



A REVIEW ON HERBAL REMEDIES FOR UTI INFECTION

Ghosh Tonmoy¹, Singh P Neha²

¹Student, B. Pharma, Dev Bhoomi Institute of Pharmacy and Research, Dehradun

²Associate Professor, School of Pharmacy Pharmacy and Research, DBUU, Dehradun

ABSTRACT :

This review addresses the global impact of urinary tract infections (UTIs), affecting millions annually and exacerbated by antimicrobial resistance. The dominant pathogen, Uropathogenic Escherichia coli (UPEC), underscores the urgency for alternative solutions. Despite varied management approaches, recurrent UTIs persist as a socio-economic burden. Herbal remedies like cranberry, cinnamon, clove, garlic, and coconut water are explored for their antibacterial properties as potential alternatives to conventional treatments. The complexity of UTIs, classified by factors like symptoms and site, necessitates tailored treatments, particularly for complicated cases linked to underlying conditions. Various factors contribute to UTI prevalence, especially in females. Symptoms range from mild to severe, requiring prompt treatment to prevent complications and combat antimicrobial resistance. The situation in India, with E. coli resistance to key antibiotics, emphasizes the need for innovative strategies, including the integration of herbal medicine alongside antibiotics. Future prospects involve the development of new drugs, vaccines targeting uropathogens, and exploration of novel antibiotics. The review emphasizes revisiting traditional practices in alignment with the World Health Organization's strategy. In essence, the review contributes insights into alternative UTI treatments, urging attention to this pressing global health concern.

Keyword - Urinary tract infections , Herbal medicine , Uropathogenic Escherichia coli , Herbal remedies

INTRODUCTION :

A urinary tract infection (UTI) is a distinct health issue in which some urinary tract (urethra, bladder, urethra and kidneys) get a bacterial or sometimes fungal infection bypasses The protective barrier of the host's immune system and colonizes the urine road The effects of a urinary tract infection vary from mild to self-limiting from the disease Leading to severe sepsis with a mortality rate ranging from 25% to 40%. The risk of urinary tract infections rises inexplicably with age. Both males and females are prone to such infections, with a female-to-male ratio of 2:1 in individuals aged 70 and above, as opposed to a ratio of 50:1 in the younger population. It is the second most common infection, trailing behind respiratory infections. Various approaches are employed in the management of Persistent and repeated. urinary tract infection ie. Using antibiotics, including the consumption of bioactive natural foods, the use of probiotics, and maintaining adequate personal hygiene, however they still have not been successfully treated. Because Bacterial infections are the typical cause of UTIs, and antibiotics represent the most common course of treatment. However, the choice of medication and the duration of treatment are contingent upon factors such as the bacteria type, its sensitivity, the patient's medical history, symptoms, and the condition of the immune system[5].

Urinary tract infections (UTIs) constitute a significant public health issue, impacting a minimum of 150 - 250 million individuals annually, inclusive of both males and females. Females, however, display a higher susceptibility to UTIs. Lifetime incidence is 45-60% in women 5-18% in men and 4-8% in children and the recurrence rate is high (25%). UTI area from a simple bladder infection to serious instances of uroseptic shock. Symptoms of UTI encompass primarily discomfort or increased frequency during urination, painful urination (dysuria), and pain in the suprapubic region. The detection of UTIs involves analyzing bacterial cultures in the patient's urine. A positive indication is usually defined as a symptomatic urinary tract infection if the number of bacteria is jagt; 10³ colony-forming units (CFU) per milliliter (ml) of free urine. The initial treatment of choice is antibiotics, but excessive use of antibiotics, highly resistant uropathogens, and high recurrence rates of UTIs have made UTIs a major socioeconomic burden. The increasing challenge posed by the crisis of antimicrobial resistance that the search for a cure UTI management options are critical to global serious threats health One solution could be herbal preparations. 60 percent use traditional medicines of the world's population to primary health care, This encompasses various infectious diseases, and approximately half of the existing antibiotics are sourced from plants or fungi. This review may reveal lesser known herbs drugs with a significant antibacterial effect[2] .

Urinary tract infections result from the presence of both gram negative and gram positive bacteria, along with specific bacterial strains[15]. Uropathogenic Escherichia coli (UPEC) stands out as the predominant important uropathogen (50-70%) and other common causes include Klebsiella, Enterococcus, Staphylococcus and Candida species. Since the main cause is bacteria, antibiotics are common level of treatment. The rapid development of microbial resistance to classic The use of antibiotics has reached a critical stage in the management of infectious diseases. An approximation suggests that 15% of antimicrobials In humans, it is used to treat urinary tract infections , which increases MDR due to overuse,

Particularly noteworthy is the fact that only a quarter of women experiencing urinary tract symptoms actually exhibit a cultured bacterial infection[2]. Due to this factor and the multitude of individual treatments, the Antibiotic resistance can also be referred to as antimicrobial insistance in uropathogens as a pivotal issue in the escalating global challenge of antimicrobial resistance (AMR)[15]. crisis In 2017, when the WHO published a list of antibiotic-resistant priority pathogens, many were uropathogens known to acquire increasing resistance to existing agents antibiotics and in some cases cannot be treated[16]. For example, there is resistance Ciprofloxacin is a commonly prescribed antibiotic for the management of urinary tract infections(UTIs), accounts for 8.5–92.91% of UPEC and 4.2–79.4% for *K. pneumoniae*, varies by geographic location. Gram negative uropathogens are the most resistant, 33% of uropathogens are resistant to at least three. classes of antibiotics . In addition, bacterial cells (e.g. *K. pneumoniae*, *E. coli*, *S. saprophyticus*) or biofilm (most uropathogens) cells of the same bacteria exhibit higher resistance to antibiotics in comparison to their planktonic counterparts Because Based on these considerations, The management of urinary tract infections in both hospital and outpatient environments is becoming progressively challenging because doctors have few treatment options[2].

