Journal of Cardiovascular Disease Research

ISSN:0975-3583,0976-2833 VOL12,ISSUE05,2021

Wound Healing Potentials of Phytochemicals from Commonly Used Indo-Africa Vegetables, Fruits & Spices: A Guide to Common Man

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ABSTRACT:

A wound is an injured tissue in any part of the body that may be due to accidental cuts, can be in the form of nicks, grazes, punctures, scratches, broken knobs, shatter-bruised areas, or essentially any area where there is a break in the skin, etc, that everyone has to meet in everyone's daily life. The main problem with any type of wound is pain and sepsis, to manage these wounds, the allopathy system prescribes multi-combination of antibiotics, which are the main culprits of microbial resistance, side-effects and inadequate management. Hence this chapter focuses on the wound management phytochemicals reported from the common vegetable fruits& spices that every individual uses in daily life like pepper (*Piper nigrum*), pumpkin (*Cucurbita pepo*), garlic (*Alium sativum*), Onions (*Alium cepa*), Bael fruit (*Aegle marmelos*), Banana(*Musa paradisiaca*), Mustard (*Brassica nigra*), pepper (Piper nigrum), Tamarind (*Tamarindus indica*), Coffee (*Coffea arabica*) and Green tea (*Camellia sinensis*). The chapter also explains the importance of these herbs in sense of their phytochemicals and how to use them in wound management.

Keywords: Spices, vegetables, Phytochemicals, wound management, *Alium cepa*, Microbial resistance.

INTRODUCTION:

The Antimicrobial activity and wound healing discovery from plants:

An antimicrobial is an agent that inhibits or kills the growth of bacteria. Medicinal plants representing a rich source of antimicrobial agents. Over the globe, these medicinal plants are being used as antimicrobial aids and are major phytochemical resources of many potent new drugs.[1] The antimicrobial properties of certain Indian medicinal plants were reported based on ethnic practices.[2] In nature, there are a large number of different types of wound healing antimicrobial compounds like phytoalexins, flavonoids, alkaloids, tannins, phenolics, etc., constituted a major group of secondary metabolites that are ubiquitously distributed in higher plants.

1.2 Wound healing:

The wound's healing starts immediately from the injury and continues for varying periods depending on the wound extent and the process and can be divided into three stages proliferate phase inflammatory phase, and finally the transformation phase which ultimately determines the strength and appearance of the healed tissue. The entire process consists of complex series of interrelated events mediated through various phases of chemically co-ordinate cellular hormonal influences.[3-4]

Antibiotic resistance in wound management:

The current problem in wound infection is multi-resistant bacteria at the site of infection and which is mainly due to unnecessary dumping of synthetic antibiotics without rationality and this major issue can be addressed with the help of alternative therapies and new drug molecules or the plants that have a multidimensional mechanism of action.[5]

Keeping in mind, all these above facts, urgent attention is required to heal these wounds without antibiotics and heal by using the peels, pastes, extracts or decoctions from the vegetables, fruits or spices that everyone uses in their common day

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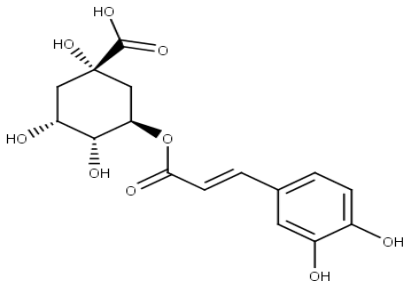
to day life, hence this chapter is giving attention to attract the readers how to heal wounds like cuts as a first-aid measure in the home itself and listing out the wound healing potentialities of commonly used herbs in one's daily life.

