



## A Review of Healing Potential of *Moringa olifera* Leaves in Wound

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### ABSTRACT

Wound healing is regeneration of cellular and anatomic continuity of tissue. The process of healing is complicated, where the skin or other body tissue repair its self after injury. Natural process of healing is good for the human body. Plant derived compounds, apart from the nutritional values, they are important therapeutic weapon to fight wound. Herbal medicines are providing natural healing. Herbal medicine having Antimicrobial, Antioxidant properties, they provide effective healing. This review discuss about the healing potential of *Moringa olifera* belongs to family moringaceae, and also includes the phytochemical screening and their actions. It is helpful for research and development of new formulations for wound healing, And also discusses the effect of leaves *in vivo* studies.

**Keywords:** Moringaolifera, wound, Phytoconstituent, alkaloid, Cinnamic acid.

### INTRODUCTION

Wound may occur due to chemical, immunological, physical and microbiological attack to the tissue leading to cellular disruption of tissue is occurring. Wound healing is a complex and dynamic process it restores normal functions of damaged tissue. There are number of plants are used for the treatment of wound healing<sup>1</sup>. About 400 years ago India and china written their knowledge about the plant remedies is called as herbals. Herbal medicines are act on the body; their action is depending on the presence of constituents present in the plant. Herbal plants are providing stamina, support the action of digestive system, enhance the absorption, improving blood flow to the body, eliminate the toxins, maintain the infections and heal the injury<sup>2</sup>. Wounds are cause burden on the patient as well as health care professional worldwide. Wound is affect the physically as well as mental health of millions of patient. Current statement shows that 6 millions of people are suffering chronic wound<sup>3</sup>.

*Moringa olifera* is a small fast growing tree [Figure: 1], it belongs to moringaceae family. The main origin of the *Moringa olifera* is reported that in south Himalayas and North West region of India. In English it is known as Horseradish tree, Drumstick tree. Many of whose parts are consumed for both nutritional as well as medicinal values world wide. Its maximum height is reported that about 7-12m. Moringa leaves, fruits, flower, seed and braches have there on medicinal properties it good for human growth and development<sup>4</sup>. And also its all parts is used for the treatment of various disease like Inflammatory bowel disease, Crohn's disease<sup>5</sup> and other immunological disorders like arthritis, ulcerative colitis, asthma, allergy etc.<sup>6</sup>. The moringa leaves possess several

properties, its main principle are growth enhancing properties, antitumor, antiepileptic, antispasmodic, antioxidant, anti-inflammatory<sup>7</sup>, anti-ulcer, antihypertensive<sup>7</sup> antimicrobial, anti-helminthic, analgesic activity, antipyretic, diuretic and cholesterol lowering activity, hepatoprotective, cardiac and circulatory stimulant<sup>8</sup> anti-sickling activity<sup>9</sup> also it used as abortifacient and chronic rheumatism. Moringa leaves having good wound healing property and leaves were used for rubbed against temple can relive headache, to stop bleeding from cuts and wounds<sup>10</sup>.



[Figure: 1]

### Classification of Wounds

The normal skin consist of epidermis and dermal layer [Figure: 2]. Different types of wound can adversely affect the both layer. Wounds can be classified as four types according to etiology, type and location. Open wound, closed wound, acute wound and chronic wound<sup>11,12</sup>.

2.1. Open wound: Blood is escape from the body and clearly visible bleeding may also occur. Five types of wound are coming under the open wound it is based on the object that cause the wound.



2.1.1. Incision wound: Sharp object like knife can cause this wound with minimal tissue damage [Figure: 2.1.1].

2.1.2. Tear wound: It is a non-surgical cut and with some type of disturbance that cause tissue damage. It is also known as laceration wound [Figure: 2.1.2].

2.1.3. Superficial wound: It is caused by a sliding fall onto a rough surface. This wound is also known as Abrasion wound [Figure: 2.1.3].

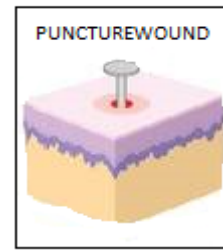
2.1.4. Puncture wound: It is caused by an object like nail or needle that creates some holes. In this wound chance of infections are common because dirt can cause infection while entering into the wound [Figure: 2.1.4].

