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Review Article

A REVIEW STUDY ON UTILITY OF AYURVEDIC DRUGS IN UTI AMONG CHILDREN

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ABSTRACT

Urinary tract infection (UTI) in pediatric age group are associated with high morbidity and long term complications. Conventional antibiotics are the first choice in an acute episode of UTI; therefore resistance of pathogenic bacteria to antibiotics is of high clinical concern. As per Ayurveda plants are main reservoirs which have been used for the treatment of different ailments. The review presents various clinical and experimental evidences which support the efficacy of Ayurveda drugs against urinary tract infections. *Nelumbo nucifera*, *Nymphaea nouchali*, *Moringa oleifera*, *Tribulus terrestris*, *Boerhavia diffusa*, *Hemidesmus indicus*, *Crataeva nurvala*, *Terminalia chebula*, *Allium sativum*, *Coleus aromaticus*, Chandanadi Churna, Chandanasava, Trinapanchamula kwatha, Punarnavasava drugs were reviewed in the present study after reviewing their safety studies. All drugs poses potent anti-bacterial properties against both gram positive and negative bacteria causing UTI, maximum of the drugs also poses anti-inflammatory, diuretic, antioxidant, nephroprotective and antiurolithiatic properties beneficial in the management of UTI and all drugs are safe even in high doses thus can be effectively used in pediatric age group. Thus proving Ayurveda to be a better treatment modality in successful and complete management of simple UTI and drug resistant UTI.

Keywords: Ayurveda, Antibacterial, Nephro-protective, Pediatric, UTI

INTRODUCTION

Urinary tract infections (UTI) in pediatric age group are associated with high morbidity and long term complications. The majority of causative organisms of UTI are gram-negative bacteria in which *Escherichia coli* alone contribute to 80 percent of cases. *Proteus mirabilis*, *Klebsiella pneumoniae*, and *Enterobacter aerogenes* are also involved in the pathogenesis of the disease. Gram-positive bacteria include *Staphylococcus saprophyticus* (10–15%), *Enterococci*, and *Staphylococcus aureus* (associated with calculi and catheterization). Microbiologically, UTI is defined as presence of at least 10⁵ organisms/mL of urine in an asymptomatic patient or as more than 100 organisms/mL of urine in a symptomatic patient with accompanying pyuria (>5 WBCs/mL).¹ Common uro-pathogens isolated were *Klebsiella* spp. (15.6%), *Enterococcus faecalis* (8.7%), *Proteas* (5.9%), *Pseudomonas aeruginosa* (5.9%) and *Candida* spp. (5.5%).² Conventional antibiotics are the first choice in an acute episode of UTI; therefore resistance of pathogenic bacteria to antibiotics is of high clinical concern. The concept of the control of drug resistance is rather widely held today.³⁻⁴⁻⁵ Several reports are available about the multidrug resistance of bacteria especially *Staphylococcus*, *Pseudomonas*, and *Escherichia*. Therefore the world looks at some alternative and effective medicine particularly of natural origin. Some of the clinical studies recommend that mannose, cranberry, and probiotics can be natural options for long-term prevention from UTIs.⁶ Apart from this Low osmolality of urine, obstruction to urine flow, pH between 6.0 to 7.0 favors bacterial growth

causing UTI⁷ which need to be addressed in the management of UTI.

Ayurveda state that plants are main reservoirs of natural entities which have been used for the treatment of different ailments. Ayurveda medication is extensively used in India for the effective management of UTI. Though there is no direct correlation of UTI in Ayurveda but based on symptoms it has been correlated with *mutrakrichha* in various studies and also with *mutragraha*⁸⁻⁹, more over the medication used in UTI are basically the drugs acting on *mutravaha srotas* (Urinary tract)¹⁰. In the present study many such drugs are described which are commonly used in the management of UTI have been review in the light of various clinical and experimental evidences which support the efficacy of Ayurveda drugs against urinary tract infections.

This review aims at scanning the scattered literature on the properties of Ayurveda drugs in the management of UTI and to provide their scientific evidences.

