

HEALING WITH NATURE: PLANT - BASED ALTERNATIVES IN URINARY TRACT INFECTION CARE

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ABSTRACT

Urinary tract infection [UTI] is one of the most common bacterial infections affecting individuals of all ages, with a higher prevalence in females. They occur when bacteria, most commonly *Escherichia coli* enter the urinary tract, leading to inflammation and discomfort. UTI's can range from asymptomatic bacteriuria to severe forms like pyelonephritis and urosepsis. Herbal remedies have long been used in traditional medicine for their antimicrobial, anti-inflammatory and diuretic properties. Plants such as Cranberry (*Vaccinium macrocarpan*), Uva Ursi (*Arctostaphylos uva-ursi*), Garlic (*Allium sativum*), Neem (*Azadirachta indica*), Horsetail (*Equisetum arvense*), cornsilk (*Zea mays*), Dandelion (*Taraxacum officinale*) have shown potential in preventing or managing UTI by inhibiting bacterial adhesion, reducing inflammation and enhancing urinary flow. This article reviews the pharmacological actions, clinical relevance and therapeutic potential of selected herbal plants in the prevention and treatment of UTI's providing a natural alternative in an era of rising antimicrobial resistance.

KEYWORDS: Urinary Tract Infection, Herbal Plants, Antibacterial Drugs.

1. INTRODUCTION

The urinary system consists of the kidneys, ureters, bladder, and urethra, and its main function is to filter blood by removing waste products and excess water. The urinary system plays a key role in removing the waste products of metabolism from the bloodstream. Other important functions performed by the system are the normalization of the concentration of ions and solutes in the blood and regulation of blood volume and blood pressure. In healthy people, urine is sterile or contains very few microorganisms that can cause an infection. Urinary tract infection (UTI) is one of

the major problem influencing individuals from all age groups including neonate to geriatric age. Consistently around 150 million individuals are being determined to have urinary tract contamination around the world. In an estimation, about 60% females and 13% males are suffered from UTI. About 24 % of cases are reported in developing countries like India.

UTIs are basically categorized as complicated or uncomplicated. Complicated UTIs are UTIs related to factors that compromise the urinary tract or host defence, including urinary obstruction, urinary retention caused by pregnancy, neurological disease, renal failure, immunosuppression, renal transplantation, and the presence of foreign bodies, for example, indwelling catheters, calculi, or other drainage objects. Uncomplicated UTIs, on the other hand, influence those who have no neurological or structural urinary tract issues and are healthy. UTIs can be caused by bacteria (both Gram-negative and Gram-positive) and fungi. Uropathogenic *Escherichia coli* (UPEC) is the most prevalent pathogen for UTIs, followed by *Klebsiella pneumoniae*, *Staphylococcus saprophyticus*, *Enterococcus faecalis*, group B *Streptococcus*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Candida* spp.

The main predisposing factors are sex, age, history of UTI, sexual activity and diabetes. Urinary tract infection is more common in diabetic patients and older people that are more prone to infection than the young. Prevalence of UTI is greater in female as compared to male. However, the prevalence of UTI is greater in uncircumcised males than in circumcised males. Sexually active females are more prone to UTI particularly those using spermicidal agents and diaphragms for contraception because of immune suppression in such females. UTI in pregnant women may cause premature delivery and high blood pressure. Spread of infection to the kidney is more common in pregnant women due to their weakened immune system during pregnancy.

Though typically treated with antibiotics, the increasing resistance to these medications has sparked interest in natural and plant based alternatives. In many cultures, herbal remedies have long been used to support urinary tract health, offering a gentler and often safer approach to prevention and treatment. One such promising alternative is the use of herbal plants, which have been utilized for centuries in traditional medicinal systems such as ayurveda, traditional Chinese medicine, and folk remedies across the globe. These medicinal plants are valued for their antimicrobial, anti inflammatory, and diuretic properties, which can help alleviate symptoms, inhibit bacterial growth, and promote urinary tract health. Herbs like Cranberry(*Vaccinium macrocarpon*), Garlic(*Allium sativum*), Neem(*Azadirachta indica*), Coriander(*Coriandrum sativum*) and Bearberry(*Arctostaphylos uva- ursi*) are among those recognized for their beneficial effects in managing UTI. These plants not only help combat pathogens responsible for UTI but also support the immune system and overall kidney function.

