World Journal of Pharmaceutical research

Volume 2, Issue 6, 2587-2595. Short Communication ISSN 2277 – 7105

THE THERAPEUTIC EFFICACY OF KATIRA GUM IN BURN INJURY HEALING

Priti Girotra*, Shailendra Kumar Singh

Department of Pharmaceutical Sciences, G. J. University of Sci. & Tech., Hisar, India.

Article Received on
20 August 2013,

Revised on 24 Sept. 2013,
Accepted on 29 October 2013

***Correspondence for Author:**

Priti Girotra
Department of Pharmaceutical Sciences, G. J. University of Sci. & Tech., Hisar-125001, India.
. ph.arora13@gmail.com

ABSTRACT

Introduction: Katira gum, a natural polysaccharide, possesses anodyne property because of which, traditionally it has been used in the dressing of burns. The present study was undertaken for evaluation of the therapeutic efficacy of Katira gum in the management of burn injuries.

Method: The animals were allocated into four groups of six animals each. Gels were formulated with Katira gum (3.75%), silver sulfadiazine as standard (1% with 1.5 % carbopol 934 as gel forming agent) and 1.5% carbopol gel was used as control. Starving the rats overnight, under ketamine anaesthesia, partial thickness burns were inflicted on their back. Group I was selected as control, Group II as test, Group III as standard and Group IV for the combination effects of Katira gum and silver sulfadiazine. The gels were applied topically, once daily from day 0 to the day of complete healing. The wound healing was evaluated for Period of epithelialization, percent wound contraction. and burn scar scale based on color.

Results: A significant reduction ($P<0.001$), when compared to Group I and Group II, was observed in the burn wound contraction and period of epithelialization in case of group IV.

Conclusion: The combination of Katira gum and silver sulfadiazine was found to be more effective than either of the two in the therapeutic management of burn injury.

Keywords: Epithelialization period; Katira Gum; silver sulfadiazine; wound contraction.

INTRODUCTION

Burns, considered to be the third largest cause of accidental deaths across the globe, can be defined as tissue damage occurring due to the effect of fire, chemical agents, electric shocks, sunlight and nuclear radiation or car accidents. Approximately, 1.25 million people suffer from burn injuries every year. [1]

Suffering a burn injury and its subsequent treatment fall amongst the most excruciating experiences a person can encounter in his/her life. Burns are usually associated with severe pain, scarring, skin discoloration, impairment of the functional activities and psychology of the patient. Burns, sometimes, get further complicated because of the loss of body fluids and most often such conditions get aggravated by microbial infections. Timely management of burns is essential for the prevention or control of infection and to minimize the aesthetic after effects. The strategies involved in the treatment of burns are mainly based on the healing of wounds and the reduction of the required epithelialization period. [2]

Many naturally occurring substances such as Aloe vera, tea tree oil, saliva [3] and coconut oil from *Cocos nucifera* [4] have been studied for the treatment of burns. The studies based on natural polymers till date, have been made mostly for the control of infections [5] but now the research is directed to obtain an ideal formulation which should produce an analgesia effect and halt the progression of the burn injury along with faster epithelialization. Natural polysaccharides have been in use since long times as versatile pharmaceutical excipients. These polymers possess extensive range of properties, are easily available, inexpensive, highly stable and often non-toxic. One such natural polysaccharide, Katira gum (*Cochlospermum religiosum*, family Bixaceae), is a pale and semi-transparent plant exudate, which swells into a pasty transparent mass upon contact with water. Amongst the twenty available species of Cochlospermum, *C. religiosum* is the only species that is found in India. It consists of d-galactose, d-galacturonic acid and l-rhamnose in a molar ratio of 2:1:3 along with ketohexose. This gum has drawn the attention of many researchers in recent years. The gum is sweet in taste and possesses anodyne property.[6] Traditionally, Katira gum has been used externally for dressing burns. It is also thought to help in fighting infections, although no scientific validity has been demonstrated.

