

Development and Evaluation of a Polymeric Wound Dressing Containing *Commiphora wightii* Extract and Epidermal Growth Factor for Enhanced Wound Healing

Singh A^{1*}, Chauhan R D², Kannojiya P³

¹M.Pharm (Pharmacology), Research Scholar, BIU COP, Bareilly International University, Pilibhit Bypass Road, Bareilly, Uttar Pradesh 243006, India

²Professor, BIU COP, Bareilly International University, Pilibhit Bypass Road, Bareilly, Uttar Pradesh 243006, India

³Principal, BIU COP, Bareilly International University, Pilibhit Bypass Road, Bareilly, Uttar Pradesh 243006, India

*Corresponding Author: Singh A, M.Pharm (Pharmacology), Research Scholar, BIU COP, Bareilly International University, Pilibhit Bypass Road, Bareilly, Uttar Pradesh 243006, India

Email: singhabhi029112000@gmail.com

ABSTRACT

Wound repair is a coordinated process involving inflammation, tissue proliferation, extracellular matrix formation and re-epithelialization. Polymeric wound dressings can provide a local platform for combining bioactive plant constituents with growth factors. The present study focused on the development and evaluation of a wound dressing film containing ethanolic extract of *Commiphora wightii*, alone and in combination with Epidermal Growth Factor (EGF). The oleo-gum resin was extracted by Soxhlet extraction using 70% ethanol and gave a 6.28% w/w yield. Preliminary phytochemical screening reported alkaloids, flavonoids, tannins, phenolic compounds, glycosides, saponins, triterpenoids and fixed oils. Films were prepared by solvent casting using polyvinyl alcohol and chitosan with glycerol as plasticizer. The extract film and extract + EGF film showed surface pH values of 6.58 and 6.74, respectively, with tensile strengths of 2.84 and 3.41 and folding endurance values of 302 and 317. Wound-healing activity was evaluated in an excision wound model using 30 Wistar rats divided into five groups (n=6). Wound area was recorded on days 0, 4, 8, 12 and 16. By day 16, the wound area was $6.24 \pm 1.08 \text{ mm}^2$ in the extract-film group and $0.00 \pm 0.00 \text{ mm}^2$ in the extract + EGF group, compared with $15.62 \pm 2.14 \text{ mm}^2$ for 1% silver sulfadiazine. The corresponding epithelialization periods were 13.24 ± 0.42 and 11.76 ± 0.38 days. The findings support further investigation of the combined plant-extract and EGF dressing in more detailed wound-healing models.

Keywords: *Commiphora wightii*; epidermal growth factor; wound dressing; chitosan; polyvinyl alcohol; excision wound; wound healing.

How to cite this article: Singh A^{1*}, Chauhan R D², Kannojiya P³. Development and Evaluation of a Polymeric Wound Dressing Containing *Commiphora wightii* Extract and Epidermal Growth Factor for Enhanced Wound Healing. *Int J Drug Deliv Technol.* 2026;16(86s):2244-2249. DOI: 10.25258/ijddt.16.86s.206

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Wound healing is a dynamic biological process in which hemostasis, inflammation, proliferation and tissue remodeling occur in a coordinated sequence. Successful repair depends on the interaction of inflammatory cells, fibroblasts, keratinocytes, endothelial cells, extracellular matrix components and multiple signaling molecules. Disturbance of any of these phases can delay closure and increase the risk of persistent tissue damage or infection.¹⁻⁴

The wound dressing is therefore more than a physical covering. A suitable dressing can protect the

wound, manage moisture and exudate, reduce external contamination and provide a local environment that supports cell migration and tissue repair. Polymeric systems have attracted attention because they can be engineered for flexibility, adhesion and controlled delivery of therapeutic agents. Chitosan, in particular, has been widely investigated in wound-care systems because of its film-forming and biocompatible characteristics.^{1,5-7}

Growth factors represent another approach to improving repair. Epidermal Growth Factor (EGF) is associated with the proliferation and migration of

epithelial cells and has therefore been investigated as a component of strategies intended to accelerate re-epithelialization. Combining a growth factor with a polymeric matrix may allow local administration at the wound site while reducing dependence on repeated systemic exposure.^{1,8}

Medicinal plants are also being explored as sources of multifunctional wound-healing constituents. *Commiphora wightii*, traditionally valued for its oleo-gum resin, contains phytochemical constituents that have been investigated in relation to anti-inflammatory and antioxidant activity. The thesis underlying the present work selected *C. wightii* resin as the herbal component of a topical polymeric dressing and combined it with EGF to evaluate whether the formulation could support wound contraction and epithelialization.

