

Traditional Herbs as Effective Natural Remedies for Treating Urinary Tract Ailments

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Abstract

Urinary tract infections have become quite chronic currently. Approximately 150 million people are affected with urinary tract infections (UTIs) annually. The prevalence of urinary tract infections is high among the women population in comparison with men. It is coexistent with high mortality as well as morbidity. Urinary tract infections may exert their influence on any part of the tract such as urethra, ureters and kidneys. Synthetic drugs are being administered unrestrained to control such diseases leading to many impediments. Frequent administration of antibiotics causes adverse effects and impairs healthy bacteria in the body. Under such circumstances, traditional herbs as an efficacious alternative therapy has surfaced and playing a central role. This review explores the efficacy of some of these traditional herbs and the critical role that they play in managing urinary tract infections among the populace. It is advocated that herbal medicines can be a potential, sustainable alternative therapy for managing urinary tract infections.

Keywords: Alternative therapies, Sustainable approach, Traditional herbs, Treatment, Urinary tract infections

Introduction

Urinary tract infection (UTI) is a severe public health problem and involves any part of the urinary system. UTI is caused by both Gram-pos-

itive and Gram-negative bacteria such as *Enterococcus faecalis*, *Escherichia coli*, *Klebsiella pneumonia*, *Proteus mirabilis*, and *Staphylococcus saprophyticus*. The common symptoms of UTI include pain during urination and in the lower back. Fifty per cent of women are affected by such infections (1). Other complications like fever, myalgia, frequent urination, blood in the urine, protein in the urine may occur if the microbes reach the gastrointestinal tract, urethra, bladder or kidney (2). Spread of UTI occurs due to sexual intercourse, unhygienic practices, and lack of adequate intake of water. UTIs can also occur while using a catheter or during chemotherapy (3). Antibiotics are prescribed to prevent recurrence of UTIs (4). Antibiotic therapies can control these UTI infections but the pathogenic strains develop resistance overtime via efflux pumps or by other biochemical mechanisms. Prevention of recurrence of disease is therefore of paramount importance (5). Reoccurrence of UTI can be prevented by antibiotic treatment and non-antibiotic measures (vitamins, hygienic measures, vaccines, oestrogens) that are of poor quality and ineffective (6). Drugs like trimethoprim- sulphamethoxazole or fosfomycin and nitrofurantoin (7,8) are used to treat *Escherichia coli*, *Proteus*, *Klebsiella* and *Staphylococcus saprophyticus* infection and lead to side effects. An overview of the utilization of traditional herbs to treat the infections is depicted in the figure 1. Many antibiotics were used in treating UTIs. Adverse effects were noticed depending

on the type of specific antibiotics used, and the duration of treatment. Some of the common antibiotics with their adverse effects are shown in the Table 1. Trimethoprim-sulfamethoxazole was used to treat common complicated UTI, but it caused severe joint pains and fever. Trimethoprim-sulfamethoxazole and fluoroquinolones showed little effect on vaginal and fecal anaerobic flora, but resulted in skin rashes, urticaria, angioedema/laryngeal edema, nausea, vomiting, abdominal pain, neuromuscular and gastrointestinal problems tendinopathy, respiratory problems, and pneumonia (9).

in women is five times higher than in men (13). According to the Ahmad et al 80% of uro-pathogens have shown resistance to two antibiotics (14). Whenever the pathogens cause UTI, they enter the urinary tract via urethra. Bacteria enter in to urethra from the bowel they colonize and attach to the bladder and form a biofilm that make the pathogens to escape the host immune response (15). Pathogens can enter in to urinary tract due to improper urogenital area via sexual intercourse, feminine products and contraceptives. In the urinary tract, the pathogens develop and cause infections. Pathogens may enter blood stream and migrates to kidney or bladder that lead to infection (16). In uncomplicated infection, the infection of healthy patient responds to antibiotic treatment. But, complicated infections occur in the people having abnormal urinary tract and often obstructed by stones or bladder ureter reflux. Isolated infection occurs at an interval of six months without the connection between two episodes and it represents the mother infection. Unresolved infection does not respond to any antibiotic treatment and reinfection recurrence is the last stage of urinary tract infection. In this type of infection, the patient is infected again with the same pathogen after treating urinary tract infection. Different stages of UTI are shown in the figure 2. Long term usage of antibiotics to treat the urinary tract infection is leading to the development of resistant microbial strains which persist in the environment up to six months. This leaves a window for us to develop and use the effective alternative therapies like that of herbal medicines. Nearly 40% of the population, mostly tribal folk and people living in rural areas are still dependent on such herbs for many treatments.