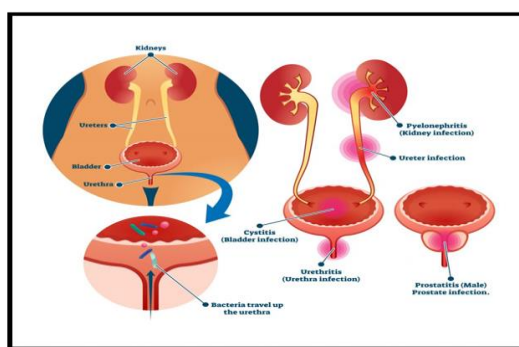


Fig. 1: UTI.

1.1 CLASSIFICATION OF UTI

1.1.1 Based On Location

Urethritis (Affects the urethra): It is an infection that spreads in the urethra, the narrow tube through which the urine passes. This can cause a discharge and burning sensation while peeing.

Cystitis (Affects the bladder): A bacterial infection that sometimes has progressed from the urethra up into the bladder. As a result, a person may feel the recurring need to pee. Also, it may hurt while peeing, and low belly pain and cloudy or bloody urine are other symptoms.

Pyelonephritis (Affects kidneys): It can be caused by urinary tract obstruction or an infection in the kidneys that has spread up the system. Urine may flow back into the ureters and kidneys because of a blockage in the urinary system. As a result, fever, chills, nausea, vomiting, and pain in the upper back or side areas can crop up.

Vaginitis (Affects the vagina): Vaginal infection is known as vaginitis.

1.1.2 Based On Complicated Risk:

Uncomplicated UTI: Occurs in otherwise healthy individuals with normal urinary tracts (Typically non-pregnant women)

Complicated UTI: Occurs in individuals with structural or functional abnormalities of the urinary tract, immunosuppression, catheter use, or in men, children, and pregnant women.

1.1.3 Based On Recurrence

Relapse: Recurrence of the same organism within 2 weeks of treatment.

Reinfection: New episode with a different organism or the same organism after 2 weeks.

1.1.4 Based On Clinical Presentation:

Asymptomatic Bacteriuria: Presence of bacteria in the urine without symptoms.

Symptomatic UTI: Presents with dysuria, frequency, urgency, suprapubic pain, fever, or flank pain.

1.2 URINARY TRACT INFECTING BATERIA

Urinary tract infection generally caused by infection of one species of bacteria. However, in case of obstructive uropathy (bladder stone , prostate hypertrophy, spinal paralysis)it may be caused by more than one species of bacteria. Worldwide E.coli is the cause of 80-85% of urinary tract infection, Staphylococcus species the causes of 5-10%.

Table: 1 Microorganism.

Gram positive organism	Gram negative organism
<i>Staphylococcus aureus</i>	<i>Escherichia coli</i>
<i>Enterococcus spp</i>	<i>Enterobacter spp</i>
<i>Bacillus subtilis</i>	<i>Klebsiella spp</i>
<i>Lactobacillus acidophilus</i>	<i>Proteus spp</i>
<i>Mirococcus luteus</i>	<i>Pseudomonas spp</i>
<i>Corynebacterium riegelii</i>	<i>Acinetobacter spp</i>
<i>Strptococcus pyogenes</i>	<i>Serratia spp</i>

1.3 PATHOGENESIS OF UTI

Entry and colonization: Most UTI start when bacteria from the bowel or genital area colonize the periurethral area. The bacteria then ascend the urethra into the bladder.

Adherence to uroepithelium: Uropathogenic bacteria, especially *Escherichia coli*, use adhesion (like type 1 fimbriae and P fimbriae) to attach tightly to the epithelial cells lining the urinary tract, preventing them from being flushed out by urine flow.