The present study was aimed to evaluate the therapeutic efficacy of Katira gum in the management of burn injury healing, based on the water retaining capacity and anodyne effect of Katira gum in the form of mucilage, which produces a soothing effect on burn wounds,

upon topical application. The possible primary outcome of this would be faster epithelialization since the epithelialization period is reduced in moist environment,[7] along with some secondary effects on wound contraction.

MATERIALS AND METHODS

Materials: Silver sulfadiazine was generously gifted by Galentic Pharma (India) Pvt. Ltd. Katira gum was procured from a local vendor at Hisar, Haryana (India) and got authenticated from Raw Materials, Herbarium and Museum Division, National Institute of Science and Communication and Information Resources (NISCAIR), New Delhi (Reference no. NISCAIR/RHMD/Consult/-2011-12/1835/135). All the chemicals used in the experimental work were of suitable analytical grade and used as and when supplied.

Animals: Wistar Rats (150-200 g) were procured from the Disease-Free Small Animal House, Lala Lajpat Rai University of Veterinary Sciences, Hisar, Haryana. The experimental protocol was approved by the Institutional Animals Ethics Committee (IAEC) and proper care of laboratory animals was taken as per the guidelines of CPCSEA, Ministry of Forests and Environment, Government of India (Registration number 0436).

METHODS

The present investigation involved the below mentioned steps:

Formulation of the topical gels of Katira gum and silver sulphadiazine, alone as well as in combination; Carbopol 934 was used as the gelling agent in silver sulfadiazine gel.

Evaluation of the prepared topical gels for permeation characteristics by *in-vitro* diffusion study.

Assessment of Katira gum and silver sulfadiazine topical gels for the management of burn injuries using Partial thickness burn wound model on Wistar Rats.

EXPERIMENTAL DESIGN

Formulation of Silver sulfadiazine and Katira gum gels

In the present study, gels were formulated with gum Katira (3.75%) with water. Silver sulfadiazine (SSD) 1% with 1.5% carbopol 934 as gel forming agent, was used as standard taking 1.5% carbopol gel as control. The formula for the gels of various concentrations has been shown in Table 1.

Table 1: Formula of Gels prepared

Sr. No.	Gel prepared	Ingredients	Quantity taken
1.	Control	Carbopol 934	0.3 g
2.	KG	Katira gum	0.75 g
		Water	20 mL
3.	SSD	Silver sulphadiazine	0.2 g
		Carbopol 934	0.3 g
		Water	20 mL
4.	KS	Katira gum	0.75 g
		Silver sulphadiazine	0.2 g
		Water	20 mL

KG: Katira gum gel; SSD: Silver Sulfadiazine gel; KS: Combination of Katira gum and SSD gel

Evaluation of the topical gel formulations

The topical gels were evaluated for their efficiency of permeating the skin by studying their *in-vitro* diffusion through rat skin, tied onto a Franz diffusion cell assembly. Water was taken as the diffusion medium. 1 mL sample was withdrawn at an interval of 15 minutes, which was regularly replenished with fresh diffusion medium. The samples were analyzed by diluting with 9 ml 0.05% ammonia solution, essential for measuring their UV absorbance at λ_{max}= 254 nm. The study was carried out for a time span of 3 hours.

Partial thickness burn wound model on Wistar Rats

The animals were divided into four groups of six animals each:

Group I: Control

Group II: Pure Katira gum (KG) gel

Group III: Standard- Silver sulfadiazine (SSD) 0.5 g of 1% gel

Group IV: Combination of silver sulfadiazine and Katira gum gel (KS)

Six animals were housed in each cage (430×270×150 mm^3) with feed and water supply *ad libitum.* Three days prior to carrying out the operation, the animals were depilated using a depilatory cream (Veet® Hair Removal Cream). The skin was again depilated, few minutes before infliction of the burn wounds, so that a completely hairless and smooth skin could be obtained.