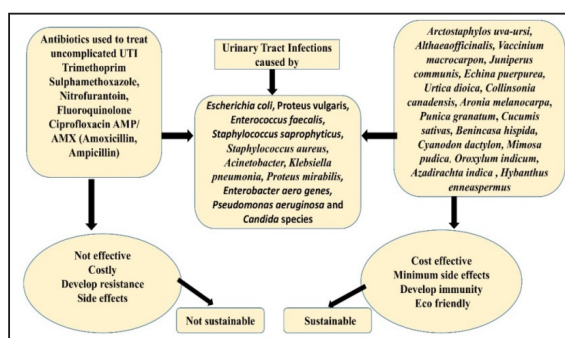


Fig. 1: An overview of urinary tract infection, causal organisms, herbs that can be effectively used to treat UTI are shown in the figure.

Complicated and uncomplicated urinary tract infections

UTI is of two types; complicated and uncomplicated. Complicated UTI occurs in people having abnormalities in any part of genitourinary tract and lead to serious issues compared to uncomplicated UTI. Uncomplicated UTI infections occur in the absence of abnormalities (10). An uncomplicated urinary tract infection is the bacterial infection of bladder and its structure. Uncomplicated UTI is known as cystitis or as lower UTI. Treatment of UTI helps to control the kidney infection or pyelonephritis that may lead to the destruction of delicate structures in nephrons and cause hypertension. UTI is the most common and approximately 800 million are affected with at least one urinary tract infection in every year (11,12). The prevalence of the UTI

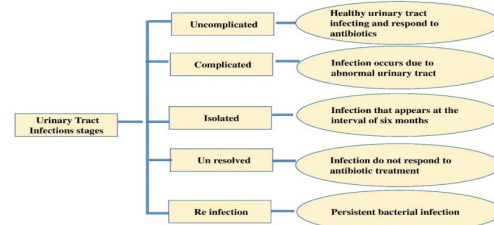


Fig. 2: Various stages of urinary tract infections

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Table 1. Antibiotics and their unpropitious effects on urinary tract

Name of the antibiotics	Adverse effects
Trimthoprim-sulfamethoxazole and Fluroquinolones	Little effect on vaginal and faecal anaerobic flora
Nitrofurantoin Fluroquinolone Trimethoprim-sulfamethoxazole AMP/ AMX (Amoxicillin, Ampicillin)	Skin rash
Nitrofurantoin Fluroquinolone Trimethoprim-sulfamethoxazole AMP/AMX (Amoxicillin, Ampicillin)	Urticaria (skin reaction itchy welts) angioedema/laryngeal edema, nausea, vomiting, abdominal pain, neuromuscular and gastrointestinal problems, tendinopathy, respiratory problems, pneumonia
Amoxicillin	Nausea, diarrhea and rash
Fosfomycin	Diarrhoea, head ache and abdominal pain
Trimethoprim-sulfamethoxazole Applied to treat common complicated UTI	Joint pains, fever
Ciprofloxacin	Headache, nausea, dizziness

Symptoms

UTI can be diagnosed by the symptoms like urinary frequency, hematuria, dysuria or suprapubic pain. Such a condition can be confirmed by microscopic observations of urine and by culturing the urine sample. For complicated UTI in addition to above symptoms other symptoms like fever, chills, sepsis can be seen in patients. Burning sensation associated with urine, foul smell from urine, pain in lower abdomen back and pelvic area in women (17), change in urine color are common. If kidney gets infected then it causes fever, nausea, vomiting and back pain (18). Continuous use of antibiotics lead to vaginal candidiasis and gastrointestinal symptoms and it is difficult to prevent the recurrence of infections. *E. coli* causes gastrointestinal diseases and diarrhea (19). If these infections are not treated, they lead to pyelonephritis an infection of kidneys, and sepsis which may leads to threaten the life, and damage to the kidneys. UTI can be controlled by using antibiotics and the choice of antibiotics depends on the type of the bacteria involved. UTI infections can be prevented by taking good hygiene especially after

sexual intercourse. Drinking excess water can drain the bacteria out of the urinary tract. However, use of catheter can complement the use of bacteria.