1) Banana

Scientific name: *Musa paradisiaca*, Family: Musaceae

The common daily fruit and stems obtained from the plant *Musa paradisiaca or M.acuminata* belongs to the family Musaceae. The studies revealed that fruit peels and stems proved to have wound healing, antimicrobial activity including antioxidant activity. The plant is documented for its phytochemicals like phenols, tannins, flavonoids, etc., the *in-vitro* studies proved that the methanolic extracts of the peel significantly contracted the wound and improved the healing process in animal experimental models.[6] However, phenolics and terpenoid molecules like chlorogenic acid, 4-cyclomusalenone and cycloeucalenol acetate were isolated from the rhizomes extract of this plant and proved to have antioxidant activity.[7] However further scientific evidence is required to propose the molecular mechanism of these banana peels. The Harvard medical school researchers investigated the banana leaves and proved that banana leaf dressings reduce the pain in wounds and cool the burn.[8] Clinical studies carried out in India's LTMG Hospital and LTM Medical College proved that banana peel dressings reduced the burns from pain and reduced the risk of microbial infection at the wound site.[9] Banana peel wound healing occurs from a DNA level, as thymidine is into cellular DNA incorporation. This increases cell growth. These studies proved that banana peel and leaf can be use as band-aids or dressings over the affected area.[10]

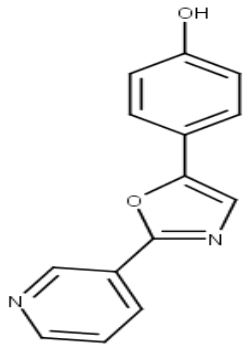


Chlorogenic acid

2) Bael

Scientific name: Aeglemarmelos L, Family:Rutaceae

Bael is one of the sacred trees of Hindus and commonly known as bilvam in Sanskrit and consists of ripening fruits obtained from the *Aegelemarmelos* belongs to the family Rutaceae. The fruit is possessing to have many wound healing phytochemicals like halfordinol, phellandrene, Marmesin, skimmianine, rutin. The ripe fruits are scientifically documented for their wound healing properties in intestinal ulcers and the unripe fruit possesses to have astringent properties due to the high load of tannins.[11] As per the ancestral practices in India, the fruit juice of wood apple along with honey and cumin proved to heal peptic ulcers and the leaves of bael tree used in the olden days as an external wound dressing, however, scientific evidence is still pending, In Ayurveda, the bilvamleghyam and the churnam are available in Indian traditional market and used as a dietary supplement to heal internal wounds known as ulcers.



Halfordinol

3) Coffee

Scientific name: *Coffea arabica*, Family: Rubiaceae

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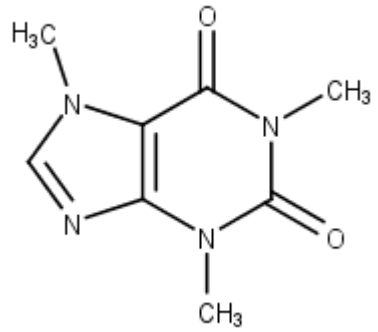
The refreshing daily drink obtained from the roasted or fresh green beans of *coffea arabica* belongs to the family Rutaceae. The studies conducted by the International Wound Journal in 2014 proved that the coffee decoction impedes epithelialization and hindered the wound healing process. The main phytochemical present in coffee is caffeine and the wound healing property of coffee is mainly due to caffeine. In human ex-vivo studies, caffeine is proved to nullify the effect of adenosine in the promotion of wound healing.[12] Even during my childhood, I practically evidenced myself that old people in India sprinkle the coffee powder externally over the wound due to accidents.

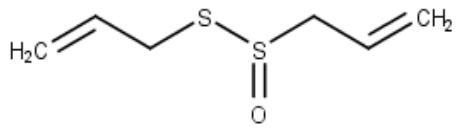


Caffeine

4) Garlic

Scientific name: Allium *sativum*, Family: Amaryllidaceae

The traditional spice of India is obtained from the dried bulbs of Allium *sativum* of the family Amaryllidaceae. The allicin is the important phytochemical responsible for many broad-spectrum pharmacological activities. The studies proved that the topical application of garlic paste externally over the affected areas of wounds accelerates wound healing by increasing the number of fibroblasts. The countries like India and Indonesia, garlic tubers paste is using as dressing around the wounds.[13]

