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Review on Tamarindus Indica on Diabetic complication like Wound Healing

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ABSTRACT
Tamarindusindica is a well-known medicinal plant which belongs to Fabaceae family. Tamarind is a plant that can be used traditionally in wound healing, snake bite, abdominal pain, colds, inflammations, diarrhea, helminth infections, and fever.however there's no experimental data related to its efficacy in wound healing potential thus the present study was undertaken to study the wound healing potential of part of T. indica. Various part of Tamarindusindica are used as Antioxidant, Anti-inflammatory and Antimicrobial activity that are responsible factor for its wound healing property.Wound healing efficiency of tamarind seed was evaluated. Tamarindusindica with different solvents: phosphate buffer saline (PBS), water, methanol and ethanol extract increases the wound healing rate.The Tamarindusindica seed extract showed significant reduction within the period of epithelialization and percentage wound contraction compared to normal control.
Our present study during this review encompasses (i) active components isolated from the plant and their biological role in disease targeting. (ii) Effect of TamarindusIndica on the Diabetic complication like Wound Healing
KEY WORDS: TamarindusIndica, Wound Healing, Tamarind seed Extract, Antioxidant Effect, Phytoconstituents.

I. INTRODUCTION

Tamarindusindica Linn.ofCaesalpiniaceae is usually identified and known as Chincha in Ayurveda system of medicine. Its fruit, tender leaves and flowers are used extensively in culinary preparations. It's a huge wide spreading tree 12 to 18 m high. The trunk shows dark rough bark with deep cracks, and seeds are smooth, red brown (sepia), enveloped by tough leathery membrane. It's scientifically reported for several medicinal properties viz. anti-oxidant, anti-inflammatory, analgesic, anti-arthritic activity (for seed); anti-oxidant, anti-microbial activity (for fruit); antibacterial, hepatoprotective effect (for flowers);anti-microbial activity (for leaves); and hyperglycemic, anti-microbial activity (for bark).[1].TheTamarindusindica Linn is a tree belonging to the Magnoliophyta, Order Fabales, Family Fabaceae (subfamily Caesalpinioideae). It is native to tropical Africa and its cultivation was widespread, developing well altogether tropical continents [2]. Tamarind seed coating exhibit antioxidant activity when extracted with ethyl acetate and ethanol (Tsuda et al., 1994; Luengthanaphol et al., 2004).

Wound healing is one among the major concerns among health care practitioners and scientists. Poor wound healing not only cause trauma to the patient but increase the burden of monetary resources and requirement for cost effective management within health care system (Bowler et al., 2001). Antioxidant is vital as it is needed to decrease the oxidative stress. An oxidation process produces free radicals that are dangerous and may hinder the process of wound healing as they tend to accept electrons from the nearby healthy cells and induce the cell/tissue damage.

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Within the present study, influence of tamarind seeds on wound healing was demonstrated. Differing types of tamarind seed extracts, Phosphate Buffer Saline (PBS), water, methanol and ethanol extract are used as the treatment groups in this study. This review, we focus our attention to: (1) biological roles reported in humans and animals and active components from the plant. ,(2) Effect of TamarindusIndica on the Diabetic complication like Wound Healing.

From available literature, there's no known experiment conducted to determine the effect of Tamarindusindica on superficial wound closure. However, related studies are carried out to determine the effect of tamarind seed polysaccharide (TSP) on the repair of corneal wounds and it was discovered that TSP has a positive effect on cellular adhesion, thus promoting rapid healing [2].

Fig.1:Plant OfTamarindusIndica Linn With Fruits And Seeds

- Taxonomic classification:

Kingdom - Plantae
Sub kingdom - Tracheobionta
Super division - Spermatophyta
Division - Magnoliopsida
Sub class - Rosidae
Super order - Rosanae
Order - Fabales
Family - Fabaceae
Sub family - Caesalpinioideae
Genus - Tamarindus Linn
Species - T.indica
Tribe - Detarieae
Binomial name - Tamarindusindica Linn.

- **PHYTOCONSTITUENTS OF TAMARINDUS INDICA**

Preliminary phytochemicals study of Tamarindusindica have revealed presence of phenolic compounds, cardiac glycosides, mallic acid, tartaric acid,uronic acid, mucilage, pectin, arabinose, xylose, galactose and glucose.