Bacterial multiplication and invasion: After attachment, bacteria multiply and may invade the bladder lining, causing inflammation (cystitis). In some cases, bacteria can travel further up to infect the kidney (Pyelonephritis).

Host immune response: The body responds by triggering inflammation, recruiting immune cells to fight the infection, which causes symptoms like pain and urgency.

Persistence and recurrence: Some bacteria can form biofilms or intracellular bacterial communities that protect them from antibiotics and immune cells, leading to recurrent infections.

1.4 SYMPTOM OF UTI

When infectious bacteria enter the urinary tract, the inner lining shows inflammation and redness. The irritation caused due to infection leads to rectal pain in men and pelvic pain in women. The most common symptoms are uncontrolled urination, burning, and pain while urinating.

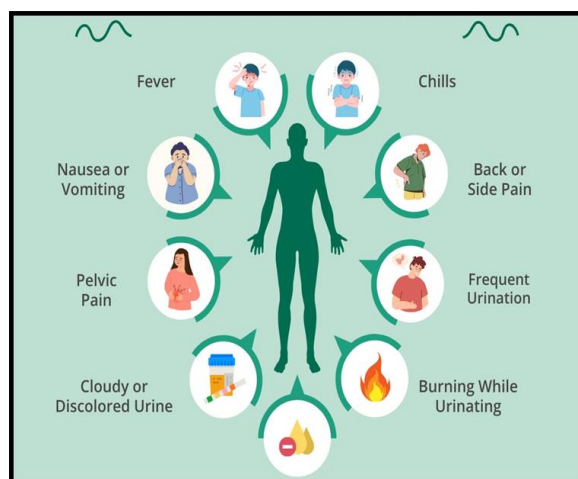


Fig. 2: Symptom Of UTI.

1.5 DIAGNOSIS OF UTI

Urine analysis: A urine sample is collected and tested for various physical analysis indicating UTI.

Complete blood count and culture: It helps design treatment for UTI based on bacterial growth seen.

Plain X-ray: It is helpful to detect kidney stones that may cause infection. **Ultrasonography:** It assists in the diagnosis of incomplete emptying of the urinary bladder or urine retention. It may indicate the presence of pus cells or abscess in the prostate in case of severe infection.

Cystoscopy: It is performed with the help of a tube attached to a camera to detect the presence of tumours, diverticulum in the urinary bladder.

CT scan: The three-dimensional image is obtained with a contrast dye injection in the body to find defects such as stones, infections, tumours, cysts, etc.

Intravenous Pyelogram (IVP) and Voiding cystourethrogram (VCUG): It is used to detect obstruction in the urinary tract. In this test, chemical dye is injected into the arm vein or bladder, as the dye travels X-ray imaging is carried out to detect defects.

Magnetic resonance imaging: It is used to detect any abnormalities in the urinary tract.

2. HERBAL PLANTS USED IN TREATMENT OF UTI

Table 2: Herbal Plants Used In Treatment Of UTI.

