Category and Pharmacological Action
24.1	7-epi-trans-sesquisabinene hydrate	$C_{15}H_{26}O$	77.2	Sesquiterpenes; anticancer
24.6	(1R,4R)-1-methyl-4-(6-Methylhept-5-en-2-yl) cyclohex-2-enol	$C_{15}H_{26}O$	87.5	Sesquiterpenes, anticancer
25.01	7-epi-cis-sesquisabinene hydrate	$C_{15}H_{26}O$	75	Sesquiterpenes, anticancer
25.4	aR-Turmerone	$C_{15}H_{20}O$	96.4	Sesquiterpenes, anti-inflammatory, antioxidant
25.5	Tumerone	$C_{15}H_{22}O$	94	Sesquiterpenes, anti-inflammatory, antioxidant
25.8	α-Bisabolol	$C_{15}H_{26}O$	94.8	Sesquiterpenoids, anti-inflammatory, analgesic
26.0	3,7-Cyclodecadien-1-one, 3,7-dimethyl-10-(1-methylethylidene)-,(E,E)-	$C_{15}H_{22}O$	96.8	Sesquiterpenoids, anti-inflammatory
26.2	2-Methyl-6-(4-methylenecyclohex-2-en-1-yl) hept-2-en-4-one	$C_{15}H_{22}O$	96.7	Sesquiterpenes, anti-inflammatory
26.4	2-Methyl-5-(2,6,6-trimethyl-cyclohex-1-enyl)-pentane-2,3-diol	$C_{15}H_{28}O_2$	73.4	-
26.5	(Z)-α-Atlantone	$C_{15}H_{22}O$	84.9	Sesquiterpenes, antiviral
26.8	Curcumenol	$C_{15}H_{22}O_2$	86.6	Sesquiterpenoids, anti-tumor, anti-inflammatory, antibacterial, antioxidant, anti-diabetic
27.1	(6R,7R)-Bisabolone	$C_{15}H_{24}O$	86.5	Sesquiterpenoids, anti-inflammatory
27.7	(E)-Atlantone	$C_{15}H_{22}O$	97.6	Sesquiterpenoids, antiviral
28.7	erythro-(cis)(1,4),(cis)(1′,4′)-4,4′-Dihydroxybicyclooctyl	$C_{16}H_{30}O_2$	76.7	-
29.1	1-(Hydroxymethyl)-2,5,5,8A-tetramethyldecahydro-2-naphthalenol	$C_{15}H_{28}O_2$	75.9	Sesquiterpenoids, anti-inflammatory

Table 2. *Cont.*

Retention Time (min)	Compound Name	Molecular Formula	Match Percentage	Category and Pharmacological Action
32.0	Ethyl 9-hexadecenoate	$C_{18}H_{34}O_2$	87.5	Unsaturated fatty acids, antioxidant
32.1	Hexadecanoic acid, ethyl ester	$C_{18}H_{36}O_2$	98.3	Long-chain fatty acid ethyl ester, antioxidant
34.3	Phytol	$C_{20}H_{40}O$	97.4	Acyclic diterpene alcohol, anxiolytic, antioxidant, anti-inflammatory, antimicrobial, immune modulating
35.1	Linoleic acid ethyl ester	$C_{20}H_{36}O_2$	96.5	Fatty acid esters, anti-inflammatory
35.2	9,12,15-Octadecatrienoic acid, ethyl ester	$C_{20}H_{34}O_2$	98.2	Fatty acid, anti-inflammatory
35.7	Octadecanoic acid, ethyl ester	$C_{20}H_{40}O_2$	88.4	Fatty acid, anti-inflammatory
37.0	δ-8-Tetrahydrocannabinol	$C_{21}H_{30}O_2$	87.1	Cannabinoids, appetizer, reflective mood, management of chronic pain, chemotherapy
37.7	δ-9-Tetrahydrocannabivarin	$C_{19}H_{26}O_2$	93.1	Cannabinoids, appetizer, reflective mood, management of chronic pain, chemotherapy
38.6	1H-4-Oxabenzo(f)cyclobut(cd) inden-8-ol, 1a-α,2,3,3a,8b-α,8c-α.-hexahydro-1,1,3a-trimethyl-6-pentyl	$C_{21}H_{30}O_2$	90	Cannabinoids, chemotherapy
39.5	Cannabidiol	$C_{21}H_{30}O_2$	97.9	Cannabinoids, management of chronic pain, chemotherapy (non-psychoactive reactions)
39.7	Cannabichromene	$C_{21}H_{30}O_2$	96.2	Cannabinoids, management of chronic pain, chemotherapy
40.1	Cannabicoumaronone	$C_{21}H_{28}O_3$	75.1	Cannabinoids, management of pain, skin burn, asthma, epilepsy
41.0 1	Dronabinol	$C_{21}H_{30}O_2$	98.4	Cannabinoids, management of pain, skin burn, asthma, epilepsy
42.0	Cannabinol	$C_{21}H_{26}O_2$	97	Cannabinoids, management of pain relief, sleep aid (mild psychoactive reactions)

Table 2. *Cont.*

Retention Time (min)	Compound Name	Molecular Formula	Match Percentage	Category and Pharmacological Action
42.4	Pregna-5,7-diene, 3-(methoxymethoxy)-20-formyl-	$C_{24}H_{36}O_3$	75.2	Cannabinoids, management of pain
45.4	Squalene	$C_{30}H_{50}$	89.7	Triterpenoid hydrocarbon, anticancer, antioxidant, emollient
49.3	Vitamin E	$C_{29}H_{50}O_2$	91.1	Antioxidant
50.4	(3methyl,24R)-ergost-5-en-3-ol	$C_{28}H_{48}O$	76.8	Triterpenoid, anticancer, anti-inflammatory, antibacterial, antiviral
51.5	γ-Sitosterol	$C_{29}H_{50}O$	90.6	Phytosterol, management of hypercholesterolemia
53.0	Olean-12-en-3-ol, acetate, (3β)-	$C_{32}H_{52}O_2$	75.9	Triterpenoid, anticancer, anti-inflammatory, antibacterial, antiviral
53.4	9,19-Cycloergost-24(28)-en-3-ol, 4,14-dimethyl-, acetate, (3β,4α,5α)-	$C_{32}H_{52}O_2$	79.6	Triterpenoid, anticancer, anti-inflammatory, antibacterial, antiviral

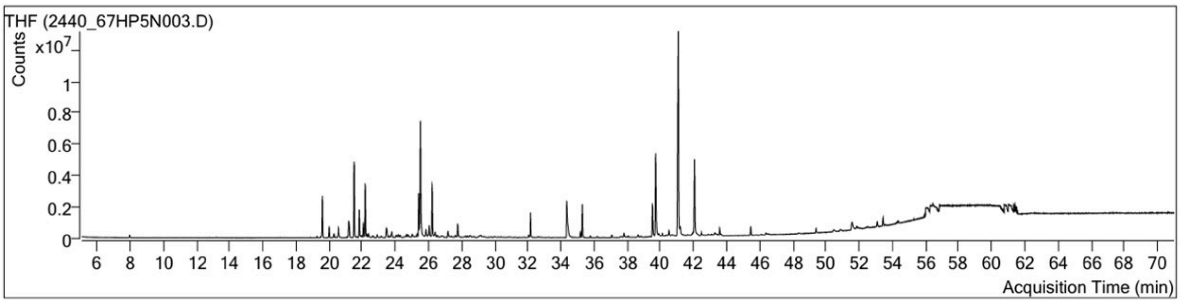


Figure 5. GC-MS chromatogram of major chemical compounds in Thai herbal formulation.