The present study was therefore undertaken to develop a polymeric wound dressing film containing ethanolic extract of *C. wightii* and to compare an extract-only film with an extract + EGF film using an excision wound model. The study also examined basic physicochemical characteristics of the films and monitored local safety observations during the experimental period.

MATERIALS AND METHODS

Plant material and authentication

The oleo-gum resin of *Commiphora wightii* was used as the plant material. According to the thesis record, the material was authenticated by Dr. Alok Shrivastava, Professor, Department of Plant Science, Mahatma Jyotiba Phule Rohilkhand University, Bareilly, Uttar Pradesh. A voucher specimen was deposited in the departmental herbarium under voucher number RU/PS/PS/2025-16.

Extraction of *Commiphora wightii*

Fifty grams of crude resin were subjected to Soxhlet extraction using 500 mL of 70% ethanol. Extraction was continued for approximately 6–8 h. The extract was concentrated using a rotary evaporator followed by desiccation. The dried extract weighed 3.14 g, corresponding to a reported extraction yield of 6.28% w/w.

Preliminary phytochemical screening

The ethanolic extract was screened using the qualitative procedures described in the thesis for alkaloids, carbohydrates, glycosides, saponins, flavonoids, tannins and phenolic compounds, steroids and triterpenoids, proteins, and fixed oils/fats. The results reported in the thesis indicated the presence of alkaloids, flavonoids, tannins, phenolic compounds, glycosides, saponins, triterpenoids and fixed oils.

Preparation of polymeric wound dressing films

The films were prepared by the solvent-casting method. A 10% w/v PVA solution was prepared in distilled water by heating at 80–90°C with continuous

stirring until a clear solution was obtained. Chitosan (2% w/v) was dissolved in 1% v/v acetic acid. The PVA and chitosan solutions were blended in a 70:30 ratio and stirred for 30–45 min. The required quantity of *C. wightii* extract was incorporated with continuous stirring. Glycerol (0.5–1% w/v) was added as plasticizer. For the combined formulation, EGF was incorporated aseptically after cooling to room temperature, with gentle stirring to avoid excessive agitation. The mixture was allowed to stand or sonicated for 5–10 min to remove trapped air, cast in sterile Petri dishes and dried at 40°C for 24 h. Films of approximately 2 × 2 cm were cut for evaluation and application.

Ingredient	Concentration	Function
PVA	10% w/v	Film-forming polymer
Chitosan	2% w/v	Biopolymer
<i>C. wightii</i> ethanolic extract	Required quantity	Herbal bioactive agent
EGF	Required quantity	Growth factor
Glycerol	0.5–1% w/v	Plasticizer
Acetic acid	1% v/v	Solvent for chitosan
Distilled water	q.s.	Vehicle

Table 1. Composition of the polymeric wound dressing films.

Physicochemical evaluation

The prepared films were evaluated for appearance, surface pH, tensile strength, moisture content, folding endurance, weight variation, thickness, swelling index and percentage elongation at break. The thesis states that physicochemical measurements were performed in triplicate and expressed as mean ± SD. The reported values are summarized in Table 2.

Parameter	<i>C. wightii</i> extract film	<i>C. wightii</i> extract + EGF film
Surface pH	6.58	6.74
Tensile strength	2.84	3.41
Moisture content	7.2	7.6
Folding endurance	302	317
Weight variation	0.41	0.43
Thickness	0.24	0.26
Swelling index	186.2	214.5
Elongation at break (%)	71.4	82.1

Table 2. Physicochemical characteristics of the prepared films. Values are reported as given in the thesis.