Classical texts of Ayurveda as well as PUBMED, MEDLINE database were used for the search of relevant literature and research papers. Papers published between Jan 1980 to Jan 2015 were only considered. The key words used for the search were 'Ayurveda', 'Anti-bacterial', '*Nelumbo nucifera*' 'UTI' etc. In-vitro analysis, experimental trials as well as clinical studies were included in the review to search out the reported therapeutic potential of Ayurveda drugs. Only research articles published in English language were considered.

List of few Ayurveda drug helpful in management of UTI

Nelumbo nucifera (Kamal): Its rhizome¹¹ and flowers¹²⁻¹³ have good diuretic properties. Along with its rhizome, leaves and stamen of the plant possess antibacterial properties¹⁴. Flowers were also effective against many gram negative bacteria causing Urinary tract infections¹⁵⁻¹⁶. Its leaves were found to be effective in the management of hematuria¹⁷. Antioxidant properties were found in lotus liquor made from leaves and flowers¹⁸ and rhizome also have good antioxidant properties¹⁹⁻²⁰. Root extract of *Nelumbo nucifera* improves kidney function against gentamicin induced nephrotoxicity²¹. Its Stamens is very effective as nephro-protective drug²². In pediatric age group viral UTI may occur in immunocompromised children, especially herpes zoster may present with cystitis and lower urinary tract infection. In such patients *Nelumbo nucifera* may prove beneficial with anti-viral properties especially against Herpes Zoster Virus. Anti-viral effect have been found in its Seeds and leaves²³⁻³⁴. No treatment-related signs of toxicity or mortality was noted at higher dose of 5000mg per kg even²⁵.

Nymphaea nouchali (Neelkamal): Antimicrobial studies of Flowers of *N. nouchali* have shown it to be effective against Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus subtilis²⁶, Escherichia coli, Enterococcus faecalis, Xanthomonas campestris, Streptococcus mutans, Lactobacillus casei and Lactobacillus acidophilus²⁷. Its ethanolic extract of leaves has shown considerable antibacterial activity against E. coli²⁸, it possess effective anti-inflammatory activity²⁹ thus proving it to be an effective drug against UTI. No significant treatment-related changes in any hematological or serological parameters or toxicity were observed in safety study of the plant³⁰.

Moringa oleifera (Shigru): Studies have shown that decoction of *M. oleifera* is an effective remedy for symptomatic relief in UTIs due to the antibacterial and anti-inflammatory agents present in the plant³¹. Stem bark of *M. oleifera* has been tested against a variety of microorganisms like E. coli, S. aureus, B. cereus, P. aeruginosa, and P. mirabilis. It shows prominent effect against E. coli³² (MIC 64 µg/mL)³³. Urinary stone is also one of the conditions which facilitate UTIs; therefore antiurolithiatic activity³⁴ of shigru might also contribute in its action on urinary system. Urinary tract infection aggravates the oxidative stress in some cases like diabetes³⁵ and pregnancy³⁶. Antioxidant activity³⁷ of its bark is effective against oxidative stress produced in UTI because of phenolic component³⁸. It is a potent diuretic thus inhibit adherence of bacteria to the wall of the bladder by sloughing them off in urine³⁹. The extract did not elicit any sign of toxicity in treated rats.⁴⁰

Tribulus terrestris (Gokshura): All parts (fruits, stems plus leaves and roots) of *T. terrestris* in middle Asia showed antibacterial activity against Enterococcus faecalis, S. aureus, E. coli and P. aeruginosa⁴¹ and only fruits and leaves of Indian *T. terrestris* were active exclusively against E. coli and S. aureus⁴²⁻⁴³. Its decoction was studied against gentamicin-induced renal damage in rats and proved to be an effective nephroprotective medication⁴⁴. It has very effective diuretic action⁴⁵. Studies shows decoction of fruit in rats⁴⁶ and alcoholic extract in rats and dogs exhibited diuretic effect⁴⁷. Toxicity study did not exhibited any toxicity sign and histopathological evidence of gross pathological changes were not revealed in the vital organs at a dose of 2000mg/kg. Thus making it a safe drug⁴⁸.

