International Journal of Holistic Health and AYUSH
Monthly | Open Access | Double-Blind Peer-Reviewed
Advancing Evidence-Based Integrative Medicine

Volume / Issue	Month and Year	Article Type	Article ID	DOI
Vol. 1, Issue 2	September 2026	Review Article	RA05IJHHA3588	https://doi.org/10.5281/zenodo.24269004

REVIEW ARTICLE

Antimicrobial Potential of Plant-Based Surgical Sutures: A Review of Infection Prevention and Wound Healing Applications

Prof. (Dr) Manish Sharma*

Ph.D. Scholar (Ayurveda Vidyavaridhi), Department of Shalya Tantra, Institute for Ayurved Studies and Research, Shri Krishna AYUSH University, Kurukshetra, Haryana – 136118, India; and Professor, Department of Shalya Tantra, S.B.M.N. Ayurvedic College, Asthal Bohar, Rohtak, Haryana – 124021, India

Dr Rajender Singh (Guide)

Associate Professor and Chairperson, Department of Shalya Tantra, Institute for Ayurved Studies and Research, Shri Krishna AYUSH University, Kurukshetra, Haryana – 136118, India

Dr Geeta Singh (Co-Guide)

Assistant Professor, Department of Bio-Medical Engineering, Deenbandhu Chhotu Ram University of Science and Technology (DCRUST), Murthal, Sonipat, Haryana – 131039, India

Dr Hari Mohan (Co-Guide)

Assistant Professor, Centre for Medical Biotechnology, Maharshi Dayanand University (MDU), Rohtak, Haryana – 124001, India

*Corresponding Author: Prof. (Dr) Manish Sharma

Correspondence: manishsharma12330@gmail.com

ABSTRACT

Background: Surgical site infection (SSI) is one of the most common problems after an operation, and the suture thread itself can become a hiding place for bacteria. Germs stick to the thread, form a protective slimy layer called biofilm and delay healing. Synthetic antibacterial sutures such as triclosan-coated threads are available, but worries about cost, tissue reaction and drug resistance remain. Ayurveda described Sivana Karma (suturing) long ago in the Sushruta Samhita, using plant fibres such as Shana, Kshauma, Ashmantaka bark, Murva and Guduchi. Many of these plants, and the herbs used for dusting the stitched wound, have Krimighna (anti-microbial) and Vranaropana (wound healing) actions. Present-day laboratory work also shows that sutures coated with neem, turmeric (curcumin), Durva and similar plant extracts can resist bacteria. This review brings both views together.

Aim: To review the antimicrobial and wound healing potential of plant-based surgical sutures in Ayurveda and modern science.

Objectives: To study the concept of Vrana and Sivana Karma in classical Ayurvedic texts. To list plant-based suture materials and the herbs advised for post-suture wound care. To compile modern evidence on the antimicrobial and wound healing action of herbal-coated sutures. To explain the Samprapti of suture-related wound infection and how plant-based sutures may break it.

Material and Methods: Classical Ayurvedic texts with commentaries were studied for Vrana, Sivana Karma and suture materials. PubMed, Google Scholar and DOAJ were searched for studies on herbal-coated sutures. Data were compiled, compared and critically analysed.

Observation and Results: Sushruta described eight suture materials, three types of needles and four suturing methods. Neem, curcumin and Durva coated sutures showed clear zones of bacterial inhibition. Animal studies reported faster healing and fewer signs of infection than with plain sutures.

Discussion: Plant-based sutures work through Krimighna, Shothahara and Vranaropana properties, which match modern antibacterial and antioxidant actions. Most of the present evidence is still from laboratory and animal studies.

Conclusion: Plant-based sutures are a promising, low-cost and eco-friendly option for preventing SSI. Standard manufacturing methods and well-planned clinical trials are needed before routine use.

Keywords: *Sivana Karma; Herbal coated suture; Surgical site infection; Krimighna; Vranaropana; Wound healing*

INTRODUCTION

Every surgical wound is a break in the body's natural protective barrier, the skin. When germs enter this break and multiply, the result is a surgical site infection (SSI). SSI causes pain, pus discharge, wound gaping, longer hospital stay, repeat dressings, extra cost and, in some cases, a second operation. Global guidelines on SSI prevention describe it as one of the most frequent infections linked with health care, with a much heavier burden in low- and middle-income countries such as India. These guidelines stress that SSI prevention must cover every step of surgery, from preparing the patient to closing the wound.[1]

The suture is the last thing a surgeon leaves inside the wound, and it stays in close contact with tissue for days or weeks. Because it is a foreign body, it lowers the number of germs needed to start an infection. Braided threads have tiny spaces between their fibres; fluids and bacteria are drawn into these spaces by capillary action and are shielded from the body's defence cells and from antibiotics given by mouth or injection. Laboratory work has shown that common pathogens such as Staphylococcus aureus and Escherichia coli attach readily to the surface of ordinary sutures, and that an antibacterial coating on the thread can clearly reduce this attachment.[2] This simple observation is the main idea behind antimicrobial sutures.