Herbal medicines have been employed since ancient times people on this planet. Progress of the original carriers for the use of drugs and Medicinal plants provide substantial financial support in the treatment of various diseases. Natural products are suggested for addressing diverse infectious diseases due to their potent antimicrobial properties in the active ingredients, coupled with mild side effects when compared to the assessment of other antibiotics in specific cases. Highlights of Herbal Medicine for the Nov chemotherapy options because they are strong achievements in reducing adverse drug reactions, Possessing potential antimicrobial characteristics, they can diminish infections caused by drug-resistant pathogenic microorganisms[10].

Types of Urinary Tract Infection :

Categorization of UTI can be done on the basis of complexity, site, and type of infection and the presence of symptoms (Fig. 1)[6]

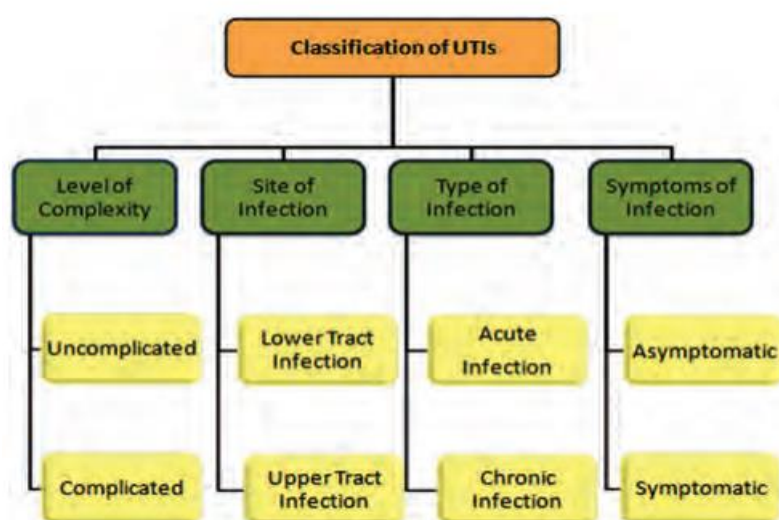


Figure 1. Classification of UTIs on the basis of different parameters.

According to Level of complexity of infection –

Urinary tract infections are differentiated into two types: complicated and uncomplicated. People with this background have complicated infections diseases or infections affecting any segment of the urinary tract can lead to abnormalities that makes The infection is of a more severe nature and More challenging to address compared to uncomplicated infections. In comparison, uncomplicated urinary tract infections Fall into the category of emergent lack of infections concomitant diseases or additional anatomical urinary tracts anomalies of the road and kidney[4]. The frequency of complicated UTIs is notably less compared to the occurrence of uncomplicated UTIs in individuals who are physically well with typical anatomy of the urinary tract[17]. Nevertheless, treating complex infections is generally more manageable, often requiring a short antibiotic regimen. In the case of urinary tract infections in children and men, they are typically considered uncomplicated, given their lower probability of concurrent health issues[18]. In particular, rates of antibiotic resistance have increased due to the proliferation of complicated bacteria that cause UTIs. so the development Effective treatment for These circumstances are essential, Not solely for the purpose of decreasing the occurrence of these infections, but also slows down the progression of new antibiotic resistant bacteria positions[4].

According to body part of infection –

Urethritis: An infection affecting the urethra, the tube responsible for carrying Urine transported from the bladder to the external region of the body.

Cystitis: An infection affecting the bladder frequently resulting from the upward movement of bacteria from the urethra.

Pyelonephritis: A kidney infection typically arises from the extension of an infection along the urinary tract or from a blockage in the urinary pathway. The obstruction leads to the retrograde flow of urine into the ureters and kidneys.

Vaginitis: An infection of the vagina[6].

According to Type of Infection –

A chronic urinary tract infection (UTI) is characterized by its resistance to treatment or its tendency to repeatedly recur. It may also be referred to as a persistent or recurring UTI. While acute UTIs typically show improvement within a few days with a brief antibiotic treatment, certain UTIs do not respond to short antibiotic courses, leading to persistent symptoms.

According to symptoms of infection –

Asymptomatic bacteriuria is characterized by the presence of two consecutive clean catch midstream urine samples should exhibit a minimum of 10⁵ colony forming units per milliliter (CFU/mL) of the same uropathogen to indicate a consistent presence. Importantly, individuals with asymptomatic bacteriuria do not exhibit any indications or manifestations related to urinary infections.