Experimental animals and ethical approval

Healthy adult Wistar albino rats of either sex weighing 180–220 g were used. Thirty animals were acclimatized for one week and housed under standard laboratory conditions of $25 \pm 2^\circ\text{C}$, $55 \pm 5\%$ relative humidity and a 12 h light/12 h dark cycle, with standard pellet diet and water ad libitum. The experimental protocol was approved by the Institutional Animal Ethics Committee (IAEC), BIU College of Pharmacy, Bareilly International University, under approval number CAH/BIU/2026/008 dated 21 February 2026. The CPCSEA registration number reported in the thesis was 2293/PO/ReBi/S/2024/CCSEA, dated 14 April 2024. The excision-wound procedures were performed under ketamine anaesthesia (50 mg/kg, intraperitoneally), with anaesthetic depth assessed by loss of pedal reflex and response to external stimuli. The source thesis does not specify an analgesic regimen or euthanasia procedure; these details should be verified against the original laboratory record before submission.

Excision wound model and treatment

The dorsal thoracic region was selected as the wound site. Hair was removed, the skin was cleaned with 70% ethanol and disinfected with povidone-iodine. A sterile template was used to mark the wound area, and a full-thickness excision of approximately 500 mm² was produced without removal of underlying muscle. Bleeding was controlled using sterile cotton. The assigned formulations were applied topically once daily for 16 consecutive days. Wound area was recorded on days 0, 4, 8, 12 and 16.

Gro up	Treatm ent	Dose/applic ation	Rout e	Freque ncy	n
I	Healthy control	None	—	—	6
II	Disease control	Untreated	—	—	6
III	Standar d	1% silver sulfadiazine, 0.2 g/wound	Topi cal	Once daily	6
IV	Extract film	50 mg C. wightii extract/wou nd	Topi cal	Once daily	6
V	Extract + EGF film	50 mg extract + 10 µg EGF/wound	Topi cal	Once daily	6

Table 3. Experimental design of the excision wound-healing study.

Measurement of wound area and epithelialization

Wound area was measured on days 0, 4, 8, 12 and 16. The period of epithelialization was recorded

for each experimental group. Safety observations included erythema, edema, skin irritation, infection, allergic reaction, general behaviour and mortality, as reported in the thesis.

Statistical analysis

The thesis states that experimental values were expressed as mean $\pm$ SEM and that comparisons among the five groups were performed using one-way ANOVA followed by Tukey's multiple-comparison post hoc test, with $p < 0.05$ considered statistically significant. The wound-area results table itself is reported as mean $\pm$ SD ($n=6$); therefore, the presentation below retains the dispersion format reported in that table. The thesis provides day-wise significance summaries but does not provide the underlying exact p-values or group-by-group post hoc outputs.

RESULTS

Extraction and phytochemical screening

Soxhlet extraction of 50 g of *C. wightii* resin with 70% ethanol yielded 3.14 g of dried extract, corresponding to 6.28% w/w. The thesis describes the extract as semi-solid, dark brown, with a characteristic aromatic odour and sticky consistency. Qualitative phytochemical screening reported alkaloids, flavonoids, tannins, phenolic compounds, glycosides, saponins, triterpenoids and fixed oils as present.

Physical characteristics of the films

The prepared films were described as smooth and uniform, with a pale yellow to light-brown appearance, good flexibility and satisfactory homogeneity without visible air bubbles. The extract-only film showed a surface pH of 6.58, while the extract + EGF film showed a surface pH of 6.74. The combined film also showed higher tensile strength (3.41) and folding endurance (317) than the extract-only film (2.84 and 302, respectively). The reported swelling index and elongation at break were 186.2 and 71.4% for the extract film and 214.5 and 82.1% for the extract + EGF film, respectively.

Wound-healing activity

All groups began with the same wound area of 500 mm². The wound area decreased progressively over the 16-day observation period. The decrease was more pronounced in the treated groups, particularly the extract-containing films. On day 16, the residual wound area was 168.46 ± 5.72 mm² in the healthy control group and 62.14 ± 3.48 mm² in the untreated disease-control group. The corresponding values were 15.62 ± 2.14 mm² with 1% silver sulfadiazine, 6.24 ± 1.08 mm² with the *C. wightii* extract film and 0.00 ± 0.00 mm² with the *C. wightii* extract + EGF film.

