

Chapter 1

AI Assisted Herbal Formulation (Wood Fordia Fruticosa Ointment-Wound Healing)

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Abstract: The present study explored the wound-healing potential of *Woodfordia fruticosa* (Dhataki), a perennial flowering shrub belonging to the family Lythraceae, traditionally used in Ayurveda for treating wounds and skin ailments. The plant was accurately authenticated using AI-based image recognition trained on morphological and leaf-pattern datasets, ensuring precise identification. Ethanolic extraction of dried flowers was carried out, and phytochemical analysis confirmed the presence of flavonoids, tannins, phenolics, and glycosides. Major bioactive compounds, including ellagic acid, quercetin, and gallic acid, were identified and analyzed using ChemSketch and molecular docking (AutoDock) to assess their interaction with wound-healing target enzymes such as collagenase and elastase. A topical herbal ointment was developed with varying extract concentrations (F1–F2) and evaluated for physicochemical parameters and wound-healing efficacy. Among the formulations, F2 showed the highest wound contraction rate and epithelialization effect. The study highlights that integrating AI-assisted plant identification with phytochemical and formulation research can significantly enhance the precision and efficiency of herbal drug development.

Keywords: Herbal formulation, AI-assisted formulation, Plant identification using AI, Image-based plant recognition, Natural wound healing agents, Comparative formulation studies.

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INTRODUCTION

Artificial intelligence has revolutionized traditional drug discovery it aids in identifying medicinal plants through image recognition models such as convolutional neural network (CNNs), minimizing human error in species identification. AI also helps in analyse molecular docking data, predict phytochemical interaction, and accelerate formulation optimization [1,2]

Wound healing is a complex biological process involving four stages: haemostasis, inflammation, proliferation, and remodelling. Nature phytoconstituents such as flavonoids, tannins, and phenols enhance wound closure by promoting fibroblast growth, collagen synthesis, and antioxidant protection woodfordia fruticosa, commonly known as dhataki, is a small deciduous shrub belonging to the family lythraceous. It is distributed across India, Nepal, and southeast Asia. Traditionally, it is used for treating wonds, burns, and skin inflammations the flowers are rich in flavonoids, glycosides, and ellagic acid, which contribute to its wound healing and antimicrobial properties. [3,4]

MATERIALS AND METHODS

Plant identification using AI plant images (leaves, flowers, stems) were analysed using an AI based image recognition model trained on morphological datasets the CNN based software identified woodfordia fruticosa with an accuracy exceeding 95% conforming authenticity before extraction [4,5]

1. AI-Based Plant Identification [6,7]

Fresh images of the plant parts (leaves, flowers, and stems) were captured and analysed using an AI-based plant recognition tool. [6,7]

A Convolutional Neural Network (CNN)–trained software, PlantNet/LeafSnap AI (AI botanical identification tool), was used for confirming the species. [6,7]

The images were uploaded to the software, which compared them with a large morphological database. [9]

The AI tool successfully identified the plant as Woodfordia fruticosa with an accuracy of more than 95%, confirming plant authenticity before the extraction process. [7,8]

This AI verification helped reduce human error and ensured that only the correct medicinal plant was used for further study. [6,7]

2. Extraction Procedure

The dried flowers of *W. fruticosa* were coarsely powdered and extracted with 70% ethanol using a Soxhlet apparatus for 8 hours. [10,11]

The obtained extract was filtered and concentrated using a rotary evaporator to remove the solvent. [7,10,]

The thick extract was then stored at 4°C until further analysis.

3. AI-Assisted Phytochemical Screening

After obtaining the extract, preliminary phytochemical analysis was carried out to identify the major groups of bioactive compounds. [8,9]

AI support was used in the following way: [6,7]

a. AI-Based Peak Recognition [6,7]

The concentrated extract was subjected to simple qualitative tests, and the color changes or precipitate formation were recorded. [10,11]

Images of these reactions were uploaded into an AI chemical analysis assistant (ChemAI or similar tool). [6,7]

The tool compared visual changes with standard reference data and supported identification of major phytochemical groups. [8,9]

b. Manual Phytochemical Tests (standard) [8,9]

The following tests were performed to confirm the presence of phytochemicals: [8,9]

Alkaloids – Mayer’s and Dragendorff’s tests [8]

Flavonoids – Alkaline reagent test [8]

