



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPA)**

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

MOLECULAR CHARACTERISATION OF ANTIMICROBIAL RESISTANCE AND VIRULENCE GENES AMONG *ESCHERICHIA COLI* ISOLATED FROM URINARY TRACT INFECTION FOR BIOMEDICAL APPLICATIONS

HARIKA DEVI M^{1*}, PRASAD M², ANNI CLIYONA N³ AND MUBEEN B⁴

1: Assistant professor (PTL) in VCIW (Veeranari Chakali Iamma Women's university),
Department of Health Science, Koti, Hyderabad-500 095, Telangana State, India

2: Associate Professor Department of Pharmacy Practice Anurag Pharmacy College
Ananthagiri Kodad, Koti, Hyderabad-500 095, Telangana State, India

3: Assistant Professor (PTL) in VCIW (Veeranari Chakali Iamma Women's University),
Department of Health Sciences, Koti, Hyderabad-500 095, Telangana State, India

4: Assistant Professor (PTL) in VCIW (Veeranari Chakali Iamma Women's University),
Department of Genetics & Biotechnology, Koti, Hyderabad-500 095, Telangana State,
India

***Corresponding Author: Dr. Manubolu Harika Devi: E Mail: hariharika00@gmail.com**

Received 25th June 2025; Revised 6th Aug. 2025; Accepted 26th Oct. 2025; Available online 1st Sept. 2026

<https://doi.org/10.31032/IJBPA/2026/15.9.10145>

ABSTRACT

Urinary Tract Infection (UTI) is a frequent illness in humans that affects any part of the urinary tract, including the kidney, ureter, urinary bladder, and urethra. UTI can be brought on by fungi, parasites, and viruses, but bacteria are to be blamed in 95% of the instances. *E. coli* causes 80-90% of all urinary infections it is in charge of the majority of cases of urinary tract infections. Instead of antibiotics Natural substances isolated from spices and herbs, Microorganisms, especially actino bacteria, are of great interest because they produce an abundance of antibiotics and other secondary metabolites that are helpful in the industry. The efficacy of the combination of two spice extracts, viz., *Syzygium aromaticum* and

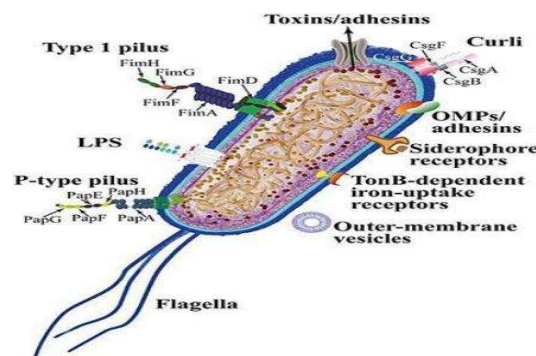
Trachyspermum ammi against UPEC for antimicrobial activity. Two marine fishes source namely *Engraulis* sp. And *Trachurus trachurus* were selected for the study. As a therapeutic approach co-culture method was also performed to enhance the anti-bacterial activity of fish gut-associated actino bacteria which showed a promising result. The aim of current research about to reduce the prolong usage of antimicrobial resistance, negative side effects in patients by choosing natural medicinal plant and marine sources instead of synthetic drugs.

Keywords: Anti-Microbial Resistance, Virulence Genes, *Escherichia coli*

INTRODUCTION:

Humans frequently contract urinary tract infections (UTIs), which can affect any part of the urinary tract, including the urethra, urinary bladder, ureter, and kidneys. causes inflammatory reaction of urothelial lining to the invasion of bacteria in conjunction with pyuria and bacteriuria [1-3]. It is only surpassed by upper respiratory tract infections when it comes to the number of cases that are recorded each year, which range from 150 to 250 million. UTI can develop in both settings, Community Associated UTIs (CAUTIs) and Hospital Associated UTIs (HAUTIs). Women are much more likely than males to get urinary tract infections (UTIs), which account for at least 8 million annual visits to different types of healthcare institutions in the United States [4-6]. The majority of these infections are cystitis, or bladder infections There is a higher likelihood of women who have had their first UTI caused by *E.coli*. Pathogenic microorganisms originating from vaginal or perineal region gain access to the urinary tract through the urethra, subsequently in

filtration the bladder in a process known as ascending infection. It can ascend to the kidneys from the bladder via the ureters [7]. Due to their shorter urethra, women are more likely to develop ascending infection. The presence of perineal soiling, utilisation of urinary catheters.

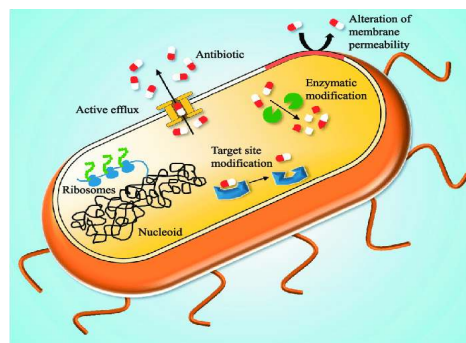


Virulence factors of uropathogenic *E. coli*.

