

Study on Effect of Wound Healing Activity Using Herbal Treated Wound Dressings

S. Priyalatha*

Abstract

The main aim of this work is to study healing activity of deep cut and cutaneous wounds with naturally treated wound dressings. Cotton gauze and cotton nonwoven wound dressings were treated with extracts prepared from the leaves of VitexNegundo (Nochi leaves) by various extraction methods. The wound dressings were tested for their antimicrobial property and the rate of wound healing activity. Both the cotton nonwoven wound dressings treated with the aqueous and heated aqueous extracts were found to have superior antibacterial activity. The cotton nonwoven wound dressings with aqueous extracts of leaves showed a greater wound healing rate among all the samples. This present study thus offers an effective way to manage deep cut and cutaneous wounds with the help of active wound dressing and the traditional plant.

Keywords: Wound, Wound Dressings, Rate of Wound Healing, Nonwoven, Gauze, Extraction

INTRODUCTION

The Wound is an injury, any physical damage to the body caused by external violence or accident or fracture or some mechanical agency etc. rather than disease usually involving division of tissue or rupture of the integument or mucous membrane [1]. The affected tissue activates the reaction and works towards renovating damaged living tissue. The development of damaged tissues leads to wound healing [2]. The treating wounds include the formation of a complex network of blood vessels, cytokines, and growth factors, which results in the tissue returning to its original state [3]. Despite the considerable progress in the treatment of wounds by different wound dressings and external synthetic formulations, the search for new ways continues due to the requirements of wound management differences and also the associated disadvantages of synthetic drugs.

Factors Determining Faster Wound Healing

The most important factors which affect wound healing are the age of the patient, chronic diseases of the patient, type of wound, infection, poor nutrition, lack of hydration, poor blood circulation, edema, and patient behaviors. Out of these factors, to handle different wounds, to avoid infections, and edema, and to provide hydration around the wound proper wound management is required. There are numerous management options practiced to heal the wounds such as regular cleansing, debridement, special wound dressings, and so on. The role of wound dressing plays a vital role in the treatment of wounds and assists in faster healing.

*Author for Correspondence

S. Priyalatha

Associate professor, Department of Fashion Technology, Sona College of Technology, Salem, Tamil Nadu, India

Received Date: August 24, 2024

Accepted Date: September 07, 2024

Published Date: October 10, 2024

Citation: S. Priyalatha. Study on Effect of Wound Healing Activity Using Herbal Treated Wound Dressings. Journal of Polymer & Composites. 2024; 13(1) : 251–259p.

Requirement of Wound Dressing

For a wound of any kind (Minor abrasion or deep cut), it is very essential to care for it properly to heal it quickly and avoid further complications. Wound dressing is an unavoidable component of wound management and assists in faster wound healing. Wound dressing is generally a textile product that

gets in contact with the wound. It provides a moist environment to the wound which assists in a fast re-epithelialization process.

Many types of textile materials have been used as wound dressing in the past and the basic requirements of a wound dressing are as follows:

- It should promote the wound healing process
- It should be highly absorbent to avoid frequent replacement
- It should provide a moist environment
- It should be air-permeable
- It should maintain an appropriate temperature
- It should act as a barrier to outside contaminants and infections
- It should protect the damaged area and resist microbial growth
- It should be non-adherent to the wound which assists in easy replacement without tissue damage and less pain
- It should be non-toxic and non-allergic.
- It should be lightweight and comfortable for the patient
- It should withstand the sterilizing process
- It should be cost-effective

By considering the above-mentioned requirements, many wound dressings were designed and available. The woven gauze wound dressing prepared as multiple layers is widely used in most of wound care. In this study, an alternate nonwoven wound dressing with improved absorbency, holding capacity, and permeability was attempted. An ideal wound dressing which capable of promoting faster wound healing was prepared as a medicated dressing by incorporating it with the natural herb, *Vitex Negundo*.

