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PLANTS AS POTENT ANTI DIABETIC AND WOUND HEALING AGENTS- A REVIEW

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Abstract

Wounds generally termed as physical injuries that result in an opening or breaking of the skin. There are different types of wounds which range from mild to potentially fatal. Wound healing is impaired in diabetic patients with infection or hyperglycaemia. Diabetes mellitus is one of the major contributors to chronic wound healing problems. The diabetic patients with ulcer become at high risk for major complications which include infection and amputation. In traditional medicine plants are generally used for treatment of various acute and chronic diseases and abnormalities in the body. Due to the present fast life of the humans a drastic increase in chronic disease conditions mainly diabetes has been determined. Most of these patients tend to face a tremendous problem when they get an infected wound. Hence in the current review a list of the plants used in traditional medicine for the treatment of wounds and diabetes were screened. The work includes a list of traditionally claimed plants used for diabetes and wounds which are scientifically proved as well as scientifically not proved.

Key words: Inflammatory, Proliferative, Remodelling, Diabetes mellitus, Homeostasis

1. Introduction

Plants have anchored to the mother earth long before man has set his feet and it is said that god had endowed them with materials for survival of man and animal long before these creatures were made by him¹. The world health organization (WHO) estimates that about 80% of the population is still depends upon these herbal medicines for their treatment of diseases due to easy availability, economic and less side effects when compared to allopathic system of medicines. Nearly 2000 of natural drugs are mentioned in Indian Materia Medica that have reported various pharmacological activities, out of these 1600 are from plant origin.² Herbal remedies have formed the basis of traditional medicine for millennia, and have formed the root of modern pharmacology. While science from roughly the 1880's onwards has striven to isolate the active compounds found in medicinal herbs, the list is ever growing³. Wound infections are most common in developing countries, such as Sub-Saharan African and South Asian countries, than in developed countries. Current estimates indicate that nearly 6 million people suffer from chronic wounds worldwide⁴.

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The prevalence of chronic wounds in the community was reported as 4.5 per 1000 population, whereas that of acute wounds was nearly double, at 10.5 per 1,000 populations⁵. Plant products are potential agents for wound healing, and largely preferred because of their widespread availability and effectiveness as crude preparations. Due to the present stress filled life a lot of people are developing diabetes at a very younger age. It was reported that a lot of children too are developing this chronic and fatal disorder. Hence this encouraged to develop a list a plants which posses the power to heal these conditions.

1.1. Over view of wound

A wound is one in which the skin or another external surface is torn, pierced, cut, or otherwise broken⁶. It can be classified into two type ; open wound and a closed wound⁷. There are many different types of wounds ranging from mild to severe to potentially fatal. Contusions, small incisions, and abrasions tend to be non-threatening, though some may pose the risk of infection. Deep punctures, avulsions, and amputations, however, may be life threatening. In most cases, the risks posed by all types of wounds differ in severity based on the instrument causing them, the ease of blood flow, and the cleanness or jaggedness of the edges of the damaged skin. Abrasions, Avulsions, Contusions, Crush wounds, Cuts, Incised wound, Lacerations, Penetrating wound, Punctures are few examples of types of wound^{8,9}

Phases of wound

Bleeding phase¹⁰

Bleeding phase is relatively short lived depend in the nature of the wound and the intensity of the wound and the vascular system available at the site if the wound.

Inflammatory phase¹⁰

The inflammatory phase prepares the area for healing and immobilizes the wound by causing it to swell and become painful, so that movement becomes restricted. The fibroblastic phase rebuilds the structure, and then the remodelling phase provides the final form.

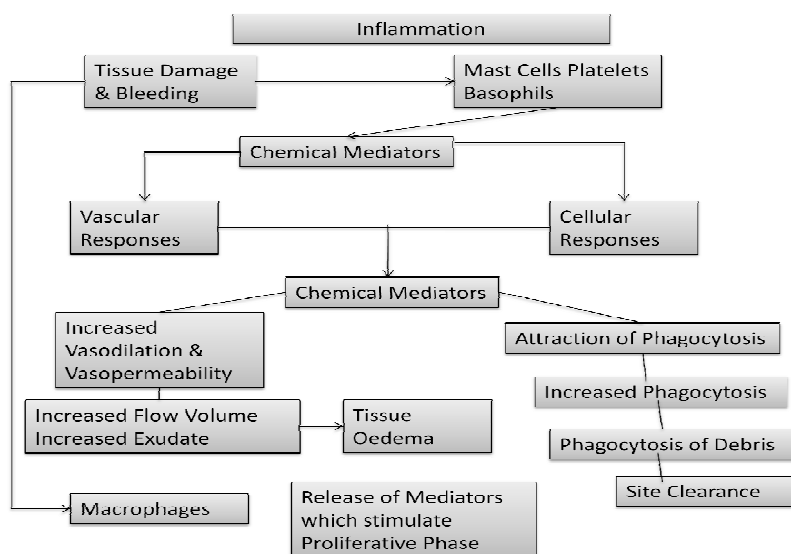


Figure 1: Events in the Inflammatory Phase

Inflammation is a normal and necessary prerequisite to healing. Changes in vascular flow are responsible for the clinical symptoms used to detect an inflammatory response. The majority of the specialised cells involved in this phase of the wound healing process come from blood.

