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EVALUATION OF WOUND HEALING ACTIVITY OF THE CRUDE EXTRACTS *MALVA NEGLACTA* (MALVACEAE) ROOT IN ALBINO RATS

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ABSTRACT

Malva neglecta Wallr. (common mallow), a member of the family Malvaceae, is a widely distributed medicinal plant traditionally used in various systems of medicine for the treatment of wounds, inflammatory disorders, respiratory ailments, gastrointestinal diseases, skin infections, and urinary tract disorders. The plant is rich in bioactive constituents, including alkaloids, flavonoids, tannins, saponins, hydroxycinnamic acids, anthocyanins, proanthocyanidins, organic acids, proteins, oils, and mucilage, which contribute to its diverse pharmacological activities. Traditional medicinal practices across Asia, Europe, and the Middle East have extensively utilized different parts of the plant, such as leaves, flowers, roots, stems, fruits, and seeds, for their therapeutic benefits. Experimental studies have demonstrated that *M. neglecta* possesses antimicrobial, antioxidant, anti-inflammatory, anti-ulcerogenic, hepatoprotective, anti-urolithiasis, anticholinesterase, angiotensin-converting enzyme inhibitory, α -amylase inhibitory, α -glucosidase inhibitory, pancreatic lipase inhibitory, and wound-healing activities. The presence of mucilage and polyphenolic compounds plays a significant role in promoting tissue repair by reducing inflammation, scavenging free radicals, and enhancing collagen synthesis during wound healing. This review summarizes the botanical profile, geographical distribution, traditional uses, phytochemical composition, and pharmacological properties of *M. neglecta*, with particular emphasis on its therapeutic potential in wound

management. The compiled evidence highlights the plant as a promising source of bioactive compounds for the development of safe and effective herbal formulations, while also emphasizing the need for further preclinical and clinical investigations to validate its traditional claims and establish its clinical efficacy.

Keywords: *Malva neglecta*, Common mallow, Wound healing, Phytochemistry, Traditional medicine, Pharmacological activities, Medicinal plants

INTRODUCTION

Wounds are physical injuries that result in an opening or break of the skin [1]. It is a process that is fundamentally a connective tissue response. Initial stage of this process involves an acute inflammatory phase followed by synthesis of collagen and other extracellular macromolecules that helps in the formation of a scar. This intricate process that is initiated in response to an injury restores the function and integrity of damaged tissues [2]. This dynamic process is briefly divided into three overlapping phases “inflammation, proliferation and remodeling [3]. There are various natural agents, which assist in wound healing process and one of the folkloric plant that is amply available was selected for the present experimentation.

Malva neglecta is a species of plant of the family Malvaceae, native to most of the Old World except sub-Saharan Africa. It is an annual growing to 0.6 m (2 ft). It is known as common mallow in the United States and also as button weed, cheeseplant, cheeseweed, dwarf mallow, and roundleaf mallow [4, 5]. This plant is often consumed as a food, with its leaves, stalks and seed all being considered edible [6-

8]. This is especially true of the seeds, which contain 21% protein and 15.2% fat [9].

Malva neglecta is a common traditionally used medicinal plant, contained alkaloids, tannins, saponins, hydroxycinnamic acids, flavonoids, flavonols, proanthocyanidins, anthocyanins, organic acids, protein, oils and sugars. It possessed antimicrobial, antioxidant, anti-inflammatory, anti-ulcerogenic, hepatoprotective, anti-urolithiasis, anticholinesterase and angiotensin converting enzyme, α -amylase, α -glucosidase and pancreatic lipase inhibitory effects. This current review highlighted the chemical constituents and pharmacological effects of *Malva neglecta*.

Plant profile:

Synonyms: *Malva neglecta* is the only accepted name of this species [10].

Taxonomic classification: **Kingdom:** Plantae, **Subkingdom:** Tracheobionta, **Superdivision:** Spermatophyta, **Division:** Magnoliophyta, **Class:** Magnoliopsida, **Subclass:** Dilleniidae, **Order:** Malvales, **Family:** Malvaceae, **Genus:** *Malva*, **Species:** *Malva neglecta* [11].

Common names: Arabic: Khubbaizah; English: common mallow, dwarf mallow; German: Käsepappel, Weg-Malve; Swedish: skär kattost; Turkey: ebegumeci, develik, gomec, komec, ebegomeci, toluk [12-15].