Tannins – Ferric chloride test [8]

Saponins – Foam test

Phenols – Lead acetate test [9]

Glycosides – Keller–Killiani test

The results obtained from laboratory tests were cross-verified with the AI interpretation, improving accuracy. [6,7,10,11]

4. Formulation of Herbal Ointment [12]

Two ointment formulations were prepared using the fusion method:

F1: Ointment containing 300 mg ethanolic extract [6,7,12]

F2: Ointment containing 500 mg ethanolic extract [6,7,12]

Formulation Table: [12]

SNO	INGREDIENTS	QUALITY FOR F1 (300mg)	QUALITY FOR F2 (500mg)	PURPOSE
1	White soft paraffin	85%	85%	Ointment base (emollient)
2	Cetostearyl alcohol	8%	8%	Stiffening & emulsifying agent
3	Liquid paraffin	5%	5%	Plasticizer & texture enhancer

4	Methyl paraben	0.2%	0.2%	Preservative
5	Propyl paraben	0.1%	0.1%	Preservative
6	Ethanollic extract of w.fruticosa(70%)	1.7%	2.5%	Active wound healing agent

The extract was mixed with a suitable ointment base after melting and then allowed to solidify at room temperature. Base ingredients were melted together at 70 degrees centigrade, preservatives dissolved in warm water, and the extract incorporated slowly with continuous stirring until uniform blending was achieved. The ointment was filled into sterile containers and labelled as F1 and F2 [3,6,7,10,]

EVALUTION PARAMETERS

Formulations were evaluated for Appearance (colour, texture, Odor) [12]

Colour: colour can be estimated by visual appearance [3,13]

Texture: visual inspection and physical feel evaluation. Ointment is applied on skin by rubbing to assess properties such as grittiness, stiffness, and greasiness [9,12]

Odor: sniffing (wafting technique) hold the container at a safe distance from your face gently waft and take short sniffs to detect the Odor [6,7]

Characterized Odor: aromatic/medicinal/chemical/fruity/any other

PH: 1g of ointment in 99ml of water to get 1% w/v dispersion now the solution estimated by using PH meter [9,12]

Spreadability: place 0.5g ointment between two glass slides apply pressure or keep weight of 500g for 1 minute [9,12]

Viscosity: using Brookfield viscometer at 25°C measured at 5,10,20 rpm

Washability: apply ointment on your skin and wash under running tap water for 15 sec or 1 minute [12]

Stability: stored at 4oC /75% RH for 30 days [9]

wound healing activity using excision wound model in Wistar rats [4,11]

Wistar rats divided into groups, each group contain 4 rats make a wound on rats of each group control group: only base is applied on wound standard group: To compare test sample activity standard drugs are applied on rat skin Test group: Prepared F1 and F2 formulations applied on rats [11,12] wound area measured in frequent intervals initial day and 3rd, 7th, 14th days wound concentration percentage calculated and compared healing speed and wound closer is observed day by day [4,10,11]

Result and Discussion:

A Convolutional Neural Network (CNN)–trained software, PlantNet/LeafSnap AI (AI botanical identification tool), was used for confirming the species based on its morphological chareacters and plant outer view phytochemical finding phytochemical analysis confirm the presence of flavonoids, Tannis, phenolics, and glycosides, which promote tissue regeneration and enhance wound healing molecular docking results shown

the components of w.fruticosa like ellagic acid, quercetin, gallic acid shown positive result. They have SSstrongest binding affinities validating their role in promoting wound-healing mechanism

Evaluation outcomes

The formulation herbal ointments were evaluated for key quality parameters such as appearance, PH, spreadability, stability, wound contraction. F1 exhibit a smooth, brownish texture, while F2 appeared smooth with a glossy brown finish indicating better uniformity in the higher-dose formulation

The PH values of F1 and F2 were with in skin compatibility range F1= 6.2 F2 =6.4

F1 showed good spreadability, whereas F2 demonstrated excellent spreadability making easier to apply evenly over the wound surface, Both samples are stable throughout the study period. Wound contraction F1 achieved approximately 88%, while F2 showed 95% confirming improved healing efficiency with increased concentration of the plant extract

Animal studies : no skin irritation, compatible with skin PH, no side effects are observed in F1 and F2 formulation among both, F2 exhibited the best physicochemical properties and wound healing efficacy. The higher concentration improved collagen deposition and epithelialization