Tamarind plant shows the presence of various essential elements like arsenic, calcium, cadmium, copper, iron, sodium, manganese, magnesium, potassium, phosphorus, lead and zinc.
The ethanolic extract of Tamarindusindica showed the presence of fatty acid, out of which 21 are saturated fatty acids such as n-heptadeconate, hexadeconic acid, n-nonadecanoate, etc. along with 11 unsaturated fatty acids such as nenodecenoic acid, 10-octadecenoic acid, heptadeconoate, etc
Fruit pulp contains organic acids such as tartaric acid, acetic acid, citric acid, formic acid, mallic acid and succinic acid. And also the pulp shows the presence of high amounts of ascorbic acid, vitamin B1, B3, amino acids such as alanine, phenylalanine, proline, serine, leucine; volatile oils; pectin; proteins and fat. Pulp also contains alkaloids, glycosides, saponins, sesquiterpenes.

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TABLE 1: PROPERTIES AND PHYTOCONSTITUENTS OF DIFFERENT PARTS OF T. INDICA

Parts of plants	Properties	Active components	References
Bark	Antiallergic, antimicrobial, antibiotic,antityrosinase, antioxidant, analgesic and spasmogenic activities.	Rich in tannins and polyphenols: N-Hexacosane, eicosanoic acid, b-sitosterol, octacosanylferulate, 21-oxobehenic acid, and (+) - pinitol and phenolic antioxidants for proanthocyanidins in several ways: catecetramer, procyanidinpentamer, procyanidinhexamer along the taxifolin, apigenin, eriodictyol, luteolin and naringenin.	[4,5]
Seed	Anti Inflammatory activity; Effects on the control of satiety, having a potential for treatment or prevention of obesity; gastroprotective effects.	Source of protein and starch, sulfur amino acids and phenolic antioxidants as proanthocyanidins and epicatechin. Inhibitors of proteinases.	[4,5, 6]
Leaves	Antiemetic activity and protection for the liver.	Source of protein, lipid, fiber and vitamins like thiamine, riboflavin, niacin, ascorbic acid and β-carotene. Composed by 13 essential oils, in which limonene benzoate and benzyl are the most important compounds, followed by pentadecanol and hexadecan	[5,6]
Fruit pulp	Hypolipidemic activity, antioxidant, anti fluorose, analgesic, hepatoregenerativa and antispasmodic.	B vitamins, minerals, tartaric acid, acetic acid, citric acid, formic acid, malic acid, and succinic acid, amino acids; invert sugar (25-30%), pectin, protein, fat, some pyrazines (trans-2-hexenal), and some thiazoles (2-ethylthiazole, 2-methylthiazole	[5,6,7]
Stem Bark	The tea is used for sore throat. Spasmogenic, analgesic, antimicrobial and hypoglycemic activities.	Flavonoids, cardiac glycosides, alkaloids, saponins and tannins.	[5,6]

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WOUND HEALING:

Wound healing is a complex and dynamic process of restoring cellular structure and tissue layers in damaged tissue as soon as possible to its original state.[1] Wound involves a disturbance within the cellular, anatomical, and functional epithelial integrity of the skin consequent to physical chemical, thermal microbial, or immunological insult; followed by dis-ruption of the structure and performance of underlying normal tissue[9] The fundamental response in wound healing involves a process of connective tissue repair and is characterized by four such as hemostasis, inflammation, prolifer-ation, and remodeling during which the repair processrequires the coordination of different cells, growth fac-tors, and cytokines[10]

Fig.2: The Wound healing process involves four stages-bleeding, inflammation, proliferation and remodling (epitheliazation)

Normal wound causes haemostasis, inflammation, proliferation, then tissue remodelling but in diabetic wound healing there is no normal healing timeline developed because diabetes mellitus is metabolic disorder and causes impaired wound healing . Impaired wound healing is very prominent diabetic complication, where we will use NO therapy effectively [11]. Process of healthy wound recovery takes place within 30 days, whereas diabetic wound remains unresolved. Many researchers that are specialize in developing effective strategies against diabetes-associated wound (a leading cause of amputations) [12].

Diabetic wounds are slow to heal, are difficult to manage, thereby posing a significant challenge to manage in a clinical setting. The precise pathogenesis of poor wound healing in diabetic wound is not adequately understood. However, human and animal studies show impairment in several phases of the wound healing process[13].

Supported the study, differing types of tamarind seed extract on induced wound model, PBS, water, methanol and ethanol extracts increases the wound healing rate, but ethanolic extract was faster during the first phase of healing, while PBS extract was the fastest at a later phase of wound healing. Alkaloid, flavonoid, saponin and tannin are the main phytochemicals present and responsible in wound healing activity. PBS extract showed the simplest activity and at the same time it showed highest protein yield and it believed to play a very important role in the activity (Muhammadet al., 2012). Xyloglucan polysaccharide of the tamarind was known to scale back the effect of damage to skin caused by UV by reducing the loss of dendritic cells (Kuchel et al., 2005). Another study regarding two sorts of xyloglucan with different molecular weight was studied and they both seem to support skin regeneration, but differ in molecular signal response (Nie and Deters, 2012).