Sutures have a long history. Early surgeons used linen, cotton, silk, animal gut and tendons, and these slowly gave way to modern synthetic threads such as polyglactin, polydioxanone and nylon. Present research is moving towards 'smart' sutures that can release drugs, resist bacteria and support healing, and natural plant extracts are one of the active areas in this field.[3] In India, the Sushruta Samhita already described Sivana Karma with threads made from plant fibres and advised dusting the stitched wound with healing herbs. Yet very few reviews have tried to link this classical knowledge with modern laboratory findings on herbal-coated sutures. The present review was planned to fill this gap in a simple, student-friendly way.

AIM AND OBJECTIVES

Aim: To review the antimicrobial and wound healing potential of plant-based surgical sutures in Ayurveda and modern science.

Objectives:

1. To study the concept of Vrana and Sivana Karma in classical Ayurvedic texts.
2. To list plant-based suture materials and the herbs advised for post-suture wound care.
3. To compile modern evidence on the antimicrobial and wound healing action of herbal-coated sutures.
4. To explain the Samprapti of suture-related wound infection and how plant-based sutures may break it.

MATERIAL AND METHODS

This is a structured narrative review. Classical sources studied were the Sushruta Samhita with the Nibandhasangraha commentary of Dalhana, the Charaka Samhita and the Bhavaprakasha Nighantu, focusing on Vrana, Vrana Chikitsa, Sivana Karma, Sivana Sutra, Suchi and herbs with Krimighna and Vranaropana action. For modern literature, PubMed, Google Scholar and the Directory of Open Access Journals (DOAJ) were searched for articles published mainly between 2000 and 2025, using the keywords 'herbal coated suture', 'plant extract suture', 'antimicrobial suture', 'neem suture', 'curcumin suture', 'surgical site infection' and 'Ksharasutra'. Full-text English articles on plant-derived suture materials or coatings with antimicrobial or wound healing outcomes were included, while non-peer-reviewed reports and studies

on purely synthetic antibiotic sutures (except for comparison) were excluded. The collected data were arranged under suitable headings, compared and critically discussed, and the overall quality of this narrative synthesis was kept in line with the six items of the SANRA scale for narrative reviews.[4]

CONCEPTUAL STUDY – AYURVEDIC REVIEW

1. Concept of Vrana (Wound)

The word Vrana comes from the root 'Vran', which means breaking or destroying a part of the body; a Vrana is that which damages the tissue and leaves a scar even after healing. Acharya Sushruta divides Vrana into two main groups: Nija (arising from within, due to vitiated Vata, Pitta and Kapha) and Agantuja (caused by an outside factor such as a weapon, fall or surgical knife). A surgical incision is therefore an Agantuja Vrana. A clean, healing wound is called Shuddha Vrana, while an infected, foul, discharging wound is called Dushta Vrana. For the management of wounds, Sushruta gives sixty measures (Shashti Upakrama), and Sivana (suturing) is one of them, showing that suturing was a well-planned step of wound care and not a random act.[5]

2. Vrana in Charaka Samhita

In the chapter Dvivraniya Chikitsa, Acharya Charaka also accepts two kinds of wounds, Nija and Agantuja, and explains thirty-six measures for their treatment. He stresses two main stages of wound care: Vrana Shodhana (cleaning the wound) and Vrana Ropana (healing the wound). A wound that is not kept clean becomes Dushta, may get infested with Krimi (micro-organisms and worms) and heals late. For such wounds, Charaka advises bitter and astringent (Tikta and Kashaya) herbs, washing with medicated decoctions and Krimighna drugs.[6] This clear idea of 'first clean, then heal' fits very well with the modern goal of an antimicrobial suture that keeps the wound free of germs while healing takes place.