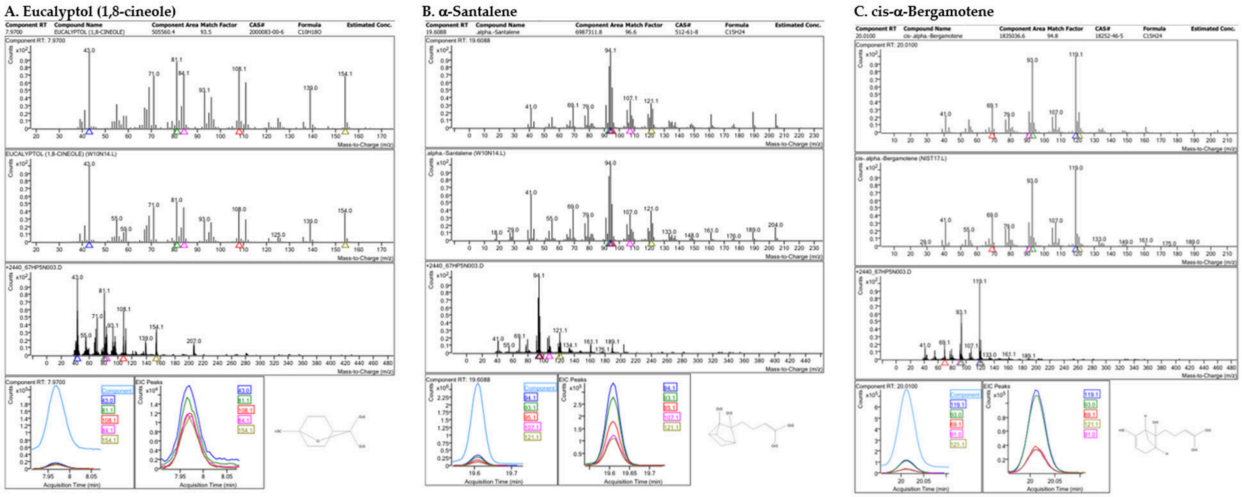


Figure 6. *Cont.*

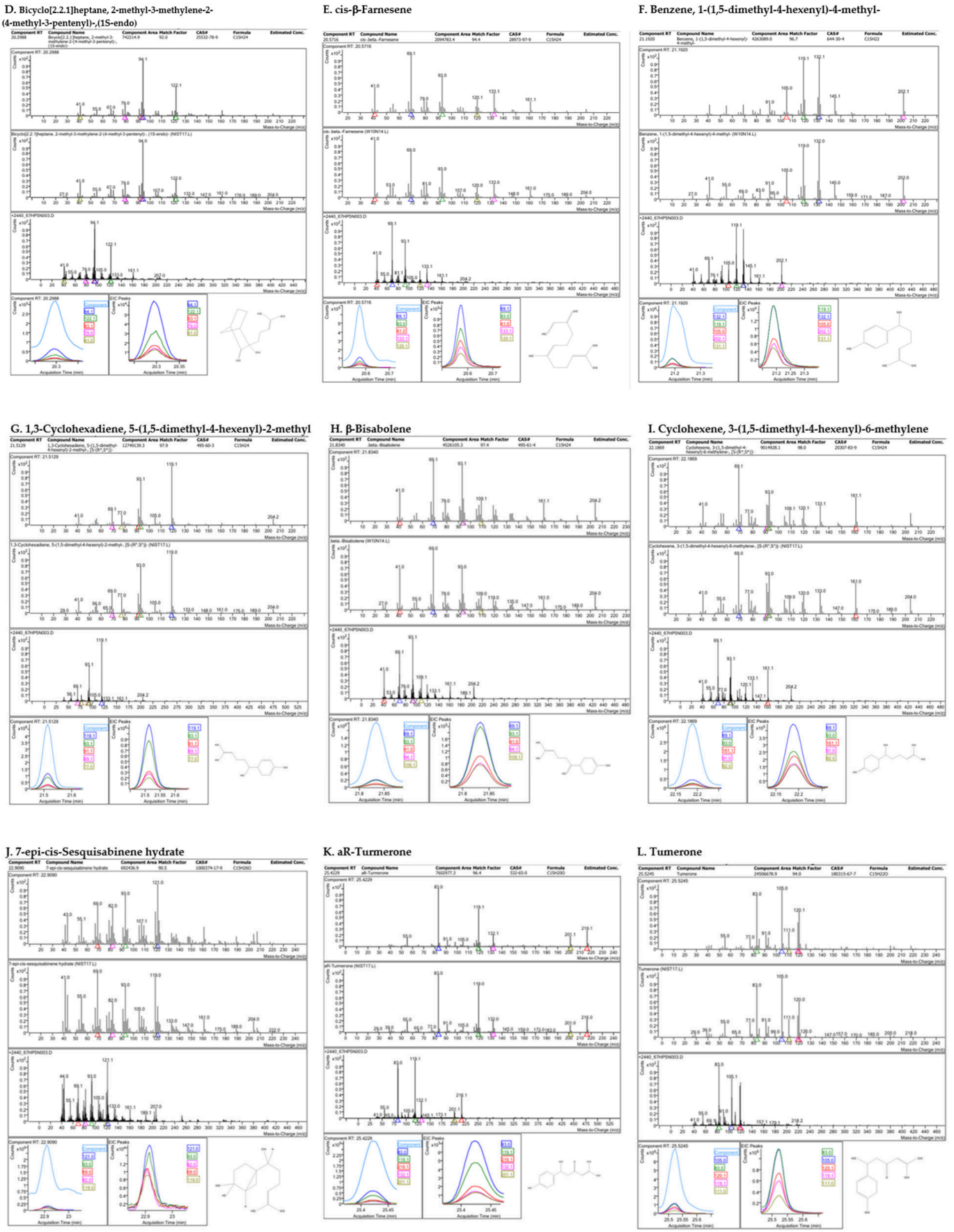


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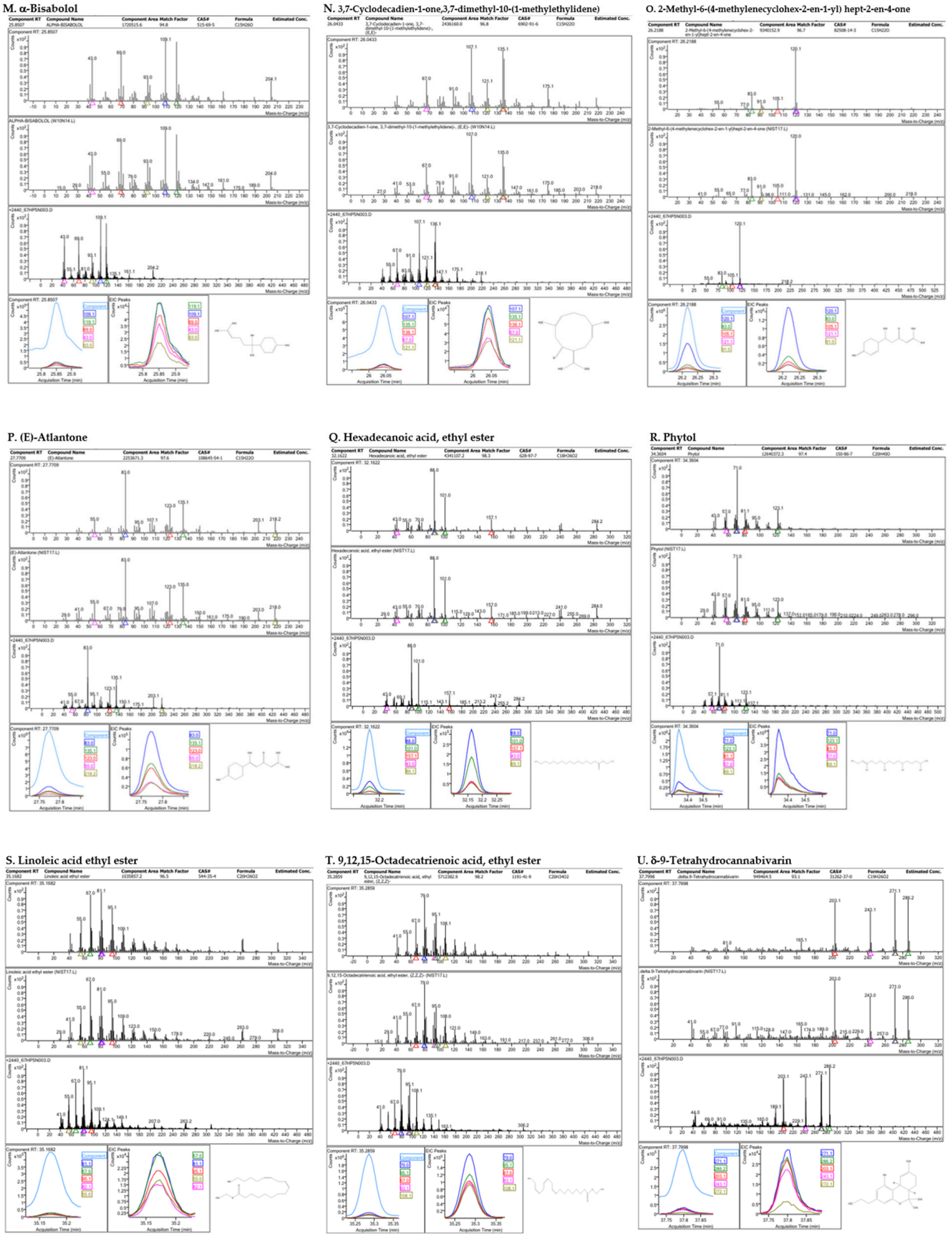