Significance of traditional herbs

Traditional herbs have been found as effective natural remedies in managing many UTIs. Traditional herbs can support the body against infections, control inflammation, diuresis, help in the proper functioning of kidneys, build up immunity and reduce clinical symptoms. Garlic, ginger and turmeric show anti-microbial properties and are generally consumed in one form or the other. Peppermint tea can sooth the bladder and prevents discomfort. Chamomile tea, willow bark and liquorice roots control inflammation and reduce symptoms. Dandelion and burdock also show diuretic properties by flushing out the toxins and fluids from the body and thus play a vital role in managing UTI. Cranberry shows antioxidant properties and supports proper functioning of kidneys. Traditional herbs have been used since time immemorial to treat UTIs. Herbs such as *Arctostaphylos uva-ursi*, *Althaea officinalis*, *Vaccinium macrocarpon*, *Ju-*

niperus communis, *Echina puerpurea*, *Urtica dioica*, *Collinsonia canadensis* help in alleviating the symptoms of urinary tract infections without any adverse effects. Further, they are cost-effective and sustainable.

Role of traditional plants in treating UTI

Herbal traditional medicine is helpful to treat UTI infections with minimum adverse effects (20). According to the World Health Organization, multi drug resistant (MDR) bacteria can cause many deaths by the year 2050. In contrast, plants have been used since ages to treat UTI. Approximately, 80 per cent of population from developing countries utilizes plant as medicine to treat multiple infections (21) which are safer than the synthetic drugs (22). Diverse plant parts like bark, leaves, flowers, fruits, seeds, stems, and roots are used for therapeutic purposes which generally consist of several bioactive compounds with pharmacological properties (23,24). Some of the important taxa used in the treatment of UTI include *Aptosimum procumbens*, *Cardiospermum halicacabum*, *Cissampelos capensis*, *Zantedeschia albomaculata*, *Hydrastis canadensis* (golden seal), *Agathosma betulina* (Buchu), *Equisetum arvense* (horse tail), *Arctostaphylos uva-ursi* (bear berry), *Vaccinium macrocarpon* (crane berry), *Echinaceae purpures* (cone flower) and others (24,25,26). Long term administration of these medicinal plants has been found safe for therapy (27). *Punica granatum* (pomegranate), *Cornus mas* (cornelian cherry), *Aronia melanocarpa* (black chock berry) and their extracts are being used currently to cure UTI. So, herbal products being prepared from plant material are highly important and eco-friendly. Research findings have demonstrated the therapeutic properties of many plants which could be attributed to the presence of phytochemical components like terpenoids, tannins, sterols, anthraquinones, saponins, phenols, phytosterols, flavonoids, sesquiterpenes and glycosides. *Cortex dictamni* is the Chinese traditional drug that helps to cure both skin and urinary tract infections. An alkaloid called dictamine extracted from *Cortex dictamni*

shows anti-bacterial, anti-cancer and anti-fungal properties (28,29,30). Leaf extract of *Arctostaphylos uva-ursi* consists of flavonoids, terpenoids, tannins, iridoids, arbutin (a glycoside) and show anti-bacterial activity. Byproducts of the *P. granatum* fruit consists of anti-microbial compounds like punicalagin, penicillins, allagic acid and gallic acid and flavonols like myricetin, quercetin and anthocyanins exhibited antibacterial activity (31,32) and its seed extract has the properties of urobactericidal activity against *E. coli*. The fruits of *Aronia melanocarpa* have polyphenols that contain antioxidant and antimicrobial properties. Arona berries consist of quinic acid, which helps in treating UTI (33). Whole plants of *Cinnamomum verum* have antioxidant and antibacterial properties due to the presence of trans-cinnamaldehyde, eugenol and others. Trans-cinnamal acetate and proanthocyanidins help in treating UTIs. *Hybanthus enneaspermus* showed *in vitro* anti-bacterial activity against *E. coli*, *P. aeruginosa*, *K. pneumoniae*, *P. mirabilis*, *E. faecalis* and *S. aureus*. The ethanolic extract of these plants consists of bioactive compounds such as flavonoids, terpenes, alkaloids that can help in mitigating UTIs.