2.1.5. Penetration wound: This wound is caused by knife like substance. It is entering into the body and in some condition it is come out from the body[Figure: 2.1.5].

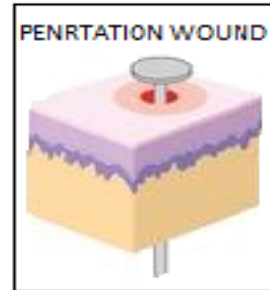
2.2. Closed wound: Blood escape the circulating system but retained in the body. It includes Contusion(capillaries and venules are damaged)[Figure: 2.2.1]and crush injury (trauma to the body resulting from an applied force over a period of time) [Figure: 2.2.2].

2.3. Acute wound: It is proceed through timely and orderly healing pathway. It is extent range from 5-10 days or within 30 days. It is usually caused by cut or surgical incision.

2.4. Chronic wound: It cannot be repaired in an orderly and timely manner. It may result from naturopathic, pressure, arterial and venous insufficient, burns and vasculitis. It take prolong time to heal and also a proper healing is not occur. Diabetic foot ulcer is the major type of chronic wound. Other examples are pressure ulcer and venous ulcer.



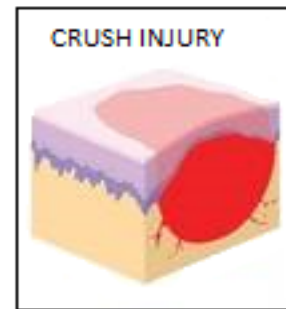
[Figure: 2.1.4]



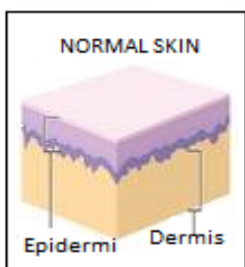
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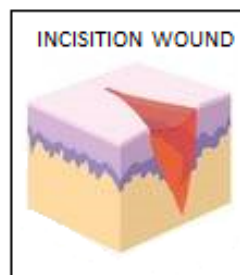
[Figure: 2.2.1]



[Figure: 2.2.2]



[Figure: 2]



[Figure: 2.1.1]



[Figure: 2.1.2]



[Figure: 2.1.3]

**Pathophysiology of Wound Healing**

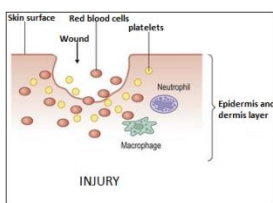
Wound healing is regeneration of cellular and anatomic continuity of tissue. The process of healing is complicated; biochemical events are help to repair the damage. When an injury happen on the body the blood cells, macrophages, neutrophils, platelets are activated [Figure: 3]. And this injured tissues following different phases for the regeneration. The basic phases of healing are essentially same for the most of the wound such phases are Hemostasis, inflammatory, proliferative and remodeling phases<sup>8, 13-16</sup>.

- 1.1. Hemostatis: Injured platelets are stick to injured site within the first few second of injury, platelet become activated and changes into amorphous shape and more suitable for clotting. They release chemical signals to promote clotting that leads to the activation of fibrin, which forms a mesh and act as glue. Platelets bind to each other and clot plug break in the blood vessel that leads to slowing or preventing further bleeding. This phase is also known as coagulation phase[Figure: 3.1].
- 1.2. Inflammatory phase: Inflammatory phase is also known as lag phase or substrate phase. In this phase having two types of stages, First one is the

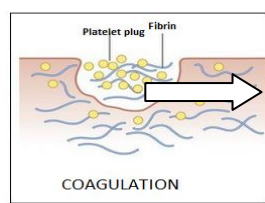
early inflammation and second stage is known as latent inflammation. In this phase inflammation starts within minutes to hours that are 0-48 hours. This phase in this phase Pathogens and dead cells are removed through the process of phagocytosis [Figure: 3.2].

1.3. Proliferative phase: Also known as fibroplasia phase. This phase has various phases such as angiogenesis, fibroplasia and granulation of tissue formation, collage deposition, epithelialization and wound contraction. It is occurring between days 3-14 [Figure: 3.3].

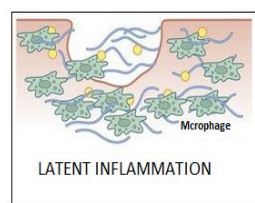
1.4. Remodeling phase: It is also known as maturation phase. Occur from 3 weeks until 1 year. Collagens forms tight cross links to other collagen and increase the tensile strength of scar [Figure: 3.4].