Medicinal Benefits of *Vitex Negundo*

Vitex negundo (Verbenaceae) is commonly known as Nochi. It is an aromatic large shrub or small tree about 3 m in height with quadrangular branches and almost found throughout India, ascending to 1500 m in the outer Himalayas, fairly common in wastelands, on the road side, the banks or streams or in moist places near deciduous forests [4]. Almost all parts of *Vitex negundo* are used for medicinal purposes but the leaves and the barks are the most important in the field of medicine for wound healing. The leaf extraction is considered as tonic, and is given along with long pepper for curing fever. An infusion of the twigs is considered to be an effective therapy for dizziness, headaches, coughs, convulsions, and mental unrest and is said to promote wakefulness. Leaves of this plant have been shown to have mosquito repellent effects as well as anti-ulcerogenic, antiparasitic, antimicrobial, and hepatoprotective potentials [5, 6]. The different activities of *Vitex negundo* extract have been reported such as anti-inflammatory, anticonvulsant, hepatoprotective, and bronchial relaxant actions [7]. There is no previous literature usage of *vitex negundo* on wound-healing activities and in this paper; we report the efficacy of *Vitex negundo* leaf extract in the treatment of wounds on different types of textile material.

It is a fragrant, big shrub or small tree which grows to a height of around 3 m with symmetrical branches. It is commonly distributed throughout India and can reach as high as 1500 m in the outer Himalayas. It is often found in waste areas, by roadsides, by the banks of streams, or in damp areas close to deciduous forests [4]. Though practically every part of *Vitex negundo* is utilized medicinally, the leaves and bark are the most significant when it comes to wound healing. The infusion of leaves is used to treat fever and is regarded as a tonic and vermifuge. It is also used with long pepper. A twig infusion is supposed to help induce wakefulness and is regarded as a helpful treatment for migraines, vertigo, convulsions, coughing, and mental disturbances. This plant's leaves have been demonstrated to have antiulcerogenic, antiparasitic, antibacterial, and hepatoprotective properties in addition to its ability to keep mosquitoes away [5, 6]. Numerous functions of *Vitex negundo* extract, including bronchial relaxant, hepatoprotective, anticonvulsant, and anti-inflammatory properties, have been

documented [7]. To the best of our knowledge, no prior literature has reported on the wound-healing properties of *Vitex negundo* on the aforementioned samples. Therefore, in this work, we report on the effectiveness of *Vitex negundo* leaf extract in the treatment of wounds.

MATERIALS AND METHODS

Materials

Two varieties of fabrics were selected for wound dressing. They are 100% cotton woven gauze fabric (Plain weave, 14s warp and weft count, 19 EPI and 16 PPI), and 100% cotton nonwoven fabric (Needle lace, 80 GSM) as given in Table 1.

Table1. Technical Particular of Fabrics.

S.N.	Particulars		
1	Fabric type	Woven fabric	Nonwoven fabric
2	Material	100% Cotton	100% Cotton
3	Structure	Plain weave	Needle punched
4	Fabric Particulars	14s warp and weft count 19 EPI and 16 PPI	80 GSM

Methods

Collection, Processing, and Extraction of Vitex Negundo

The healing herb selected for the investigation was *Vitex negundo* which was collected in and around the hometown (Salem). Fresh leaves of good quality were collected in sufficient quantity and used for this study.

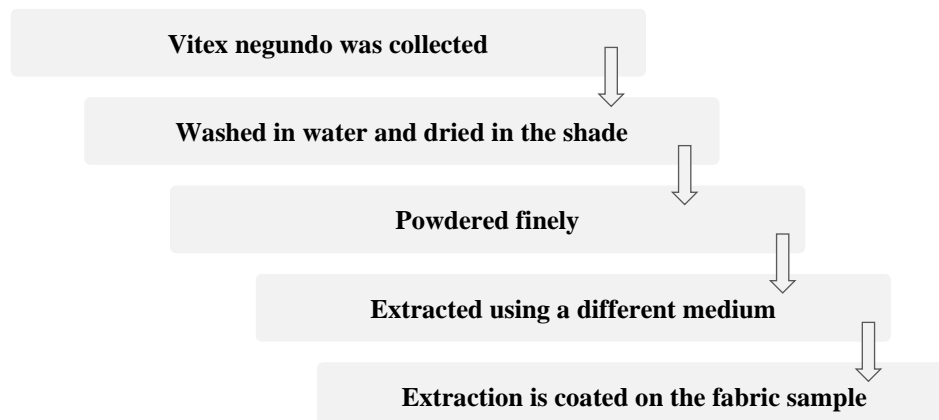


Figure 1. Flow Process of Extraction.

The collected leaves were sorted and washed thoroughly in water and dried in the shade at room temperature to make it as powder. The dried leaves were powdered finely and sieved to remove coarse particles is presented in Figure 1.

Table 2. Details of herb and extraction.