3. Sivana Karma – The Ayurvedic Art of Suturing

Sivana Karma is one of the eight basic surgical procedures (Ashtavidha Shastra Karma) described in the Sutra Sthana of the Sushruta Samhita. It is advised for fresh, clean wounds and for wounds made by cutting on parts such as the head, forehead, cheeks, eyelids, ears, lips, nose, neck and abdomen. Sushruta warns that a wound should not be stitched if it still contains foreign material, pus, blood clots or dead tissue, and that wounds caused by Kshara, fire or poison should not be sutured. Before stitching, the wound is cleaned, the edges are brought together in their natural position and bleeding is controlled. The needle should be passed neither too near nor too far from the edge and neither too deep nor too shallow, so that the stitch holds well without cutting the tissue.[7] The materials named for suturing are described by Sushruta in the Sutra Sthana.

4. Sivana Sutra – Plant-Based Suture Materials

Out of the materials listed by Sushruta, most are of plant origin. Only Snayu (tendon) and Bala (hair) come from animals. The plant materials, their likely botanical sources and their relevance today are shown in Table 1.

Table 1: Plant-based Sivana Sutra described by Acharya Sushruta

Sivana Sutra	Probable source	Part used	Ayurvedic property	Present relevance
Sukshma Sutra (Karpasa)	Gossypium herbaceum L.	Seed hair (cotton)	Soft, absorbent	Cotton thread used as suture in the past
Kshauma Sutra	Linum usitatissimum L. (Atasi)	Stem fibre (linen)	Snigdha, strong	Linen sutures; low tissue reaction
Shanaja Sutra	Crotalaria juncea L. (Shana)	Bast fibre	Strong, coarse	High-tensile natural fibre
Ashmantaka Valkala	Bauhinia racemosa Lam. (identity debated)	Bark fibre	Kashaya, Grahi	Tannin-rich, astringent bark
Murva Tantu	Marsdenia tenacissima (Roxb.) Moon	Stem fibre	Tikta, Kandughna, Kushthaghna	Strong fibre with bitter principles
Guduchi Tantu	Tinospora cordifolia (Willd.) Miers	Stem fibre	Tikta, Kashaya, Tridoshahara, Rasayana	Immune-modulating, antimicrobial

5. Pharmacological Basis of Plant Suture Materials

When the Rasa Panchaka of these plants is studied in the Nighantu literature, a clear pattern is seen. Guduchi is Tikta and Kashaya in taste, balances all three Dosha, reduces fever and burning and is a well-known Rasayana. Murva is Tikta and helps in itching and skin diseases. Shana and Atasi give strong, flexible fibres. Bitter (Tikta) taste is described as Krimighna, Kledashoshana and Vishaghna, so it fights germs and dries unwanted moisture, while astringent (Kashaya) taste is Ropana, Shoshana and Stambhana, so it promotes healing, absorbs discharge and arrests bleeding.[8] Thus the choice of Guduchi and Murva threads by Sushruta seems to be not only for strength but also for their medicinal value at the wound site.

6. Suchi (Needles) and Sivana Vidhi (Suturing Techniques)

Sushruta describes three kinds of needles for different body parts and four methods of suturing (Table 2). These methods closely match the suturing patterns used in surgery today, which shows the practical depth of the classical description.

Table 2: Suchi and Sivana Vidhi with modern correlation

Ayurvedic term	Description	Modern correlation
Vritta Suchi	Round, about two Angula long; for areas with less muscle and over joints	Round-bodied needle
Tryasra Suchi	Three-edged, about three Angula long; for fleshy parts	Cutting (triangular) needle
Dhanurvakra Suchi	Bow-shaped; for vital points (Marma), scrotum and abdomen	Curved needle
Vellitaka	Continuous winding stitch	Simple continuous suture
Gophanika	Sling-like interlocking stitch	Blanket / locking suture
Tunnasevani	Darning-like stitch under the skin	Subcuticular suture
Rijugranthi	Straight stitch with separate knots	Simple interrupted suture

7. Post-Suture Care – Churna Avachurnana and Vrana Bandhana

After stitching, Sushruta advises dusting the suture line with a fine powder of Priyangu (Callicarpa macrophylla), Anjana, Yashtimadhu (Glycyrrhiza glabra) and Rodhra (Symplocos racemosa), or with the powder of Shallaki (Boswellia serrata) fruit, or with the ash of burnt linen. The wound is then covered with a proper bandage (Vrana Bandhana) and the patient is kept on a wholesome diet and routine (Vranitopasaniya).

Most of these herbs are Kashaya in taste, stop oozing, reduce swelling and promote healing. In modern terms, this step is very close to applying an antiseptic, haemostatic and anti-inflammatory layer on the suture line. A plant-based coated suture may be seen as carrying this classical dusting step directly on the thread itself.