Figure 6. *Cont.*

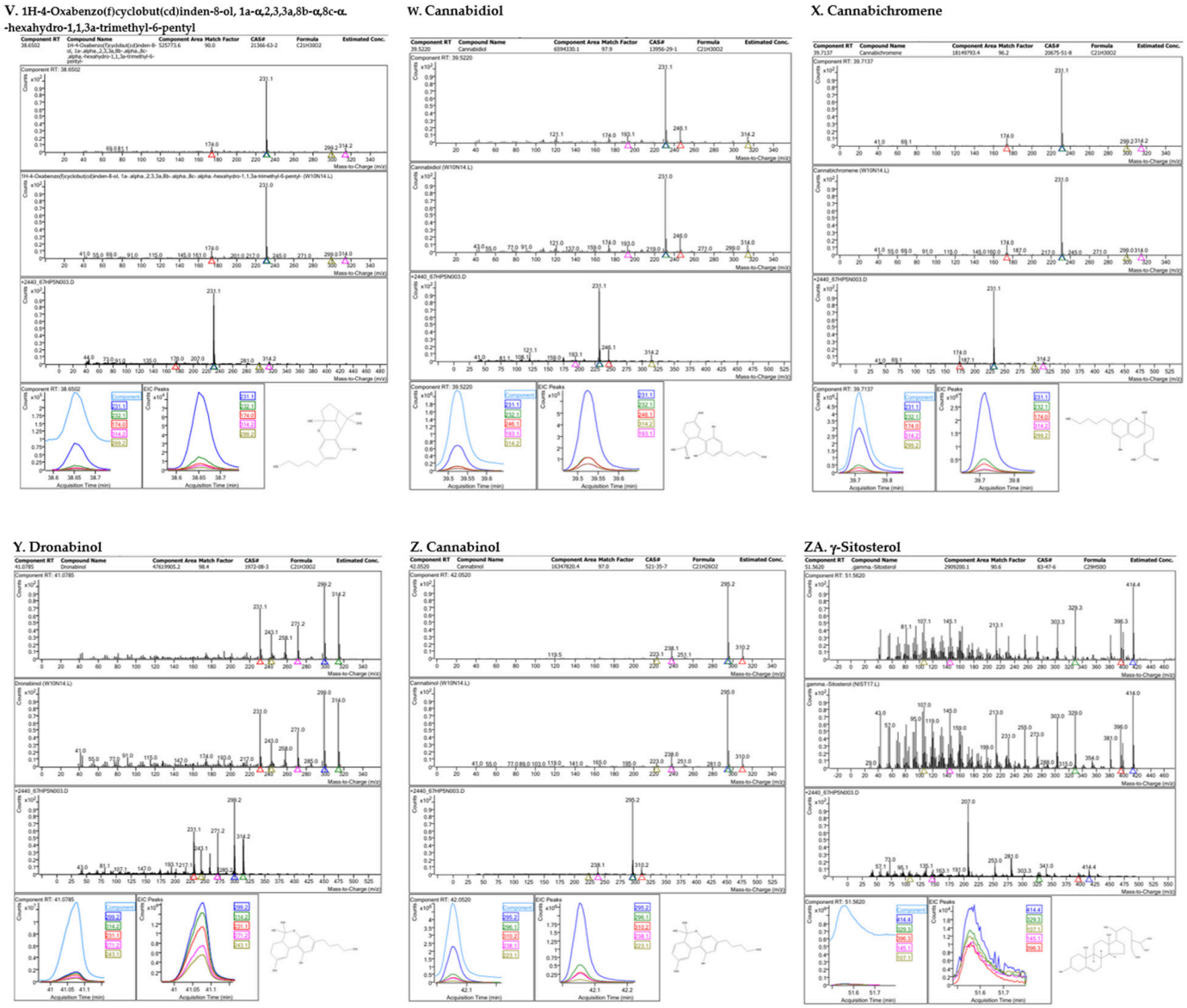


Figure 6. GC-MS chromatograms of the individually identified compounds in the Thai herbal formulation. The colorful triangles denote the chosen characteristic ions (m/z) utilized for EIC analysis, with the associated colors aligning with the respective ions depicted in the chromatographic profiles. (**A**) Eucalyptol (1,8-cineole); (**B**) α-Santalene; (**C**) cis-α-Bergamotene; (**D**) Bicyclo[2.2.1]heptane, 2-methyl-3-methylene-2-(4-methyl-3-pentenyl)-,(1S-endo); (**E**) cis-β-Farnesene; (**F**) Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl-; (**G**) 1,3-Cyclohexadiene, 5-(1,5-dimethyl-4-hexenyl)-2-methyl; (**H**) β-Bisabolene; (**I**) Cyclohexene, 3-(1,5-dimethyl-4-hexenyl)-6-methylene; (**J**) 7-epi-cis-Sesquisabinene hydrate; (**K**) aR-Turmerone; (**L**) Tumerone; (**M**) α-Bisabolol; (**N**) 3,7-Cyclodecadien-1-one,3,7-dimethyl-10-(1-methylethylidene); (**O**) 2-Methyl-6-(4-methylenecyclohex-2-en-1-yl) hept-2-en-4-one; (**P**) (E)-Atlantone; (**Q**) Hexadecanoic acid, ethyl ester; (**R**) Phytol; (**S**) Linoleic acid ethyl ester; (**T**) 9,12,15-Octadecatrienoic acid, ethyl ester; (**U**) δ-9-Tetrahydrocannabivarin; (**V**) 1H-4-Oxabenzo(f)cyclobut(cd)inden-8-ol, 1a-α,2,3,3a,8b-α,8c-α.-hexahydro-1,1,3a-trimethyl-6-pentyl; (**W**) Cannabidiol; (**X**) Cannabichromene; (**Y**) Dronabinol; (**Z**) Cannabinol; (**ZA**) γ-Sitosterol.

The results showed the presence of several bioactive compounds that belong to major categories of terpenoids and cannabinoids with fractions of minute quantities of fatty acids. These classes of phytopharmaceuticals exhibited a wide range of highly signifi-

cant pharmacological activity, as validated by numerous in vitro, preclinical, and clinical studies [32–37].

3.3. Total Phenolic and Flavonoid Contents and Antioxidant Activities

The total phenolic content, total flavonoid content, and antioxidant activities of the herbal formulation are presented in Table 3. Total phenolic and flavonoid contents were determined in the herbal formulation with values of 93.59 ± 2.69 mg GAE/g extract and 1.06 ± 0.05 mg QE/g extract, respectively. The herbal formulation displayed DPPH and ABTS free radical scavenging activities with IC_{50} values of 125.68 ± 1.26 and 34.53 ± 1.09 µg/mL, respectively. In addition, the herbal formulation also had the capability to reduce Fe^{3+} to Fe^{2+} with a FRAP value of 34.67 ± 1.04 mg Fe_2SO_4/g extract.

Table 3. Total phenolic content, total flavonoid content, and antioxidant activities of the Thai herbal formulation.

Sample	Total Phenolic Content (mg GAE/g Extract)	Total Flavonoid Content (mg QE/g Extract)	DPPH IC_{50} (µg/mL)	ABTS IC_{50} (µg/mL)	FRAP (mg Fe_2SO_4/g Extract)
THF	93.59 ± 2.69	1.06 ± 0.05	125.68 ± 1.26	34.53 ± 1.09	34.67 ± 1.04
Ascorbic acid	NA	NA	6.61 ± 0.01	2.83 ± 0.02	NA

Values are means ± SDs of three separate experiments. THF, Thai herbal formulation. DPPH, 2,2-diphenyl-1-picrylhydrazyl; ABTS, 2,2′-azino-bis (3-ethylbenzthiazo-line-6-sulphonic acid); FRAP, ferric reducing antioxidant power; GAE, gallic acid equivalent; QE, quercetin equivalent. IC_{50}, 50% inhibitory concentration NA, not applicable.