1.2. Proliferation phase¹⁰

The proliferative phase essentially involves the generation of the repair materials and majority of the skeletal muscle injuries.

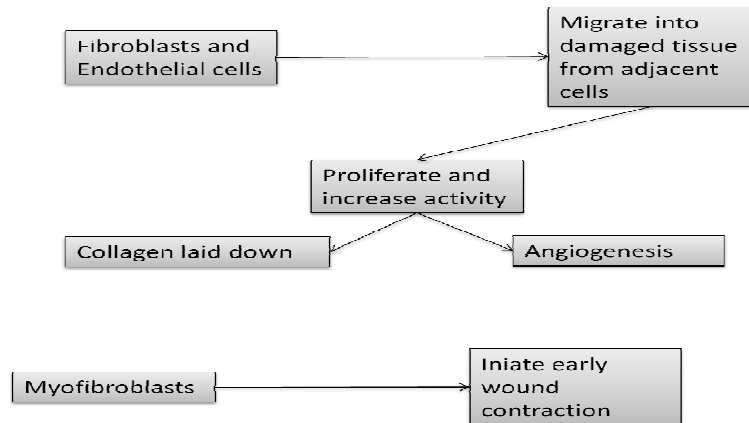


Figure 2: Events in the Proliferative Phase

1.3. Remodelling phase¹⁰

The remodelling phase is an essential component of tissue repair and is often overlooked. The final outcome of these combine events is that the damaged tissue will be repaired with scar.

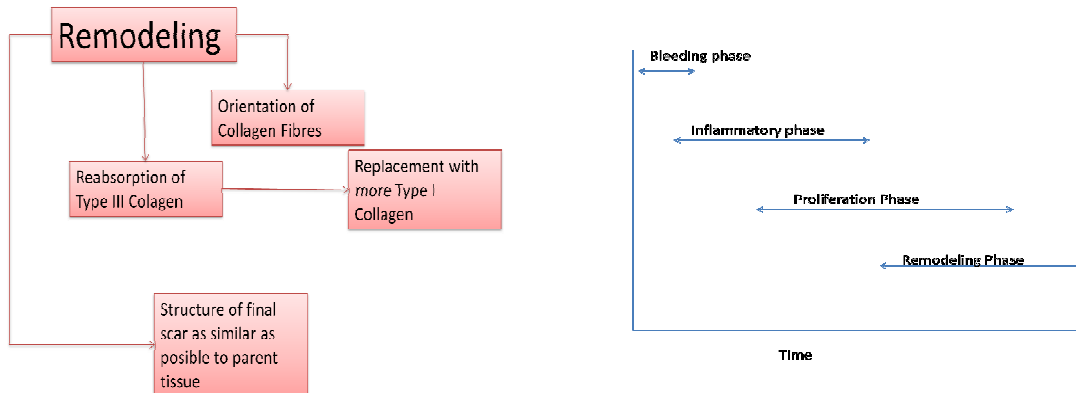


Figure 3: Showing tissue repair and time scale

1.4. Wound and Diabetes

A metabolic disorder caused primarily by a defect in the production of insulin by the islet cells of the pancreas resulting in an inability to use carbohydrates are characterized by hyperglycemia, glycosuria, polyuria, hyperlipemia (caused by imperfect catabolism of fats), acidosis, ketonuria, and a lowered resistance to infection.

Periodontal manifestations may include recurrent and multiple periodontal abscesses, osteoporotic changes in alveolar bone, fungating masses of granulation tissue protruding from periodontal pockets, a lowered resistance to infection, and delay in healing of the wounds¹¹ the most common being Type-1 diabetes and Type-2 diabetes. These are diseases of the metabolic system and involve the body's ability in metabolizing sugar using the hormone insulin¹². Diabetes mellitus is one of the major contributors to chronic wound healing problems. When diabetic patients develop an ulcer, they become at high risk for major complications, including infection and amputation. The pathophysiological relationship between diabetes and impaired healing is complex. Vascular, neuropathic, immune function and biochemical abnormalities each contribute to the altered tissue repair. Despite treatment of these chronic wounds, which involves tight glucose control and meticulous wound care, the prognosis for their healing is quite poor¹³.