Arctostaphylos uva-ursi (Uva-ursi), *Juniperus* spp., (Juniper), leaves and fruits of *Vaccinium macrocarpon* (crane berry) contain antimicrobial compounds that act against microbes and protect the humans against acute and chronic UTIs (34). Berberine is the important drug present in the roots of *Mahonia aquifolium* (dragon grape, belongs to the family Berberidaceae) and *Hydrastis canadensis* kill bacteria and fight against infections to prevent *E. coli* and *Proteus* species from adhering to the host cell (35). Aqueous extraction of *Zea mays* can prevent the symptoms of UTI by reducing the number of RBC pus cells in urine (36). *Gundelia tournefortii*, *Eruca sativa* and *Organum syriacum* increase the activity of clarithromycin against resistant strains of *E. coli*. Plant extracts coupled with antibiotics regulate MDR *E. coli* infection (37). Whole plant extracts from *Hemidesmus indicus* show urobactericidal activity against different uro-

pathogens clinically isolated from patients suffering from UTI such as *E. coli*, *Enterococcus faecoli*, *Staphylococcus aureus* and *Klebsiella pneumoniae* (38,39,40). Whole plant extracts of *Euphorbia thymifolia* controlled hematuria (41). Leaf extracts of *Agathosma capensis* also can treat urinary ailments. Root extracts of *Withania somnifera* effectively control urinary bladder infections. Root and leaf extracts of *Withania somnifera* also treats the bugs bacteria (extended spectrum beta - lactamases) present in bowel (42). Bark, leaves and flowers of *Urena lobata* control burning sensation in the urethra and other urinary troubles. Decoction prepared from *Abutilon indicum* root, *Vitis vinifera* fruit and water mixture given twice can efficaciously cure dysuria, thirst, and syphilitic fever (43). Fruit extracts of *Benincasa hispida* remediate fever, burning sensation during urination. Seed extracts of *Cucumis sativa* cures dysuria, urethritis, urolithiasis, and burning micturition (43). Some plant species like *Parietaria officinalis*, *Cucurbita maxima*, *Hordeum vulgare*, *Citrus limon*, *Allium cepa*, *Olea europaea* are used alone or mixture of these species with olive oil, goat milk and honey treats urinary diseases (44). A mixture of *Glycyrrhiza glabra* + cow milk + ghee + sugar relieves burning micturition in urethra and restores health. Similarly, *Cyanodon dactylon* roots with white pepper and butter milk reduces burning micturition, anal discomfort and dysuria. *Cyanodon dactylon* leaves show antibacterial activity and inhibit the growth of pathogenic bacteria. Gram negative bacteria

were more sensitive compared to Gram positive bacteria (45).

Flower bud and flower extract of *Hibiscus rosa sinensis* can control burning micturition. Tannins present in the flower extract act as antimicrobial agents (46). Epicarp extract of *Cucumis melo* prevents stones in kidney, and UTIs (47). Leaves and roots of *Mimosa pudica* are being used to treat urinary infection, burning urination (48,49). The roots of *Asparagus racemosus* prevent many kinds of urinary troubles (50). The extract of *Solidago canadensis* controls prostrate diseases, urolithiasis and treats UTI. Stem extracts of *Equisetum ramosissimum* (horsetail) exhibit antioxidant and antibacterial properties (51) and expels stones from kidney, help in mitigating skin infections, repairs bone fracture, and relieves joint pains (52). The Chinese herb *Coptis chinensis* (Huandluam) shows *in vitro* inhibitory and anti-inflammatory effects against uropathogenic strains. It consists of berberine, coptisine and palmatine alkaloids that inhibit *E. coli* (54). *Armoracia rusticana* prevents recurrence of UTI in pediatric patients. This herb consists of isothiocyanates which display antibacterial activities against UTI (55). Several phytopharmaceuticals like flavonoids, isoflavonoids, lycopenes, carotenoids, terpenoids, omega 3-fatty acids have been shown to exhibit antibacterial and antimicrobial activity (56), and display minimal adverse effects (56). Many plants that help to treat urinary infections are listed in Table 2.