S.N.	Particulars	
1.	Herb	Vitex Negundo (Nochi)
2.	Extraction medium	Aqueous
3.		Heated aqueous
4.		Chloroform
5.		Ethanol
6.		Methanol

20 grams of powder was added to 100 ml of water and soaked for 48 hours and the solution was filtered with filter paper. The obtained solution is an aqueous solution. 20 grams of powder was added to 100 ml of water and boiled for 30 minutes and the final solution (heated aqueous) was filtered with filter paper. 20 grams of powder is suspended separately in 100 ml each of chloroform, ethanol, and methanol for 48 hours [8]. The extracts were filtered with filter paper as given in Table 2. All these prepared extracts were used for coating the wound dressing.

Coating of the Herbal Extracts on the Fabrics

The prepared extracts (aqueous, heated, chloroform, ethanol, and methanol extract) are applied to the woven and nonwoven material by padding using a laboratory model padding mangle. The padded materials were shadow-dried and packed for further study. The treated fabrics are grouped as shown in Table 3.

Table 3. Details of Vitex negundo extract treated samples.

S.N.	Sample	Fabric Type	Treatment
1.	Sample-1	Cotton gauze	Untreated
2.	Sample-2	Cotton gauze	Aqueous
3.	Sample-3	Cotton gauze	Heated aqueous
4.	Sample-4	Cotton gauze	Chloroform
5.	Sample-5	Cotton gauze	Ethanol
6.	Sample-6	Cotton gauze	Methanol
7.	Sample-7	Cotton nonwoven	Untreated
8.	Sample-8	Cotton nonwoven	Aqueous
9.	Sample-9	Cotton nonwoven	Heated aqueous
10.	Sample-10	Cotton nonwoven	Chloroform
11.	Sample-11	Cotton nonwoven	Ethanol
12.	Sample-12	Cotton nonwoven	Methanol

The samples were prepared as swabs of size 5 cm × 5 cm × 12 folds.

Antimicrobial Assay of Finished Fabric

The treated fabrics were tested for antimicrobial properties by following the standard test procedure AATCC Test Method 147-1988 - Parallel Streak Method and AATCC test method 100-2004 - Quantitative Bacterial Reduction Test method. All the samples were tested for their antimicrobial properties and the results showing higher antimicrobial activity were used as a benchmark to select the superior wound dressing for further investigation of the rate of wound healing.

Wound Healing Analysis

For the investigation, healthy Wistar albino rats of 150–200 grams of both sexes and ages were used. They were kept in a separate housing and screened and maintained in a sterile environment, and under required experimental settings. The JKKMMRF College of Pharmacy, Namakkal's institutional animal ethics committee has approved the experimental procedure.

Under light ether anesthesia, the rats underwent excision. An electric clipper was used to shave the animals' dorsal fur. Using toothed forceps and sharp scissors, the entire skin thickness was removed from the designated location to create a wound that measured approximately 500 mm² [9, 10]. The animals were split up into five groups, each consisting of six animals. Beginning on the day of injury, all of the prepared dressings were administered once daily until full epithelialization. The ability to cure wounds was assessed once every three days. Wound contraction % and wound closure duration were used to assess the wound healing property. By covering the wound with translucent paper and sketching

its outline, the surface area of the wound was determined right away. The area of this imprint was then computed using the graph sheet. Until recovery is complete, the same process is used every third day [11, 12].

RESULTS AND DISCUSSION

Effect of Vitex Negundo Treated Wound Dressing on Antimicrobial Activity by Parallel Streak Method

From the tabulated result of antimicrobial activity by parallel Streak method from Table 4 and Figure 2, it is clearly seen that the aqueous and heated aqueous extracts have wider zones of inhibition comparatively. It is proved that these extracts give better protection against microbes. Similarly, the method of bacterial reduction by percentage shows a high degree of reduction of microbes with aqueous and heated aqueous extracts treated wound dressing [13].

Table 4. Effect of Vitex negundo treated wound dressing on Antimicrobial activity.