Wound healing is impaired in diabetic patients with infection or hyperglycemia¹⁴. The heat shock proteins (HSPs), originally identified as heat-inducible gene products, are a highly conserved family of proteins that respond to a wide variety of stress. Wounding induces HSPs, particularly in the epidermis. In the initial phase of wound healing there is an inflammatory response, followed by organization of the fibrin-rich exudates and subsequent re-epithelialisation and formation of granulation tissue. The wound bed contains abundant inducible HSP70 which contributes to protein homeostasis and cell survival within the healing wound. HSP functions are compromised under conditions of diabetes. Both type 1 and type 2 diabetes are characterized by an increased risk for the development of micro vascular and macro vascular complications. In diabetes, endogenous defence systems are overwhelmed, causing various types of stress. Uncontrolled oxidative stress represents a characteristic feature of diabetes. Among the other important conditions related to diabetes are dyslipidemia, modification of proteins and lipids, and perturbations in the tissue antioxidant defence network¹⁵. In traditional medicine plants are generally used for treatment of various diseases and abnormalities in the body. The lists of the plants used in traditional medicine for the treatment of wounds are as follows.

Table 1: List of plants having reported with possessing the wound healing activity¹⁶⁻⁷⁷

Plant	Part used
<i>Achalypha indica</i> L.	Not mentioned
<i>Achyranthes aspera</i>	Leaves
<i>Adhatoda vasica</i>	Not mentioned
<i>Aloe vera</i>	Not mentioned
<i>Altemanthera brasiliana</i>	Leaves
<i>Altemanthera brasiliana</i> Kuntz	Leaves
<i>Altemanthera sessilis</i> Linn.	Leaves
<i>Argemone mexicana</i> .	Not mentioned
<i>Arrabidaea chica</i> Verlot	Not mentioned
<i>Berberis aristata</i>	Not mentioned
<i>Blumea lacera</i> .	Not mentioned
<i>Borassus flabellifer</i> L.	Fruit
<i>Bryophyllum pinnatum</i>	Leaf
<i>Calendula officinalis</i>	Not mentioned
<i>Centella asiatica</i>	Leaves
<i>Citrus reticulata</i>	Essential Oil
<i>Citrus sinensis</i>	Peel
<i>Coleus aromaticus</i>	Leaves
<i>Cordia dichotoma</i> Forst	Fruits
<i>Coronopus didymus</i> .	Not mentioned
<i>Curcuma longa</i>	Rhizome
<i>Eleusine coracana</i>	whole grain flour
<i>Euphorbia nerifolia</i>	Leaf
<i>Evolvulus numularius</i> Linn.	Not mentioned
<i>Ficus asperifolia</i>	Aqueous extract
<i>Gentiana lutea</i>	Rhizome
<i>Gossypium arboretum</i>	Aqueous extract
<i>Grewia tiliaefolia</i> .	Not mentioned
<i>Hamelia patens</i>	Not mentioned
<i>Hippophae rhamnoides</i>	Not mentioned
<i>Hypericum perforatum</i> L.	Not mentioned
<i>Hyptis suaveolens</i>	Leaves
<i>Ipomoea Batatas</i> .	Tuberous root
<i>Juglans nigra</i> .	Leaves
<i>Kalanchoe pinnata</i> Lam.	Leaf
<i>Madhu ghrita</i>	Not mentioned
<i>Mesquite Prosopis</i>	Leaves
<i>Moringa oleifera</i> Linn	Aqueous leaves
<i>Musa sapientum</i> var. <i>paradisical</i>	Not mentioned
<i>Naravelia zeylanica</i>	Leaves
<i>Ocimum sanctum</i> Linn.	Not mentioned
<i>Paspalum scrobiculatum</i>	whole grain flour
<i>Piper betle</i>	Leaf
<i>Portulaca oleracea</i> Linn.	Not mentioned
<i>Prosopis juliflora</i> DC.	Leaf juice
<i>Pueraria tuberosa</i>	Not mentioned
<i>Punica granatum</i>	Peals
<i>Quercus infectoria</i> .	Galls
<i>Rhizopus arrhizus</i>	Not mentioned
<i>Rubia cordifolia</i>	Not mentioned
<i>Saba florida</i>	Leaf
<i>Salvia splendens</i>	Leaves
<i>Saussurea lappa</i>	Root
<i>Sesamum indicum</i> L	SEED
<i>Sphaeranthus indicus</i>	Not mentioned
<i>Sphagnum holocellulose</i>	Not mentioned
<i>Tephrosia purpurea</i>	Not mentioned
<i>Tephrosia purpurea</i> (Linn.)	Not mentioned
<i>Terminalia arjuna</i>	Stem bark
<i>Terminalia bellirica</i> Roxb.	Fruits
<i>Terminalia bellirica</i> Roxb.	Fruits
<i>Thespesia populnea</i>	Leaves
<i>Toddalia asiatica</i> Linn.	Stem bark
<i>Tridax procumbens</i>	Whole plant
<i>Verbena officinalis</i>	Not mentioned
<i>Vernonia arborea</i>	Not mentioned
<i>Vernonia arborea</i> Buch	Aqueous and methanolic extracts of bark
<i>Vernonia scopioides</i>	Not mentioned