On the other hand, symptomatic urinary tract infection (UTIs) is defined by the presence of recognizable indications or manifestations of a UTI, along with Laboratory tests validating the diagnosis. These diagnostic criteria include Bacterial presence in the urine at a concentration of no less than 10^{5.1} colony-forming units per milliliter (CFU/mL) along with the occurrence of pyuria, indicated by a minimum of 11 white blood cells observed per high-powered field in the urine specimen.

Causes of Urinary Tract Infections :

The majority of these pathogens are typically present in the gastrointestinal or vaginal microflora, elevating the likelihood of their causative role urinary tract infections. For both UTI categories uropathogenic *Escherichia coli* is a leading infectious disease account for about 70 and 60% of complicated urinary tract infections. An additional 6% and 8% of complex and complicated urinary tract infections are arise due to *Klebsiella pneumoniae*. About 6% of simple UTIs are caused by the bacteria *Staphylococcus saprophyticus*, which has no discernible effect on more severe UTIs contraceptive use and previous event recurrent infections of the urinary tract[4].

The elevated frequency of urinary tract infections (UTIs) in females can be attributed to factors such as the closeness of the urethral opening to the anus., a shorter urethra, sexual activity, incontinence, and improper toilet hygiene practices. UTIs stand as the predominant cause for prescribing antibiotics to pregnant women.[2]

UTI Pathogens:

- Pathogens for simple and complicated UTIs often originate from gastrointestinal or vaginal microflora. Uropathogenic *Escherichia coli* dominates both categories, accounting for 75% in simple and 65% uncomplicated UTIs.
- *Klebsiella pneumoniae* contributes to 5% and 9% of complex and complicated UTIs, respectively.
- *Staphylococcus saprophyticus* is responsible for causing around 7% of simple UTIs but has minimal impact on severe cases.

Bacterial Causes in UTIs:

- Enterococcus spp. accounts for about 11% of complicated UTIs, contrasting with 6% in uncomplicated cases.
- Proteus spp, particularly Proteus mirabilis, and Pseudomonas aeruginosa collectively account for approximately 2% of both uncomplicated and complex urinary tract infections (UTIs).

Fungal and Viral Infections:

- Urinary tract infections can also result from fungal and viral pathogens, although their occurrence is less frequent when compared to bacterial UTIs.

Pathogen Movement and Biofilm Formation:

- Pathogens causing UTIs are usually excreted through the urethra into the urine. Bacteria from the intestine move into the urethra, attach to the bladder wall, and form biofilms, aiding in evading the host immune response.

Hygiene and UTI Risk Factors:

- Good urogenital hygiene is crucial, but exposure to certain products and sexual relations can contribute to pathogen penetration and create favorable conditions for infections. opposite-sex intercourse, contraceptive use, and a history of recurrent infections.
- It involve underlying diseases, catheter use, genitourinary disorders, anatomy, and physiology issues, hospitalization, and antibiotic exposure.

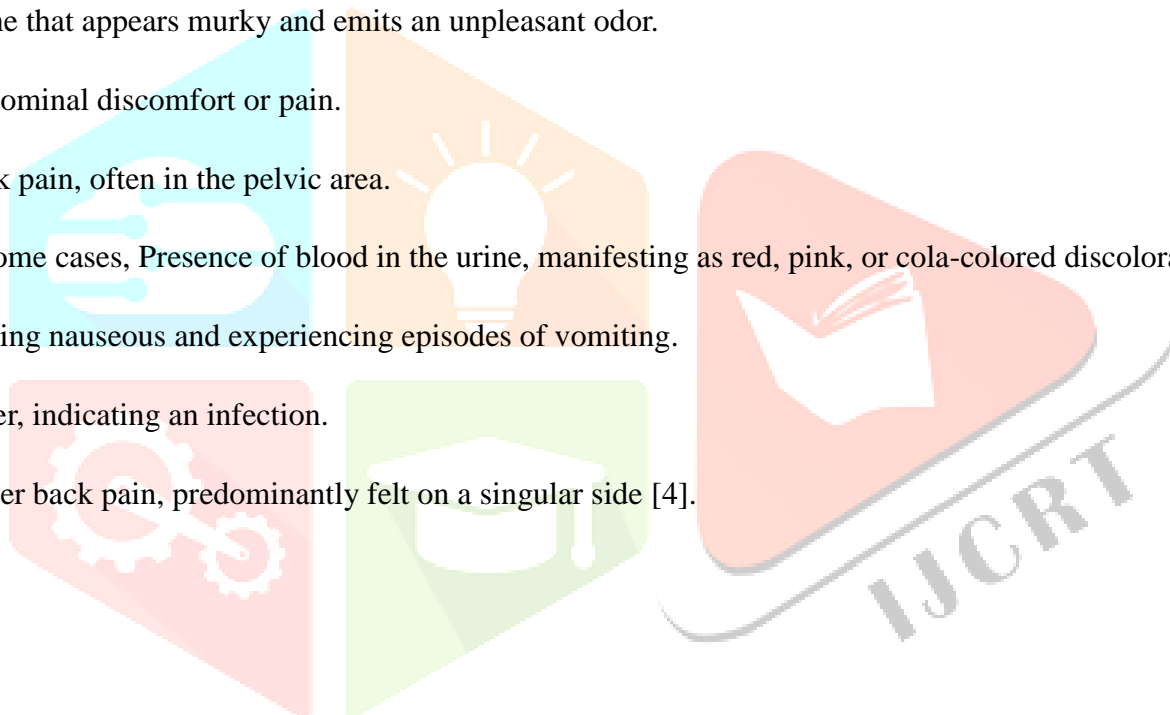
Prevalence in Females:

- High prevalence in females attributed to factors like close urethral-anal proximity, shorter urethra, sexual intercourse, incontinence, and poor toilet hygiene.