Common name	Botanical name	Family	Chemical constituents	Properties	UTI use
Uva Ursi	<i>Arctostaphylos uva-ursi</i>	Ericaceae	Arbutin, hydroquinone, tannins, flavonoids	Anti bacterial, astringent	Kill bacteria, reduces inflammation
Cranberry	<i>Vaccinium macrocarpon</i>	Ericaceae	Proanthocyanidins, flavonoids, quinic acid	Anti-adhesion, antioxidant	Prevent E.coli adhesion
Butterfly pea	<i>Clitoria ternatea</i>	Fabaceae	Flavonoids, anthocyanins, saponins, alkaloid.	Anti-oxidant, anti inflammatory, anti- microbial, diuretic.	Inhibit bacterial growth, reduce inflammation, promote urination.
Cornsilk	<i>Zea mays</i>	Poaceae	Mucilage, flavonoids, potassium salts, saponins	Soothing, diuretic	Soothes urinary tract infection, promote urination
Indian spurge	<i>Boerhavia diffusa</i>	Nyctaginaceae	Alkaloid, flavonoids, glycosides, lignans, steroids	Diuretic, anti-inflammatory, anti-oxidant, anti microbial analgesic.	Reduce inflammation, support kidney and bladder health.
Garlic	<i>Allium sativum</i>	Amaryllidaceae	Allicin, ajoene, sulfur compounds	Anti bacterial, immune-supportive	Natural antibiotic against UTI pathogens
Horsetail	<i>Equisetum arvense</i>	Equisetaceae	Silica, flavonoids, saponins, tannins	Diuretic, astringent	Promote urination, flushing effect
Goldenseal	<i>Hydrastis Canadensis</i>	Ranunculaceae	Berberine, hydrastine, canadine	Antibacterial	Strong natural antimicrobial
Marshmallow root	<i>Althaea officinale</i>	Malvaceae	Mucilage, flavonoids, tannins	Demulcent, anti-inflammatory	Disinfectant for urinary and bladder infection
Buchu	<i>Agathosma betulina</i>	Rutaceae	Diosphenol, volatile oil, (limonene, menthone) flavonoids	Anti-septic, diuretic	Support urination, bladder health
Dandelion	<i>Taraxacum officinale</i>	Asteraceae	Inulin, taraxasterol, flavonoids	Diuretic, anti-inflammatory	Support urination, bladder health
Nettle	<i>Urtica dioica</i>	Urticaceae	Flavonoids, caffeic acid, minerals,	Diuretic, anti-inflammatory	Promote urination,

			vitamins A&C		relieves inflammation
Parsley	<i>Petroselinum crispum</i>	Apiaceae	Apiol, myristicin, flavonoids, vitamins C	Diuretic, anti-microbial	Increases urine flow, flushes bacteria
Cleavers	<i>Galium aparine</i>	Rubiaceae	Iridoids, tannins, flavonoids, coumarins	Diuretic, lymphatic tonic	Cleanses urinary and lymphatic system
Yarrow	<i>Achillea millefolium</i>	Asteraceae	Azulene, achilleine, flavonoids, tannins	Antimicrobial, astringent	Reduce UTI-related inflammation
Lingonberry	<i>Vaccinium vitis-idaea</i>	Ericaceae	Proanthocyanidins, arbutin, benzoic acid	Anti-adhesion, anti-oxidant	Prevents bacterial adhesion
Chamomile	<i>Matricaria chamomilla</i>	Asteraceae	Apigenin, bisabolol, chamazulene, coumarin	Anti-inflammatory, calming	Soothes irritation and bladder spasms

2.1 UVA-URSI

Arctostaphylos uva-ursi (uva ursi), also known as bearberry is a useful herb for bladder infection. Bearberry leaves and preparations made from them have significant antibacterial activity (especially against *E. coli*) and astringent activity due to its arbutin content and diuretic properties.

Antibacterial properties: Uva ursi contain arbutin, which is converted in the body into hydroquinone, a compound with antibacterial effects, especially in the alkaline urine.

Anti-inflammatory effects: It may reduce inflammation in the urinary tract lining, easing symptoms like burning or irritation.

2.2 CRANBERRY

Cranberry prevents the attachment of bacteria to uroepithelial cells. It contains catechin, anthocyanidin, flavanols, quercetin, myricetin and phenolics that are supposed to be responsible for such activities.

Prevents bacterial adhesion: Cranberries contain proanthocyanidins(PACs), which help prevent *E. coli* (the most common UTI causing bacteria) from adhering to the walls of the urinary tract. This action makes it harder for bacteria to colonize and cause infection

2.3 CORNSILK

Cornsilk is a traditional herbal remedy often used to support urinary tract health, including for UTIs bladder irritation and kidney function.

Diuretic effect: Increases urine flow, which may help flush out bacteria.

Anti-inflammatory: Soothes irritation of the urinary tract lining.

Supports bladder and kidney function: Traditionally used to relieve burning, urgency and mild inflammation.

2.4 GARLIC

Garlic is a potent natural remedy with broad spectrum anti- microbial properties, and it has been studied for this potential to help with urinary tract infection

Antibacterial: Contain allicin which has been show to inhibit *E.COLI*, the main bacteria responsible for UTI.