The rats were fasted overnight before the experimentation and partial thickness burn wounds were inflicted upon rats under ketamine anaesthesia (50mg/kg i.p), by pouring hot molten wax at 80^{o}C, into a hollow cylinder with 300 mm^{2} circular opening, placed on the back of the animal.[4,8]

The formulations KG, SSD, KS and Control (0.5 g each) were applied topically, once daily from day 0 to the day of complete healing in the partial thickness burn wound model. Carbopol 934 was used as a dummy gel in the control group, so as to nullify any effect of the gelling agent on the healing of burn wounds.

The wound healing was evaluated for period of epithelialization, percent wound contraction and burn scar scale based on color.[9] The number of days in which the eschar fell completely and no raw wound was left behind, was considered as the end point of the period of epithelialization. Photographs of the wound on the back of animals were taken under appropriate lighting conditions using a digital camera. The appearance of the wounds was evaluated on a personal computer by two blinded assessors for fall of eschar and study of epithelialization.

Changes in wound contraction were observed on days 7th and 14th and were measured planimetrically. The boundaries of wound on the back of the animals were traced manually on a trace paper and these tracings were then transferred to a 1 mm^{2} graph paper, from which the wound area was assessed.

The percent wound contraction was evaluated using the following formula, taking the initial size of the wound 300 mm^{2} as 100%:

Percentage of wound contraction =

$$\frac{\text{(Size of the wound on Day 0- Size of the wound on a particular day)}}{\text{Size of the wound on Day 0}} \times 100$$

The scar wound was analyzed for the healing process of wound by assessing the color against normal skin color, taking purple as a severe scar, red as moderate scar, Dark pink as minor moderate scar and light pink as minor scar.[9]

Statistical Analysis

The statistical analysis was performed using GraphPad Instat [DataSet3.ISD]. The results

were analyzed using One-Way ANOVA followed by Dunnett's t-test. P<0.001 was considered as statistically significant.

RESULTS AND DISCUSSION

Evaluation of the topical gel formulation

The diffusion study of SSD through KG gel network was carried out for 3 hours, in which the percentage drug permeated through rat skin was found to be around 26%, exhibiting the gel formulation to be effective enough for the use as a topical preparation. The graph of *in-vitro* diffusion study of the prepared topical gel through the rat skin has been shown in Figure 1, which suggests that the prepared formulations were found to be capable of sufficiently permeating the rat skin, essential for exhibiting its pharmacological activity.

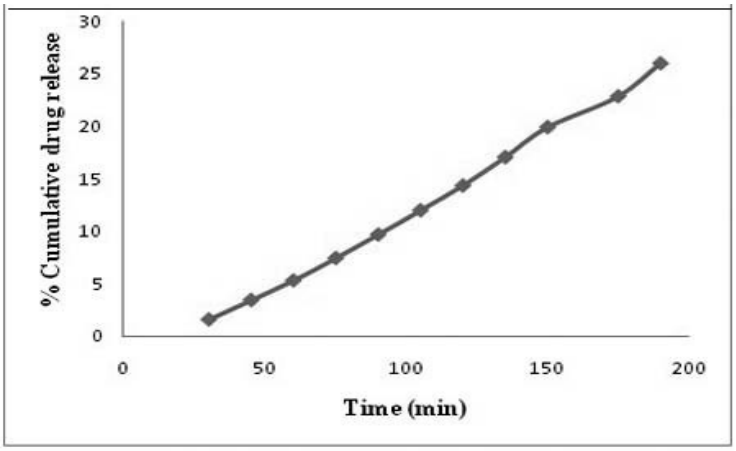

Figure 1: *In-vitro* diffusion study of silver sulfadiazine from katira gum gel network through rat skin

Comparative study of all the four treated groups based on burn scar color and wound contraction

Figure 2 depicts the photographs of the burnt skin of rats of all the four groups of animals. It can be clearly seen from the figure that the color of the burnt skin was grey for the first two days after infliction of burns. A change in the sequence of color could be observed from purple to red, followed by dark pink and pink to that of the normal color of rat skin.

