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COMBINATION OF B-GLUCANS AND *TERMINALIA ARJUNA* EXTRACT ENHANCE WOUND HEALING EFFECT IN ALBINO RATS

Krishnaraju Venkatesan[*1], Rajalakshimi Vasudevan[1], Absar Ahmed Qureshi[1], Ester Mary Pappiya[2], Premalatha Paulsamy[3], Rama Ramaiah[3], Kalpana Krishnaraju[4]

[1*]Department of Pharmacology, College of Pharmacy, King Khalid University, Abha, Asir Province, Saudi Arabia.
[2]Directorate of General Health Affair, Ministry of Health, Najran, Saudi Arabia.
[2]King Khalid University, Khamis Mushait, Asir Province, Saudi Arabia.
[4]Department of Pharmacy, Erode College of Pharmacy, Veppampalayam, Erode, Tamilnadu, India.

ABSTRACT

In vivo models were used to test the effects of *Terminalia arjuna*, β-glucan, and the combination of *Terminalia arjuna* + β-glucan on the healing of rat cutaneous wounds. When compared to control, the combination increased the tensile strength of incision wounds and the % epithelialization of excision wounds by a statistically significant amount ($p<0.05$). Combination wounds had the fastest rate of epithelialization, even when compared to excision wounds. These findings support the hypothesis that the *Terminalia arjuna* + β-glucans accelerates the healing process.

KEYWORDS

Albino rats, *Terminalia arjuna* and β-glucans.

Author for Correspondence:

Krishnaraju Venkatesan,

Department of Pharmacology,

College of Pharmacy, King Khalid Universiy,

Abha, Asir Province, Saudi Arabia.

Email: kvenkatesan@kku.edu.sa

INTRODUCTON

The loss or breaking of the cellular, anatomical, or functional continuity of live tissue is known as a wound[1]. Wound healing, or the restoration of living tissue continuity, is a complicated (but orderly) process involving a number of steps, regeneration of parenchymal cells, including wounding-induced acute inflammatory response, migration and proliferation of both parenchymal and connective tissue cells, connective tissue re-modelling, and papillary re-modelling[2].

Several natural products, such as tannins[3], saponins[4], flavonoids[5], napthaquinone[6], triterpenes,

alkaloids[7], and biomolecules, stimulate wound healing[8]. These agents are involved in disinfection, and debridement, providing a moist atmosphere to stimulate the creation of a favorable environment for the natural healing process[9].

Terminalia arjuna (Combretaceae) has been reported to have therapeutic properties. For almost three centuries, the bark of the *Terminalia arjuna* tree has been utilized in Ayurvedic medicine, particularly as a heart tonic. It is also said to cleanse the blood and improve the complexion. *Terminalia arjuna* bark was previously used in wound healingin rat models of incision and excision wound healing[10,11]. The findings revealed an increase in the tensile strength of incision wounds as well as increase in the rate of epithelialization. This prompted a study to further evaluate the role of β-glucan in combination with *Terminalia arjuna* in wound healing activity of rats.

MATERIAL AND METHODS

Animals and plant Extraction

Albino rats (Wistar strain) of either sex, weighing 180-250g, were utilized. They were kept in clean, sterile polyvinylcages and fed a regular pellet diet with water adlibitum. The plant's bark was coarsely pulverized in a hammer mill and extracted with a Soxhlet extractor for 18 hours using 50 percent ethanol as a solvent. Animals were carefully monitored for signs of infection, and those that showed signs of infection were removed from the trial and replaced.

The treatment was carried out in accordance with the consent of King Khalid University's animal ethics committee and the National Institute of Health's guidelines for the care and use of laboratory animals in the United States (NIH Publication No. 85-23, revised 1996). Through an intragastric tube, Group I got 2 ml of gum acacia 2 %. *Terminalia arjuna* 400mg/kg po was given to Group II. *Terminalia arjuna* (400mg/kg) po +β-glucan 80mg/kg were given to Group III. The alcoholic extract of *Terminalia arjuna* was suspended in a 2 % gum acacia suspension.

Dosing Schedule

In the incision wound models, *Terminalia arjuna* extract alone and in combination with β-glucan were given orally once daily from day 0 to day 9; in the excision wound model, from day 0 to the day of full healing or the 21st postoperative day, whichever came first.

Wound models

Pentobarbitone (3mg/100g) anesthesia was used for all wounding procedures. There were no evidence of infection in the animals in this investigation.