Oxidative stress is one of the major phenomena associated with eczema and psoriasis pathogenesis [38]. Some studies demonstrated that bioactive compounds with anti-oxidant effects have been extensively used to combat skin oxidative stress for the management of inflammatory skin diseases [39,40]. Therefore, treatment based on plant-derived antioxidants may be a beneficial strategy for eczema and psoriasis management [40,41].

3.4. Antibacterial Effects

Intrinsic antibacterial activities of the herbal formulation were evaluated against *E. coli* ATCC 25922, *S. aureus* ATCC 25923, *S. pyogenes* DMST 17202, and *P. aeruginosa* ATCC 27853. The herbal formulation possessed mild intrinsic antibacterial activities against all tested bacterial strains, with MIC and MBC of more than 512 µg/mL.

Medicinal plant extracts have been harnessed for their antibacterial and anti-inflammatory activity, contributing to skin healing [42]. Previous studies documented that most medicinal plant extracts exhibited weak antibacterial activities in comparison with antibiotics; however, some medicinal plant extracts could act as resistance-modifying agents to reverse the resistance to antimicrobial agents in the bacterial cell [43,44]. Various antibacterial mechanisms of medicinal plants included the inhibition of DNA, protein, and cell envelope biosynthesis and damage to the cell membrane, depending on the spectrum and the content of compounds present in herbal medicines [43,44]. Moreover, the effectiveness of medicinal plant extracts in inhibiting bacterial growth was related to synergistic effects between the active compounds in the extracts.

3.5. Cytotoxic Effects in RAW 264.7 Macrophages and Effects of Herbal Formulation on Nitric Oxide Levels in Lipopolysaccharide-Stimulated Macrophages

Prior to in vitro assessment of anti-inflammatory activity, the potential cytotoxicity of the herbal formulation towards the macrophage cell line RAW 264.7 was evaluated by

mitochondrial-MTT reduction assay. The results indicated that all studied concentrations (0.0001–0.1 mg/mL) of the herbal formulation did not affect the viability of RAW 264.7 cells, compared to the positive control (TA) (Table 4).

Table 4. Viability of RAW 264.7 macrophages treated with Thai herbal formulation (THF) and triamcinolone acetonide (TA).

Sample	% Cell Viability at Various Concentrations (mg/mL)			
	0.0001	**0.001**	**0.01**	**0.1**
THF	100.54 ± 1.29	97.67 ± 1.28	95.72 ± 1.55	94.47 ± 1.79
TA	101.82 ± 2.74	102.25 ± 2.75	104.10 ± 1.95	105.80 ± 2.41

Values are means ± SDs of three separate experiments.

The inhibitory activities of the herbal formulation and the positive control on NO production in LPS-stimulated macrophages, compared to the controls, are shown in Table 5. The final concentrations of herbal formulation at 0.01 and 0.1 mg/mL showed effective inhibition of NO production at 15.68 ± 5.64% and 15.79 ± 2.81%, respectively. Meanwhile, the corresponding concentration of the positive control (TA) showed 25.81 ± 3.18% and 26.88 ± 3.10% inhibition, respectively. The anti-inflammatory claims are regarded as moderate relative to the concentration of the positive control. However, additional indicators such as iNOS, COX-2, TNF-α, IL-6, IL-17, IL-4/IL-13, NF-κB, MAPK, or keratinocyte-based models will continue to be assessed in future investigations.