Symptoms of Urinary Tract Infections :

Some of among the widespread signs and symptoms are:

- Increased and persistent urination.
- Painful burning sensations during urination.
- Frequent urge to urinate.
- Reduced volume of urine during each event.
- Urine that appears murky and emits an unpleasant odor.
- Abdominal discomfort or pain.
- Back pain, often in the pelvic area.
- In some cases, Presence of blood in the urine, manifesting as red, pink, or cola-colored discoloration.
- Feeling nauseous and experiencing episodes of vomiting.
- Fever, indicating an infection.
- Upper back pain, predominantly felt on a singular side [4].



PLANTS USED IN URINARY TRACT INFECTION

Cranberry :



Figure 2 . Cranberry

Cranberry has been used in the treatment of urinary tract disease for centuries, and its antibacterial activity has long been present. It includes > 79.8% water, 10.2% carbohydrates (glucose and fructose) and other phytochemicals such as These compounds include terpenoids, anthocyanins, catechins, flavonoids organic acids such as, malic acid, quinic acid, citric acid along with a minor quantity of benzoic acid, ascorbic acid, and glucuronic acids. Due to the high urinary excretion of hippuric acid, it was thought that quinic It functions as a substance with antibacterial properties and also demonstrates the capacity to acidify urine[5]. Recently a number of reviews have evaluated the effectiveness of cranberry and D-mannose in preventing or treating UTIs.[1]

The use of various cranberry itames has assisted both younger and older women to prevent and protect against them. However, these compounds cannot be used for long periods of time because they may induce undesired effects such as increased body weight, gastrointestinal issues, and negative interactions with other medications. Clinical trials frequently presented challenges, and outcomes were suboptimal for individuals with complex urinary tract infections, while the use of blueberries Effectively averted the onset of acute cystitis in women at high risk.

Escherichia coli strains isolated from urine adhered to uroepithelial cells three times more effectively than E. coli obtained from alternative experimental origins such as feces, sputum or wounds. This suggests a distinct set of E. coli strains accountable for UTIs[19]. Volunteers who consumed a cranberry juice cocktail exhibited anti-adherence Potency against Gram negative bacteria obtained from urine and various medical origins. This impact was noticeable in the urine and urothelial cells gathered following the ingestion of the cocktail, highlighting its effectiveness in managing urinary tract infections[5]. The use of various cranberry items has Assisted both younger and older women to prevent and protect against them[20].

However, these compounds cannot be used for long periods of time because they may induce undesired effects such as increased body weight, gastrointestinal issues, and negative interactions with other medications[5]. Clinical trials frequently presented challenges, and outcomes were suboptimal for individuals with complex urinary tract infections (UTIs), while the use of blueberries effectively inhibited the onset of acute cystitis in women at a heightened risk. [21].

Cinnamom :



Figure 3 . Cinnamon

Cinnamon has antibacterial activity against bacteria causing UTI infectious[14]. It has a longstanding history of use in the medical field. Cinnamon oil, rich in cinnamyl acetate, alcohol, and cinnamom aldehyde, exhibits antibacterial properties. Additionally, its composition includes various volatile and aromatic components that disrupt typical protein pathways. For instance, cinnamom aldehyde disrupts the standard amino acid decarboxylase pathway, demonstrating antimicrobial effects[10] .

Chronic recurrent urinary tract infections (UTIs) were observed In individuals with urinary catheters, primarily caused by the development of biofilms through Multiple Drug Resistance (MDR) UroPathogenic Escherichia Coli (UPEC). The application of trans-cinnamaldehyde at varying concentrations (0%, 1%, 1.25%, or 1.5%) proved effective in inhibiting UPEC Formation of biofilms observed on both plate cultures and catheters that are in place. When incorporated into a catheter lock solution, trans-cinnamaldehyde successfully deactivated UPEC formation of biofilm on catheters. Importantly, These quantities showed no harmful effects on human bladder epithelial cells, indicating the potential application as a coating on catheter surfaces or in solutions used for catheter locks to obviate urinary tract infections[5]. Trans-cinnamaldehyde demonstrated a notable decrease in the Adherence and penetration of uroepithelial cells by UroPathogenic Escherichia Coli (UPEC) By inhibiting the activity of crucial genes associated with its attachment and penetration into host tissues. These results provide evidence endorsing the utilization of cinnamon as a natural solution for urinary tract infections (UTIs)[22].