Group	Day 0	Day 4	Day 8	Day 12	Day 16
-------	-------	-------	-------	--------	--------

I – Healthy control	500.0 0 ± 0.00	452.8 0 ± 8.74	381.5 4 ± 7.96	279.8 2 ± 6.84	168.4 6 ± 5.72
II – Disease control	500.0 0 ± 0.00	438.2 4 ± 8.43	336.7 2 ± 7.24	204.3 8 ± 5.82	62.14 ± 3.48
III – 1% silver sulfadiazine	500.0 0 ± 0.00	420.3 6 ± 8.21	288.6 4 ± 6.95	122.8 4 ± 5.36	15.62 ± 2.14
IV – Extract film	500.0 0 ± 0.00	392.1 6 ± 7.52	246.4 8 ± 6.18	84.62 ± 1.08	6.24 ± 1.08
V – Extract + EGF film	500.0 0 ± 0.00	364.4 2 ± 7.14	186.5 4 ± 5.42	46.82 ± 3.28	0.00 ± 0.00

Table 4. Wound area during the experimental period. Values are mean ± SD, n=6, as reported in the thesis.

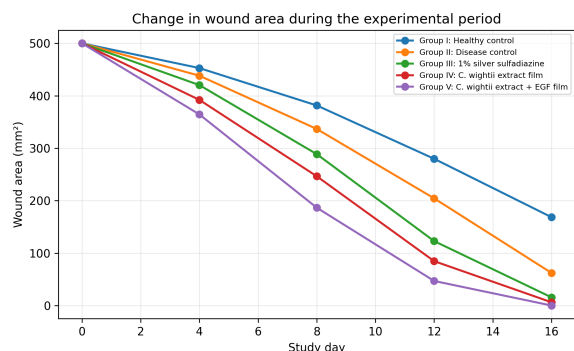


Figure 1. Change in wound area over the 16-day experimental period.

Statistical observations

The thesis reports no significant difference among groups on day 0 ($p > 0.05$). From day 4 onward, the wound-area comparisons were reported as statistically significant, with $p < 0.05$ on day 4, $p < 0.01$ on day 8 and $p < 0.001$ on days 12 and 16. Because the thesis does not provide the exact Tukey post hoc pairwise outputs, the present article does not assign significance symbols to individual group pairs.

Period of epithelialization

The epithelialization period varied across the experimental groups. The values reported were 18.62 ± 0.72 days for the healthy control, 14.18 ± 0.48 days for the disease control, 16.34 ± 0.56 days for the silver sulfadiazine group, 13.24 ± 0.42 days for the extract-film group and 11.76 ± 0.38 days for the extract + EGF film group.

Group	Period of epithelialization (days)
I – Healthy control	18.62 ± 0.72
II – Disease control	14.18 ± 0.48
III – 1% silver sulfadiazine	16.34 ± 0.56

IV – Extract film	13.24 ± 0.42
V – Extract + EGF film	11.76 ± 0.38

Table 5. Period of epithelialization. Values are mean ± SD, n=6, as reported in the thesis.

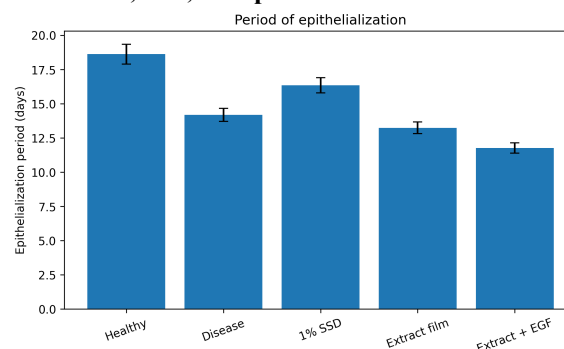


Figure 2. Period of epithelialization across the experimental groups.

Safety and skin irritation observations

The thesis reports absence of erythema, edema, skin irritation, infection and allergic reaction during the safety and skin-irritation assessment, with no mortality observed. The table in the thesis records “Absent” for general behaviour; because this wording is not interpretable as a conventional safety endpoint, the present article does not convert it into a positive or negative behavioural conclusion.