Table 2. Traditional plants to treat urinary tract infections

Botanical name of the plant	Common name	Plant parts used	Benefits
Agathosmacapensis (L.)	Spicy buchu	Leaves	Controls urinary ailments
Ballota africana	Cat herb	Leaves	Treats bladder and kidney ailments (53)
Withania somnifera (L.)	Ashwagandha/ winter cherry	Roots	Treats urinary bladder infections (42)
Euphorbia thymifolia	Laghu dudhidika / chotidudhi	Complete plant	Controls blood in urine (41)
Mimosa pudica L	Sensitive plant	Leaves and roots	Treats urinary infection and burning urination (48, 49)

Urena lobate L	Caesar weed	bark, leaves and flowers	Relieves from burning sensation and urine trouble
Abutilon indicum	Country mallow	Decoction consisting of Abutilon indicum root, Vitis vinifera fruit and water mixture	Cures dysuria, thirst, syphilitic fever (43)
Benincasa hispida	Winter melon	Fruit extract	Controls fever, burning sensation during urination. Fruit extract inhibits bacterial and fungal growth
Cucumis sativas	Cucumber	Seeds	Cures dysuria, urethritis. Seeds cure urolithiasis, burning micturition
Parietaria officinalis Cucurbita maxima Hordeum vulgare Citrus limon Allium cepa Olea europaea	Pellitory Cucumber Barley Lemon Onion Olive	Mixture of these species with olive oil, goat milk and honey	Treats urinary diseases (44)
Glycyrrhiza glabra Linn	Licorice	Glycyrrhiza glabra + cow milk + ghee + sugar	Treats burning micturition
Cyanodon dactylon	Bermuda grass	Decoction	Decoction of Cyanodon dactylon roots with white pepper and butter milk reduces burning micturition, anal discomfort and dysuria. Cyanodon dactylon leaves show antibacterial activity and inhibit the growth of pathogenic bacteria (Gram negative and positive) (45)
Hibiscus rosa sinensis	Chinese hibiscus	Flower bud Flower extract	Relieves burning micturition. Flower extracts act as antimicrobial agents (46)
Hygrophila arculata	Kokilaksha	Seeds	Effective against syphilis and burning micturition in urethra
Oroxylum indicum	Midnight horror	Whole plant	Effective against uropathogens
Vitis negundo	Chinese chaste tree	Roots	Effective against uropathogens (57)
Cucumis melo L.	Melon	Epicarp	Expels stones from kidney, and controls urinary tract infections (47)

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Euphorbia thymifolia L.	Laghududhika	Whole plant	Controls blood in urine
Azadirachta indica	Neem	Leaves	Urinary trouble
Argemone mexicana L	Mexican poppy	Root	Urinary trouble (58)
Adiantum lunulatum Burm.F	Hamsapadi	Roots	Controls hematuria (59)
Asparagus racemosus wild	Satawar	Roots	Cures urinary troubles (50)
Nyctanthes arbortristis	Tree of sadness	Leaf juice	Acts as diaphoretic, laxative and diuretic (60)
Arctostaphylos uva ursi	Uva ursi	Leaf extract	Urinary anti-septic and diuretic
Solidago canadensis, S. virgaurea and S. gigantea	Canadian golden rod	Extract	Controls prostrate diseases, urolithiasis and treats UTI (61)
Equisetum ramosissimum	Horse tail	Stem extract	Exhibits antioxidant and anti-bacterial properties (51)
Hybanthus enneaspermus	Spade flower	Ethanol extract	Regulates many UTIs
Punica granatum	Pomegranate	Seed extract	Urobactericidal activity against E. coli
Anthocephalus cadamba	Burflower tree	Bark	Antibacterial properties against uropathogens (E. coli) (62)
Armoracia rusticana	Horse radish	Whole herb	Prevents recurrence of UTI in pediatric patients. Antibacterial activities against UTI (55)

Conclusion

UTI is a serious health concern among the mankind. Proper diagnosis and therapeutic intervention at the right time is therefore indispensable. Traditional herbs play a pivotal role in nursing and managing the UTI by reinforcing the life's innate immunity. Traditional herbs minimize inflammation, support proper functioning of kidneys and relieve the symptoms with minimal adverse effects. They are potent with proven efficacy. The dose, combination of herbs, and length of treatment must however be recorded properly for their bona fide medicament. On the negative side, it is believed that not all the traditional herbs are efficacious and give relief from the clinical symptoms to the people and cannot unfasten all the infections compared to modern medical treatment or antibiotics. So, further research in the usage of herbs for treating UTIs is warranted and many innovative methods need to be developed based on the insights generated thus far and critical analysis. Herbs can certainly serve as a sustainable resource too.

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Conflict of interest

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Data availability

Not applicable.

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