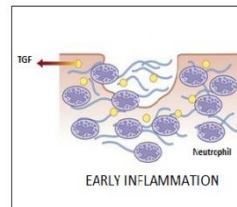
[Figure: 3]



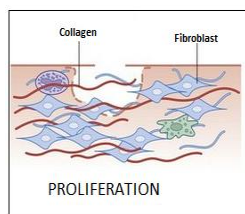
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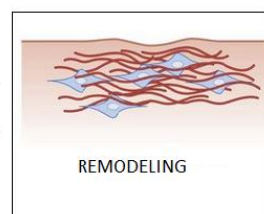
[Figure: 3.3]



[Figure: 3.2]



[Figure: 3.4]



[Figure: 3.5]

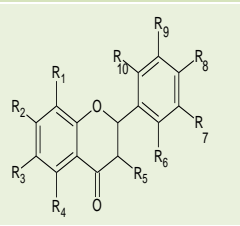
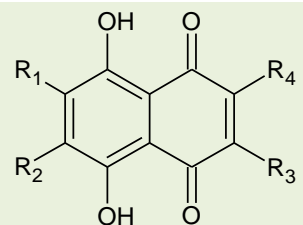
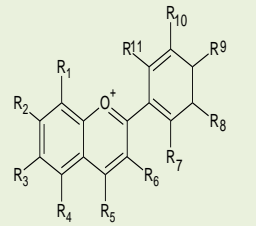
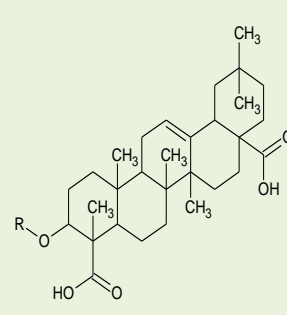
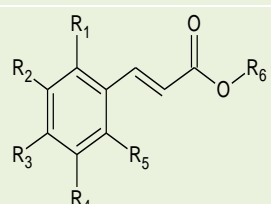
Several factors can adversely affect the process of healing such as infections improper diet, tissue perfusion and insufficient oxygen supply to the wound area, drugs and other disease conditions. During the process of healing reactive oxygen species are produced at the site of wound and it active against the invading bacteria. And

also impaired wound healing is occurring due to increasing the concentration of reactive oxygen species. Oxidative stress has important role in the tissue damage during the process of healing. Oxidative stress is due to imbalance between the granulation of reactive oxygen species and endogenous antioxidant<sup>17</sup>. Oxidative stress can be reducing by using the anti-oxidant property having drugs or medicinal plants. Herbal plant provides natural way of wound repairing. Moringa leaves having antimicrobial and anti-oxidant property which essential for wound healing and *Moringa olifera* contains 92 nutrient and 46 types of antioxidant. Various types of vitamins are also present such as vitamin A (Beta carotene), vitamin B1 (Thiamine), vitamin B2 (Riboflavin), vitamin B3 (Niacin), vitamin B6 (Pyridoxine), vitamin B7 (Biotin), vitamin C (Ascorbic acid), vitamin D (Cholecalciferol), vitamin E (Tocopherol) and vitamin K<sup>18</sup>. Also it contains high content of carotenoids, the sulphur containing amino acids methionine and cysteine flavonoids, tannins, alkaloids, triterpenoids, saponins, anthraquinone glycoside, proteins, carbohydrates, cardiac glycosides etc. These constituents are support the healing process, enhancing the angiogenesis and flow of blood at the wound site<sup>19</sup>.

**Phytochemical Constituents and Their Actions**

The article of “Phytoextract in wound healing” mentioned that moringa leaves containing phytochemical constituents are essential for the wound healing. At the site of injury these are activated the platelet, macrophage, neutrophils, and fibroblast. Any infections are in the wound site healing become impaired and increasing the ROS damage the tissue. Main constituents present in leaves such as flavonoids, quonescinnamic acid, saponin, tannins, triterpenoids, anthocyanin etc and also there structures are mentioned. Phytoextract in wound healing by Prasanta K G and Anjali G done like some research work on it in that they come to know that is many constituent in that extract like that. And also specific functions and actions of flavonoids, tannins, quinones, anthocyanin, saponins are explained<sup>20,21</sup>. [Table: 4.1].