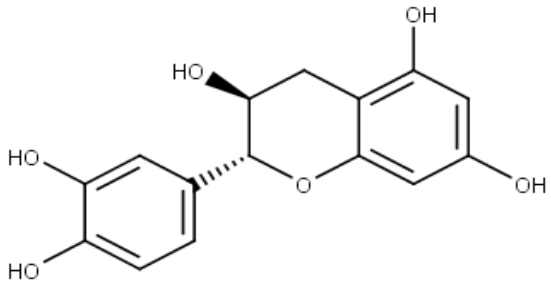


Allicin

5) Green tea

Scientific name: *Camellia sinensis*, Family: Theaceae

The refreshing daily liquid obtained from leaves of *Camellia sinensis* belongs to the family Theaceae which consists of more than 2000 compounds in which catechins are very important, the preclinical studies proved that the animal who consume a cup of green tea daily have faster-wound healing and epithelial neo tissue formation. However *in-depth* clinical studies on the wound healing activity of green tea were not carried out and clinical data was missing from the literature evidence, but in India many of the homes, people use the green decoction as an antiseptic washing.[14]



Catechin

6) Mustard

Scientific name: *Brassica nigra*, Family: Brassicaceae

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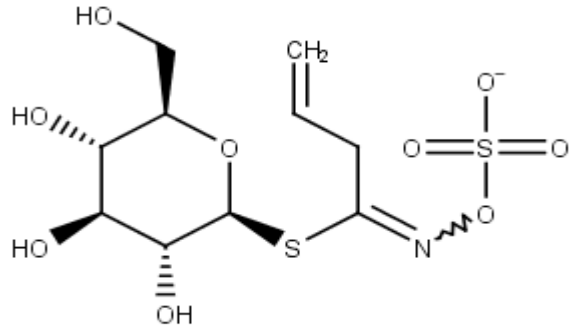
It is the common spice in everyone kitchen of India and some regions in India use mustard oil as a source of cooking; the seeds are obtained from the herb of *Brassica nigra* belongs to Brassicaceae. The sinigrin is the famous phytochemical responsible for any type of pharmacological activity. The sinigrin proved to have significant *in-vitro* wound healing activity on human keratinocytes (HaCat), the Phyto some –sinigrin complex was proved 100% wound closure activity.[15] The mustard oil can be used gently over the wounds, this will heal the wounds faster. Still, clinical records are missing from the literature evidence.

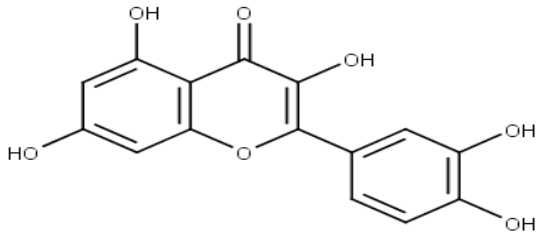


Sinigrin

7) Onions

Scientific name: *Allium cepa* L, Family: Liliaceae

The common mouth-watering vegetable in every house obtained from the stems of *Alium cepa* belongs to the family Amaryllidaceae. The phytochemicals cepaenes, quercetin and kaempferol were reported from onions. In northeast India, the onions will be used as hound healing topical dressings to heal wounds due to burns, even onion-based traditional wound healing oils are being practiced by some Indian traditional healers.[16]

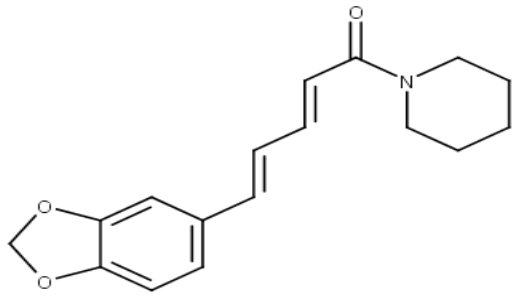


Quercetin

8) Pepper

Scientific name: *Piper nigrum*, Family: Piperaceae

Black pepper is the common spice in everyone's kitchen and is the fruit obtained from the *Piper nigrum that* belongs to the family Piperaceae. Even though hundreds of secondary metabolites were identified from this spice, the phytochemicals like piperine, Piperettine are major phytochemicals reported from this spice and are responsible for various pharmacological activities.[17] Even pepper oleo-resins encapsulated in wound dressing films proved to heal the wound significantly and also prevented sepsis due to microbial infections.[18] This pepper can be used as powder in-between two layers of sterile gauze/cloth and can be used as a band-aid over the wounded area



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Piperine

9) Pumpkin

Scientific name : *Cucurbita pepo*, Family: Cucurbitaceae

Pumpkins, the common fruit in most Indian houses, are the fruits obtained from the *Cucurbita moschata* belongs to the family Cucurbitaceae. The fruit peel and its seeds were proved to have wound-healing action on the burns. The phytochemical screening proved to consists of phenolics, flavonols, tannins, etc., All this scientific evidence may confirm that the peel of this fruit can be used as wound healing dressings on accidental cuts.[19] All the Cucurbitaceae peels may be used as wound dressing materials as per the literature evidence.