Table 5. Inhibitory activity of Thai herbal formulation (THF) and triamcinolone acetonide (TA) against nitric oxide (NO) production in lipopolysaccharide (LPS)-stimulated RAW 264.7 macrophages.

Sample	% Nitric Oxide Inhibition at Various Concentrations (mg/mL)			
	0.0001	**0.001**	**0.01**	**0.1**
THF	11.25 ± 3.51	5.33 ± 3.69	15.68 ± 5.64	15.79 ± 2.81
TA	21.86 ± 3.41	23.66 ± 1.80	25.81 ± 3.18	26.88 ± 3.10

Values are means ± SDs of three separate experiments.

Inflammation due to eczema and psoriasis causes weakness of the skin barrier structure and increased cell permeability, exacerbating serious skin-moisturizing problems [45]. Scientific evidence has revealed that medicinal plants or natural compounds could reinforce the skin barrier due to their anti-inflammatory activity [45–47].

3.6. Physical Stability, Viscosity, and pH of a Traditional Topical Thai Herbal Cream Before and After Freeze–Thaw Stability Test

The characteristics of the novel topical Thai herbal cream are demonstrated in Table 6. The physical appearance of the topical Thai herbal cream appeared greenish, smooth, and homogenous before the freeze–thaw stability test. After the freeze–thaw stability test, their characteristics were similar in terms of texture, homogeneity, and pH.

The semi-solid formulation, cream, is designed for topical application to the skin. The formulation offers skin protection and hydration while serving as a vehicle for phage delivery. Moreover, cream is simple to use, slightly irritating to the skin, and often readily removable with water [48]. According to the physicochemical properties, an oil-in-water cream (o/w) was selected as the dosing form for this study. Additionally, the o/w cream supported the barrier function of baby's skin without occlusion, provided a good, longer-lasting hydration effect, and had adequate consistency, easy spreading, a pleasant skin feeling, proper pH, and good microbiological stability [49].

Table 6. Physical stability, viscosity, and pH of cream before and after freeze–thaw stability test.

Characteristics	Before Freeze–Thaw Stability Test	After Freeze–Thaw Stability Test
Physical appearance		
	Greenish, smooth, homogenous	Dark green, smooth, homogenous
Viscosity (cP)	2100	1700
pH value	pH 6.2	pH 6.2

Centipoise, cP.

3.7. Preliminary Clinical Evaluation of the Therapeutic Effects of a Traditional Topical Thai Herbal Cream for Eczema and Psoriasis Therapy

Four female patients, aged 21 to 45 years with a mean age of 33.25 years, diagnosed with eczema, underwent treatment for 4 weeks. All patients alleviated their symptoms by applying the topical herbal cream three times daily for 4 weeks. The EASI and DLQI scores after 4 weeks of treatment were compared with the scores at baseline (Table 7). A significant reduction in EASI scores was observed at the end of 2 weeks and onwards, indicating that the topical herbal cream required a certain amount of time to elicit therapeutic effects . At the end of the study, the means of the EASI and DLQI scores were greatly reduced, from 4.11 ± 3.14 to 1.28 ± 1.46 [95% CI: 2.83 (−0.14 to 5.80)] and 6.25 ± 5.25 to 1.00 ± 0.82 [95% CI: 5.25 (−2.03 to 12.53)], respectively. The condition of topical herbal cream-treated patients markedly improved after treatment, with a decrease in erythema, edema, scaling, itching, and lichenification (Figure 7). Regarding psoriasis therapy, a 44-year-old male patient with psoriasis was treated with topical herbal cream three times daily for 4 weeks. At the end of the study, the patient responded effectively to the treatment, as indicated by the PASI score, which decreased from 39 to 16.2. In addition, the DLQI score also decreased, from 7 (moderate effect on patients' lives) to 2 (small effect on patients' lives). The condition of the topical herbal cream-treated psoriasis patient remarkably improved after treatment, with a decrease in erythema, scaling, itching, and induration (Figure 8).

Table 7. Improvements in the Eczema Area and Severity Index (EASI) score and Dermatology Life Quality Index (DLQI) score over a four-week intervention for four participants with eczema.

Variable	Before Therapy (n = 4)	After Therapy (n = 4)	Mean Difference (95% CI)	p Value
EASI				
Week 2	4.11 ± 3.14	2.96 ± 2.62	1.15 (0.31 to 1.99)	0.022 *
Week 4	4.11 ± 3.14	1.28 ± 1.46	2.83 (−0.14 to 5.80)	0.056
DLQI				
Week 4	6.25 ± 5.25	1.00 ± 0.82	5.25 (−2.03 to 12.53)	0.105

Values are presented as mean ± SD. Statistical comparisons were performed using the paired t-test. * p value < 0.05 was considered statistically significant.



Figure 7. Clinical photos of a representative eczema patient prior to Thai herbal cream treatment at week 0 (**A**), and after treatment at week 4 (**B**).

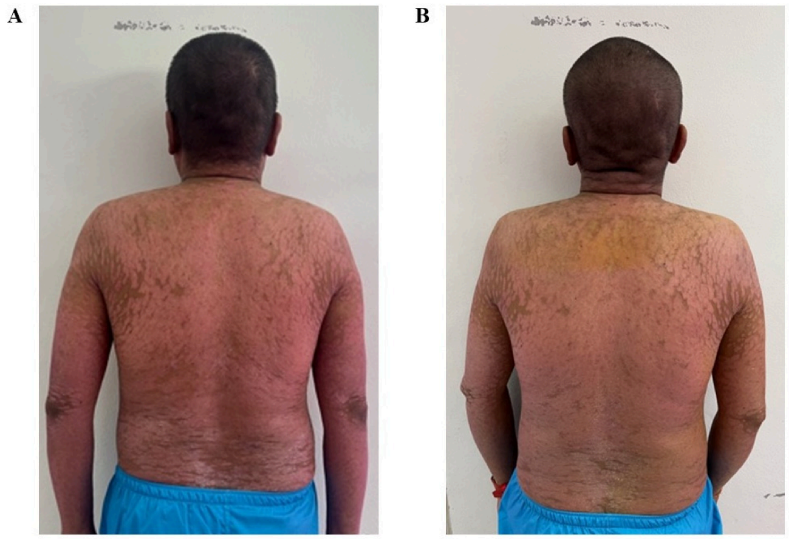


Figure 8. Clinical photos of a psoriasis patient prior to Thai herbal cream treatment at week 0 (**A**), and after treatment at week 4 (**B**).

A preliminary uncontrolled clinical evaluation revealed reductions in EASI and DLQI scores among the four patients with eczema. An enhancement in PASI score was noted in the patient with psoriasis. However, interpretation is limited by the small sample size, lack of controls, and participant attrition. This was a pilot study that aimed to assess the feasibility and dosage of a herbal cream before performing a randomized controlled trial. In our upcoming study, we plan to increase the dosage and reevaluate all data.

