Wound healing activity of *Solanum xanthocarpum* Schrad. & Wendl. fruits

Neeraj Kumar1, Dhan Prakash2 and Pankaj Kumar3

1Department of Pharmacy, Sri Ram Murti Smarak College of Engineering and Technology, Bareilly-243 202, Uttar Pradesh, India
2Amity Institute of Herbal Research & Studies, Amity University, Sector-125, Gautam Budh Nagar-201 303, Uttar Pradesh
3Faculty of Pharmacy, Moradabad Educational Trust Group of Institutions, Moradabad-244 001, Uttar Pradesh

Received 9 February 2009; Accepted 9 November 2010

*Solanum xanthocarpum* Schrad. & Wendl. (Family-Solanaceae), commonly known as Yellow-Berried Nightshade, fruits are used traditionally in the folklore for treatment of various kinds of wounds. The present study was undertaken to verify the effects of its fruits on experimentally induced excision and incision wound models in Sprague Dowlay rats. *Aloe vera* Linn. was used as standard wound healing agent. The methanolic fruit extract was formulated at 10% w/w in white petroleum jelly. In excision wound model, compared to the control, per cent wound healing was significantly higher (51.2%, 36% and 30% at 4th, 8th and 12th day of wound creation) in *S. xanthocarpum* treated group. In incision wound model, tensile strength of the healing tissue after treatment was also found to be significantly higher (37.5%) as compared to the control. The results suggested that methanolic fruit extract of *S. xanthocarpum* possess significant wound healing potential.

Keywords: *Solanum xanthocarpum*, Solanaceae, Yellow-Berried Nightshade, Wound healing, Wound contraction, Incision wound, Excision wound, Tensile strength.

IPC code; Int. cl.8—A61K 36/00

Introduction

Wound is a breach in the normal tissue continuum resulting in a variety of cellular and molecular sequelae1. Wound healing is body's natural process of regenerating dermal and epidermal tissues2. The healing cascade is activated when platelets come in contact with exposed collagen leading to platelet aggregation and release of clotting factors resulting into contact with exposed collagen. It leads to platelet aggregation and release of clotting factors resulting in deposition of a fibrin clot at the site of injury3. Natural products are still the primary and most preferable health care system in some parts of the world and described by traditional herbal medicine practitioners4-6. Wound healing is an important area of clinical medicine explained in most of the Ayurvedic texts since about 5000 BC under the heading “Vranaropaka”4. The wound as a medical problem was discussed by Maharishi Agnibesa in “Agnibesa samhita” (latter known as “Charak Samhita”) as verna and Maharshi Sushruta in “Sushruta samhita” also elaborated on this subject7.

*S. xanthocarpum* is a very prickly perennial herb with local names *Kantkari*, *Kateli* and Yellow-Berried Nightshade and found in Southeast Asia, Malaya and tropical Australia. It is very commonly found throughout India in plains from seashore to hills up to 1000 m of height. In literature it is some times dealt with as a synonym of *Solanum surattense* Burm.f. It is used in Dhasamoolaristha and in combination with other expectorants, demulcents and aromatics, astringent and heart disease. Fumigation with the vapour of the burning seeds of this plant was in high repute to cure toothache and when smoked like tobacco, the natives believed that smoke killed the insects, which they assumed caused the pain. In Bengal the plant was used as a diuretic in dropsy and root paste was utilized by the Mukundara tribals of Rajasthan for the treatment of hernia8.

Steroidal alkaloid solasodine, present in fruits and the glycol-alkaloid content of fruits collected from plants growing in Jammu & Kashmir were reported to be 3.5% (total alkaloids: 1.1%) and plant samples collected from Kolkata contained solasodine of 0.0287%. Seeds yield 19.3% of greenish yellow, semi-drying oil with a characteristic odour. The unsaponifiable matters of fruits contain two sterols, one of which is carpesterol.

---

8Correspondent author
E-mail: neerajsitm@yahoo.com
Phone: +919897325740 (Mob.); Fax: 0581-2582330
Solanum xanthocarpum, which is considered to be a good wound healing agent. Aloe vera Cream—(Glenmark Pharm. Ltd., Himachal Pradesh, composition: Aloe extract 10% w/w and Vitamin E, 0.5% w/w), Ketamine HCl – (Themis Medicare Ltd., Mumbai), White Petroleum Jelly [Central Drug House (P) Ltd., New Delhi].

**Material and Methods**

**Collection and identification of the plant**

The fruits of S. xanthocarpum used in present studies were obtained from the local market of Bareilly, Uttar Pradesh and were identified on the basis of its physical and morphological characteristics and the voucher specimen (Srmscet/Pharma/09/087) has been deposited in the department of Pharmacognosy, SRMS College of Engineering and Technology, Bareilly. The fruits were crushed to small pieces using mortar and pestle and powdered in an electric grinder.

**Experimental animals**

Healthy inbreed Sprague-Dowlay rats of either sex weighing 200-280 g were procured from Indian Veterinary Research Institute, Bareilly. The experimental protocol was approved by Institutional Animal Ethical Committee for the purpose of control and supervision of experiments on animals (715/02/c/CPCSEA). The rats were anaesthetized prior to and during infliction of the experimental wounds. The surgical interventions were carried out under sterile conditions using Ketamine anaesthesia (80 mg/kg body weight).