8. Nimba (Azadirachta indica) – A Krimighna Herb for Suture Coating

Nimba is Tikta and Kashaya, Sheeta in potency, and is described as Krimighna, Kandughna, Vranashodhana and Vranaropana. Its leaves are used in Ayurveda for wound washing, fumigation (Dhupana) and medicated oils. Modern studies have found that neem and its active compounds such as nimbidin, nimbin and azadirachtin have antibacterial, antifungal, anti-inflammatory, antioxidant and wound healing actions, and can act against many organisms that are commonly found in infected wounds.[9] This makes Nimba one of the strongest plant candidates for antimicrobial suture coating.

9. Haridra (Curcuma longa) – A Vranya Herb

Haridra is Tikta and Katu in taste, Ushna in potency, and is called Vranya, Krimighna, Kushthaghna and Varnya. It is one of the most common household remedies for cuts and wounds in India. Its main active principle, curcumin, has been shown to reduce inflammation, remove harmful free radicals, kill bacteria, increase the formation of new tissue and collagen, and speed up wound contraction in different wound models.[10] Because of these many actions, curcumin is widely studied as a coating and as a built-in drug for new suture materials.

10. Ksharasutra – The Ayurvedic Model of a Medicated Thread

The idea of a 'medicated thread' is not new to Ayurveda. Sushruta advised passing a thread smeared with Kshara in Nadi Vrana (sinus), and later texts expanded this method. In the modern era, Ksharasutra was standardised by coating a surgical thread repeatedly with Snuhi (Euphorbia neriifolia) latex, Apamarga (Achyranthes aspera) Kshara and Haridra powder, and it was successfully used for fistula-in-ano with good cure and low recurrence.[11] Ksharasutra proves that a thread can carry plant-based drugs that cut, clean and heal at the same time. This same principle supports the development of plant-based antimicrobial sutures for general wound closure.

11. Modern Evidence – Neem-Oil-Coated Sutures

An in-vitro study from India compared sutures coated with 100% and 50% neem oil against triclosan-coated and uncoated sutures, using plaque samples grown in anaerobic culture. Both neem-oil-coated sutures produced clear zones of inhibition, with the larger zone for the 100% coating, while the triclosan-coated and uncoated sutures showed no zone in this setting. The authors concluded that neem-oil-coated sutures could help prevent infection and discomfort after oral surgery.[12] This study is important because it shows a plant coating performing well against anaerobic germs where a synthetic coating did not.

12. Modern Evidence – Neem and Chitosan-Coated Silk Sutures

In another study, braided silk sutures were dip-coated with ethanolic neem extract mixed with chitosan at 5% to 20% strength. At 20%, the sutures showed inhibition zones of about 15 mm against E. coli and 19 mm against S. aureus, low toxicity to cells and very low damage to red blood cells. In rats with deliberately infected incisions, the side closed with coated sutures healed completely within seven days, while the side closed with uncoated sutures still showed signs of infection.[13] This gives animal-level support to the Krimighna and Vranaropana role of Nimba when it is carried on the suture.

SAMPRAPTI (PATHOGENESIS)

Shastrakrita Agantuja Vrana (surgical incision)

↓

Sivana with ordinary thread (foreign body in tissue)

↓

Nidana: poor asepsis, braided thread, Apathya Ahara-Vihara, low Vyadhikshamatva

↓

Entry and adhesion of Krimi (bacteria) on thread → biofilm

↓

Dosha Prakopa: Pitta-Rakta (redness, heat), Kapha (discharge, swelling), Vata (pain)

↓

Dosha-Dushya Sammurchhana in Twak, Rakta and Mamsa at suture line

↓

Dushta Vrana (surgical site infection) → delayed Ropana, gaping, ugly scar

Breaking the chain with a plant-based antimicrobial suture

Plant-based suture (Nimba, Haridra, Guduchi, Durva) at Sivana stage

↓

Krimighna → no bacterial adhesion | Shothahara → less swelling | Raktastambhana → less oozing

↓

Dosha Shamana and Shuddha Vrana

↓

Samyak Vrana Ropana (healthy healing with minimal scar)

