

Remedial Effect of *Boswellia Serrata* on Thermal Burn Injuries

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Background: It has been shown that inflammation and insufficient blood vessel formation delay wound healing, whereas *Boswellia serrata*, besides anti-inflammatory activity, increases blood vessel formation.

Objectives: This study was performed to investigate the effect of *Boswellia serrata* in promoting burn injuries healing in BALB/c mice.

Materials and Methods: In this experimental study, a burn wound was created by placing a 1.5 cm² hot plate on the back of animals. Fifty four mice were designated in four equal groups, counting 14 each. Three groups of animals were treated with *Boswellia* 2%, silver sulfadiazine and vaseline two times per day for 21 days. The fourth group represented the control group. The total percentage of wound healing and time required for complete healing were evaluated and compared between groups, using the ANOVA test.

Results: Results showed that the effect of *Boswellia* on wound healing was statistically significant compared to the control group ($P < 0.01$).

Conclusions: *Boswellia serrata* is clearly effective for burn injuries healing and might be used in patients with burn wound.

Keywords: Mice, Inbred BALB/c; *Boswellia*; Burns; Wound Healing

1. Background

Burns and their consequences are important causes of mortality in the world. More than one thousand persons in The USA are affected yearly by a burn, which requires treatment (1). Healing of skin wound is a process which is performed through the cooperation of tissues, cells and different factors (2). Among the most important reasons for delays in wound healing one can count the residual inflammation or the insufficient blood vessel formation. Although several drugs are available for skin burns, however, none of them is free from adverse effects. In contrast, medicinal plants present significantly less side effects (3-5). Chemical compounds in plants mediate their effects on the human body through processes identical to those already well documented for the chemical compounds present in conventional drugs; therefore, herbal medicines do not differ greatly from conventional drugs in terms of mechanism of action. This enables herbal medicines to be as effective as conventional therapeutic compounds.

The World Health Organization (WHO) estimates that 80% of the population of several Asian and African countries currently use herbal medicine for multiple aspects of primary health care. Studies in the United States and Europe have shown that their use is less common in clinical

settings. Nevertheless, in recent years, it has become increasingly more prominent, as scientific evidence about the effectiveness of herbal medicine has become more widely available.

Medicinal plants and their products have been confirmed to be effective against various conditions, including burns (6-8), diabetes (5, 9, 10), atherosclerosis (11-13), infections (14-16), cancer (17-19), and anxiety or amnesia (20). At present, plants are used not only for the prevention or for treatment of diseases, yet they have also been examined for toxicities of contained toxins. They have also been found to reduce the complications of diseases, such as diabetes (4, 21-25) or atherosclerosis (25-27). Most of these beneficial effects of medicinal plants have been related to their antioxidant activities (25-28).

The field of herbal medicine is, in some cases, extended to include fungal and bee products, as well as minerals, shells and certain animal parts. *Boswellia* is a type of fragrant resin gum, which is obtained from several species of *Boswellia* genus (29). *Boswellia* genus belongs to the Burseraceae family of the sapindales order (30). *Boswellia serrata* (*B. serrata*), available in Iranian markets, are obtained from two species of *B. carteri* and *B. serrata* (31, 32). Generally, *Boswellia* contains 25-35% of insoluble gum in

alcohol, 60-70% resin, while the remaining percentages represent a kind of essence (33). Its insoluble component in alcohol includes arabin and bassorin, while the soluble component contains olibanorjen and a group of mono-, di- and triterpens (34). Bosolic acids consist of a group of pentacyclic triterpenoids and are the main constitutive substances of the resin available in *Boswellia* (35). Up to present, no study has been conducted on the effects of this medicinal plant on burn wound healing. The critical issues in burn wounds medical care management are late treatment, which affects the condition of the patients and the lack of a medication to accelerate the healing process with only minimal side effects. Traditional use of *Boswellia* medicinal herbs as wound healing agents is popular between people in Chaharmahal and Bakhtiyari and, in recent years, anti-inflammatory effects of this plant have been reported. However, at present, no study has been conducted on its burn wounds healing capacity on mice.

2. Objectives

This study was conducted to assess the remedial effect *Boswellia* extract on the burn wound healing process in Balb/c murines.

3. Materials and Methods

In this experimental study, 54 Balb/c mice with approximate weight of 30 ± 3 gram were selected. After anesthesia and induction of burn wound with an area of 1.5 cm^2 , by application of a hot metal plate on the back of the mouse and confirmation of second-degree burn, the animals were assigned to seven groups under treatment with 2% *Boswellia* extract, silver sulfadiazine cream 1%, vaseline or nothing (controls). Animals were maintained under normal conditions (22-25°C, 50% humidity, 12 hours dark-light cycle and normal nutrition) in individual cages.