FACTORS AFFECTING WOUND HEALING:

There are various factors that affect wound healing, and a best understanding of these factors and their possible influence on wound healing. Factors affecting the wound healing are dis-cussed below.

- **Wound site:**

The wound site is an important factor in wound healing as wound infection is most common reason for impaired wound healing.

- **Immune state:**

Various components of the immunology system are affected in patients with diabetes. It's been Reported that polymorphonuclear leukocyte function is reduced particularly in the presence of acidosis while leukocyte adherence, chemotaxis, and phagocytosis can also be negatively affected in diabetic state. Diabetes may be a risk factor for bacteria in patients with pneumococcal pneumonia and is linked to increased mortality[13]

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- **Reactive oxygen species (ROS):**

The high concentration of ROS could induce serious tissue damage which could lead on neoplastic transformation, further resulting in impaired healing process by inducing cellular, DNA, proteins, and lipids damages [13,14].

MECHANISMS OF WOUND HEALING:

Antioxidant effects:

Reactive oxygen species (ROS) and other free radicals are produced during ininflammation cellular injuries. ROS facilitates lipid peroxidation and breakdown of the many macromolecules and cause injury to tissues. As a result, inflammatory mediators are released[15] Reactive oxygen species (ROS) play an important role in the preparation of the normal wound healing response. Therefore, a accurate balance between low or high levels of ROS is essential.

The antioxidant activity is usually related to the presence of phenolic compounds that show specific common structures that allow them to be reducing agents, hydrogen donors and oxygen scavengers, among other reaction mechanisms. At the cellular level, several antioxidant compounds are known to be capable of stabilizing or destroying free radicals, thereby preventing damage to cell.

the effects of methanol extract of the Seed coat of T. indica in Wistar rats and observed decreased activity of SOD (55%), catalase (73%) and peroxidase (78%), and that they also observed this extract protects and restore hepatic architecture[16] the pharmacological effects and the toxicity from the extract of tamarind leaves in erythrocyte and their results found that despite the presence of saponin, no adverse effects were showed and observed that the extract worked as a protector of the cells, probably because of their antioxidant mechanisms and flavonoid content[17].The seed and pericarp of T. indica contain phenolic antioxidant compound.

Antiseptic effect:

Tamarindusindica containing phytochemical constituents such as tannins, flavonoids, alkaloids and number of other aromatic compounds are secondary metabolites of plants that serve as defense mechanisms against predation by many microorganisms, insects and herbivores[18] Tamarind fruit showed anti-bacterial and also anti-fungal activity. In an agar dissemination test, T. indicaflower extracts appeared antibacterial properties against four microbes which are Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli. T. indica as Antimicrobial action has been credited to lupeol study [19,20]

Immunomodulating activity:

Herein, TKP-2-1, a water-soluble polysaccharide with a weight-average relative molecular weight of 1693 kDa, was isolated from the seed kernels of Tamarindusindica L. UV, FT-IR, GC–MS and 1D, 2D-NMR data analysis revealed that TKP-2-1 is mainly contain of a (1 → 4)-β-D-glucan backbone with side chains of α-D-xylopyranosyl, α-D-xylopyranosyl-(1 → 4)-β-D-galactopyranosyl and β-D-galactopyranosyl-(1 → 2)-α-D-xylopyranosyl sugar moieties linked to the C-6 positions of the glucose residues. Furthermore, TKP-2-1 exhibited a potent immunostimulatory activity through enhancing phagocytosis and Nitric Oxide production, also the expression of iNOS, IL-1β, IL-6, and TNF-α in RAW264.7 macrophages. Mechanistically, TKP-2-1 caused the degradation of IκBα and nuclear translocation of NF-κB p65, and phosphorylation of

ERK, JNK and p38 MAPK in RAW264.7 cells. Specific inhibitors of NF-κB, ERK, JNK, and p38 MAPK obviously abolished TKP-2-1-induced Nitric Oxide production in RAW264.7 cells, respectively. Thus, TKP-2-1 obtain from the seed kernels of T. indica might potentially be used as a natural immunomodulator in functional foods[21].