The percentage wound contraction was assessed on the 7^{th} and 14^{th} day after the burn was inflicted on the animals, which along with the period of epithelialization can be seen in Table 2.

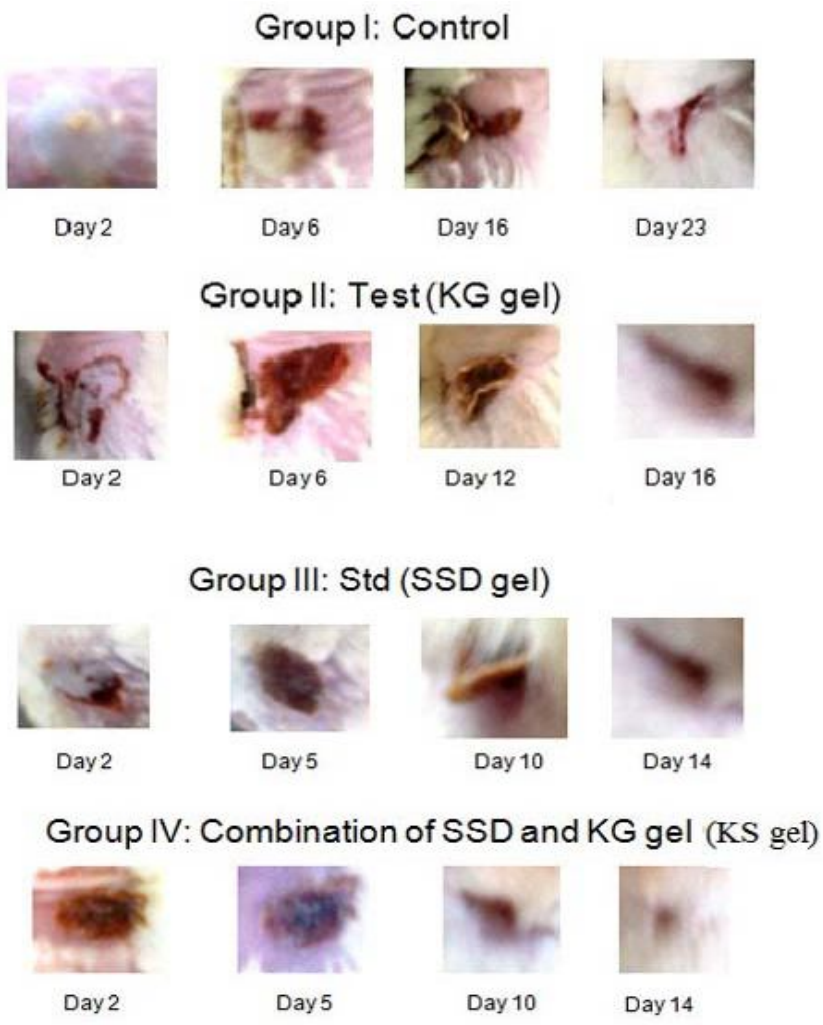

Figure 2: Comparative study of the burn inflicted groups based on burn scar color

Table 2: Effect of Katira gum on % Wound contraction and period of epithelialization in burn inflicted groups

Treatment (n=6)	%Wound contraction (mean±SD)		Period of epithelialization in days (mean±SD)
	7th day	14th day	
Control	19.25±2.03	41.71±1.68	26.16±1.47
KG	45.83±2.42	76.68±3.7[b]	18.816±0.75
SSD	65.18±2.12	93.06±3.1[b]	16.5±1.04
KS	76.41±2.67[a]	96.6±4.13[b]	13.5±1.04[a]
P value	<0.001	<0.001	<0.0001

KG: Katira gum gel; SSD: Silver Sulfadiazine gel; KS: Combination of Katira gum and SSD gel . [a]Pvalue<0.001 against control; [b]P value<0.001 against control and SSD

In case of group I (control), the wound was contracted only to a meager extent of about 41 % in 14 days and it took around 26 days for epithelialization. The wound was contracted by approximately 76 % on 14th day in group II (KG gel), which also took 18 days for complete epithelialization. A large extent in the reduction of the wound area could be observed in group III (SSD gel) and group IV (KS gel), i.e. about 93 % and 96 % respectively. The period of epithelialization for groups III and IV were respectively, 16 days and 13 days. A significant increase in the percentage burn wound contraction was observed in group IV, i.e. KS gel ($P<0.001$), when compared to group I and II. The mean period of epithelialization was found to be decreased to a great extent (13 days) in the combination group when compared to the other groups.