Table 2: List of plants used in traditional system of medicine as antidiabetic^{78,79}

<i>Acacia farnesiana</i>	<i>Albizia amara</i>	<i>Bergia capensis</i>	<i>Boswellia serrata</i>	<i>Buchanania axillaries</i>
<i>Caesalpinia decapetala</i>	<i>Cardiospermum helicacabum</i>	<i>Crotolaria medicaginea</i>	<i>Desmodium motorium</i>	<i>Discorea hispida Den nst</i>
<i>Dodonaea viscosa</i>	<i>Eclipta prostrate</i>	<i>Equisetum bogotense (H.B.K.) Kunth</i>	<i>Erythrina variegnta L.</i>	<i>Gliricidia sepium</i>
<i>Grewia flavensis</i>	<i>Impatiens flavescens</i>	<i>Kalanchoe lacinata</i>	<i>Kalanchoe piñata</i>	<i>Kalanchoe verticulata</i>
<i>Lygodium flexuosum</i>	<i>Mallotus philipensis</i>	<i>Matricaria frigidum</i>	<i>Melhanie incana</i>	<i>Murraya paniculata</i>
<i>Nymphae nouchali</i>	<i>Piper aduncum L</i>	<i>Pisum sativum</i>	<i>Plantago major L.</i>	<i>Pleurostyliya opposite</i>
<i>Polygala javana</i>	<i>Polygala erioptera</i>	<i>Sageretia parviflora</i>	<i>Samanea saman</i>	<i>Schleichera oleosa</i>
<i>Scutia myrtina</i>	<i>Sesbania grandifolia</i>	<i>Sesbania sesban</i>	<i>Soymida febrifuga</i>	<i>Tetrastigma leucostaphylum</i>
<i>Thyallis glanea</i>	<i>Trigonella foenum-graecum</i>	<i>Uncaria tomentosa</i>		

Table 3: Plants having claim on wound and diabetes⁸⁰⁻⁸⁴

Sl.No	Plant	Traditional claim	Scientificallly proved	
			Wound	Diabetes
1	<i>Homalium zeylanicum</i>	◆		
2	<i>Linum usitatissimum</i>	◆		
3	<i>Biophytum sensitivum</i>	◆		
4	<i>Cipadessa baccifera</i>	◆		
5	<i>Chloroxylon swietenia</i>	◆		
6	<i>Fillicum decipens</i>	◆		
7	<i>Acacia nilotica</i>	◆		☐
8	<i>Nerium oleander</i>	◆		
9	<i>Calotropis procera</i>	◆	☐	
10	<i>Barleria Montana</i>	◆		
11	<i>Aerva lanata</i>	◆		☐
12	<i>Ficus bengalensis</i>	◆		☐
13	<i>Bambusa arundinaceae</i>	◆	☐	☐
14	<i>Cynadon dactylon</i>	◆	☐	☐
15	<i>Paspalum serobiculatum</i>	◆	☐	☐
16	<i>Phragmites karka</i>	◆		
17	<i>Triticum aestivum</i>	◆		
18	<i>Sida cordata</i>	◆		
19	<i>Cieba pentandra</i>	◆		☐
20	<i>Grewia tiliifolia</i>	◆	☐	
21	<i>Pterocarpus marsupium</i>	◆		
22	<i>Acacia polycantha</i>	◆		
23	<i>Mimosa pudica</i>	◆		
24	<i>Argyreia nervosa</i>	◆	☐	☐

◆= traditional claim

☐= Scientificallly proved

Conclusion

Herbal medicine have long history of use and better patient tolerance as well as acceptance. Medicinal plants have a renewable source, which are sustainable supplies of cheaper medicines. Availability of medicinal plants is not a problem especially in developing countries like India which is having rich agro-climatic, cultural and ethnic biodiversity. Herbal medicines may offer testimony of their safety and efficacy throughout the world. From the current review a lot of plants were identified with potent wound healing and anti diabetic activity, hence these plants can be considered in effective treatment of wounds of diabetic patients and normal people.