Clove :

Figure 4. Clove

Clove, an aromatic dried flower bud, is recognized as a natural treatment source in Western countries and particularly favored in China. Its constituents, including gallic, ellagic, and oleanolic acids, myricetin, rhamnocitrin, and biflorin, along with essential oils such as cinnamaldehyde, eugenol, thymol, and carvacrol, provide a range of beneficial activities and antimicrobial properties. Numerous studies have confirmed that clove demonstrates strong antifungal, antiviral, and antibacterial effects by disrupting membrane function[5]. Eugenol, a key constituent of clove oil, displays an extensive variety of antimicrobial capabilities, targeting Gram positive and Gram negative bacteria, in addition to acid-fast bacteria, and also shows antifungal activity. The flavonoids in clove are crucial for numerous cellular protective actions, such as combating various inflammatory agents and species of free radicals[23].

Garlic :

Figure 5. Garlic

The antibacterial assessment of garlic's aqueous and ethanol extracts demonstrated notable potency against the tested organisms. The phytoconstituents of garlic, recognized for their antibacterial properties and extensively documented (Gibbons, 2010), were affirmed in this investigation. These constituents belong to various chemical classes, including glycosides, alkaloids, saponins, tannins, and flavonoids. Their collective presence in garlic manifested antibacterial activity, showcasing the synergy of bioactive compounds in inhibiting the tested uropathogens[24]. The responsiveness of uropathogens to garlic extracts observed in this study signals the therapeutic capabilities of garlic against the causative agents of UTI. Alkaloids were the most abundant phytochemicals present (7.2%), with tannin (4.5%), saponin (4.15%), flavonoids (2.15%), and glycoside (1.12%) following in quantity. [13].

The extract exhibited an extensive variety of effectiveness; the tested Gram negative and Gram positive bacteria were susceptible to both aqueous and methanol extracts of garlic at various concentrations. This finding aligns with the research conducted by Mukhtar et. al. (2001), which investigated the antibacterial properties of aqueous and methanol extracts of *Pistia stratiotes*[25].

Coconut water :



Figure 6. Coconut water

Coconut water stands out among fruit beverages due to its significant chloride content, deviating from the typical fruit profile. Unlike the assumption that potassium in beverages is accompanied by organic anions, coconut water primarily contains potassium chloride. This emphasizes the importance of directly measuring organic anions and pH to evaluate a beverage's alkali content[26].

For an optimal diet to reduce urinary stone risk factors, it is advisable to consume low-calorie, low-animal protein, low-sodium, and low-oxalate options, while emphasizing citrate and total alkali load. Coconut water, compared to grapefruit and orange juice, boasts 50% fewer calories and 60% less sugar. Although its citrate content is lower than in other citrus beverages, the substantial alkali load contributes significantly to its citraturic effect. Consequently, coconut water may be a superior choice for enhancing urinary citrate compared to lemon-based beverages[9].

This study, the first to assess coconut water's antilithogenic properties in humans, yields promising results. The exclusion of individuals with a history of nephrolithiasis aimed to discern if coconut water could alter urinary stone risk factors. Larger studies are necessary to determine if the citraturic effect of coconut water holds true for patients prone to calcium stone formation with hypocitraturia. Additionally, future research could explore potential significant differences in pH and calcium oxalate supersaturation between groups with

sufficient statistical power[9].

Table .1

COMMON NAME	SCIENTIFIC NAME	PART OF USE
Cranberry	<i>Vaccinium macrocarpon</i>	Fruits
Cinnamon	<i>Cinnamomum verum</i>	Bark
Clove	<i>Syzygium aromaticum</i>	Flower
Garlic	<i>Allium sativum</i>	Bulb
Coconut	<i>Cocos nucifera</i>	Fruits
Paperbark thorn	<i>Acacia sieberiana</i>	Bark and roots
Butterfly pea	<i>Clitoria ternatea</i>	Leaves
Bearberry	<i>Arctostaphylos uva-ursi</i>	Leaf
Cucumber	<i>cucumis sativus</i>	Seed
Touch-me-not	<i>Mimosa pudica</i>	Root, leaf
Mango	<i>Mangifera indica</i>	Branch

PRESENT SCENARIO OF URINARY TRACT INFECTION:

Urinary tract infections (UTIs) impose a substantial global health burden, impacting 150-250 million individuals annually, making them the prevalent infectious ailment and the primary ambulatory infection in humans. The lifetime occurrence is approximately 50-60% in women, 5-20% in men, and 5-8% in children[28].

In India, the prevalence of UTIs varies between 21.8% and 31.3%. According to a 2023 survey, the prevalence is reported at 33.54%, with women being affected in 66.78% of cases and men in 33.22%[7]. Out of 8,856 symptomatic UTIs subjected to microbiological culture and sensitivity testing, 27.2% exhibited significant pathological growth, comprising 92.1% bacterial growth and 7.81% fungal growth. Gram-negative bacteria constituted 85.01%, with *E. coli* being the most common isolate (57.42%), followed by *K. pneumoniae* (21.2%) and *Pseudomonas aeruginosa* (12.11%). Resistance to third generation cephalosporins was noted in 76.12% of *E. coli* and 71.61% of *K. pneumoniae*, while *P. aeruginosa* displayed the highest carbapenem resistance at 61.8%. Resistance to colistin has been identified in various strains, including *Enterobacter* spp. (15.1%), *Acinetobacter* spp. (9.11%), *K. pneumoniae* (7.7%), *E. coli* (6.8%), and *P. aeruginosa* (4.9%). Among Gram-positive isolates, 47.51% of *Staphylococcus aureus* were methicillin-resistant, and 3.71% exhibited vancomycin resistance, while 14.1% of *Enterococcus* spp. were vancomycin-resistant[8].