Antifungal & antiviral: Can help if there a fungal or viral component to urinary symptoms

Anti- inflammatory: May reduce inflammation in the urinary tract lining.

Immune- boosting: Support overall immune function, which can help fight infection.

2.5 HORSETAIL

Horsetail (*Equisetum arvense*) is a traditional herbal remedy with properties that may support urinary tract health, especially in the context of mild UTI, bladder irritation, and water retention.

Diuretic: Increases urine output, helping flush bacteria from the urinary tract.

Astringent: Tones and tightens urinary tract tissues, which may reduce inflammation and discomfort.

Anti- inflammatory: Soothes irritated bladder or urethral lining.

Mild antimicrobial: Contains small amount of compounds with antibacterial activity.

2.6 CLITORIA TERNATEA

Clitoria ternatea (Butterfly pea) is used in traditional medicine as a supportive remedy for urinary tract infection (UTI).

Diuretic effect: Promote increased urination, which helps flush out bacteria from the urinary tract.

Anti inflammatory: Soothes the urinary tract lining, reducing pain, burning sensation and inflammation.

Antimicrobial activity: Contains bioactive compounds (like flavonoids and anthocyanins). That may help inhibit the growth of UTI- causing bacteria like E.coli.

Antioxidant protection: Protects urinary tract tissues from oxidative stress, supporting healing and recovery.

2.7 INDIAN SPURGE

Indian spurge (*punarnava*, *boerhavia diffusa*) is widely used in traditional medicine for urinary tract infection (UTI) due to its potent diuretic, anti-inflammatory, and anti microbial properties.

Diuretic effect: Increases urine output, helping flush out bacteria and toxins frm the urinary tract.

Anti- inflammatory: Soothes the urinary tract lining, reducing pain,, burning sensation, and swelling.

Anti-microbial action: Contains compounds that may inhibit bacteria responsible for UTI, like E.coli.

2.8 CHAMOMILE

Chamomile is a widely used medicinal herb known for its anti- inflammatory, antimicrobial, and antispasmodic properties. Traditionally, it has been employed to alleviate symptoms related to urinary tract infection (UTI), including bladder irritation, dysuria (painful urination), and spasm.

Anti- inflammatory: Chamomile contains bioactive compounds like chamazulene and bisaboolol, which reduce inflammation in the urinary tract mucosa.

Anti- microbial activity: Studies have demonstrated chamomile inhibitory effects against some bacteria strains, although its efficacy against common UTI pathogens such as *Escherichia coli* relatively mild compared to conventional antibiotics.

Analgesic effects: It relaxes smooth muscle and can reduce bladder spasms and discomfort during urination.

2.9 PARSLEY

Parsley is a common culinary herb with a long history of medicinal use, particularly for urinary system support. It is widely recognized in traditional herbal medicine as a diuretic and anti- inflammatory herb that may assist in flushing out pathogens and reducing urinary tract infection.

Diuretic effects: Parsley increases urine output, helping flush bacteria from the urinary tract. This flushing effect may reduce the risk of bacterial adhesion to the bladder wall.

Anti- inflammatory: Compounds like apigenin and flavonoids reduce inflammation in the urinary tract lining, potentially easing symptoms like burning and pain during urination.

Anti- microbial: Parsley essential oil has shown mild antimicrobial effects in vitro, though this is less studied and not a primary mechanism for treating UTI.



UVA-URSI



CRANBERRY



CORN SILK



GARLIC



HORSETAIL



CLITORIA TERNATEA



INDIAN SPURGE



CHAMOMILE



PARSLEY

Fig. 3: Herbal Plants Used In Treatment Of UTI.

3. CONCLUSION

Herbal plants offer a natural approach to managing urinary tract infection. Some herbs such as uva ursi, cranberry, garlic, dandelion etc., have properties that may help reduce bacteria and support the body's ability to flush out infections. These natural treatments can be helpful for preventing UTIs or easing mild symptoms. However, they work best when combined with good hygiene and proper hydration. Overall, using herbal plants can be a natural way to support the body and reduce the risk of UTIs when used properly.

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