References:

1. Mazumdar BC, Mukhopadhyay PM, Principles and Practices of Herbal Garden, Daya publishing house, Delhi, 2006, 1.
2. Pulok K.Mukherjee, Quality Control of Herbal Drugs an approach to evaluation of Botanicals, Business horizons, New Delhi, 2008, 2.
3. www.herbalremediesinfo.com/history-of-herbal-medicine.html Retrieved on 05-05-2010.
4. Kumar B, Vijayakumar M, Govindarajan R, Pushpangadan, P, Ethnopharmacological approaches to wound Healing Exploring medicinal plants of India. 'J. Ethnopharmacol.' 114, 2007, 103–113.
5. Gupta N, Gupta SK, Shukla, VK, Singh, S.P, An Indian community based epidemiological study of wounds, 'J. Wound Care', 13, 2004, 323–325.
6. <http://www.answers.com/topic/wound> Retrieved on 23/3/11
7. <http://en.wikipedia.org/wiki/Wound> Retrieved on 23/3/11
8. <http://www.wisegeek.com/what-are-different-types-of-wounds.htm> Retrieved on 23/3/11
9. Pascal Mallefet, The Mechanism Of Wound Healing, Novartis Healthcare, Technical Editor.
10. Tim Watson, Soft Tissue Wound Healing Review, Soft Tissue Healing & Repair, 2006.
11. <http://www.answers.com/topic/diabetes-mellitus> Retrieved on 23/3/11
12. <http://diabetes.co.in/> Retrieved on 23/3/11
13. Greenhalgh DG, Wound healing and Diabetes mellitus, 'Clin Plast Surg.', 30(1), 2003, 37-45.
14. McMurry JF Jr., Wound healing with diabetes mellitus. Better glucose control for better wound healing in diabetes., 'Surg Clin North Am.' 64(4), 1984, 769-78.
15. Mustafa Atalay et.al., Heat Shock Proteins in Diabetes and Wound Healing., 'Current Protein and Peptide Science', 10, 2009, 85-95.
16. Sharma c s, Rohilla Ruby, Gaur Kalpesh, Nema R K, Sharma Mahesh C, Meyyanathan S N, Phytochemical and antimicrobial properties of *Gossypium herbaceum* Linn.. 'Adv Pharmac Toxic', 9(1), 2008,153-6.
17. Gopinathan A, Pawde A M, Singh G R, Singh K, Amarpal, Kinjavdekar, Effect of *Calendula officinalis* in burn wounds of bovine calves and heifers,' Indian J Anim Sci '76(6), 2006, 437-41.
18. Jhirwal S K, Purohit N R , Evaluation of turmeric rhizome juice as topical medicament on wound healing in buffalo calves: gross and histopathological study, ' Indian J Anim Sci '76(3), 2006, 230-2.
19. Mahajan A, Sharma S K, Varshney A C, Tyagi S P, Amit Kumar , Therapeutic efficacy of sea buck thorn (*Hippophae rhamnoides*) in infected cutaneous wounds in bovines,' Indian J Anim Sci' , 76(2), 2006,134-6.
20. Chopda MZ, Mahajan RT, Wound healing activity of *Terminalia arjuna* (Roxb) stem bark in albino rat, ' Bionano Frontier', 2009 , 36-39.
21. Patil SM, Patil MB, Somapur CK, Evaluation of wound healing properties of *Saussurea lappa* Clarke root extracts, ' Advances in Pharmacology and Toxicolog', 10(2), 2009,85-90.
22. Soni H, Nayak G, Pathak AK, Singhai AK, Evaluation of wound healing activity of peel of *Punica granatum* leaves, and their polyherbal formulation, Advances in Pharmacology and Toxicology, 10(2), 2009, 107-112.
23. Annan K, Houghton PJ, Antibacterial, antioxidant and fibroblast growth stimulation of aqueous extracts of *Ficus asperifolia* Miq. and *Gossypium arboreum* L., wound-healing plants of Ghana, 'Journal of Ethnopharmacology', 119(1) , 2008,141-144.
24. Pradhan D, Panda PK, Tripathy G, Wound-healing activity of aqueous and methanolic bark extracts of *Vernonia arborea* Buch.-Ham. in Wistar rats, Natural Product Radiance, 8, 2009,6-11.
25. Kuppatt I J and Vasudeva Nayak P, Wound healing activity of *Cordia dichotoma* Forst. f. fruits, ' Natural Product Radiance' 5, 2006, 99-102.