The Indian Council of Medical Research (ICMR) has set up a countrywide network known as the Antimicrobial Resistance Surveillance and Research Network (AMRSN) to monitor and conduct research on antimicrobial resistance across the nation[27], and the state of Madhya Pradesh has its State Action Plan on Antimicrobial Resistance (MPSAPCAR). This study, supported by ICMR-AMRSN and MPSAPCAR, aimed to delineate the antibiogram pattern of UTIs in secondary hospitals in central India[8].

AIIMS Bhopal, situated in Central India, is a distinguished Institute of National Importance (INI) and forms an integral component of the ICMR-AMRSN AIIMS Bhopal Sub-Network. It includes a Regional Antimicrobial Therapy Program (AMSP) with ten centers in smaller cities of Madhya Pradesh, carefully chosen based on the presence of onsite microbiology services laboratories and all-time microbiologists[8].

While UTIs are generally treatable with broad-spectrum antibiotics, the avoidance of fluoroquinolones, such as ciprofloxacin, is common due to perceived side effects outweighing benefits. Typical treatments comprise trimethoprim/sulfamethoxazole, ceftriaxone, fosfomycin, cephalixin, and nitrofurantoin. [4].

FUTURE PROSPECT :

Urinary tract infections prompt a substantial number of antibiotic prescriptions and are acknowledged as a significant driver of the proliferation of antimicrobial resistance[12]. Hence, The crucial objectives include discovering new drugs to combat antimicrobial resistance and expanding research efforts to explore alternative treatment approaches. A recent research by Söderström et al. represents the inaugural description of the dissemination and reproduction mechanisms of UPEC bacteria[29]. Employing a model involving human bladder cells, the researchers observed that in the course of the urinary tract infection cycle, UPECs undergo a transformation into elongated, spaghetti-like filaments, increasing their length several hundred times before ultimately adopting a rod-shaped configuration[12]. Uncovering the reasons for the bacterial transformation requires further research, yet this study has set the stage for identifying fresh therapeutic strategies for treating UTIs linked to UPECs. This is crucial, particularly since Uropathogenic Escherichia coli is accountable for almost 85% of UTIs[30]. Testing has been conducted on toxins and proteases from diverse uropathogens as potential candidates for preventing UTIs through vaccines, additional research is necessary to establish the effectiveness of the vaccines. Due to the dependence of uropathogens on an iron source for colonization, multiple siderophore systems have been investigated as potential targets for the development of vaccines. Findings indicate that these siderophore vaccines can diminish bacterial colonization in mice during bladder infection, making them valuable antigens for further scrutiny in upcoming studies[31]. Despite various studies on UTI prevention vaccines, only a limited number have been developed, and there are currently no effective vaccines against UTIs. A recent approach was introduced In research conducted by Wu and et al., the vaccine, in combination with an adjuvant, was directly introduced into the bladder to boost the attraction of cells that eliminate bacteria and prevent subsequent infections. In the realm of antibiotic development used in the management of UTIs, gepotidazine, tebipenem, and sulopenem stand out as promising candidates. Gepotidazine, as members of the pyranopyridine class, tebipenem and sulopenem selectively inhibit bacterial DNA replication., both oral carbapenems, are progressing through clinical development stages for managing complicated and uncomplicated urinary tract infections[12].

Herbal medicine: In recent years, there has been an increasing trend in the utilization of medicinal plants for preventing and treating a range of ailments[33]. Supplementary herbal treatment is an area of research that may deserve special attention. Combining antibiotics with medicinal plants primarily resulted in a synergistic impact on treatment[34]. In numerous research endeavors, herbal remedies can significantly diminish the development of bacterial resistance to antibiotics. Therefore, patients benefit from this type of treatment in many cases. Research indicates that herbal remedies can significantly contribute to the treatment of certain forms of urinary tract infections[32]. As multiple plant antimicrobial compounds possess distinct functional groups within their structure, the antimicrobial activity results from several mechanisms[33]. The chemical compounds present in herbal medicines have developed as a defense mechanism plants against pathogenic microorganisms and can Thus, they serve to prevent or treat infections in animals, and a considerable number of these compounds are excreted by the kidneys, making them

particularly useful as urinary antiseptics. The antimicrobial properties of these compounds are attributed to two primary mechanisms. Some of them eliminate microbes directly, and a portion prevent the attachment of microbes to epithelial cells[32]. These herbs play a crucial role in addressing urinary tract infections (UTIs).

The initiation and progression of the WHO Traditional Medicine Strategy for the years 2013-2023 were designed to facilitate the creation and execution of forward-looking policies and action plans. The objective is to enhance the contribution of traditional medicine to public healthy life. The emphasis of the strategy is as a priority on the development of novel healthcare systems (encompassing the incorporation of complementary and traditional medicines). Reassessing traditional medicines presents an appealing prospect opportunity to develop new therapies for the treatment of Infections caused by harmful microorganisms, Herbal remedies have been commonly used for centuries, and in certain instances, millennia. In addition, The historical application of certain cultures' traditional practices is well-documented. Traditional systems from Asia, the Middle East and Africa are perhaps the most widely documented, although many treatments have not yet been thoroughly researched and Confirmed, and further research is necessary in this domain.