S.N.	Sample	Parallel Streak method (Zone of inhibition in mm)		Bacterial Reduction (in percentage)	
		<i>S. aureus</i>	<i>E.coli</i>	<i>S. aureus</i>	<i>E.coli</i>
1.	Sample-1	9	10	74.4	82
2.	Sample-2	8	9	83.2	87
3.	Sample-3	12	10	72	75.4
4.	Sample-4	11	8	82	79.5
5.	Sample-5	10	11	73.4	75.7
6.	Sample-6	14	15	86	92.2
7.	Sample-7	12	11	83	90.7
8.	Sample-8	11	12	81.5	86
9.	Sample-9	12	9	84	77.3
10.	Sample-10	13	11	78.4	80.2

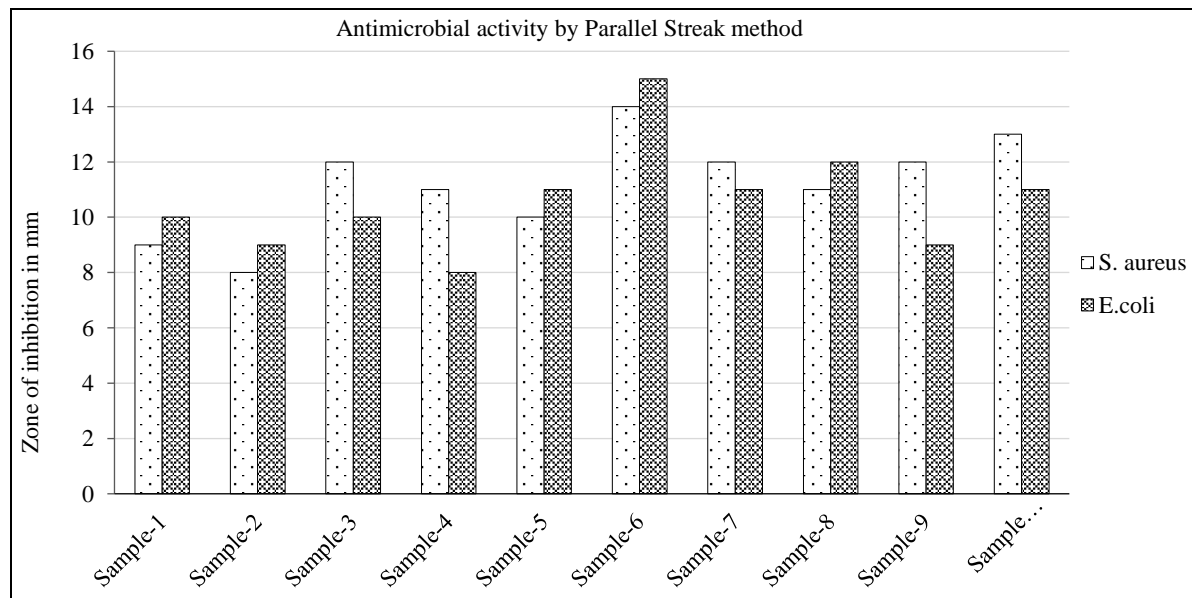


Figure 2. Results of Parallel Streak Method.

Effect of Vitex Negundo Treated Wound Dressing on Antimicrobial activity by Bacterial Reduction Method

From the given result in Table 4, there is evidence that the type of fabric also plays a role in

antimicrobial activity. The cotton gauze fabric is showing lesser activity when compared to other types of samples. The cotton nonwoven fabric gives superior activity and is clearly seen in Figure 3. This is achieved by utilizing the benefits of fabric type by giving maximum filtration.

Therefore for assessing the wound healing rate, the samples showing higher efficiency of antimicrobial activity are considered for assessing wound healing efficacy. The aqueous extract-treated cotton gauze wound dressing (Sample 1), heated aqueous extract-treated cotton gauze wound dressing (Sample 2), aqueous extract-treated cotton nonwoven wound dressing (Sample 6), heated aqueous extract-treated cotton nonwoven wound dressing (Sample 7) were finalised for assessing wound healing efficacy on albino rats [14].