Distribution: It is native to Africa (Macaronesia, Algeria, Morocco); Asia (Saudi Arabia, Azerbaijan, Georgia, China, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Mongolia, Afghanistan, Iran, Iraq, Palestine, Jordan, Lebanon, Syria, Turkey, India, Pakistan); Europe (Belarus, Lithuania, Moldova, Ukraine, Austria, Belgium, Czech Republic, Germany, Hungary, Netherlands, Poland, Slovakia, Switzerland, Denmark, Ireland, Norway, Sweden, United Kingdom, Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Italy, Macedonia, Montenegro, Romania, Serbia, Slovenia, France, Portugal, Spain); and has become naturalised outside its native range, in temperate regions [16-21].

Traditional uses: Due to its high mucilage content, it was used as soothing demulcent herbs, especially for cases of inflammation, either for the urinary, digestive or respiratory systems. Pregnant women or new mothers used mallow leaves as a source of iron, zinc and vitamins. *Malva neglecta* was substituted for spinach in many dishes, including soups, salads, gnocchi and quiche [17]. Leaves and

flowers were used for the treatment of constipation, sore throat, women sterility, wound, hemorrhoids, miscarriage swellings, rheumatic pain, stomachache, abdominal pain, abscess, renal diseases, cough, throat infection, common cold, bronchitis, peptic ulcer and indigestion. Stems and roots were used as abortifacient [18]. *Malva neglecta* was used in the treatment of common cold and to relieve cough in different parts of Iran. It was also used as a valuable and useful medicine to relieve the bruise, inflammation and mosquito bite. It was consumed for the treatment of urinary tract or digestive system diseases as well. The pulverized mallow seeds are used to treat bladder ulcers and coughs [19]. In Italy the plant was used as tea in inflammation and as a gargle in sore throat. It also was also used to treat acne, broken bones, help in abdominal pain and to treat swelling, dermatitis, burns and throat infection. *Malva neglecta* fruit was an edible traditional medicinal plant used in Anatolia to cure multiple medical conditions such as asthma, stomachache and diarrhea. It also used to promote maturation of abscesses, in wound healing, abdominal pains and cancer [20]. The plant was also used in mild cathartic [21].

Parts used medicinally:

Fruits, roots, stems, leaves, flowers and seeds [22-24].

MATERIALS AND METHODS

Materials: General surgical materials, anesthetic ether, povidone iodine having brand name (Betadine), Win medicare was obtained from Singhana market.

Collection and authentication of plant material

The indigenous whole plant was collected from nearby area Sonapat, (Haryana), India in the month of May 2025. *Malva neglecta* was selected on the basis of ethnomedical values of the plant. The whole plant of *Malva neglecta* was authenticated by a senior Botanist Dr. D.C Kasana; head of Department of Botany, I.P College of science, Bulandshahr (U.P), India.

Preparation of Extract

Shade dried Plant material was extracted by using Soxhlet apparatus. Aqueous and ethanolic extracts were made with the respective solvents. Each was kept for 24 hrs and then concentrated under vacuum to a thick paste which was further used for application to the rats.

Animals

Adult Wistar rats (180-200gms) of both sexes were procured from National Toxicology Centre, Hisar. Total 36 animals were divided into four groups (control, standard, aqueous extract treated and ethanolic extract treated) with 6 animals in each group. Animals were

housed under standard environmental conditions of temperature (23⁰ C) and 12 hours light and dark cycle. All the animals were provided with food and water ad libitum. Study protocol was approved by Institutional Animal Ethical Committee and conducted according to the guidelines of CPCSEA.

Acute dermal toxicity

Animals Adult Wistar rats (180-200gms) weight and age of 90 days were used to determine the dermal toxicity of test extracts. The toxicological study was carried out to determine the therapeutic dose of the aqueous and ethanol extracts as per the OECD guidelines. Testing of the ethanolic extract and the aqueous extract were done by applying the aqueous and ethanolic extracts of the highest concentrations on the shaved dorsal sides of the rats. Any type of adverse effect and death of rat were observed upto 24 hours. The acute toxicity test was performed according to the **OECD 423**.

Animal testing

For the in vivo wound experiment incision and excision wound models were used. Test extracts were prepared and diluted in double distilled water and applied at a dose of 200 mg/kg. Test extract was applied topically on the wounded site immediately after creating circular wounds by a surgical blade. The control group of animals was not treated with

any drug and wounds were kept open [25]. Whereas the standard drug treated group of animals were applied with reference drug cipladine [25-27].