CONCLUSION :

Urinary tract infections are highly prevalent infectious diseases worldwide; however, there is a noticeable lack of emphasis on the creation of new treatments for these infections. Antibiotics are the first-line treatment, but excessive use of antibiotics, highly resistant uropathogens.

The utilization of herbal remedies for preventing and treating recurrent urinary tract infections(UTIs) in females presents a promising alternative. Herbal medicines offer potential solutions to decrease the reliance on antibiotics for the treatment and prevention of recurrent UTIs in women. To gain a more comprehensive understanding, larger studies conducted under optimal conditions with clearly defined inclusion criteria, including the specific dose and type of natural product employed, as well as investigations into subgroups, are essential.

However, the implementation of efficient clinical trials and scientific validation will enhance the credibility of employing these traditional resources, ultimately aiding in the prevention of these prevalent yet troublesome ailments.

REFERENCES

1. Russ Chess-Williams a, Kylie Mansfield b , Betty Exintaris c , Iris Lim a , Donna Sellers a , Natural products for the treatment of urinary incontinence : (2023) 100714 , www.elsevier.com/locate/cont
2. Cathrina Geldard, Jessica Browne, Andrea Bugarcic, Herbal medicines for urinary tract infections – Global contemporary naturopathic herbal medicine practice and Balkan ethnopharmacology: 2020
3. Herman van Wietmarschena, , Noortje van Steenbergen , Esther van der Werf , Erik Baars , Effectiveness of herbal medicines to prevent and control symptoms of urinary tract infections and to reduce antibiotic use : (2022) 100892 , www.elsevier.com/locate/imr
4. Ian Cock , Nothando Mavuso, and Sandy Van Vuuren , A Review of Plant-Based Therapies for the Treatment of Urinary Tract Infections in Traditional Southern African Medicine : 2021, Article ID 7341124, <https://doi.org/10.1155/2021/7341124>
5. Sarita Das , Natural therapeutics for urinary tract infections : (2020) 6:64 , <https://doi.org/10.1186/s43094-020-00086-2>
6. Nisha Devi, Kanika Rani, Pushpa Kharb¹, and Minakshi Prasad , Herbal Medicine for Urinary Tract Infections with the Blazing Nanotechnology : (June 2021) 19002 , <https://www.researchgate.net/publication/35286405>
7. Christy John, Nithyananda Chowta, Sathish Rao , Antibiotic usage and susceptibility patterns in Uncomplicated UTI in a Tertiary Hospital in South India : 2023.07.02 (23292129) , <https://doi.org/10.1101/2023.07.02.23292129>
8. Apurva Vyas , T Karuna , Shweta Kumar , Ayush Gupta , Ananyan Sampath , Pramod Goel , Pankaj Shukla, Vivek Mishra , Sandeep Sharma , Sourabh Chakraborty, Shree Prakash Jaiswal, Abhi Mishra, Apoorwa Gupta, Manisa Sahu, Shreshtha Tiwari, Anisa Pal, Manish Nagendra, Harish Gautam, Kamlesh Patel, Shruti Asati, Mukul Nema, Sagar Khadanga , Antimicrobial Resistance Trends in Urinary Tract Infection at Secondary Care Centres in Central India: Carbapenem Resistance Crossing 20% in Community : 28 September 2023 , www.doi.org/10.29011/2577-1515.100235
9. Roshan M. Patel , Pengbo Jiang, John Asplin, Ignacio Granja, Taylor Capretz, Kathryn Osann,³ Zhamshid Okhunov, Jaime Landman, and Ralph V. Clayman , Coconut Water: An Unexpected Source of Urinary Citrate : 1 November 2018 (3061742) , <https://doi.org/10.1155/2018/3061742>
10. Sumaira Noreen , Bilal Aslam , Zunaira Alina , Ramsha Abbas , Muhammad Shiraz Aslam , Hira Ijaz , Ambreen Mehmood Awan , Shahneel Kousar, Abida Niazi and Faiza Naseer , Antibacterial Activity of Medicinal Plants (Clove, Cinnamon, Garlic) Extracts and their Combined Effect with Antibiotics in Urinary Tract Infection Caused by Escherichia coli : 29 June 2018 , <http://ijpp.edwiserinternational.com>
11. Deepjyoti Paul , Nimmy Anto , Mohit Bhardwaj, Alison Prendiville, Ravikrishnan Elangovan , Till T. Bachmann , Debadatta Dhar Chanda and Amitabha Bhattacharjee , Antimicrobial resistance in patients with suspected urinary tract infections in primary care in Assam, India : 24 September 2021 , <https://doi.org/10.1093/jacamr/dlab164>