Table 3: Samprapti Ghataka of suture-related wound infection

Samprapti Ghataka	Description
Dosha	Pitta and Kapha dominant, with Vata (pain)
Dushya	Twak, Rakta, Mamsa, Meda
Srotas	Raktavaha, Mamsavaha
Srotodushti	Sanga (stasis) and Vimargagamana (spread of infection)
Adhishthana	Suture line and surrounding tissue
Rogamarga	Bahya Rogamarga
Vyakta Rupa	Raga, Daha, Shotha, Ruja, Srava (redness, heat, swelling, pain, discharge)
Sadhyasadhyata	Sukhasadhya if treated early; Kricchrasadhya if biofilm and deep infection develop

RESULTS AND FINDINGS

1. Sivana Karma is clearly described in the Sushruta Samhita as one of the eight surgical procedures and one of the sixty measures of wound care.
2. Sushruta named eight suture materials, of which six (Sukshma Sutra, Kshauma, Shana, Ashmantaka Valkala, Murva and Guduchi) are of plant origin.
3. Three types of needles (Vritta, Tryasra, Dhanurvakra) and four suturing methods (Vellitaka, Gophanika, Tunnasevani, Rijugranthi) were described, and all of them have clear modern equivalents.
4. Clear rules were given for when to suture and when not to suture, which agree with present-day principles of wound closure.
5. Herbs for dusting the suture line (Priyangu, Yashtimadhu, Rodhra, Shallaki) are mainly Kashaya and act as natural haemostatic, anti-inflammatory and healing agents.
6. The plant suture materials and coating herbs are mostly Tikta-Kashaya in taste, which gives Krimighna, Kledashoshana and Ropana actions.
7. Ksharasutra is a proven Ayurvedic example of a thread carrying plant-based drugs for cutting, cleaning and healing.
8. Neem-oil-coated sutures produced inhibition zones against anaerobic oral germs, whereas triclosan-coated and uncoated sutures did not in the same test.
9. Neem/chitosan-coated silk sutures showed inhibition zones of about 15 mm (E. coli) and 19 mm (S. aureus), were safe for cells, and gave complete healing in infected rat wounds.
10. Durva (Cynodon dactylon) and curcumin-loaded sutures also showed good antibacterial action with acceptable strength.
11. Most present studies are laboratory or animal-based; well-designed human clinical trials on plant-based sutures are still very few.

DISCUSSION

The results of this review show that the Ayurvedic view and the modern view of wound infection meet at one point: the suture line must stay clean if the wound is to heal well. In Ayurveda, a wound becomes Dushta when Dosha and Krimi settle in it, and the remedy is Shodhana followed by Ropana. In modern science, the suture acts as a surface for bacterial attachment and biofilm, and the remedy is a thread that resists germs. A good example of joining these two views is the silk suture coated with chitosan and an extract of Cynodon dactylon (Durva), which showed useful antimicrobial activity while keeping acceptable tensile and knot strength.[14] In Ayurveda, Durva is known as Raktastambhaka and Vranya, so its use on a suture combines bleeding control with infection control, in the same spirit as the classical post-suture dusting with Kashaya herbs.

A plant-based suture can work in two ways. In the first, the plant fibre itself is the suture, as with Guduchi or Murva threads in the Sushruta Samhita. In the second, a standard thread is coated with, or made to carry, a plant drug. Newer work shows that the second method can now be done with high accuracy. For example, absorbable chitosan monofilament sutures strengthened with titanium dioxide and loaded with curcumin killed nearly 99% of S. aureus within 24 hours and released most of their curcumin over about a day, while keeping good mechanical strength.[15] Such controlled release is important, because the first few days after surgery are the period when bacteria try to settle on the thread. At the same time, problems remain: plant extracts differ in strength from batch to batch, some coatings wash off or weaken the thread, sterilisation by heat or radiation may destroy active compounds, and shelf life is not yet known. These issues must be solved through Dravya standardisation, quality control and proper testing of tissue reaction.

Today, triclosan-coated sutures are the main antimicrobial sutures in clinical use, and pooled analysis of randomised trials has shown that they lower the risk of SSI when compared with non-coated sutures.[16] Any plant-based suture must therefore be tested against this standard and not only against plain thread. Plant coatings have some extra advantages: they act through many compounds at once, so bacteria find it harder to develop resistance; they often reduce swelling and support tissue repair in addition to killing germs; and they are low-cost, locally available and eco-friendly. Future research should include standardised preparation of plant sutures, in-vivo comparison of tissue reaction and material profile, and multicentre randomised clinical trials in different types of wounds. With such evidence, Sushruta's concept of Sivana with medicinal plant threads can be developed into a modern, safe and affordable tool for infection prevention and wound healing.