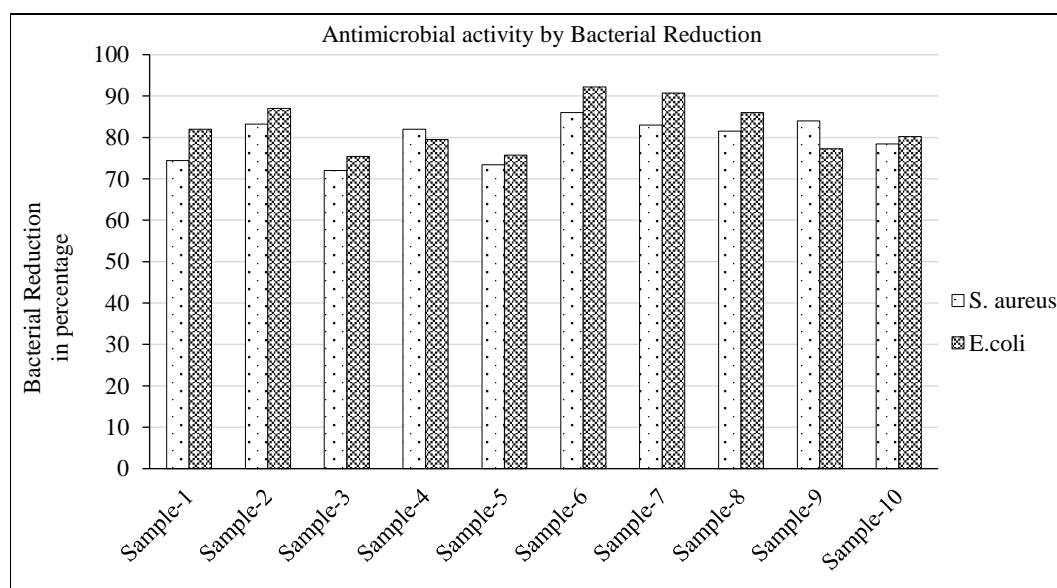


Figure 3. Results of Bacteria Reduction Method.

Effect of Vitex Negundo Treated Wound Dressing on Wound Healing Efficacy

In this study, significant promotion of wound healing activity was observed in all the vitex negundo treated wound dressings. The mean surface area of the wound was measured on 0, 3, 6, 9, 12, 15, and 18 post wounding days in all the groups and is given in Table 5 and Figure 4. There is a rapid increase in the percentage of wound contraction with samples 6 and 7 comparatively. When comparing with fabric type, it is proved that cotton nonwoven fabric has its influence greatly in wound healing rate.

Table 5. Effect of Vitex negundo treated wound dressing on wound healing efficacy.

Sample	Type of Sample	Wound Surface Area (mm ²)						
		0-Day	3rd Day	6th Day	9th Day	12th Day	15th Day	18th DAY
Control	No wound dressing	513.23 ± 0.24	486.34 ± 0.43	402.42 ± 0.38	360.12 ± 0.21	275.56 ± 0.46	193.75 ± 0.28	92.35 ± 0.63
Sample-1	Cotton gauze with aqueous extract	506.54 ± 0.56***	436.78 ± 0.24***	332.54 ± 0.65***	261.59 ± 0.71***	146.28 ± 0.45***	62.35 ± 0.89***	5.66 ± 0.48***
Sample-2	Cotton gauze with heated aqueous extract	504.32 ± 0.35***	462.67 ± 0.87***	341.56 ± 0.42***	269.45 ± 0.47***	153.34 ± 0.96***	72.61 ± 0.85***	12.53 ± 0.76***
Sample-6	Cotton nonwoven with aqueous extract	508.23 ± 0.65***	402.34 ± 0.52***	320.12 ± 0.44***	254.64 ± 0.38***	138.47 ± 0.81***	12.34 ± 0.43***	0***
Sample-7	Cotton nonwoven with heated aqueous extract	507.41 ± 0.64***	421.78 ± 0.87***	326.77 ± 0.95***	258.29 ± 0.69***	141.38 ± 0.93***	49.46 ± 0.68***	0***

The mean value is presented as ± S.E.M. for each group and for comparison, one-way ANOVA analysis and the Tukey-Kramer multiple comparison test were used. the values are statistically

significant at three levels, $***p < 0.001$, $**p < 0.01$, $*p < 0.05$. But ns if $p > 0.05$.