Moringa leaves having several uses such as Antimicrobial, Anti-inflammatory, Anti helminthic, Analgesic, Anti-diabetic, Anti-oxidant, Anti-pyretic, Anti-hypertensive, Diuretic and cholesterol lowering activity, Hepatoprotective, Anti-spasmodic and Anticancer, Cardiac and circulatory stimulant, Anti-sickling activity. Many article reported that the leaves contains phytochemical constituent having principle activities. Different phytochemical evaluation test are given below<sup>22</sup> [Table: 5.1].

CONSTITUENTS	GENERAL STRUCTURE	ACTIONS
FLAVANOIDS		It shows strong radical scavenging it is more beneficial for healing activity (antioxidant) and possesses inhibition or killing of microorganisms (anti-microbial). They having other activities are anti-inflammatory, anti-carcinogenic, antimutative.
QUINONES		Soluble Quinone's have antimicrobial and antioxidant properties.
ANTHOCYANIN		Its general structure shows strong antioxidant property and antimicrobial properties.
SAPONIN		Saponin having strong radical scavenging property. It stable in both acidic and alkaline media. It possesses anti-inflammatory, anti-apoptosis, immunostimulant. And also having detergent property.
CINNAMIC ACID		Substituted cinnamic acid possesses antimicrobial and anti-oxidant property.

[Table: 4.1]

### Phytochemical Evaluation Testes

Sl no	Experiment	Observation	Inference
1.	<b>TEST FOR ALKALOIDS:</b> The extract is treated with few drops of dil.Hcl and filter.	Formation of orange or orange reddish brown precipitate.	Indicate the test as positive.
	a. <b>Dragendroff's Test:</b> Take 2ml of filtrate add 1ml of dragendroff's reagent along the side of the test tube.		
	b. <b>Mayer's Test:</b> Take 1ml of filtrate add two drops of mayer's reagent along the side of the test tube	Formation of white creamy precipitate	Confirmed test as positive

	<p>c. <u>Hager's Test:</u> Take 1ml of filtrate add two drops of hager's reagent along the side of the test tube.</p>	Formation of yellow precipitate	Indicate the test as positive
	<p>d. <u>Wagner's Test:</u> Take 1ml of filtrate add two drops of wagner's reagent along the side of test tube</p>	Formation of yellow or brown precipitate	Confirmed test as positive
2.	<p><u>TEST FOR TANINS:</u> a. <u>Ferric chloride Test:</u> Take 2ml of extract and add few drops of 5% Ferric chloride solution.</p>	Formation of blue color.	Indicate the presence of hydrolysable tannins.
	<p>b. <u>Gelatin Test:</u> Take 1ml of extract add 1% gelatin containing 10% sodium chloride.</p>	Formation of white precipitate.	Confirmed the test.
3.	<p><u>TEST FOR CARBOHYDRATE:</u> a. <u>Molish's Test:</u> Take 2-3ml of extract; add few drops of alpha naphthol solution in alcohol. Shaken and add con. Sulphuric acid along the side of the test tube.</p>	A deep violet coloration is produced at the junction of two layer.	Presence of carbohydrate.
	<p>b. <u>Iodine Test:</u> Take 4-5 drops of iodine solution add 1ml of extract solution and content gently mixed.</p>	Formation of blue color	Presence of polysaccharide
	<p>c. <u>Seliwanoff's Test:</u> Take 1ml of test solution add 3ml of seliwanoff's reagent and heated on a water bath for 1 minute.</p>	Formation of a cherry color precipitates within minutes. OR Formation of a faint red.	Presence of ketose. Presence of aldehyde.
	<p>d. <u>Fehling's Test:</u> Take 2ml of test solution add 2ml of fehling's solution boiled for 10 minute.</p>	Formation of red precipitate.	Presence of reducing sugar.
	<p>e. <u>Barfoed's Test:</u> Take 2ml of test solution add 2ml of freshly prepared barford's reagent and boiled in water bath for 3 minute.</p>	Formation of deep blue color with red precipitate.	Presence of monosaccharide.
4.	<p><u>TEST FOR TRITERPENOID:</u> a. <u>Salkowski Test:</u> Take 2mg dry extract shaken with 1ml of chloroform and add few drops of con. Sulphuric acid along the side of the test tube.</p>	Formation of red brown color	Indicate test as positive.
5.	<p><u>TEST FOR FLAVANOIDS :</u> a. <u>Shinoda Test:</u> Few magnesium turnings and 5 drops of con.Hcl add dropwise to 1ml of test solution</p>	Pink, scarlet, crimson red/ occasionally green to bluecolor.	Confirmed the test.
	<p>b. <u>Lead acetate test:</u> Take 1ml of test solution add few drops of 10% lead acetate.</p>	Formation of Yellow precipitate	Confirmed flavonoids.