Incision wound

Two paravertebral incisions of 6cm length were made on the depilated backs of the animals, cutting through the complete thickness of the skin. To approximate the cut edges of the skin, interrupted sutures were inserted 1cm apart. On the seventh post-wound day, the sutures were repositioned, and skin breaking strength was assessed using Lee's continuous water flow technique on the tenth day[12].

Excision wound

On the depilated back of the rat, an excision wound was inflicted by cutting away 500mm^2 complete thickness of a pre-determined area. The number of days after injury that the dead tissue had to break off and leave no raw wound was recorded as the epithelialization time. On alternate days, planimetric measurement of the wound area was used to track the pace of wound contraction. The wound was traced on graph paper to create this. The wound area reduction was expressed as a percentage of the original wound size.

Statistical analysis

Student's t-test was used to examine the results, which were represented as mean SD, with a significance level of ($p<0.05$).

RESULTS AND DISCUSSION

Table No.1 shows the average breaking strength. The breaking strength was significantly increased ($p<0.001$) when *Terminalia arjuna* and β-glucan were given together. Table No.2 shows the percentage of wound contraction measured on the 1st, 5th, and 15th days in the control group. We found a positive trend in wound contraction rate in the *Terminalia arjuna* + β-glucan treated group ($p<0.001$) and a negative trend in the control group ($p<0.001$).

Discussion

Wound healing is a multi-step process that includes homeostasis, re-epithelialization, granulation tissue development, extracellular matrix re-modelling, and

scar formation[13]. No single model can adequately reflect the many components of the wound healing process as a whole in order to evaluate wound healing activity[14]. As a result, two models were utilized to evaluate the effects of the various stages of wound healing in this study. Although the healing process occurs on its own, different risk factors such as infection might cause the wound to take longer to heal[15]. As a result, there is a pressing need to speed up the procedure.

The current study looks at the impact of a plant called *Terminalia arjuna* on rat cutaneous wound healing. A study documented the therapeutic effects of a hydroalcohol extract of *Terminalia arjuna* bark in wound healing[11]. In comparison to the control, the current investigation showed that a hydroalcohol extract of *Terminalia arjuna* in conjunction with β-glucan increased the tensile strength of incision wounds and increased the rate of epithelialization of excision wounds. The increase in collagen turnover at the wound site could be responsible for the increased tensile strength of the incision wound[16,17].

The use of β-glucan for topical treatments is on the rise, thanks to their pluripotent qualities. β-glucan aid wound healing by promoting macrophage infiltration, which promotes tissue granulation, collagen deposition, and re-epithelialization.

β-glucan wound dressings are a good wound healer because they are stable and resistant to wound proteases. Based on the aforesaid individual properties of *Terminalia arjuna and* β-glucan combining the two in a multi-modal therapeutic method considerably improved wound healing. *Terminalia arjuna's* improved wound contraction impact and epithelization could be used clinically to aid in the healing of open wounds.

Table No.1: Wound healing effect of *Terminalia arjuna*+ β-glucansin incision wound model

S.No	Parameter	Placebo control	*Terminalia arjuna*	*Terminalia arjuna* + β-glucans
1	Skin breaking strength (g)	314.13 ±3.18	423± 4.47**	468± 4.37**

N = 6, Values are expressed as mean ± SD

**p* < 0.05 and **p < 0.001 vs. control. Independent *t*-test

Table No.2: Wound healing effect of *Terminalia arjuna*+ β-glucansin excision wound model

S.No	Parameter	Placebo control	*Terminalia arjuna*	*Terminalia arjuna*+ β-glucans
	Wound area (mm^2)			
1	Day 1	225.3±24.80	245.50 ± 11.7	235.52 ± 14.7
2	Day 5	183.6 ± 24.8	184.16 ± 32.56	174.16 ± 34.59
3	Day 15	129.8±25.81	65.40 ± 24.8 **	63.40 ± 24.8 **
4	Period of Epithelization (day)	15.4 ± 0.10	12.20 ± 0.14**	9.30 ± 0.14**

N = 6, Values are expressed as mean ± SD

**P < 0.001 vs. control. Independent *t*-test

CONCLUSION

The current study not only supports the traditional assertion that *Terminalia arjuna* is a wound healing agent, but it also demonstrates the importance of β-glucan as a significant phytoconstituent in the wound healing process.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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