Animals to be used

Healthy male inbred albino rats of Wistar strain, weighing between 180 - 200gm were used in the present study. They were be individually housed and maintained on normal diet and water ad libitum. Animal was periodically weighed before and after the experiments. The rats were anesthetized during infliction of wounds. The anesthetic administered was pentobarbitone at a dose of 30mg/kg of rat (as per CPCSEA guidelines). The surgical materials were sterilized and skin was prepared by clipping the fur. Rats showing signs of infection were excluded from the study.

Materials: General surgical materials, pentobarbitone, povidone iodine having brand name (Betadine), Win medicare was obtained from Singhana market.

Route of administration: The plant both extracts were subjected to topical administration. The experimental protocol approved by the Institutional Animal Ethics Committee (IEAC), experimental study was carried out under controlled condition. The animals are housed in group of 6 animals per cage and maintained at 20-30°C and 50-55% humidity in a natural light/ dark cycle with free access to food and water. The animals were divided into six groups each containing 6 rats.

Excision wound model

Swiss albino rats were divided into six groups (n=6). The different groups of animals are assigned as follows.

Groups	Concentration	Route of Administration	Animals
Control		Topical	6
Standard (Povidone Ointment)	10 %	Topical	6
Extract of Aqueous of <i>Malva neglacta</i> root	2%	Topical	6
	4%	Topical	6
Extract of ethanolic <i>Malva neglacta</i> root	2%	Topical	6
	4 %	Topical	6

The back of the animals was shaved and sterilized with 70% ethanol before 7 X 7 mm excision wound were created by a surgical blade from a predetermined shaved area on the back of each animal (Abu-Al-Basal, M.

2001). The wound was left undressed to the open environment and no local or systemic antimicrobial agents was used. This model was used to monitor the rate of wound contraction. The experimental groups were

topically applied with the extract twice daily for consecutive 16 days. The standard group treated with povidone iodine drug served as a reference. A progressive decrease in the wound area was monitored periodically at every 8th day interval. The wound contractions was measured by a tracing paper on the wounded margin and calculated as percentage reduction in wound area. The actual value was converted into percentage value taking the size of the wound at time of wounding as 100 % (Omale J. et al., 2010).

Wound healing analysis

Results obtained from excision wound models was analyzed i.e. wound contraction time and complete wound healing time. Result Expectation of Author from present study. The author expects a better result for both plant extract *Malva neglacta* root for its wound healing activity with its extracts. However, it was depend after the research that which of the extracts has maximum healing potentials.

Additionally, author's intention is towards the healing with the plants. Based on the above, the author was formulating a best of its semi solid dosage form. At last, author expects to develop a best of herbal formulation for wound healing and for the use by the mankind in future.

STATISTICAL ANALYSIS

Results obtained from the one wound healing models have been expressed as Mean $\pm$ SD and were compared with control group. The data were statically analyzed by Graph pad prism Software version (7.1).

RESULT & DISCUSSION

Screening For Wound Healing Activity of *Malva Neglacta*

Wound healing activity of *Malva Neglacta* was determined by topical route of administration Excision wound model. In this study six groups each of six animals taken. Animal groups treated as control (no medication), standard (Povidine iodine), 2% ethanolic extract of *Malva Neglacta*, 4 % ethanolic extract of *Malva Neglacta*, ad 2% Aqueous extract of *Malva Neglacta*, 4 % Aqueous extract of *Malva Neglacta*. It was observed that wound contraction in animal treated with 4% ethanolic extract and 4 % Aqueous extract of *Malva Neglacta* showed significant wound contraction from fourth day onwards and achieved 100% wound closure on 16th day. The Result showed (**Figure 1**) that the Aqueous extract (2% and 4%) were effective wound healing capacity than similar extract of ethanol. The Result showed that the Aqueous extract (2% and 4%) has effective wound healing capacity than similar extract of ethanol.