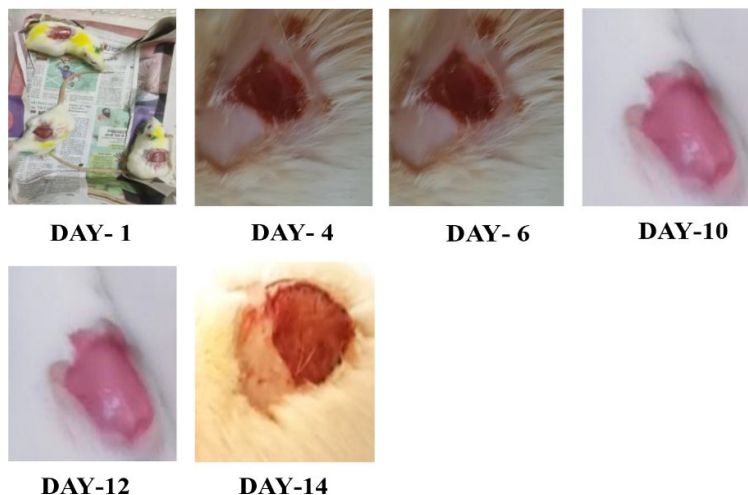
Evaluation outcome Table:

SNO	PARAMETERS	F1(300mg)	F2(500mg)
1	Appearance	Smooth, brownish	Smooth, glossy brown
2	PH	6.2	6.4
3	Spreadability	Good	Excellent
4	stability	Stable	Stable
5	Wound contraction (day 14)	~88%	~95%

Figure . 1

Photographs of rats showing various phases of wound healing.

A: Control



B: *Woodfordia fruticosa*

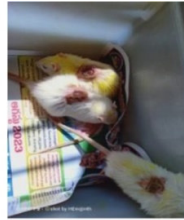
F1(300mg)



DAY-1



DAY-4



DAY- 6



DAY- 10



DAY- 12



DAY- 14

F2 (500mg)