CONCLUSION

The Sushruta Samhita gives a detailed and scientific account of Sivana Karma, including plant-based suture materials, needles, suturing methods and post-suture care with healing herbs. Many of these plants and herbs have Krimighna, Shothahara, Raktastambhana and Vranaropana properties. Modern studies on neem, curcumin, Durva and similar plant-coated sutures support these classical ideas by showing clear antibacterial activity, good safety and faster wound healing in laboratory and animal models. Plant-based sutures may therefore become a low-cost, eco-friendly and resistance-sparing option for preventing surgical site infection. However, standard manufacturing methods, sterilisation and stability studies, and well-designed clinical trials comparing them with present antimicrobial sutures are needed before they can be recommended for routine surgical practice.

DECLARATIONS

Conflict of Interest: Nil

Source of Support: None

REFERENCES

1. World Health Organization. Global guidelines for the prevention of surgical site infection. 2nd ed. Geneva: World Health Organization; 2018.
2. Edmiston CE, Seabrook GR, Goheen MP, Krepel CJ, Johnson CP, Lewis BD, et al. Bacterial adherence to surgical sutures: can antibacterial-coated sutures reduce the risk of microbial contamination? J Am Coll Surg. 2006;203(4):481-9.
3. Dennis C, Sethu S, Nayak S, Mohan L, Morsi YY, Manivasagam G. Suture materials – current and emerging trends. J Biomed Mater Res A. 2016;104(6):1544-59.
4. Baethge C, Goldbeck-Wood S, Mertens S. SANRA – a scale for the quality assessment of narrative review articles. Res Integr Peer Rev. 2019;4:5.
5. Shastri AD, editor. Sushruta Samhita of Maharshi Sushruta, Ayurveda Tattva Sandipika Hindi commentary. Part 1, Chikitsa Sthana, Chapter 1. Reprint ed. Varanasi: Chaukhambha Sanskrit Sansthan; 2014.
6. Shukla V, Tripathi RD, editors. Charaka Samhita of Agnivesha, Vaidyamanorama Hindi commentary. Vol 2, Chikitsa Sthana, Chapter 25. Reprint ed. Delhi: Chaukhambha Sanskrit Pratishthan; 2017.
7. Sharma PV, editor. Sushruta Samhita with English translation of text and Dalhana's commentary. Vol 1, Sutra Sthana, Chapter 25. Reprint ed. Varanasi: Chaukhambha Visvabharati; 2013.
8. Chunekar KC, Pandey GS, editors. Bhavaprakasha Nighantu of Sri Bhavamishra. Reprint ed. Varanasi: Chaukhambha Bharati Academy; 2010.

9. Alzohairy MA. Therapeutics role of Azadirachta indica (Neem) and their active constituents in diseases prevention and treatment. Evid Based Complement Alternat Med. 2016;2016:7382506.
10. Akbik D, Ghadiri M, Chrzanowski W, Rohanizadeh R. Curcumin as a wound healing agent. Life Sci. 2014;116(1):1-7.
11. Deshpande PJ, Sharma KR. Treatment of fistula-in-ano by a new technique: review and follow-up of 200 cases. Am J Proctol. 1973;24(1):49-60.
12. Kaur B, Sekhar V, Sharma P, Malhotra S, Jain A. A comparative assessment of antibacterial properties of neem oil coated sutures: an in vitro study. J Indian Soc Periodontol. 2023;27(5):487-91.
13. Rasheed U, Kiani MN, Butt MS, Saeed H, Hanif R, Anwar S. Fabrication and biocompatibility of neem/chitosan coated silk sutures for infection control and wound healing. J King Saud Univ Sci. 2024;36(10):103435.
14. Sudha D, Dhurai B, Ponthangam T. Development of herbal drug loaded antimicrobial silk suture. Indian J Fibre Text Res. 2017;42(3):286-90.
15. Demirci F. Development of curcumin-loaded TiO2-reinforced chitosan monofilaments for biocompatible surgical sutures. Polymers (Basel). 2025;17(4):484.
16. de Jonge SW, Atema JJ, Solomkin JS, Boermeester MA. Meta-analysis and trial sequential analysis of triclosan-coated sutures for the prevention of surgical-site infection. Br J Surg. 2017;104(2):e118-33.

HOW TO CITE THIS ARTICLE

Sharma M, Singh R, Singh G, Mohan H. Antimicrobial Potential of Plant-Based Surgical Sutures: A Review of Infection Prevention and Wound Healing Applications. Int J Holist Health AYUSH. 2026;1(2):38–45.