3.8. Preliminary Mechanistic Evaluation of a Traditional Topical Thai Herbal Cream for Eczema and Psoriasis Therapy

Psoriasis and eczema are chronic inflammatory skin disorders characterized by dysregulated immune responses, oxidative stress, epidermal barrier dysfunction, and sustained activation of pro-inflammatory signaling pathways. Molecular docking was employed to elucidate the binding affinity and interaction profiles of selected phytochemicals with two relevant protein targets (PDB IDs: 5E1E and 6N7A) involved in inflammatory pathways, keratinocyte proliferation, and immune modulation (Table 8 and Figure 9). The docking outcomes provide mechanistic insight into the potential of these phytoconstituents as multi-target anti-inflammatory and skin-protective agents. The protein targets 5E1E and 6N7A were selected because they represent key components of the Janus kinase (JAK)-mediated

inflammatory signaling pathway, which plays a central role in the pathogenesis of psoriasis and eczema. Aberrant activation of JAK-dependent cytokine signaling contributes to immune dysregulation, chronic inflammation, and excessive keratinocyte proliferation observed in these skin disorders. Since JAK inhibitors have demonstrated significant clinical efficacy in the treatment of inflammatory dermatological diseases, these proteins were considered suitable molecular targets for evaluating the potential anti-inflammatory activity of the selected phytochemicals through molecular docking studies.

Table 8. Binding affinities and protein interactions of selected phytoconstituents in psoriasis and eczema.

Compound	IUPAC	Binding Energy		Compound Interaction
		5E1E	6N7A	
1,8-cineole (eucalyptol)	1,3,3-trimethyl-2-oxabicyclo[2.2.2] octane	−5.2	−5.6	Pi-Alkyl/Alkyl–LEU A:881, VAL A:889, LEU A:1010 Conventional H-bond–LYS B:908 Carbon H-bond–GLY B:1023
aR-Turmerone	(6S)-2-methyl-6-(4-methylphenyl)hept-2-en-4-one	−7.3		Pi-Sigma–LEU B:881 Pi-Alkyl/Alkyl–LEU B:881, VAL B:889, LEU B:1010 Pi-Sigma–LEU A:881 Pi-Alkyl/Alkyl–LEU A:881, LEU A:1010
Tumerone	2-methyl-6-(4-methylcyclohexa-1,3-dien-1-yl)hept-2-en-4-one	−6.8	−6.9	Conventional H-bond–LEU B:959 Pi-Alkyl/Alkyl–LEU B:881, VAL B:889, LEU B:1010 Pi-Alkyl/Alkyl–LEU A:881, VAL A:889, ALA A:906, PHE A:958, LEU A:959, LEU A:1010
α-Bisabolol	(2R)-6-methyl-2-[(1R)-4-methylcyclohex-3-en-1-yl]hept-5-en-2-ol	−6.4	−5.6	Pi-Alkyl/Alkyl–LEU A:881, ALA A:906, PHE A:958, LEU A:959, LEU A:1010 Carbon H-bond–GLY A:884 Pi-Alkyl/Alkyl–HIS A:885, PHE A:886, LEU A:910, HIS A:918, ARG A:1041
Curcumenol	(1S,2S,5S,8R)-2,6-dimethyl-9-propan-2-ylidene-11-oxatricyclo[6.2.1.01,5] undec-6-en-8-ol	−7.4	−7.4	Pi-Alkyl/Alkyl–LEU B:881, VAL B:889, ALA B:906, LEU B:1010 Carbon H-bond–SER B:963 Pi-Alkyl/Alkyl–LEU B:881, VAL B:889, ALA B:906, LEU B:1010
Cannabidiol	2-[(1R,6R)-3-methyl-6-prop-1-en-2-ylcyclohex-2-en-1-yl]-5-pentylbenzene-1,3-diol	−6.8	−6.4	Conventional H-bond–LEU B:881, LEU B:959 Pi-Sigma–LEU B:881 Pi-Alkyl/Alkyl–VAL B:889, LEU B:891, ALA B:906, MET B:956, PHE B:958, LEU B:1010 Conventional H-bond–ILE A:1060, ALA A:1061 Pi-Sigma–ILE A:1060 Pi-Alkyl/Alkyl–ILE A:1028, ILE A:1060, ALA A:1061, VAL A:1064 Pi-Anion–GLU A:1033
Vitamin E	(2R)-2,5,7,8-tetramethyl-2-[(4R,8R)-4,8,12-trimethyltridecyl]-3,4-dihydrochromen-6-ol	−7.3	−5.8	Pi-Sigma–LEU B:1010 Pi-Alkyl/Alkyl–LEU B:881, VAL B:889, ALA B:906, ALA B:1005, LEU B:1010, TRPP B:1047 Pi-Alkyl/Alkyl–VAL A:865, PRO A:896 Pi-donor H-bond–TYR A:894
Tofacitinib (Standard)	(3R,4R)-4-methyl-3-[methyl(7H-pyrrolo[2,3-d]pyrimidin-4-yl)amino]piperidine	−8.9	−8.2	Pi-Alkyl/Alkyl Gly A 884 and Leu A959

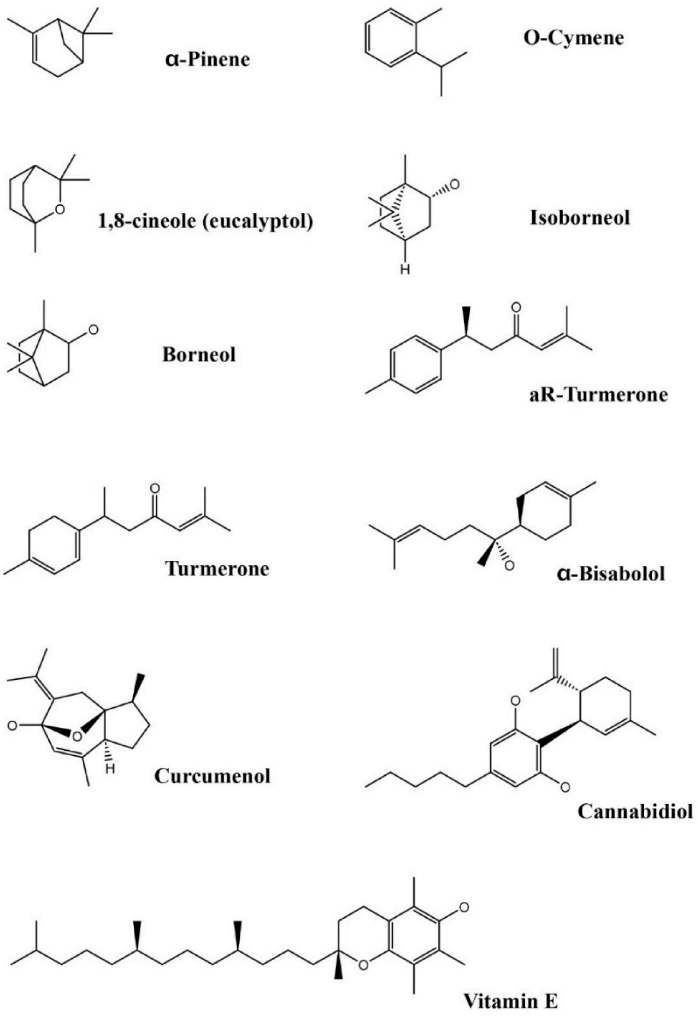


Figure 9. Chemical structures of selected phytochemicals in the plant based on LC-MS data.