DISCUSSION

The present study used a polymeric film as a local delivery platform for an ethanolic extract of *C. wightii* and EGF. This approach is consistent with the broader rationale for advanced wound dressings, in which the dressing is expected not only to cover the wound but also to provide a suitable physical environment for repair and, where appropriate, deliver bioactive agents at the site of injury. Polymeric wound dressings have been investigated for this purpose because their composition can influence flexibility, moisture handling and drug or biomolecule delivery.^{1,5}

The extraction process yielded 6.28% w/w dried extract from the resin. The qualitative screening reported several classes of phytoconstituents, including flavonoids, tannins, phenolic compounds, glycosides, saponins and triterpenoids. These findings provide a phytochemical basis for further investigation of the extract, although the present study did not quantify individual constituents or directly measure antioxidant, anti-inflammatory or antimicrobial activity. Therefore, those biological activities should be regarded as possible explanations from the literature rather than mechanisms demonstrated by the current experiment.

The prepared films showed measurable mechanical and physical characteristics. The surface pH values of 6.58 and 6.74 were close to the range

expected for topical skin contact, while the extract + EGF film showed higher tensile strength, folding endurance and elongation at break than the extract-only film. The thesis interpretation is that these properties support better flexibility and structural stability. The present results establish these as formulation characteristics; they do not, by themselves, establish long-term stability or controlled release of EGF.

The *in vivo* results showed a progressive reduction in wound area in all groups, with a particularly marked reduction in the groups receiving the experimental films. By day 16, the extract + EGF film group reached a reported wound area of $0.00 \pm 0.00 \text{ mm}^2$, while the extract-only film group had $6.24 \pm 1.08 \text{ mm}^2$. The silver sulfadiazine group had $15.62 \pm 2.14 \text{ mm}^2$. The same pattern was reflected in the reported epithelialization periods, with 11.76 ± 0.38 days for the extract + EGF group and 13.24 ± 0.42 days for the extract-only film.

The combination of the extract with EGF may have contributed to the observed pattern because plant-derived constituents and growth factors can influence different components of tissue repair. EGF is associated with epithelial-cell proliferation and migration, whereas the thesis proposes antioxidant and anti-inflammatory contributions from the plant extract. However, the current study did not measure EGF release, cytokines, oxidative-stress markers, collagen deposition or molecular signaling. Thus, a synergistic mechanism cannot be established from the wound-area measurements alone and should be tested in future experiments.

An important strength of the study is that the same wound size was used at baseline and that wound area was assessed at multiple time points, allowing the trajectory of closure to be followed rather than relying only on the final observation. The study also included a conventional topical standard, silver sulfadiazine, which provides a useful comparator. At the same time, the interpretation should remain limited to the acute excision-wound model. The thesis does not provide detailed pairwise post hoc *p*-values, molecular endpoints, a formal release study for EGF, or detailed long-term stability data for the films. These limitations should be addressed before conclusions are extended to chronic wounds or clinical use.

CONCLUSION

The study developed polymeric wound dressing films containing ethanolic extract of *Commiphora wightii*, with and without Epidermal Growth Factor, using PVA and chitosan as the principal film-forming polymers. The films showed acceptable basic physicochemical characteristics and were tolerated in the reported skin-safety observations. In the excision

wound model, the extract-containing films produced progressive reductions in wound area, and the extract + EGF formulation reached a reported wound area of $0.00 \pm 0.00 \text{ mm}^2$ by day 16 with an epithelialization period of 11.76 ± 0.38 days. These findings support further controlled studies examining formulation stability, EGF release, histopathological changes and molecular markers of repair before any clinical translation is considered.

ETHICS STATEMENT

The animal study was approved by the Institutional Animal Ethics Committee (IAEC), BIU College of Pharmacy, Bareilly International University, approval no. CAH/BIU/2026/008 dated 21 February 2026, and was conducted according to CPCSEA guidelines. Ketamine (50 mg/kg, intraperitoneal) was used for anaesthesia during wound creation. No mortality occurred during the study; therefore, no euthanasia procedure was performed.

ACKNOWLEDGEMENTS

The authors acknowledge BIU College of Pharmacy, Bareilly International University, for providing the academic and laboratory setting for the study, and the Institutional Animal Ethics Committee for review and approval of the experimental protocol.

FUNDING

External funding was not specified in the source thesis.

CONFLICT OF INTEREST

A conflict-of-interest declaration was not specified in the source thesis and should be confirmed by all authors before submission.