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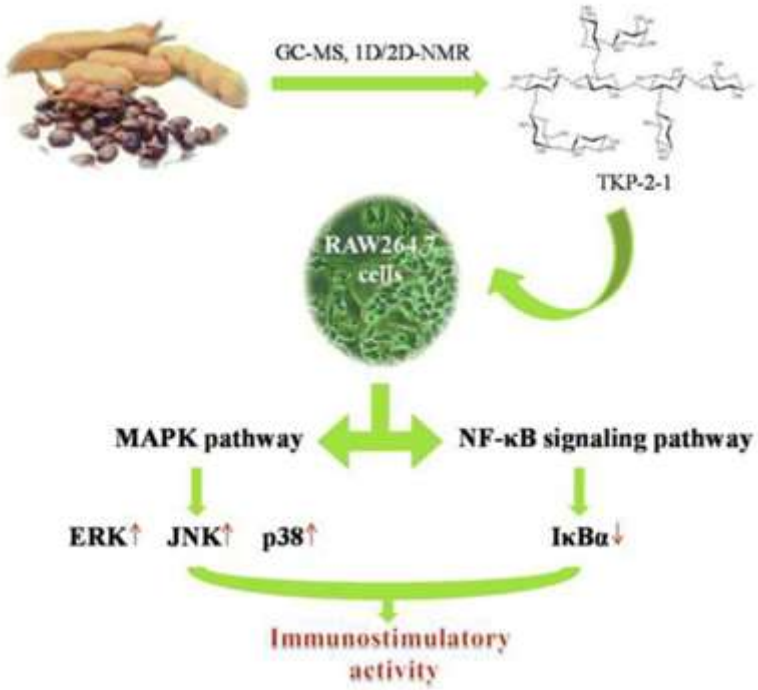

Fig.3: Immunostimulatory activity

Immunostimulatory activity plays an important role during acute wound healing. The activation of immune cells and factors started the inflammatory process, facilitate wound cleansing and promote subsequent tissue healing. However, dysregulation of the immunity system during the wound healing process leads to persistent inflammation and delayed healing, which ultimately end in chronic wounds[22].

Effects on Inflammation:

Inflammatory processes play a fundamental role within the initial defence of the body after infection or damage of a tissue, hence limiting further damage to the affected site.Tamarind has played fundamental roles in traditional medicine as an anti-inflammatory and analgesic drug.

Ethanol, chloroform and aqueous extracts of T. indica were assessed for anti-inflammatory activity in rats (subplantaroedema influenced by carrageenan) and mice (ear oedema influenced by arachidonic acid) after administration. The Plant shows anti-inflammatory activity as shown by results[24].

The preclinical studies provided strong pharmacological evidence for the anti-inflammatory and analgesic activities of the various parts of T. indica and this might be attributed to the various bioactive compounds in it including alkaloids, flavonoids, tannins, phenols, saponins, and steroids. The anti-inflammatory and analgesic effects of the extracts from the various parts of T. indica could also be due to its ability to inhibit a number of biological processes including cyclooxygenase-2 (COX-2) expression, inducible NO synthase (iNOS), 5-lipoxygenase biosynthesis, and tumor necrosis factor-α. The analgesic activity of T. indica can also be through the activation of the opioidergic mechanism at both the peripheral and central levels[23].

II. CONCLUSION :

Wound healing is a complex and dynamic process of restoring cellular structure and tissue layers in damaged tissue as soon as possible to its original state. The excision wound healing has three important phases like inflammatory phase, which is characterised by haemostasis and inflammation, Proliferative phase characterised by angiogenesis, collagen deposition and remodelling Phase characterised by wound undergoes contraction and granulation tissue formation.In Ayurveda and different traditional system of drugs hundreds of herbs were mentioned for its medicinal use.

The results of this study substantiate the use of T. indicavarious parts in folklore medicine for the treatment of wounds.We consider plants are

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the rich sources of therapeutically diverse molecules with potential therapeutic value. The phyto-constituents like tannins, alkaloids, coumarins and flavonoids features a strong antioxidant, anti-inflammatory and anti-microbial activities. In excision wound initially there'll be production of reactive oxygen species (ROS) as a part of tissue injury. These ROS were liable for initiating the inflammatory response followed by interference in the wound healing process.In majority cases there'll be infection due to microbial attack. Hence the first aim of therapy for wound healing is to prevent further tissue injury due to oxidative stress or either prevention of inflammatory process or prevention of microbial infection. T. indica seed has showed the presence of flavonoids which is established to possess potent anti-oxidant activity, radical scavenging effect along with anti-inflammatory and antimicrobial activity thus the collective anti-inflammatory, anti-oxidant and anti-microbial property of T. indica cork and seed might be the responsible factor for its wound healing property.

Hence from these findings we wil conclude that the various part of T. indica are often a potential therapeutic agent and used against wound caused by tissue injury. This supports its traditional usage of Chincha (T. indica) in wound healing as mentioned in Ayurvedic text and folklore claim.

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