Among the evaluated compounds, curcumenol, αR-turmerone, and vitamin E exhibited the strongest binding affinities (−7.3 to −7.4 kcal/mol), indicating stable ligand–protein complexes (Figures 10 and 11) when compared with Tofacitinib as a reference standard JAK inhibitor. Curcumenol demonstrated consistent binding energies against both targets (−7.4 kcal/mol) and formed hydrophobic interactions with key residues such as LEU, VAL, and ALA, along with a stabilizing carbon hydrogen bond with SER B:963. These interactions suggest effective accommodation within the active site, supporting curcumenol's reported anti-inflammatory and antioxidant properties, which are highly relevant in attenuating cytokine-mediated inflammation and oxidative damage in psoriatic and eczematous skin. αR-Turmerone showed favorable binding (−7.3 kcal/mol) dominated by π-sigma and π-alkyl interactions with hydrophobic residues (LEU and VAL) across both chains. Such interactions indicate strong hydrophobic complementarity, which is often associated with effective inhibition of inflammatory mediators. Given its known immunomodulatory and anti-inflammatory activity, αR-turmerone may contribute to reducing erythema, scaling, and immune cell infiltration observed in psoriasis and eczema. Vitamin E, a well-established antioxidant in dermatological therapy, displayed good binding affinity (−7.3 kcal/mol for 5E1E) and formed π-alkyl and π-donor hydrogen bond interactions with residues such as TYR A:894 and LEU B:1010. These interactions reinforce its role in stabilizing the target proteins and mitigating oxidative stress–driven inflammation. The docking results complement its clinical utility in improving skin barrier function and reducing pruritus and inflammation in eczematous conditions.

Cannabidiol (CBD) exhibited moderate to strong binding (−6.8 to −6.4 kcal/mol) and formed multiple conventional hydrogen bonds, π-sigma, and π-anion interactions, notably with GLU A:1033. This diverse interaction profile indicates robust target engagement and supports CBD's reported ability to suppress inflammatory cytokines, regulate keratinocyte proliferation, and alleviate itching—key pathological features of both psoriasis and eczema. Turmerone, α-bisabolol, and 1,8-cineole demonstrated moderate binding affinities (−5.2 to −6.9 kcal/mol) with predominantly hydrophobic and occasional hydrogen-bonding interactions. α-Bisabolol and 1,8-cineole, known for their soothing, anti-irritant, and anti-inflammatory properties, showed stable interactions with residues involved in the binding pocket, suggesting their supportive role in reducing skin inflammation and irritation, particularly in eczema. Therefore, the predominance of hydrophobic interactions (π-alkyl, π-sigma) across most ligands reflects the lipophilic nature of the binding cavity, favoring phytochemicals with terpenoid and phenolic scaffolds. The presence of conventional and carbon hydrogen bonds further enhances complex stability, indicating potential inhibitory effects on inflammation-related targets. Proposed mechanisms require further experimental validation.

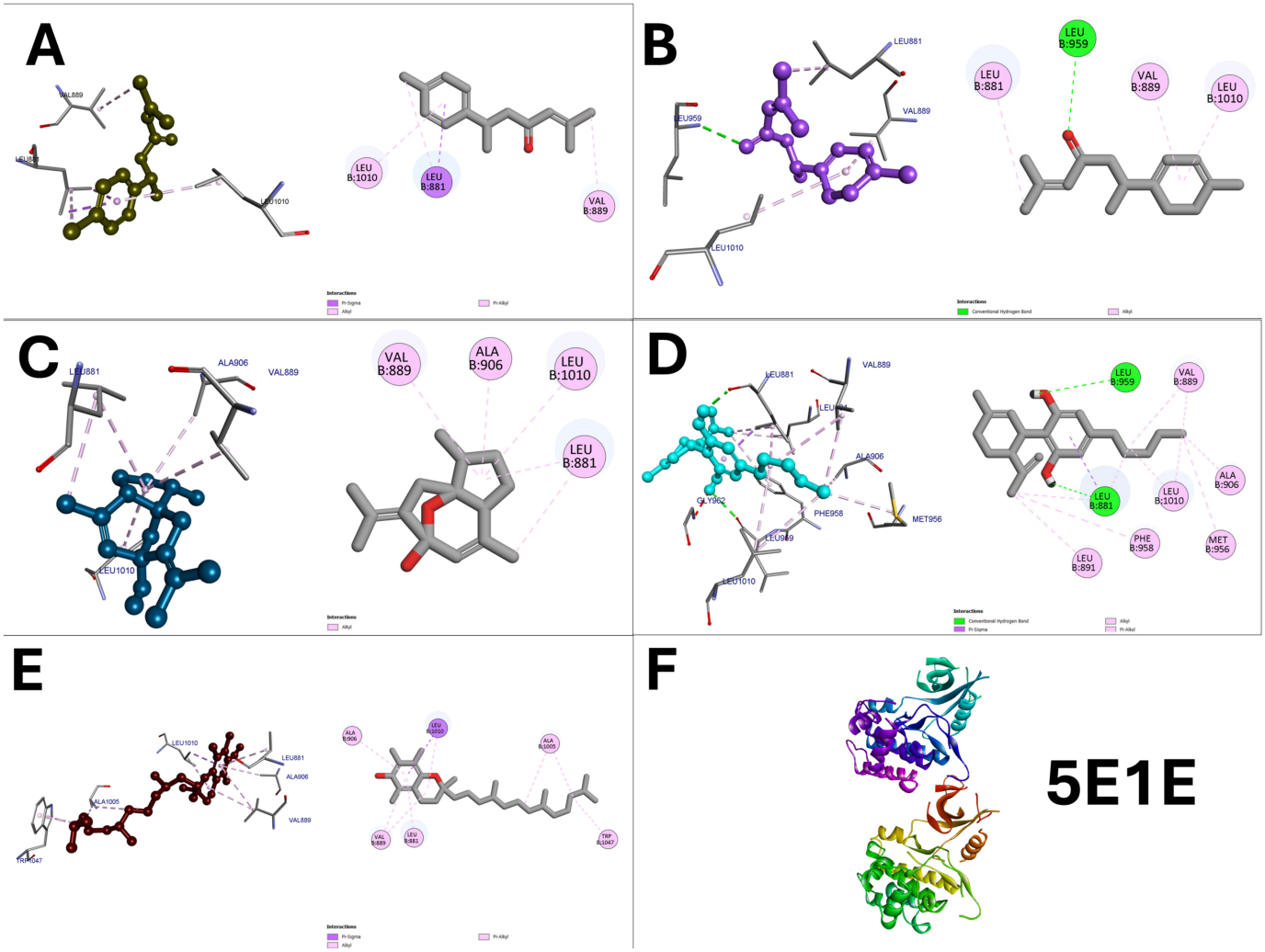


Figure 10. Two- and three-dimensional structures of ligands and proteins in molecular docking against 5E1E. (**A**) αR-turmerone; (**B**) Tumerone; (**C**) Curcumenol; (**D**) Cannabidiol; and (**E**) Vitamin E; (**F**) 5E1E as protein in molecular docking.