REFERENCES

1. Boateng JS, Matthews KH, Stevens HNE, Eccleston GM. Wound healing dressings and drug delivery systems: a review. *J Pharm Sci*. 2008;97(8):2892–2923. doi:10.1002/jps.21210.
2. Guo S, DiPietro LA. Factors affecting wound healing. *J Dent Res*. 2010;89(3):219–229. doi:10.1177/0022034509359125.
3. Gonzalez AC, Costa TF, Andrade ZA, Medrado AR. Wound healing: a literature review. *An Bras Dermatol*. 2016;91(5):614–620.
4. Wilkinson HN, Hardman MJ. Wound healing: cellular mechanisms and pathological outcomes. *Open Biol*. 2020;10(9):200223. doi:10.1098/rsob.200223.
5. Frykberg RG, Banks J. Challenges in the treatment of chronic wounds. *Adv Wound Care*. 2015;4(9):560–582.
6. Sen CK, Gordillo GM, Roy S, Kirsner R, Lambert L, Hunt TK, et al. Human skin wounds: a major and snowballing threat to public health and the economy. *Wound Repair Regen*. 2009;17(6):763–771.

7. Atiyeh BS, Costagliola M, Hayek SN, Dibo SA. Effect of silver on burn wound infection control and healing: review of the literature. *Burns*. 2007;33(2):139–148.
8. Dhivya S, Padma VV, Santhini E. Wound dressings – a review. *Biomed Res Int*. 2015;2015:1–12.
9. Ahmed S, Ikram S. Chitosan and its derivatives: a review in recent innovations. *Int J Pharm Sci Res*. 2016;8(1):1–6.
10. Dash M, Chiellini F, Ottenbrite RM, Chiellini E. Chitosan—A versatile semi-synthetic polymer in biomedical applications. *Prog Polym Sci*. 2011;36(8):981–1014.
11. Rinaudo M. Chitin and chitosan: properties and applications. *Prog Polym Sci*. 2006;31(7):603–632.
12. Peppas NA, Bures P, Leobandung W, Ichikawa H. Hydrogels in pharmaceutical formulations. *Eur J Pharm Biopharm*. 2000;50(1):27–46.
13. Winter GD. Formation of the scab and the rate of epithelialization of superficial wounds in the skin of the young domestic pig. *Nature*. 1962;193:293–294.
14. Singer AJ, Clark RAF. Cutaneous wound healing. *N Engl J Med*. 1999;341(10):738–746. doi:10.1056/NEJM199909023411006.
15. Martin P. Wound healing—aiming for perfect skin regeneration. *Science*. 1997;276(5309):75–81.
16. Eming SA, Krieg T, Davidson JM. Inflammation in wound repair: molecular and cellular mechanisms. *J Invest Dermatol*. 2007;127(3):514–525.
17. Gurtner GC, Werner S, Barrandon Y, Longaker MT. Wound repair and regeneration. *Nature*. 2008;453(7193):314–321.
18. Velnar T, Bailey T, Smrkolj V. The wound healing process: an overview of the cellular and molecular mechanisms. *J Int Med Res*. 2009;37(5):1528–1542.
19. Broughton G 2nd, Janis JE, Attinger CE. The basic science of wound healing. *Plast Reconstr Surg*. 2006;117(7 Suppl):12S–34S.
20. Diegelmann RF, Evans MC. Wound healing: an overview of acute, fibrotic and delayed healing. *Front Biosci*. 2004;9:283–289.
21. Schultz GS, Sibbald RG, Falanga V, Ayello EA, Dowsett C, Harding K, et al. Wound bed preparation: a systematic approach to wound management. *Wound Repair Regen*. 2003;11 Suppl 1:S1–S28.
22. Ratner BD, Hoffman AS, Schoen FJ, Lemons JE, editors. *Biomaterials Science: An Introduction to Materials in Medicine*. 3rd ed. London: Elsevier; 2013.
23. Indian Pharmacopoeia Commission. *Indian Pharmacopoeia*. Ghaziabad: Indian Pharmacopoeia Commission; 2022.
24. Central Drugs Standard Control Organization / CPCSEA. *Guidelines for Laboratory Animal Facility*. New Delhi: Government of India; 2023.
25. National Research Council. *Guide for the Care and Use of Laboratory Animals*. 8th ed. Washington (DC): National Academies Press; 2011.