Boerhavia diffusa (Punarnava): Its root have a good anti diuretic effect⁴⁹. HPTLC profiling of ethanolic extract showed

the presence of β-sitosterol in *B. diffusa*, which have a good antibacterial activity⁵⁰, especially in the inhibition of UTI causing bacteria like Proteus, Klebsiella, Pseudomonas, E.coli, and Enterococcus when compared to gentamycin antibiotic⁵¹. Toxicity study reveals it to be a safe drug with no any toxicity noted at higher doses even⁵².

Hemidesmus indicus (Sariva): *H. indicus* ethanolic root extract showed maximum zone of inhibition against E.coli⁵³. In another antimicrobial assay by disc diffusion method it showed antibacterial activity against S.aureus, P.aeruginosa, k.pneumoniae⁵⁴. One of the experimental study with single individual oral dose of aqueous and ethanolic extract of *H. indicus* root (200 mg/kg and 400 mg/kg per oral (p.o.) each) proved the drug as diuretic agents⁵⁵. *Hemidesmus indicus* root extract was evaluated against gentamycin induced renal toxicity in animal study with single dose 5 g/kg, p.o., last 6 days of treatment showed reduced renal impairment, induced by gentamycin. Thus proving its Reno-protective activity⁵⁶. The drug is quite safe at therapeutic dose. LD50 was found to be 2500mg/kg⁵⁷, but should be used cautiously in liver disorders⁵⁸.

Crataeva nurvala (Varun): *Crataeva* is also indicated for chronic infections of the urinary system. In a clinical study the majority (85%) of patients with proven chronic urinary tract infections were symptom-free after 4 weeks of treatment with *Crataeva* decoction⁵⁹. In the experimental study with decoction of *Crataeva nurvala*, it was revealed that the drug is effective in the management of urolithiasis which is regarded as one of the predisposing factor for UTI⁶⁰. There is no observed adverse effects level (NOAEL) value of 2000 mg/kg body weight implies that the drug is safe.⁶¹

Terminalia chebula (Haritaki): Ethanolic extract and Acetone extract of fruit of *T. chebula* were studied for inhibition of proteus vulgaris one of the antibiotic resistant and causative organism reported for UTI. Both the extracts exhibited good antimicrobial activity against UTI associated with P. vulgaris.⁶² Another study revealed antibacterial activity of extract from *T. chebula* fruit against E. coli, P. aeruginosa, shigella flexneria, and S. aureus⁶³. Its extracts demonstrated no cellular toxicity at even higher doses thus proving it to be a safe drug⁶⁴.

Allium sativum (Lashuna): *Lahasun (A. sativum)* was studied by disc diffusion method against gram-positive and gram-negative bacterial isolates from Urinary Tract of patients. In this study, aqueous allicin from *A. sativum* cloves and leaves were used in five quantities (10, 20, 30, 40 and 50µg). Maximum inhibitory activity and statistically significant (P< 0.01) result was obtained at 40µg of allicin against all test isolates.⁶⁵ At higher dose even it have no significant adverse event with no side effect on kidney and liver functions as well as the blood composition.⁶⁶

Coleus aromaticus (Pashanbhed): The oils of *C. aromaticus* showed remarkable antibacterial activity with minimal inhibitory concentration (MIC) ranging from 0.5µl/ml -6µl/ml.⁶⁷ It was tested against many multi drug resistant bacteria: Gram positive (Bacillus subtilis, Staphylococcus aureus, Enterococcus faecalis) and Gram negative ((Escherichia coli, Shigella sonnei, Pseudomonas aeruginosa, Klebsiella pneumoniae, Proteus vulgaris) causing UTI, it was found effective in inhibition of both type of bacteria effectively but maximum zone of inhibition was found in Gram positive pathogens as compared to Gram negative, apart from this it possess potent antioxidant property.⁶⁸ Study reveals that there was no mortality or any toxicity

observed up to the maximum dose level of 2000mg/kg body weight of the extract administered orally.⁶⁹