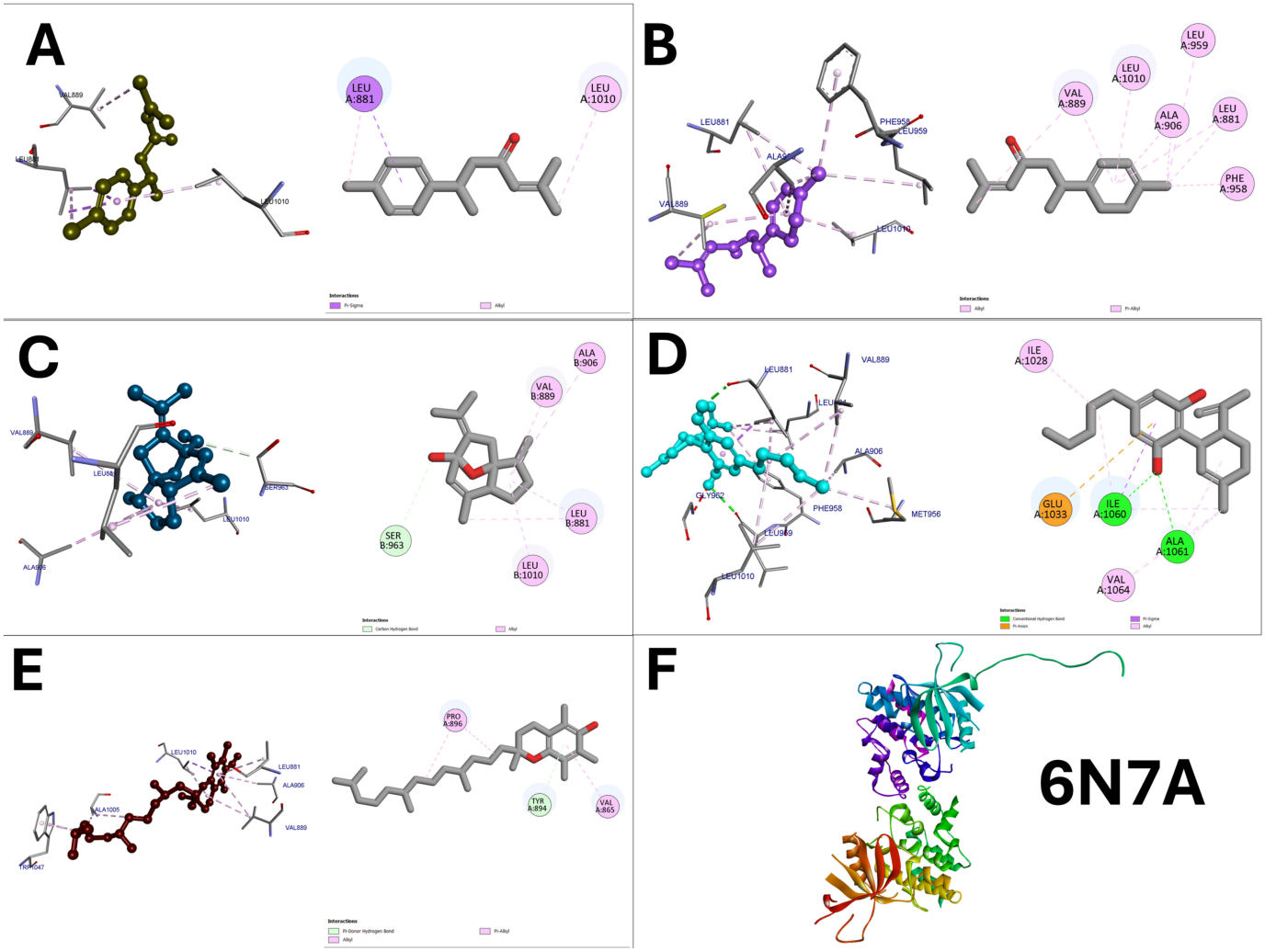


Figure 11. Two- and three-dimensional structures of ligands and proteins in molecular docking against 6N7A. (**A**) αR-turmerone; (**B**) Tumerone; (**C**) Curcumenol; (**D**) Cannabidiol; and (**E**) Vitamin E; (**F**) 6N7A as protein in molecular docking.

Traditional Thai herbal medicine provides a theoretical basis for the treatment of eczema and psoriasis. The findings indicated that successful treatment of eczema and psoriasis with the topical herbal cream derived from its antioxidant and anti-inflammatory activities, promoting healing and protecting the skin's barrier function. These results were in accordance with a previous study that applied a combination of antioxidant and anti-inflammatory molecules as a therapeutic strategy to ameliorate the clinical symptoms of eczema and psoriasis patients [50,51]. Thai herbal formulations including *C. sativa* and *C. longa* are important sources for research on novel eczema and psoriasis treatments due to their wide diversity of biological compounds and activity (Table 2). Cannabinoids, the active constituents of *C. sativa*, and their derivatives are known to have anti-inflammatory properties, immunological activity, and anti-proliferative effects on keratinocytes that can be utilized for eczema and psoriasis treatment [9,10]. Two major phytocannabinoids, THC and CBD, are derived from *C. sativa*. The bioactive compounds THC and CBD interact with the human endocannabinoid system in the skin, helping to reduce inflammation and alleviate symptoms of eczema and psoriasis [11–13]. Curcumin, the main active ingredient extracted from *C. longa*, has been proposed as a treatment for eczema and psoriasis. Curcumin has been claimed to have potent anti-inflammatory effects with potential mechanisms of action identified, such as suppression of pro-inflammatory cytokines (TNF-α, IL-1β, IL-6, and

IL-17), inhibition of iNOS, cyclooxygenase-2 (COX-2), prostaglandin E2 (PGE2), and NO production, and downregulation of the MAPK (P38, JNK, ERK) pathway [14,15]. Increasing evidence has shown that herbal products' structural diversity and multidirectional mechanisms of action have synergistic activity in the treatment of eczema and psoriasis [52,53]. The combined mechanisms of cannabinoid receptor inhibition, pro-inflammatory cytokine production, NO reduction, and MAPK pathway inhibition by the topical herbal cream are considered therapeutic strategies to treat eczema and psoriasis.

4. Conclusions

The present findings indicate that a topical herbal formulation containing *C. sativa* and *C. longa* includes cannabinoids, terpenoids, and curcuminoids exhibiting quantifiable antioxidant properties. The herbal formulation demonstrated minimal cytotoxicity and a moderate reduction in nitric oxide synthesis in LPS-activated macrophages. Docking studies indicated beneficial interactions between specific phytochemicals and targets related to inflammation. Preliminary clinical findings suggested that the herbal cream improves the EASI, PASI, and DLQI scores among patients with eczema and psoriasis. The herbal cream exhibited antioxidant and anti-inflammatory properties and indicated beneficial preliminary clinical effects in eczema and psoriasis. However, the clinical observations were derived from a very limited sample size and should be interpreted cautiously. Further mechanistic investigations and adequately powered randomized controlled trials are required to validate efficacy, safety, and therapeutic mechanisms.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data and materials are all available within this article.

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