26. Rathi BS, Bodhankar SL, Baheti AM, Evaluation of aqueous leaves extract of *Moringa oleifera* Linn for wound healing in albino rats, 'Indian Journal of Experimental Biology' 44, 2006, 898-901.
27. Agarwal PK, Singh A, Gaurav K, Shalini Goel, Khanna H D, Goel R K, Evaluation of wound healing activity of extracts of plantain banana (*Musa sapientum* var. *paradisica*) in rats, 'Indian Journal of Experimental Biology'; 47, 2009, 32-40.
28. Udupa SL, Somashekar Shetty, Udupa AL, Somayaji SN, Effect of *Ocimum sanctum* Linn. on normal and dexamethasone suppressed wound healing, Indian Journal of Experimental Biology, 44, 2006, 49-54.
29. Anjana Goel, Sandeep Kumar, Dilip Kumar Singh, Ashok Kumar Bhatia, Wound healing potential of *Ocimum sanctum* Linn. with induction of tumor necrosis factor- α ; 'Indian Journal of Experimental Biology', 48, 2010, 402-406.
30. Shivananda Nayak B, Julien R Marshall, Godwin Isitor; Wound healing potential of ethanolic extract of *Kalanchoe pinnata* Lam. leaf—A preliminary study, 'Indian Journal of Experimental Biology'; 48, 2010, 572-576.
31. Kotade Kiran, Mohammed Asad, Wound healing activity of *Sesamum indicum* L seed and oil in rats, 'Indian Journal of Experimental Biology', 46, 2008, 777-782.
32. Prashant S Hegde, Anitha B, Chandra TS, *In vivo* effect of whole grain flour of finger millet (*Eleusine coracana*) and kodo millet (*Paspalum scrobiculatum*) on rat dermal wound healing, 'Indian Journal of Experimental Biology', 43, 2005, 254-258.
33. Annie Shirwaikar, Radhika Shenoy, Udupa AL, Udupa SL, Somashekar Shetty, Wound healing property of ethanolic extract of leaves of *Hyptis suaveolens* with supportive role of antioxidant enzymes, 'Indian Journal of Experimental Biology', 41, 2003, 238-241.
34. Barua CC, Talukdar A, Begum SA, Sarma DK, Wound healing activity of methanolic extract of leaves of *Alternanthera brasiliana* Kuntz using *in vivo* and *in vitro* model, 'Indian Journal of Experimental Biology', 47, 2009, 1001-1005.
35. Choudhary GP, Wound healing activity of the ethanol extract of *Terminalia bellirica* Roxb. Fruits 'Natural Product Radiance', 7, 2008, 19-21.
36. Wound healing activity of Mesquite leaf juice in calves, 'Natural Product Radiance', 3, 2004, 292. http://www.niscair.res.in/sciencecommunication/researchjournals/rejour/npr/npr2k4/npr_jul04.asp#s7.
37. Wound healing potential of Common Purslane, 'Natural Product Radiance', 4, 2005, 222. [http://nopr.niscair.res.in/bitstream/123456789/8100/1/NPR%204\(3\)%20218-222.pdf](http://nopr.niscair.res.in/bitstream/123456789/8100/1/NPR%204(3)%20218-222.pdf).
38. Ahamed BMK, Krishna V, Malleshappa KH, *In vivo* wound healing activity of the methanolic extract and its isolated constituent, gulonic acid γ -lactone, obtained from *Grewia tiliaefolia*, 'Planta Medica', 75(5), 2009, 478-482.
