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# Effect of a topical curcumin preparation (*BIOCURCUMAX*) on burn wound healing in rats

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***Abstract :*** Back ground: Curcumin, a naturally occurring o-methoxyphenol derivative, has been shown to possess several biological properties including antioxidant (free radical scavenging activity), induction of detoxification enzymes and provides protection against degenerative diseases. Topical applications of compounds with free radical scavenging properties in patients have shown to improve significantly wound healing and protect tissues from oxidative damage.
**Objectives:** To assess the effect of a topical curcumin preparation on healing of partial thickness burn wounds in rats.
**Methods:** The rats are randomly divided into four groups, comprising of six rats in each group. Partial thickness burn wounds are created by pouring hot molten wax at 80ºC. Group I acts a control, Group 2 receives the standard silver sulphadiazine cream, Group 3 gets 20% curcumin cream, and Group 4 receives the combination of the dexamethasone and curcumin cream. Parameters observed are epithelialization period and wound contraction.
**Results & Discussion:** The percentage of wound contraction was significantly increased in the topical curcumin preparation (20%) and silver sulfadiazine group compared to control group. The mean period of epithelization was significantly reduced in topical curcumin preparation (20%) group and silver sulfadiazine group as compared to the control.
**Conclusion:** Topical curcumin preparation is effective in healing burn wound and the effect was comparable to that of standard drug i.e. silver sulfadiazine.

***Keywords*:** Topical curcumin, burn wound, epithelization period, wound contraction.

## *Introduction:*

Wound healing is a complex multifactorial process that results in the contraction and closure of the wound and restoration of a functional barrier [1]. Repair of injured tissues occurs as a sequence of events, which include inflammation, proliferation, and migration of different cell types [2]. Inflammation, which constitutes a part of the acute response, results in a coordinated influx of neutrophils at the wound site. These cells, through their characteristic "respiratory burst" activity, produce free radicals [3]. Wound related non-phagocytic cells also generate free radicals by involving non-phagocytic NAD(P)H oxidase mechanism [4]. Thus, the wound site is rich in both oxygen and nitrogen centered reactive species along with their derivatives. The presence of these radicals will result in oxidative stress leading to lipid peroxidation, DNA breakage, and enzyme inactivation, including free radical scavenger enzymes [5].

Evidence for the role of oxidants in the pathogenesis of many diseases suggests that antioxidants may be of therapeutic use in these conditions [6]. Curcumin, a naturally occurring *o*-methoxyphenol derivative, has been shown to possess several biological properties including antioxidant (free radical scavenging activity), induction of detoxification enzymes and provides protection against degenerative diseases [7]. The antioxidant activity of curcumin was reported as early as 1975. It acts as a scavenger of oxygen free radicals [8, 9]. Curcumin reduces oxidized proteins in amyloid pathology in Alzheimer transgenic mice [10].

It also decreases lipid peroxidation in rat liver microsomes, erythrocyte membranes and brain homogenates. This is brought about by maintaining the activities of antioxidant enzymes like superoxide dismutase, catalase and glutathione peroxidase [11].

Topical applications of compounds with free radical scavenging properties in patients have shown to improve significantly wound healing and protect tissues from oxidative damage [12]. However, the mode of application of polyphenols is a matter of concern. In one study curcumin was incorparaetd into collagen films and used topically to treat burn wounds [13]. Although studies have been done on curcumin on various wound models; direct topical application of curcumin cream on burn wound has not been tried. Curcumin has also shown antiinflammatory activities in variuos studies. Curcumin is effective against carrageenin-induced oedema in rats [14] and mice [15]. The natural analogues of curcumin, viz. FHM and BHM, are also potent anti-inflammatory agents [16]. Curcumin also enhances wound-healing in diabetic rats and mice [2], and in $H_2O_2$-induced damage in human keratinocytes and fibroblasts [17].

## *Objectives*

- To study the effect of a topical curcumin preparation on healing of burn wound.
- Effect topical topical curcumin preparation on healing of burn wound in presence of dexamethasone.

- To compare its effect with that of standard (Silver sulfadiazine).

## Materials and methods

### Animals:

Singly housed male Wistar rats (150-200g) were used in this study. They were given water ad libitum and fed with commercial food pellets. The study protocol was approved by institutional animal ethics committee, Kasturba medical college, Manipal and care of the animals was taken as per standard guidelines. Animals will be housed individually in polypropylene cages containing sterile paddy husk as bedding throughout the study and will have free access to sterile food (animal chow).