9) Tamarind

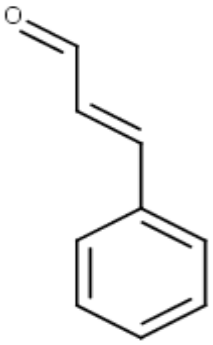
Scientific name: *Tamarindus indica*, Family: Fabaceae

The tamarind is everyone's favorites fruit to enhance the sourness and taste of many dishes and In India, every kitchen having this fruit. Evidence claim that the seed extract, peel extract and fruit pulp have wound healing capacity and also anti-inflammatory action. The phytochemical screening proved that phenolics, tannins and flavonoids are predominant in this plant, however still the isolated phytochemical responsible for wound healing activity is a missing area where the researchers can focus to prove its molecular mechanism.[20] Even I remember my childhood dressing made by my grandmother on my leg wound using tamarind pulp and rice flour.

11) Cinnamon

Scientific name: *Cinnamomum zeylanicum*, Family: Lauraceae

The cinnamon bark is the all-time favorite spice in Indian and African countries and a common ingredient in most herbal teas. Cinnamaldehyde is a biomolecule present in this bark and responsible for showing broad-spectrum antibacterial activity. The preclinical studies showed that 1.5% w/w alcoholic extract ointment proved to show significant wound healing activity on rats model due to its antioxidant mechanism.[21]



Cinnamaldehyde

12) Turmeric

Scientific name: *Curcuma longa*, Family: Zingiberaceae

Turmeric is a validated ancient healing herb for various diseases and the rhizomes contain curcumin, desmethoxycurcumin, and bisdemethoxycurcumin which are known as curcuminoids. Preclinical studies proved that 10%w/w of hydro alcohol extract was proved to be significant in wound healing against excision wound models on rats.[22] In India, traditionally people used to apply turmeric paste on wounds or cuts for its antiseptic activity.

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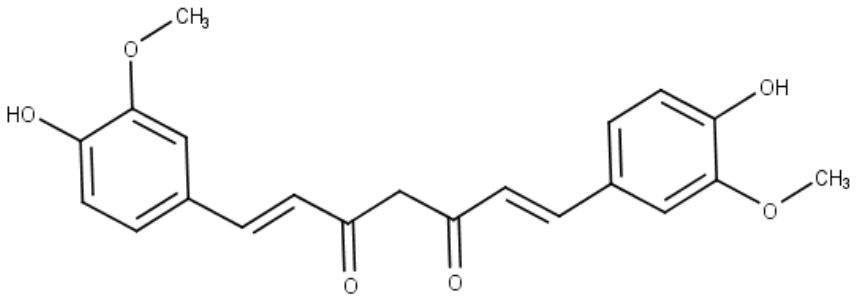


Curcumin

13) Pineapple

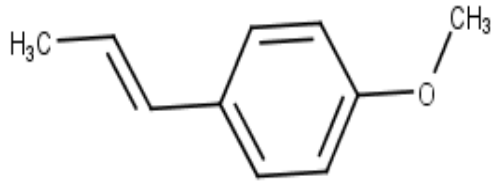
Scientific name: *Ananas comosus* Family: Bromeliaceae

Dexa Laboratories of Biomolecular Science (DLBS) developed an aqueous extract from the stem of this fruit and named Tacori and the phytochemistry was revealed that this aqueous extract consists of protein made up of amino acids glycine, proline, glutamine and arginine. The *in-vitro* and *in vivo* studies proved that Tacori is responsible for wound healing activity and the results were found to be significant on animal molecular mechanism studies. The stimulation of wound healing was found to be by modulation of the expression of tumor necrosis factor α, transforming growth factor β and matrix metalloproteinase 2. However, information on clinical studies is in progress.[23] The pineapple fruit aqueous extract proved to have an abundance of flavonoids, phenolics, proteins reported for their antibacterial and wound healing activities. [24-25]