Animals were closely observed for any infection and those which show signs of infection were separated and excluded from the study. After infliction of wounds, 6 animals each were randomly distributed into 3 groups (n=6) according to their similarity in weight. Group1=control-treated with white petroleum jelly only, Group2 = experimental-treated with 10% (w/w) S. xanthocarpum extract in white petroleum jelly and Group3 = standard- 10% (w/w) Aloe vera cream.

**Results**

**Acute dermal toxicity**

The acute dermal toxicity was performed according to the OECD Guidelines (OECD 410), a limit test of 2000 mg/kg did not show any sign of lethality or moribund state and the gross behaviour of the animals was normal and no signs of dermal toxicity were observed.

**Collection of excision wound and wound area measurement**

The animals were anaesthetized. An impression was made on the dorsal thoracic region 1 cm away from ear. The particular skin area was shaved one day prior to the experiment. The skin of impressed area was excised to the full thickness to obtain a wound area of about 500 mm². Wound area was measured by tracing the wound on a millimeter scale graph paper. The percentage of wound contraction was calculated of original wound size (500 mm²) for each animal on 4, 8 and 12th days of post wounding for final analysis of results (Plate 1).

**Creation of incision wound and tensile strength measurement**

A 5 cm long abdominal incision was made in shaved area of anaesthetized rat and closed with interrupted sutures (Mersilk, Ethicon Aurangabad) at a distance of 1 cm. These were housed individually in different cages. On 12th day of post wounding, the animals were sacrificed by cervical dislocation and wound areas from each animal were removed carefully. Wound stripes of equal size (width) were cut and both ends of each strip were fixed with a pair of steel clip, one clip was allowed hanging on a stand and other clip with a polyethylene bag. It was then gradually filled with water till the wound strip was broken at the site of wound. The amount of water required to break the wound was noted and expressed as tensile strength of wound in grams.
Plate 1—Excision wound healing: A. Excision wound on first day; B. Excision wound on 4th day; C. Excision wound on 8th day; D. Excision wound on 12th day

Plate 2—Incision wound healing: A. Incision wound on first day; B. Incision wound on 4th day; C. Incision wound 8th day; D. Incision wound on 12th day
Results and Discussion
The methanolic extract of fruits of *S. xanthocarpum* (10% w/w) ointment did not show any signs of lethality or moribund state and gross behavior of the animals was normal without any signs of dermal toxicity, when performed a limit test of 2000 mg/kg (OECD guidelines 410).

The methanolic extract of fruits (10% w/w) ointment had produced significant (*P*<0.01) increase in mean % wound contraction (104, 58 and 43%) after 4th, 8th and 12th day of treatment. Similarly a significant (*P*<0.01) increase in tensile strength (60%) on 12th day was observed, as compared with control (Plate 1 & 2). The wound contraction and tensile strength of experimental ointment under test were in close proximity with control *Aloe vera* 10% cream (Fig. 1 & 2).

Wound healing is the process of repair that follows injury to the skin and other soft tissues. After injury, an inflammatory response occurs and the cells below the dermis begin to increase collagen production and latter, the epithelial tissue is regenerated. Wound contraction is a process that occurs through out the healing process, commencing in the fibroblastic stage whereby the area of the wound undergoes shrinkage.

The present study was undertaken to evaluate whether fruit extract of this plant could promote wound healing in experimentally produced wounds in...
rats. The results substantiated its use in folklore medicine for the treatment of wounds. The extract applied topically increased the tensile strength (37.5%) and wound contraction (30%) in different models after 12 days as compared to control and was in close proximity to standard cream (Table 1). It might be either due to enhanced contractile property of myofibroblasts or increased number of myofibroblast recruited in the wound area. In excision wound model it enhanced the process of epithelialization significantly ($P<0.01$). It appears that *S. xanthocarpum* was able to promote epithelialization either by facilitating the proliferation of epithelial cells or by increasing the viability of epithelial cell.

The faster wound contraction rate from the *S. xanthocarpum* treatment may be due to antioxidant, antimicrobial, and antiseptic properties of the extract and by stimulation of interleukin-8, an inflammatory α-chemokine that affects the function and recruitment of various inflammatory cells, fibroblasts, and keratinocytes. It may increase the gap junctional intracellular communication in cultured fibroblasts and induce a more rapid maturation of granulation tissue. In the incision wound model, increase (37.5%) in tensile strength of treated wounds may be due to the increase in collagen formation per unit area and stabilization of the fibers. Tensile strength depends upon the Van der Waals force interaction among the hydrogen ion bonds of the triple helix collagen, leading to twisting of the collagen fibers. The more twisting of fibers that occurs, the greater the tensile strength and hence the better healing of wounds.

### Conclusion

The methanolic extract of fruits of *S. xanthocarpum* applied topically, effectively increased (30%) the contraction of open wound, tensile strength (37.5%) after 12 days and significantly ($P<0.01$) enhanced wound healing process as compared to control. The extract did not show any dermal toxicity up to 2000 mg/kg, on topical application. Further, present investigation substantiated scientifically the use of this plant in Ayurveda for wound healing.

### References