### Drugs:

- Curcumin cream (20%) [Biocurcumax] was obtained from "Arjuna Natural Extracts Limited", Cochin.
- Silver sulphadiazine cream (1%) – commercially available.
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### Study design and Dosing Schedule:

Topical curcumin preparation and silver sulphadiazine will be administered topically, twice daily from day 0 to day of complete healing or the 21st postoperative whichever occurred earlier, in the partial thickness burn wound. There were four groups in the study viz. control (topical petroleum jelly), standard (topical Silver Sulphadiazine Cream) and test groups i.e. topical curcumin preparation (20 %) and topical curcumin preparation (20 %) with dexamethasone.

### Procedure

Rats were maintained on laboratory stock diet and fasted for 24 hours before starting the experiment. The rats were randomly divided into four groups, comprising of six rats in each group (n=6 animals per group) The rats were anaesthetized with Pentobarbitone(3mg/100g intraperitoneally) and partial thickness burn wounds created by pouring hot molten wax at 80ºC, melted on the hot water bath, into the metal cylinder, with 300mm square circular opening, mould firmly applied on the clean shaven area of the back of the animal [18]. The parameters to be observed in the study are as follows:-

### Epithelization period:

It is monitored by noting the number of days required for the eschar to fall off from the burn wound surface without leaving a raw wound behind.

### Wound contraction:

It was noted by following the progressive changes in wound area planimetrically, excluding the day of wounding. The size of the wound was traced on a transparent paper every two days, throughout the monitoring period. The tracing was then transferred to 1 mm square graph sheet, from which wound surface is then evaluated. The evaluated surface area was then employed to calculate the percentage of wound contraction, taking the initial size of the wound, 300 mm square, as 100% by using the following equation.

$$\text{PERCENTAGE OF WOUND CONTRACTION} = \frac{\text{INITIAL DAY WOUND SIZE} - \text{SPECIFIC DAY WOUND SIZE}}{\text{INITIAL DAY WOUND SIZE}} \times 100$$

### Statistical analysis:

Results were expressed in Mean±SD and were analyzed by one way analysis of variance (ANOVA) and post hoc analysis was done using Tukey's using SPSS package version 16. P-value < 0.05 was considered to be significant.

## Results & Discussion:

The percentage of wound contraction was significantly increased in the Topical curcumin preparation (20%) and silver sulfadiazine group as compared to control group. Percentage of wound contraction in plant extract and sliver sulfadiazine group is significant on 21st day, as compared to control (Table 1). The mean period of epithelization was significantly reduced in topical curcumin preparation (20%) group and silver sulfadiazine group as compared to the control (Table 2).

***Table 1 :*** **Effect of Topical 20% Curcumin (Biocurcumax) on epithelization period and wound contraction. (Values expressed in Mean±SD)**

| Groups (Topical) | Epithelization Period (In Days) | Wound Contraction (%) on 21st day |
|---|---|---|
| Group 1 - Control (Petroleum Jelly) | 19.33 ± 0.421 | 66.64±2.5 |
| Group 2 - Standard ( Silver Sulphadiazine) | 11.83± 0.307 * | 86.33±3.91* |
| Group 3 - 20% Curcumin (Biocurcumax) | 14.33± 0.21 * | 90.11±4.83* |
| Group 4 - Dexamethasone + Curcumin (Biocurcumax) | 17.33 ± 0.33 | 62.64±4.47 |
| **N= number of rats in each group= 6; * P-value <0.05, significant in comparison to control (ANOVA followed by tukey's post hoc analysis)** | | |

The present study shows a significant improvement in burn wound contraction in the rats treated by topical curcumin. It also showed improved healing in dexamethasone group. Based on these we propose that topical curcumin could significantly enrich the assortment of topical medications available for the treatment of burns. The prohealing property of curcumin can be explored further by future studies by including histopathological studies.

## Conclusion:

In this study, Topical curcumin preparation (20%) showed significant burn wound healing property as compared to control (petroleum jelly) and the effect was comparable to the standard drug silver sulfadiazine. Topical curcumin preparation (20%) can be effective alternative and as well as adjuvant to standard existing drugs used in the treatment of burns.

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