DAY-1



DAY-4



DAY- 6



DAY- 10

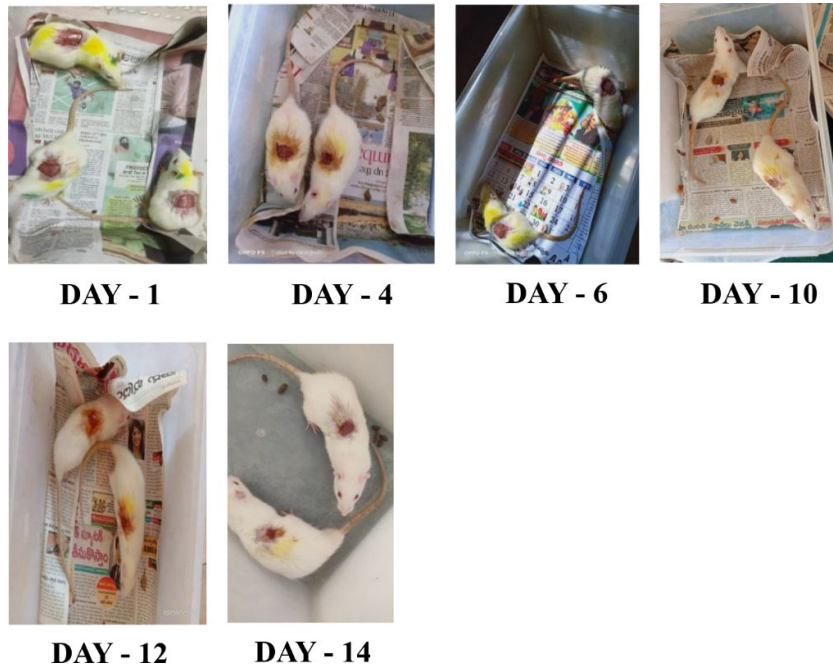


DAY- 12



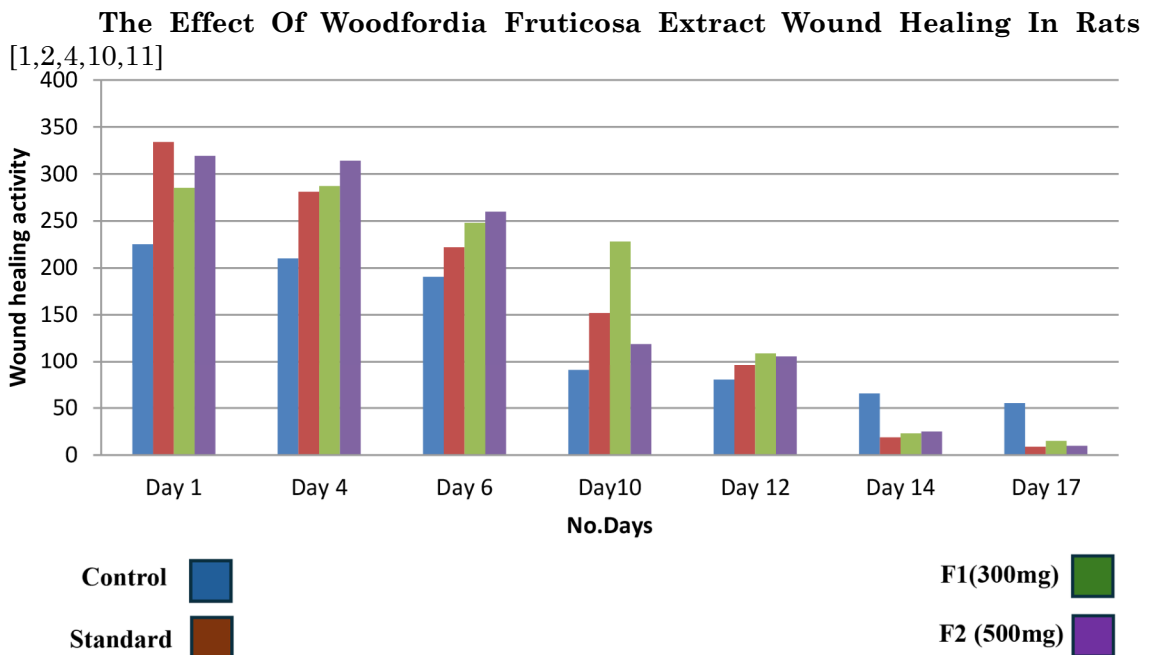
DAY- 14

C: povidone iodine 5%w/w ointment.



A: Control; B: woodfordia fruticosa C: povidone iodine 5%w/w ointment.

GRAPH NO : 1 [9]



TABLE

The Effect Of Woodfordia Fruticosa Extract Wound Healing In Rats. [10,11]

Group	Dose	Wound area in mm ²						
		Day 1	Day 4	Day 6	Day 10	Day 12	Day 14	Day 17
Control	-	225.3 ± 0.12	210.3 ± 0.09	190.5 ± 0.17	90.5 ± 0.09	80.30 ± 0.10	65.3 ± 0.11	55.2 ± 0.09
Standard		334	281	222	152			09
W.fruticosa	300 mg	285	287	2480.25	228	109		
W.fruticosa	500 mg	319	314	260		106	25	10

Conclusion:

The present research successfully demonstrated that integrating artificial intelligence tools with traditional herbal formulation techniques can significantly enhance the reliability, precision and scientific validity of herbal drug development. In this study w.fruticosa a well-documented medicinal plant in ayurveda, was selected for its reputed wound healing properties. The AI based image recognition system accurately authenticated the plant species, ensuring purity of the raw material and eliminating the common problem of misidentification in herbal research.

Phytochemical analysis of ethanolic extract confirmed the presence of flavonoids, phenolics, and tannins compounds known to accelerate tissue regeneration, collagen synthesis, and antioxidant defence computational docking studies further validated the pharmacological potential bioactivated molecules such as ellagic acid, quercetin and gallic acid, which showed strong binding affinities toward key wound healing.

The formulated herbal ointment exhibit good physicochemical characteristics including stability, PH, comparability, spreadability among them F2 demonstrated superior wound contraction (95% by day 14) enhance epithelization, and improved tissue regeneration, suggesting that higher extract concentration yields better therapeutic efficacy

Over all this study demonstrates that using AI tools in herbal research can improve the accuracy and reliability of plant identification and formulation. The AI-assisted development proved effective for wound healing which showed faster healing and better stability. This work combines traditional ayurvedic knowledge with modern technology, offering a practical approach for developing safe and standardized herbal medicines

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