39. Jorge M.P, Madjarof C, Ruiz ALTG, Fernandes AT, Rodrigues RAF, De Oliveira Sousa, IM, Foglio MA, De Carvalho JE, Evaluation of wound healing properties of *Arrabidaea chica* Verlot extract, 'Journal of Ethnopharmacology', 118(3), 2008, 361-366.
40. Dorle AK, Wound healing activity of Madhu ghrta in rats, 'Indian Journal of Pharmacology', 36(2), 2004, 125.
41. Gomez-Beloz A, Rucinski JC, Balick MJ, Tipton C, Double incision wound healing bioassay using *Hamelia patens* from El Salvador, 'Journal of Ethnopharmacology', 88(2-3), 2003 169-173.
42. Painter TJ, Concerning the wound-healing properties of *Sphagnum holocellulose*: the Maillard reaction in Pharmacology, 'Journal of Ethnopharmacology', 88(2-3), 2003, 145-148.
43. Khan M, Patil PA, Shobha JC, Influence of *Bryophyllum pinnatum* (Lam.) leaf extract on wound healing in albino rats, 'Journal of Natural Remedies', 4(1), 2004, 41-46.
44. Umachigi SP, Jayaveera KN, Ashok Kumar CK, Kumar GS, Vrushabendra Swamy BM, Wound healing potential of *Verbena officinalis* methanolic extract in rats. 'Int J chem Sci', 5(3), 2007, 1295-1300.
45. Choudhary GP, Evaluation of wound healing activity of galls of *Quercus infectoria*. 'Asian Journal of Chemistry', 19(4), 2007, 3271-3273.
46. Lodhi S, Pawar RS, Jain AP, Singhai AK., Wound healing potential of *Tephrosia purpurea* (Linn.) Pers. in rats. 'Journal of Ethnopharmacology', 108(2), 2006, 204-210.
47. Anbu J, Vasuki R, Shanmugasundaram P, George S, Vijey Aanandhi M, Analgesic, antipyretic and wound healing properties of *Citrus sinensis* peel extract, 'Biomedicine' 28(2), 2008, 117-20.
48. Patil MB, Kokate, CK., Jalalpure SS, Patil SM, Shetty LN, Wound healing activity of *Centella asiatica* leaves, National Seminar on New Millennium Strategies for Quality, Safety & GMPs of Herbal Drugs/Products, NBRI, Lucknow, p. 92, November 11-13, 2003.
49. Prabhakar KR, Srinivasan KK, Rao PGM, Chemical investigation, anti-inflammatory and wound healing properties of *Coronopus didymus*, 'Pharmaceutical Biology', 40(7), 2002, 490-493.
50. Shirwaikar A., Shenoy R, Udupa A.L, Udupa SL, Shetty S, Wound healing property of ethanolic extract of leaves of *Hyptis suaveolens* with supportive role of antioxidant enzymes, 'Indian Journal of Experimental Biology', 41(3), 2003, 238-241.
51. Ozturk N, Korkmaz S, Ozturk Y, Wound-healing activity of St. John's wort (*Hypericum perforatum* L.) on chicken embryonic fibroblasts, 'Journal of Ethnopharmacology', 111(1). 2007, 33-39.
52. Saini V, Kinger HK, Sharma DK, Ahuja N, Middha A., Gupta VB, Wound healing activity of *Evolvulus numularius* Linn., 'Asian Journal of Chemistry', 19(7), 2007, 5772-5774.
53. Bigoniya P, Rana AC, Wound healing activity of *Euphorbia nerifolia* leaf ethanolic extract in rats, 'Journal of Natural Remedies', 7(1), 2007, 94-101.
54. Sadaf F, Ahmed M, Saleem. R, Ahmad SI, Navaid-ul-Zafar, Healing potential of cream containing extract of *Sphaeranthus indicus* on dermal wounds in guinea pigs. 'Journal of Ethnopharmacology', 107(2), 2006, 161-163.