12. Giuseppe Mancuso , Angelina Midiri, Elisabetta Gerace, Maria Marra, Sebastiana Zummo, and Carmelo Biondo , Urinary Tract Infections: The Current Scenario and Future Prospects : 2023 Apr; 12(4): 623, doi: 10.3390/pathogens12040623
13. Okunye Olufemi Lionel, Idowu Philip Adegboyega, Adeleke O. Ezekiel , Babalola Caroline Olufunke , Antimicrobial Activity of Garlic (*Allium sativum*) on Selected Uropathogens from Cases of Urinary Tract Infection : 31-12-20 (10.4103) , www.atpjjournal.org
14. Masoud Dadashi , Gita Eslami , Hossein Goudarzi, Fatemeh Fallah, Hossein Dabiri, Ali Hashemi, Najmeh Ardeslari , Mohammad Javad Nasiri : Evaluation of Antibacterial Effects of Cinnamon Extract and Essence on Bacteria Isolated from Patients with Urinary Tract Infection , (2015) 523-527 <https://www.researchgate.net/publication/356788697>
15. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nat Rev Microbiol*. 2015;13(5):269-84
16. WHO priority pathogens list for R&D of new antibiotics. Geneva, Switzerland: World Health Organization; 2017.
17. C. W. Tan and M. P. Chlebicki, "Urinary tract infections in adults," *Singapore Medical Journal*, vol. 57, no. 9, pp. 485–490, 2016.
18. R. Ebana, U. Edet, U. Ekanemesang, C. Etok, G. Ikon, and M. Noble, "Phytochemical screening and antimicrobial activity of three medicinal plants against urinary tract infection pathogens," *Asian Journal of Medicine and Health*, vol. 1, no. 2, pp. 1–7, 2016.
19. Schmidt DR, Sobota AE (1988) An examination of the anti-adherence activity of cranberry juice on urinary and nonurinary bacterial isolates. *Microbios* 55(224-225)
20. Shmueli H, Ofek I, Weiss EI, Ronen Z, Hourri-Haddad Y (2012) Cranberry components for the therapy of infectious disease. *Curr Opin Biotechnol* 23(2) .
21. Cimolai N, Cimolai T (2007) The cranberry and the urinary tract. *Eur J Clin Microbiol Infect Dis* 26(11)
22. Amalaradjou MA, Narayanan A, Venkitanarayanan K (2011) Transcinnamaldehyde decreases attachment and invasion of uropathogenic *Escherichia coli* in urinary tract epithelial cells by modulating virulence gene expression. *J Urol* 185(4)
23. Chaieb K, Hajlaoui H, Zmantar T. The chemical composition and biological activity of essential oil, *Eugenia cryophyllata* (*Syzygium aromaticum* L. Myrtaceae): A short review. *Phytother Res* 2007;
24. Gibbons S. An overview of plant extracts as a potential therapeutics. *Expert Opin Ther Pat* 2003
25. Mukhtar MD, Tukur, A. Antibacterial activities of aqueous and ethanol extracts of *Pistia* sp. *Nigerian Soc Environ Biol* 2001;1:51.
26. S. G. Kof, E. L. Paquette, J. Cullen, K. K. Gancarczyk, P. R. Tucciarone, and N. S. Schenkman, "Comparison Between Lemonade and Potassium Citrate and Impact on Urine pH and 24-Hour Urine Parameters in Patients with Kidney Stone Formation," *Urology*, vol. 69, no. 6, pp. 1013–1016, 2007
27. . Walia K, Ohri VC, Mathai D (2015) Antimicrobial stewardship programme (AMSP) practices in India. *Indian J Med Res* 142

28. Pritam Pardeshi , Prevalence of urinary tract infections and current scenario of antibiotic susceptibility pattern of bacteria causing UTI : 2018, doi 10.18231/2394-5478.2018.0070
29. Soderstrom B., Pittorino M.J., Daley D.O., Duggin I.G. Assembly dynamics of FtsZ and DamX during infection-related filamentation and division in uropathogenic E. coli. *Nat. Commun.* 2022;13:3648. doi: 10.1038/s41467-022-31378-1
30. Shah C., Baral R., Bartaula B., Shrestha L.B. Virulence factors of uropathogenic Escherichia coli (UPEC) and correlation with antimicrobial resistance. *BMC Microbiol.* 2019;19:204. doi: 10.1186/s12866-019-1587-3.
31. Mike L.A., Smith S.N., Sumner C.A., Eaton K.A., Mobley H.L. Siderophore vaccine conjugates protect against uropathogenic Escherichia coli urinary tract infection. *Proc. Natl. Acad. Sci. USA.* 2016;113:13468–13473. doi: 10.1073/pnas.1606324113
32. Bibi Sedigheh Fazly Bazzaz^{1,2}, Sareh Darvishi Fork³ , Reza Ahmadi⁴ and Bahman Khameneh , Deep insights into urinary tract infections and efective natural remedies : (2021) 27:6 <https://doi.org/10.1186/s12301-020-00111-z>
33. Khameneh B, Iranshahy M, Soheili V, Fazly Bazzaz BS (2019) Review on plant antimicrobials: a mechanistic viewpoint. *Antimicrob Resist Infect Control* 8:118
34. Khameneh B, Iranshahy M, Vahdati-Mashhadian N, Sahebkar A, Fazly Bazzaz BS (2019) Non-antibiotic adjunctive therapy: a promising approach to fight tuberculosis. *Pharmacol Res* 146:104289