14) Black Cumin

Scientific name: *Nigella sativa* Family: Ranunculaceae

Black cumin is an ancient herb and the seed oil gained ethnomedicinal importance in the treatment may microbial diseases and gastrointestinal disorders in the Muslim and Unani systems of medicine. The chemistry of nigella seeds consists of anethole, p-cymene, limonene, carvone and thymoquinone and linoleic acid.[26] Recent evidence proved that freeze-dried aqueous seed extract of nigella at 25 µg/ml proved to enhance wound healing activity during proliferative and remodeling phases of soft oral tissue healing and also increases the tensile strength through improving collagen on rat models.[27]



Anethole

15) Pomegranate

Scientific name: *Punicagranatum* Family: Lythraceae

Pomegranates are flavonoid-rich fruits reported for their various therapeutic roles. The exocarp of this fruit was reported for its flavonoids, phenols, high amount of vitamin C and tannins.[28] Recent studies at the preclinical level proved that aqueous extract of the exocarp of pomegranate (peels) proved to enhance the wound healing activity due to their antioxidant and antibacterial properties.[29-30]

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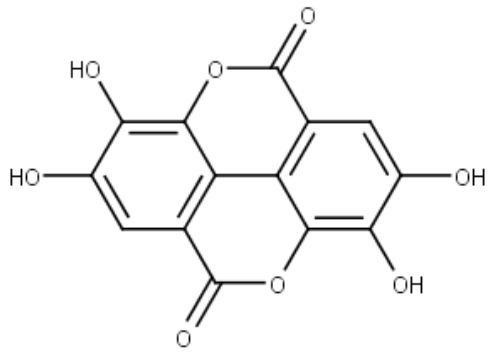
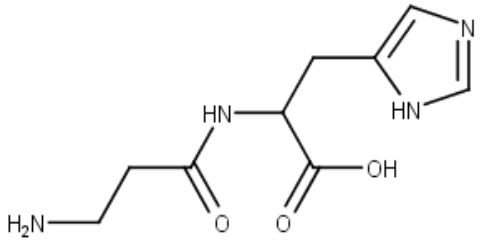


Ellagic acid

16) Papaya

Scientific name*: Caricapapaya* Family: Caricaceae

The papaya is everyone's favorite fruit in Indian and African countries. The papaya is famous for its papain, flavonoids, phenolics and fatty acids like octadecanoic acid and oleic acid.[31] The preclinical evidence proved that fruit aqueous extract proved to be promoting significant wound healing activity with 77% reduction in the wound area and also showed significant broad-spectrum antibacterial activity on both gram-positive and gram-negative bacteria.[32]

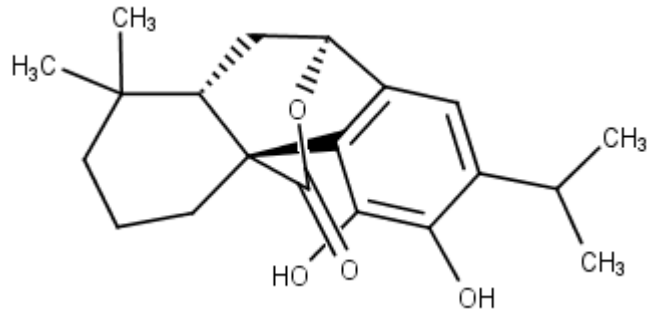


Papain

17) Rosemary

Scientific name*: Salvia rosmarinus* Family: Lamiaceae

Rosemary is a common herb that gained global recognition as a spice and medicinal herb. The Rosemary consists of volatile oils, terpenoids like carnosic acid and carnosol, rosmarinic acid, phenols, tannins.[33] The rosemary oil is reported for its antibacterial activity, and to treat minor wounds.



Carnosol

CONCLUSION

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This chapter gives in brief about the wound healing potentials of the common spices, fruits and vegetables that everyone uses in their daily life. However, this traditional knowledge is acquired not from books but ancestral origin. However, we are neglecting these excellent resources in managing minor wounds at home and giving attention to antibiotics even for managing small cuts, this led to a major event known as antibiotic resistance. Even in-depth research on these common herbs was not carried out till today date and hence this chapter gives information or idea to the researchers to come out with a wound healing multidimensional deliverable using these wastes known as fruit/ vegetable peels or seeds at a very cheaper price.

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