The high water retaining capacity of Katira gum, may possibly be the reason behind reduced period of epithelialization in the group of animals treated with Katira gum. Silver sulfadiazine is known for increasing the rate of epithelialization.[10] So, in the group treated with the gel containing combination of the drug and the polymer (KS), a potentiating effect was observed and the period of epithelialization was found to be the least as compared to the other treated groups.

The sequential change in the color of the wound from purple to red, then dark pink to light pink and ultimately to that of the normal rat skin color was suggestive of the healing process from a severe scar to moderate scar which eventually became a minor moderate scar, turning into a minor scar and ultimately no scar wound was left behind. It can be observed from the photographs that the color change was rapid and took less number of days to become normal in case of group IV (KS gel) as compared to the other three groups of burn inflicted animals.

CONCLUSION

Katira gum was found to possess excellent water retaining and anodyne property, which produced soothing effect when applied on skin. So, this property of the gum was explored for the management of burn injury healing. The combination of Katira gum and silver sulfadiazine gel was found to be more effective than either Katira gum or silver sulfadiazine gel alone which might be due to enhanced rate of wound contraction and reduced period of epithelialization. From the results obtained, it can be concluded that Katira gum potentiates the efficacy of silver sulfadiazine in the treatment of burn wound healing.

ACKNOWLEDGEMENTS

The authors express gratitude to Galentic Pharma (India) Pvt. Ltd. for providing gift sample of silver sulfadiazine. The authors also acknowledge their sincere thanks to All India Council of Technical Education, New Delhi for financial support.

REFERENCES

1. Brigham PA, McLoughlin E. Burn incidence and medical care use in the United States: estimates, trends, and data sources. J Burn Care Rehabil, 1996;17:95-107.
2. Meena K, Mohan AV, Sharath B, Somayaji SN, Bairy KL. Effect of topical phenytoin on burn wound healing in rats. Indian J Exp Biol, 2011;49:56-9.
3. Cuttle L, Kempf M, Kravchuk O, George N, Liu PY, Chang H, et al. The efficacy of Aloe vera, tea tree oil and saliva as first aid treatment for partial thickness burn injuries. Burns, 2008;34:1176-82.
4. Srivastava P, Durgaprasad S. Burn wound healing property of Cocos nucifera: An appraisal. Ind J Pharmacol, 2008;40:144-6.
5. Muhammad HS, Muhammad S. The use of Lawsonia inermis Linn. (Henna) in the management of burn wound infections. Afr J Biotechnol, 2002;4:934-7.
6. Ojha AK, Maiti D, Chandra K, Mondal S, Das D, Roy SK, et al. Structural assignment of a heteropolysaccharide isolated from the gum of *Cochlospermum religiosum* (Katira Gum). Carbohydr Res, 2008;343:1222-31.
7. Papini R. ABC of burns: Management of burn injuries of various depths. BMJ, 2004;329:158-160.
8. Bairy KL, Somayaji SN, Rao CM. An experimental model to produce partial thickness burn wound. Ind J Exp Biol, 1997;35:70-2.
9. Wang XQ, Kravchuk O, Liu P, Kempf M, Boogaard CVD, Lau P, et al. The evaluation of a clinical scar scale for porcine burn scars. Burns, 2009;35:538-46.
10. Kiolseth D, Frank JM, Barker JH, Anderson GL, Rosenthal Al, Acland RD, et al. Comparison of the effects of commonly used wound agents on epithelialization and neovascularization. J Am Coll Surg, 1994;179:305-12.