6.	<p><u>TEST FOR SAPONINS:</u></p> <p>a. <u>Foam Test:</u></p> <p>Take 5ml of test solution shaken few minutes.</p>	Formation of stable foam	Confirmed the test
	<p>b. <u>Olive oil Test:</u></p> <p>Take 2ml of test solution shaken with few drops of olive oil.</p>	Formation of stable emulsion.	Confirmed the test
7.	<p><u>TEST FOR ANTHRAQUINONE:</u></p> <p><u>Hydroxyanthraquinone:</u></p> <p>Take 1ml of test solution add 10% potassium hydroxide solution.</p>	Formation of red color.	Confirmed the test.
8.	<p><u>TEST FOR PROTEIN:</u></p> <p><u>Biuret Test:</u></p> <p>Take 2ml of test solution add 5 drops of 1% copper sulphate solution and 2ml of 10% sodium hydroxide are mixed thoroughly.</p>	Formation of purple or violet.	Confirmed proteins.
9.	<p><u>TEST FOR AMINO ACIDS:</u></p> <p><u>Millon's Test:</u></p> <p>Take 1ml of test solution adds five drops of millon's reagent and heated on a water bath for 10 minutes. Cool and added 1% sodium nitrate.</p>	Appearance of red color.	Confirmed test.
10.	<p><u>TEST FOR FATS AND FIXED OILS:</u></p> <p>Take five drops of test solution was added 1ml of 1% copper sulphate and few drops of 10% sodium hydroxide.</p>	Formation of clear blue solution.	Confirmed the test.

[Table: 5.1]

In vivo articles that mentioned the importance of moringaolifera leaves for wound healing. Evaluation of aqueous leaves extract of *Moringa olifera* linn for wound healing by B S Rathi, S L Bodhankar and A M Baheti mentioned that aqueous leaf extract of *Moringa olifera* investigated and concluded that it possess high wound healing activity. The extract was studied at doses level of 300mg/kg body weight using different type of wound like incision, excision, and dead space wound. The contribution of healing is depending on the different types of wound. And they observed that significant increase in wound closure rate, skin breaking strength, granuloma breaking strength, granuloma dry weight and decrease in scar area. And also observed that prohealing activity of leaves due to increased collagen deposition as well as better alignments and maturation. Effect of ethanolic extract of leaves of moringaolifera lam on acetic acid induced colitis in albino rats by Swarnamoni Das and Lalit Kanodia mentioned that effect of ethanolic extract of *Moringa olifera* leaves on acetic acid induced colitis in albino rat and also acute toxicity test done by using OECD guidelines. In this article shows that experiment done by using 4 set of albino rat. Acute toxicity study was done and it shows that it improves the colon architecture by

antioxidant enzyme, mainly catalase and superoxide dismutase. The leaves contain high amount of flavonoids it having anti-oxidant property and protective action against the oxidative stress induced cellular damage.

### CONCLUSION

In recent years, there has been great demand for plant derived products in developed countries. Alternative treatments based on natural plant product and herbal mixtures belonging to the realm of herbal formulations are becoming increasingly popular in india, US and other countries. *Moringa olifera* leaves having greater potential to facilitate and accelerate wound healing because Due to their anti-oxidant, anti-bacterial, anti-inflammatory properties and other properties. It is good for human health because it is herbal in nature and side effects are very less. *Moringa olifera* providing good healing effect in different types of wound also it could be promoting natural anti-bacterial agents with potential applications in pharmaceutical industry. So it can be formulating it into suitable formulation. Correct clinical management may provide rapid healing and reduce potential complications. *Moringa olifera* having rich amount of flavonoids, tannins and anthocyanin these constituents



are potential to facilitate the anti-oxidant, anti-inflammatory and anti-bacterial properties so it more helpful in therapeutic practices and research to develop new wound healing formulations for human use.

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