Chandanadi Churna: It comprises of *Santalum album*, *Acacia Arabica* *Syzgium cumini*, *Magnifera indica*, *Ptychotis ajowan*, *Tinospora Cordifolia* used in genitourinary infections. It have potent antibacterial activity against *P. vulgaris*, *K. pneumoniae*, *E. coli*, *P. aeruginosa* and *S. aureus*.⁷⁰

Chandanasava: It contains *Santalum album*, *Plectranthus vettiveroides*, *Cyprus rotundus*, *Gmelina arborea*, *Monochoria vaginalis*, *Callicarpa macrophylla*, *Prunus cerasoides*, *Symplocos cochinchinensis*, *Rubia cordifolia*, *Pterocarpus santalinus*, *Cyclea peliata*, *Andrographis paniculata*, *Ficus benghalensis*, *Ficus religiosa*, *Kaempferia galangal*, *Hedyotis corymbosa*, *Glycyrrhiza glabra*, *Alpinia galangal*, *Trichosanthes lobate*, *Bauhinia variegata*, *Mangifera indica*, *Bombax ceiba*, *Vitis vinifera*, Jaggery, *Woodfordia fruticosa* and Sugar. It have antibacterial properties especially effective against *E. coli*.⁷¹ It also possess Alkalinizing activity⁷² and diuretic⁷³ properties thus is an effective drug against UTI and studies have shown it to be a safe drug and can be used effectively among pediatric age group.⁷⁴

Trinapanchamula kwatha: It contains *Desmostachya bipinnata*, *Imperata cylindrica*, *Saccharum spontaneum*, *Saccharum munja*, *Saccharum officinarum*. It is an effective drug commonly used in urinary related ailments in Ayurveda. It possess effective antibacterial properties especially against *S.aureus*, *E.coli*, *M.flavus*, *P. aeruginosa*, *B. subtilis*.⁷⁵ Apart from antibacterial properties it further help with symptomatic relief in UTI by virtue of its role in relieving burning micturition, reduction of epithelial cells and pus cells in urine⁷⁶ and antipyretic property.⁷⁷

Punarnavasava: It contains *Zingibar officinale*, *Piper longum*, *Capsicum annuum*, *Terminalia chebula*, *Terminalia bellerica*, *Embllica officinalis*, *Berberis aristata*, *Tribulus terrestris*, *Solanum indicum*, *Solanum xanthocarpum*, *Adhatoda vasica*, *Aurondo donax*, *Picrorrhiza kurroa*, *Piper chaba*, *Boerhavia diffusa*, *Azadirachta indica*, *Tinospora cordifolia*, *Trichosanthes dioica*, *Vitis vinifera*, *Woodfordia fruticosa*, Water, Honey and Sugar. It is an effective anti-inflammatory, antipyretic⁷⁸, analgesic⁷⁹ drug. In a study antibacterial activity of Punarnavasava was screened by Disc diffusion method, Well diffusion method and Minimum Inhibitory Concentration and was found effective against *Proteus*, *Klebsiella*, *Pseudomonas*, *Escherichia coli*, *Enterococcus*. Moreover no any toxicity was noted with its use. Thus proving it to be a safe medication in UTI in all age group including children.⁸⁰

CONCLUSION

The present review entails that these Ayurveda drugs possess antibacterial, antioxidant, nephroprotective, alkalinizing, diuretic, anti-inflammatory and anti-urolithiatic properties with no toxicity or side effects and therefore are effective in reducing morbidity and complications in both uncomplicated or multi drug resistant UTI. These drugs will manage the UTI and also reduce the chances of painful prick of antibiotics in tender children. Therefore selective and careful use of these Ayurveda plants will definitely prove to be beneficial in UTI management especially in pediatric age group.

What this study adds

The present study provide a consolidated fact that Ayurveda drugs provide better and holistic approach in managing all complicated and uncomplicated UTI, with its antibacterial, diuretic, anti-inflammatory, antioxidant, nephroprotective and antiurolithiatic properties.

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