Table 1: Showing wound healing activity

S. No.	Days	Group A (mm)	Group B (mm)	Group C (mm)	Group D (mm)	Group C 1 (mm)	Group D1 (mm)
1	0	10	10	10	10	10	10
2	2	9	9	9	8	9	8
3	4	7	7	8	7	8	7.5
4	6	6	5	7.5	4	6.5	6.8
5	8	5	3	5	1	4.5	5
6	10	4	1	3.5	nil	3	3
7	12	3.5	nil	1		1.5	Nil
8	14	1		nil		1	
9	16	nil				nil	

Whereas Group A :- Control Group; B :- Standard Drug Group; C :- 2% Extract (Aqueous) Group; D :- 4% Extract (Aqueous) Group; C1 :- 2% Extract (ethanol) Group; D1 :- 4% Extract (ethanol)



Figure: 1 Showing wound healing activity

DISCUSSION

Wound healing is a complex and dynamic process of tissue repair which initially involves an acute inflammatory phase followed by the synthesis of collagen and other extracellular macromolecules and finally the formation of a scar. Drugs that

influence one phase of the wound healing process, may not necessarily affect the other phase [28]. Therefore, the development of an ideal wound healing agent by targeting the different phases of the wound healing process is still a challenge to medical scientists. The ideal agent should meet the criteria such as

rapid contraction of the wound area resulting in fast healing, reduction of the wound epithelization period, and achievement of improved tensile strength [29].

In the excision wound model of this study, both 2% and 4% of the plant extract showed significant wound contraction compared to the control group. Although there was no statistically significant difference observed in wound healing activity between the standard drug and the 2% w/w or 4% w/w crude extract paste, interestingly the 4% w/w extract ointment exhibited a better observable effect in terms of wound contraction and epithelialization compared to the standard drug and the 4% w/w extract [30].

The wound healing activity of the crude extract was evidenced by increased tensile strength in incision wounds of rats. Tensile strength indicates how much the repaired tissue resists opening under tension and may indicate the quality of the repaired tissue [31]. The increased tensile strength can be due to the stimulation of collagen synthesis and its maturation, angiogenesis, and stabilization of fibers [32]. According to a previous phytochemical study, *malva neglacta* is a rich source of vitamin A [33]. Vitamin A promotes the growth and differentiation of epithelial cells and aids in collagen synthesis, pivotal for enhancing the strength and integrity of newly

formed tissue. Collagen provides structural support to the wound site, thus contributing to its tensile strength. Furthermore, vitamin A plays a role in forming new blood vessels (angiogenesis) during the proliferative phase of wound healing ensuring an adequate blood supply to the wound site and promoting tissue repair [34].

The mechanisms of plant-derived compounds in the treatment of burn wounds include anti-inflammatory, antioxidant, antimicrobial, collagen synthesis stimulation, cell proliferative, and angiogenic actions [35]. As described earlier, previous studies indicated that the root of this experimental plant have antimicrobial, anti-inflammatory, and antioxidant activities which might contribute to the excision wound healing effect. In addition, burn injury partially suppresses the immune system. Therefore, the use of antioxidants may have a positive effect on the regeneration of the damaged skin tissue and other burn wound complications [36].

In the excision wound model, ointments prepared from aqueous and ethyl acetate fractions enhanced wound contraction. Increased contraction rate accelerates wound healing by reducing wound area, and reduced wound area facilitates re-epithelization by shortening the distance keratinocytes must migrate [37]. Additionally, the epithelization

time was significantly reduced in animals treated with aqueous as well as ethyl acetate fraction ointments. Wound re-epithelization occurs due to the proliferation and migration of epithelial cells across the wound bed [38]. Therefore, the shorter epithelization time in the aqueous and ethyl acetate fraction could be due to the facilitated proliferation of epithelial cells. Unlike the pt. ether and ethanolic extract fraction ointments, the aqueous extract fraction was show a significant wound healing activity. This could be due to the absence of wound healing phytochemicals such as tannins, terpenoids, flavonoids, saponins and glycosides in the chloroform fraction as evidenced by the preliminary phytochemical analysis of this study. Tannins improve wound healing by facilitating tissue regeneration through their antioxidant activity, [39] and the wound-healing effect of flavonoids is related to their antibacterial and antioxidant activities [40]. The wound healing activity of phenolic compounds is due to their antioxidant, In-vitro anti-inflammatory and antimicrobial activities [41, 42].

CONCLUSION

The present study indicated that the both aqueous & ethanolic extracts of the root of *Malva neglacta*, possess wound healing activity established by a significant rate of

wound contraction and shorter epithelization period that may be due to the presence of biologically active secondary metabolites acting as either individually or collectively to bring about the overall effect.

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AUTHOR CONTRIBUTION STATEMENT

Mr. Deepak Sharma Kumar conceptualized and gathered the data with regard to this work. Dr. Mohit Shrivastav analyzed these data and necessary inputs were given towards the designing of the manuscript. Both authors discussed the methodology and results and contributed to the final manuscript.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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