55. Shivakumar H, Prakash T, Nagendra Rao R, Jayakumar Swamy, Nagappa AN, Wound healing activity of the leaves of *Thespesia populnea*, 'Journal of Natural Remedies', 7(1),2007, 120-124.
56. Kar DM, Mohanty A, Sethi RK, Dash GK, Antimicrobial and wound healing properties of stem bark of *Toddalia asiatica* Linn., 'Indian Journal of Pharmaceutical Sciences', 67(2),2005, 220-223.
57. Keerthi AAP, Mendis WSJ, Jansz ER, Ekanayake S, Perera MSA, A preliminary study on the effect of an antibacterial steroidal saponin from *Borassus flabellifer* L. fruit, on wound healing, 'Journal of the National Science Foundation of Sri Lanka', 35(4),2007, 263-265.
58. Rajput S S, Soni K K, Saxena R C, Pharmacology and phytochemistry of saponin isolated from *Aloe vera* for wound healing activity, 'Asian J Chem', 21(2), 2009, 1029-32.
59. Manjunatha BK., Vidya SM., Rashmi KV, Mankani KL, Shilpa HJ, Evaluation of wound-healing potency of [*Vernonia arborea*] Hk., 'Indian Journal of Pharmacology', 37(4)2005, 223-226.
60. Nigam JM, Rajput N, Srivastava D N, Evaluation of *Adhatoda vasica* and *Berberis aristata* as wound healing agents in rats, 'Indian J vet Surg', 25(1), 2004,26-30.
61. Ghosh T, Dash GK, Bose A, Pande BR, Wound healing properties of *Argemone mexicana*. Indian J nat Prod, 20(4), 2004,3-6.
62. Shenoy MA, Sridevi G, Shastry CS, Evaluation of wound healing activity of *Naravelia zeylanica* leaves, 'International Journal of Chemical Sciences', 7(3), 2009, 1857-1866.
63. Mitra MP, Sasmal D, Narayan S, Wound healing activity of the methanolic extracts of the leaves of *Salvia splendens* Sellow ex Roem & Schult., 'J pharm Res', 7(1), 2008,39-43.
64. Anitha S, Manjunath P M; Wound healing activity of *Achalypha indica* L, Biomed, 5(2), 2010,120-4.
65. Gavimath CC, Kangralkar VA, Kundargi R, Hunkari Patil VS, Vidya H, Efficacy of essential oil of *Citrus reticulata* on dermal wound healing in rats, 'Adv Pharmac Toxic', 11(1), 2010, 31-4.
66. Srividhya V, Mazumder A, Ghosh LK, Nagarajan K, Effect of *Achyranthes aspera* leaf extracts on the wound healing activity of albino rats, 'Biosci Biotechnol Res Communs' 1(1), 2008, 38-41.
67. Kannahi M, Sangeetha K, Madhavan S, Umamaheshwari N, Antimicrobial activity of *Azardirachta indica* A. juss and *Melia azedarach* L. against wound causing pathogenic microorganisms, Adv Pl Sci, 22(2), 2009,605-6.
68. Chinkode R, Patil MB, Jalalpure SS, Agrawal N, Tripathi R, Tripathi A, Patil N Reddy, Wound healing activity of tuberous root extracts of *Ipomoea batatas*. 'Adv Pharmac Toxic' 10(3), 2009,69-72.
69. Dharmendra Kumar, Sharma SP, Sinha SRP, Sudhanshu Shekhar, Singh TB, Lugun AK, Evaluation of wound healing property of *Blumea lacera*, 'Indian vet J', 84(6), 2007, 648-9.
70. Rakes R., Chattopadhyay S, Bhattacharyya D, Bandyopadhyay SK., Chatterjee U, Exploring antiinflammatory and wound healing effects of *Piper betle* leaf extract in experimental animal models, 'Indian Journal of Pharmacology', 36(3),2004, 198.
71. Yaduvansi B, Mathur R, Velpandian T, Gupta SK, Comparative evaluation of wound healing action of topical *Tridax procumbens* and VEGF in mice, 'Indian Journal of Pharmacology' ,36(3) , 2004,194.
72. Mathew A, Taranalli AD, Torgal SS, Evaluation of anti-inflammatory and wound healing activity of *Gentiana lutea* rhizome extracts in animals, 'Pharmaceutical Biology', 42(1) , 2004, 8- 12.
73. Jalalpure SS, Agrawal N, Patil MB, Chinkode R, Tripathi A, Antimicrobial and wound healing activities of leaves of *Alternanthera sessilis* Linn., 'Int J Green Pharm', 2(3), 2008, 145-8.
74. Jain AK, Sikarwar MS, Dubey SK, Jain SK, Wound healing property of ethanolic extract of leaves of *Juglans nigra*. 'Int J Pl Sci', 2(2), 2007, 205-7.
75. Kambhoja S, Keshav Murthy KR; Wound healing and anti-inflammatory activity of *Pueraria tuberosa* (Roxb Ex wild) DC , Biomed ,2(2), 2007,229-32.
76. Karodi R ,Evaluation of the wound healing activity of a crude extract of *Rubia cordifolia* L. (Indian madder) in mice, 'International Journal of Applied Research in Natural Products' 2(2), 2009 ,12-18.
77. Omale James et al., Excision and incision wound healing potential of *saba florida* (benth) leaf extract in *Yattus novergicus*, 'International Journal on Pharmaceutical and Biomedical Research', 1(4), 2010, 101-107.
78. Bussmann et al, Blending Traditional and Western Medicine: Medicinal plant usage among patients at *Clinica Anticona* in El Porvenir, Peru, 'Ethanobotany Research & Applications', 5.
79. Madhava chetty, K.Sivaji, K.Tulasi Rao 2008.Flowering Plants of Chittoor Dist, A.P, India, Student Offset Printers , Thirupathi, 357.
80. Prashant S Hegde et al., In vivo effect of whole grain flour of finger millet (*Eleusine coracana*) and kodo millet (*Paspalum scrobiculatum*) on rat dermal wound healing, 'Indian Journal of Experimental Biology', 43, 2005, 254-258.
81. Jain S et al., Antidiabetic activity of *Paspalum scrobiculatum* Linn. in alloxan induced diabetic rats, 'J Ethnopharmacol',127(2) 2010,325-8.
82. Djomeni D zeufiet, Hypoglycaemic effect of methylene chloride/methanol root extract of *Ceiba pentandra* in normal and diabetic rats, ' Indian J Pharmac', 38(3), 2006, 194-7.
83. Ahamed, In vivo wound healing activity of the methanolic extract and its isolated constituent, gulonic acid γ -lactone, obtained from *Grewia tiliaefolia*. Planta Medica, 75(5), 2009, 478-482.
84. Alope C, Hypoglycaemic and Hypolipidaemic Effects of Feed Formulated with *Ceiba pentandra* Leaves in Alloxan Induced Diabetic Rats, 'Australian Journal of Basic and Applied Sciences', 4(9), 2010, 4473-4477.