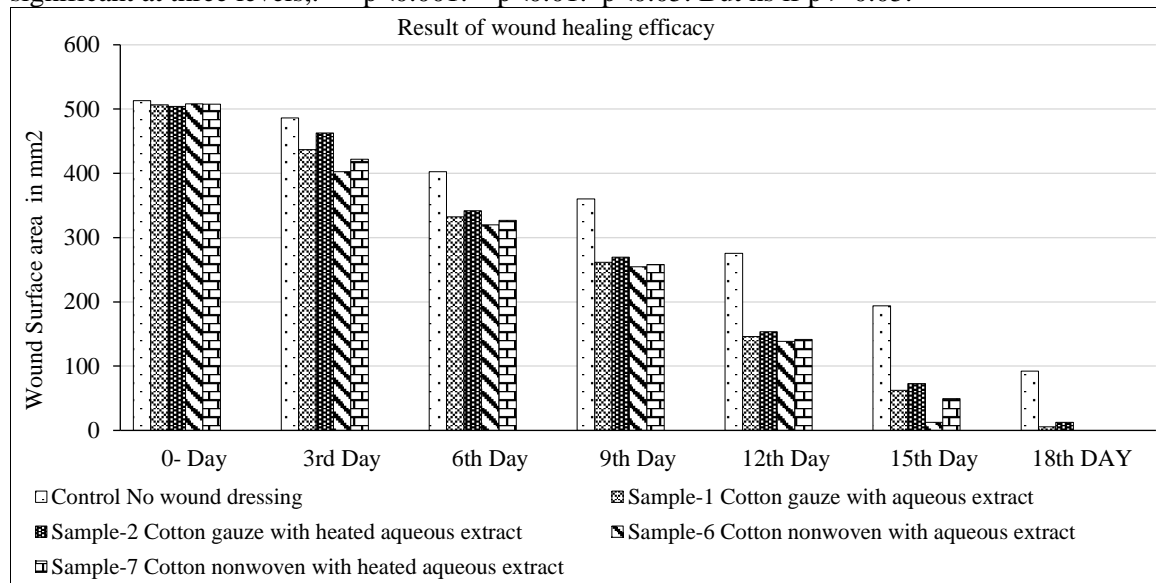


Figure 4. Results of wound healing.

Effect of Vitex Negundo Treated Wound Dressing on Period of Epithelialization

Each value is the mean \pm standard error ($n = 6$), and the Tukey-Kramer multiple comparison test was used for analysis. $* P < 0.05$, $** P < 0.01$, $*** P < 0.001$.

The healing process was compared with control and it is regular and continuous in all the types of treated samples out of which sample 6 gives the shortest period of epithelialization and is presented in Table 6 and Figure 5.

Table 6. Effect of Vitex negundo treated wound dressing on period of epithelialization.

Group	Type of Sample	Period of Epithelialization (Days)
Control	No wound dressing	24.42 ± 0.51
Sample-1	Cotton nonwoven with aqueous extract	$19.17 \pm 0.48^{***}$
Sample-2	Cotton nonwoven with heated aqueous extract	$20.08 \pm 0.21^{***}$
Sample-6	Cotton nonwoven with aqueous extract	$16.17 \pm 0.26^{***}$
Sample-7	Cotton nonwoven with heated aqueous extract	$17.82 \pm 0.34^{***}$

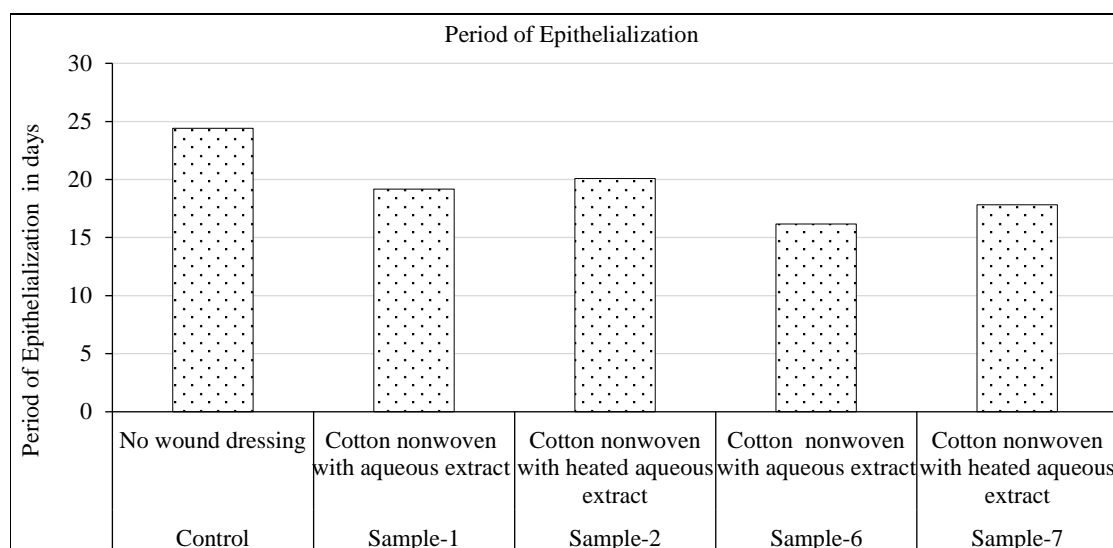


Figure 5. Results of wound healing Period.