The protocol was approved by the Ethical Committee of Shahrekord University of Medical Sciences (Ethical Code No: 91/11/1). In order to generate the wound, that area was completely cleaned (hairs removed from the back of the animals) and disinfected by alcohol and cotton, after the mice were previously anesthetized by injection of a ketamine and xylazine mixture. Afterwards, by placing a hot discus like metal plate with the area of 1.5 cm^2 in place at the area of the fifth thoracic vertebrae for 10 seconds, a second-degree surface burn wound was created. In each group, the provided pomade was used two times each day (1 mm thick application, covering the entire area of the burn) on the wounds. No substance was used on wounds in the control group. All wounds were left without dressing. Microbiology experiments on the used pomade showed no microbial agent (36). While providing the mentioned wound care protocol until complete healing, photographs were taken from the wounds on days 1, 7, 14, and 21, counting from the moment when the animal was anesthetized. Identical photography conditions dur-

ing the experiment period were considered. The area of wound was calculated using provided photos and video image analysis software (Deep Log Analyzer 6.0, Softonic, Japan) and then the healing percentage was evaluated in different days based on following formula (28, 36, 37):

Percentage of the wound = surface of the wound on day 1/surface of the wound in intended day $\times 100$

Percentage of the recovery (healing) = Percentage of the wound - 100

For general comparison of groups, first the ANOVA test and then the Dunnett's test were used. A $P < 0.05$ was considered statistically significant.

4. Results

The ANOVA test and the Dunnett's post-hoc test for the second-degree burn wounds in groups using 2% *Boswellia* extract, 1% silver sulfadiazine cream, or vaseline, on the 7th, 14th and 21th day of study, showed that there were significant differences between the first, second, third, fourth groups and the control group ($P < 0.05$). Results of the histopathological comparison of samples showed that, in comparison to the control group, the group that received *Boswellia* had better reconstruction of the epithelial cells, the fibrotic reaction was more extended and less bleeding was noticed in the burn wound area on days 7 and 14. The fibroplasia process in the burn regions in these groups was more advanced and less edema and inflammation were seen. However, no significant pathologic difference was seen between groups receiving *Boswellia* and the control group on day 21 (Table 1).

Table 1. Percentage of Wound Recovery in Different Groups and Comparison of the Healing Process

Groups	2% <i>Boswellia</i>	Silver	Vaseline	Control
Study time				
Day 7	24.42	24.83	10.03	23.29
Day14	72.01	70.83	61.12	66.33
Day 21	95.29	76.24	80.76	75.30
P Value	0.000	0.927	0.336	1

5. Discussion

The results of the healing process in this study indicated superior efficiency in the group threaded *B. serrata* in comparison with the control group. In the essence of the *B. serrata* there is a certain amount of a specific alcohol type named olibanol, in addition to pinnen, dipanten and felanderen. Bosolic acids are included in specialized and noncompetitive inhibitors of 5-lipoxygenase enzyme, which is considered a key enzyme in the biosynthesis of the leukotrienes (10, 38-41). The results obtained in this study showed that there was a significant difference between groups treated with 2% *B. serrata* and the control group regarding apparent healing of the wound on

day 21. Regarding the chemical structure of substances available in *B. serrata*, the observed useful effects of this plant on day 21 could be attributed to substances present in this plant. This intense healing phenomenon was not seen in groups treated with silver and vaseline, while the healing results in these groups was not significantly different from control group on day 21. Although there was a significant difference between the group receiving *Boswellia* on days 7 and 14 and the other groups, regarding pathologic healing, this effect was similar for all groups on day 21. Therefore, it must be noted that main effect of the *Boswellia serrata* consists of an apparent healing of the burn wound in such a manner that the average percentage of the apparent healing of the burn wound on days 7 and 14 indicated a stable positive trend which was confirmed on day 21, with significant differences compared to the control group. Since in our study, the useful effects of the *B. serrata* in apparent healing of the wound did not appear before day 21, it can be assumed that that this plant could be more effective when it is consumed for a long period.

The results of this study showed that *B. serrata* extract is effective in wound healing and could accelerate burn wound healing process in Balb/c mice. It should be noted that herbal medicines usually have low intensity side effects and, sometimes, are even used to combat the toxicity of toxic materials (3, 42-52). However, the plants and their products may induce hazardous adverse effects, too (50, 53-57). Therefore, long-term observational trials should be conducted in order to confirm the medicinal effects attributed to this plant and its safety profile.

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