CONCLUSION

The antimicrobial activities of a wound dressing prepared from aqueous and heated aqueous extracts of *Vitex negundo* treated on cotton nonwoven fabric were found to be higher than that of all other samples which was confirmed by AATCC Test Method 147-1988 and AATCC test method 100-2004. Cotton nonwoven wound dressing with aqueous extract shows a greater wound healing rate on albino rats.

REFERENCES

1. Löffler MW, Schuster H, Bühler S, Beckert S. Wound fluid in diabetic foot ulceration: more than just an undefined soup. *The international journal of lower extremity wounds*. 2013 Jun;12(2):113-29.
2. Eaglstein WH. Moist wound healing with occlusive dressings: a clinical focus. *Dermatologic surgery*. 2001 Feb;27(2):175-82.
3. Esimone CO, Nworu CS, Jackson CL. Cutaneous wound healing activity of a herbal ointment containing the leaf extract of *Jatropha curcas* L.(Euphorbiaceae). *International Journal of Applied Research in Natural Products*. 2008 Dec;1(4):1-4.
4. Rose CM, Cathrine L. Preliminary phytochemical screening and antibacterial activity on *Vitex negundo*. *International Journal of Current Pharmaceutical Research*. 2011;3(2):99-101.
5. Chowdhury JA, Islam MS, Asifuzzaman SK, Islam MK. Antibacterial and cytotoxic activity screening of leaf extracts of *Vitex negundo* (Fam: Verbenaceae). *Journal of pharmaceutical sciences and research*. 2009 Dec 1;1(4):103.
6. Zargar M, Azizah AH, Roheeyati AM, Fatimah AB, Jahanshiri F, Pak-Dek MS. Bioactive compounds and antioxidant activity of different extracts from *Vitex negundo* leaf. *Journal of Medicinal Plants Research*. 2011 Jun 18;5(12):2525-32.
7. Gupta RK, Tandon VR. Antinociceptive activity of *Vitex-negundo* Linn leaf extract. *Indian journal of physiology and pharmacology*. 2005 Apr 1;49(2):163.
8. Vishwanathan AS, Basavaraju R. A review on *Vitex negundo* L.: A medicinally important plant. *Eur J Biol Sci*. 2010 Apr;3(1):30-42.
9. Nayak BS, Sandiford S, Maxwell A. Evaluation of the wound-healing activity of ethanolic extract of *Morindacitrifolia* L. leaf. *Evidence-Based Complementary and Alternative Medicine*. 2009;6(3):351-6.
10. Nayak BS, Sandiford S, Maxwell A. Evaluation of the wound-healing activity of ethanolic extract of *Morindacitrifolia* L. leaf. *Evidence-Based Complementary and Alternative Medicine*. 2009;6(3):351-6.
11. Kubera Sampath Kumar S, Prakash C, Subramanian S. Study on performance of different wound

- dressings on surgical non infected wounds. *Journal of Natural Fibers*. 2021 Feb 1;18(2):161-74.
12. Kubera Sampath Kumar S, Prakash C, Ramesh P, Sukumar N, Palaniswamy NK. Study of Wound Dressing Material Coated With Natural Extracts of Leaf Solution Enhanced With Recombinant Human Epidermal Growth Factor (REGEN-Dtm 150). *Journal of Natural Fibers*. 2021 Dec 2;18(12):2302-14.
 13. Kubera Sampath Kumar S, Prakash C, Ramesh P, Sukumar N, Balaji J, Palaniswamy NK. Study of wound dressing material coated with natural extracts of *Calotropis Gigantea*, *Eucalyptus Globulus* and buds of *SyzygiumAromaticum* solution enhanced with rhEGF (REGEN-DTM 60). *Journal of Natural Fibers*. 2021 Dec 2;18(12):2270-83.
 14. Kubera Sampath Kumar S, Prakash C, Vaidheeswaran S, Karthic Kumar B, Subramanian S. Design and characterization of secondary and tertiary layers of a multilayer wound dressing system. *Journal of Testing and Evaluation*. 2020 Jul 1;48(4):2683-98.