The administration of spermicidal drugs by female patients all contribute to the exacerbation of this particular route's augmentation The majority of cases of pyelonephritis are caused by bacteria moving from the bladder, via the ureter, and into the renal pelvis. Conditions like

pregnancy and ureteral blockage, which limit ureteral peristalsis, facilitate bacterial ascent UPEC possesses an array of virulence factors that enable it to colonise, invade, and persist within the urinary tract. These virulence factors include adhesion, toxin generation, and iron sequestering mechanism The type 1 fimbriae, the most prevalent virulence factor of UPEC, are encoded by the *fimH* gene. It promotes adhesion, host tissue invasion, and the development of biofilms [8-9]. I the l ps the pathogen survive the mechanical stress in the urinary system by forming an extremely strong attachment with the urothelial cells The pyelonephritis associated pili known as P fimbriae, which are synthesized by the *papA-K* gene operon, facilitate the attachment of pathogens to mCytolysin A is a virulent toxin that is responsible for the apoptosis of the host cells ucosal epithelium and tissue matrix, Secreted auto transporter toxin (SAT) is a serine protease auto transporter [10-11]. It is commonly associated with pyelonephritis and exhibits toxic activity against kidney and bladder cell lines. Antibiotic degradation or modification, target modifications (target replacement, enzymatic alterations, mutations, protection, bypass, or overproduction), and reduced antibiotic accumulation due to decreased permeability and/or increased efflux are the typical causes

of antibiotic resistance [12].



The mechanisms of antibiotic resistance in bacteria. Bacteria employ four primary mechanisms to attain multi drug resistance.

Modification of antibiotics

One of the most efficacious strategies employed by bacteria to counteract the effects of antibiotics involves the production of enzymes that possess the capability to either destroy the molecular structure of the antibiotic or render it inactive by the addition of specific chemical moieties. This enzymatic activity hinders the antibiotic's ability to interact with its designated target, hence impeding its efficacy.

Enzymes that possess the ability to introduce chemical moieties exhibit acetylation (amino glycosides, streptogramins chloramphenicol phosphorylation (chloramphenicol, amino glycosides), and adenylation (lincosamides, amino glycosides) mechanisms on antibiotic molecules. The covalent modification of amino glycoside molecules by amino glycoside modifying enzymes (AMEs),

which involves altering the hydroxyl or amino groups, represents a prominent instance of drug resistance by modification. The breakdown of β -lactam molecules by β -lactamases is the main mechanism responsible for β -lactam resistance. These enzymes hydrolyze the amide link within the β -lactam ring, hence rendering the antibiotic ineffective. Bacterial efflux pumps play a crucial role in the intrinsic resistance of Gram-negative bacteria by aggressively expelling several antibiotics from the cell. The majority of bacteria possess a diverse array of efflux pumps. The five primary efflux pump families include the ATP-binding cassette (ABC) family, the multi drug and toxic compound extrusion (MATE) family, the small multidrug resistance (SMR) family, The first line of defence for treating UTIs is an antibiotic. Both in households and in hospitals, many semi-synthetic antibiotics are widely used to treat UTIs. This results in another issue, namely pathogen antibiotic resistance. As a result, the cost of therapy significantly increased, placing enormous economic pressure on all economies, but particularly those of developing nations. Alternative medicines are unrefined pharmaceuticals of plant or animal origin used to cure medical conditions. It refers to any types of medicine that do not fit into the conventional medical model. Based on several medical systems,

including Ayurveda, Homeopathy, Siddha, and Unani, the knowledge of alternative medicine has been amassed over many years. the resistance-nodulation cell division (RND) family, and the massive facilitator super family (MFS).

Resistance to β lactam antibiotics Gram-negative bacilli employ many defensive strategies against Beta-lactam antibiotics, including the development of TEM- and AmpC β -lactamases, efflux mechanisms, porin deficiency, and, more recently, extended-spectrum β -lactamases (ESBL). ESBLs are β -lactamases that hydrolyze oxyimino-cephalosporins and are blocked by β -lactamase inhibitors. Recently, natural substances isolated from spices and herbs have drawn significant interest for their therapeutic and nutritional properties. Due to the antioxidant properties, these organic compounds are regarded to be harmless for intake by humans and easily biodegradable, *Syzygium aromaticum* (Clove) is a rich source of bioactive substances with promise for use as both antioxidants and antimicrobials, *Trachyspermum ammi*, of ten known as a jwainorthymol seeds, is a plant that may be found in Asian nations like India and whose seeds are frequently used as spices. The essential oils of these spices with antibacterial activity contain a high concentration of phenolic compounds, such as carvacrol, eugenol, and thymol, which

induce changes in the cell membrane

Fish gut microbiota as a source of novel antibiotics According to research reports to date, a wide number of microbes have been

found in fish guts, especially actinobacteria, which are particularly capable of creating novel bio active secondary metabolites.

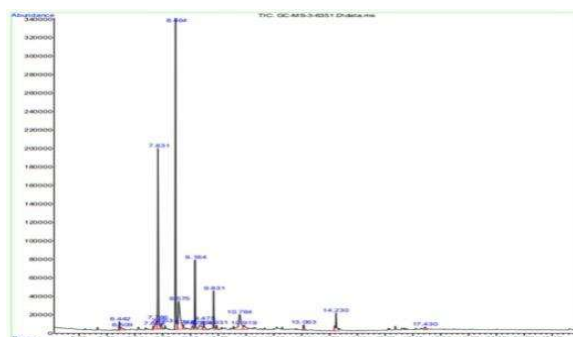
RESULTS

Age groups	Gender		Total no.
	male	female	
<10	16	19	35
10-20	3	8	11
21-40	7	45	52
41-60	10	18	28
>60	19	30	49
total	55	120	175

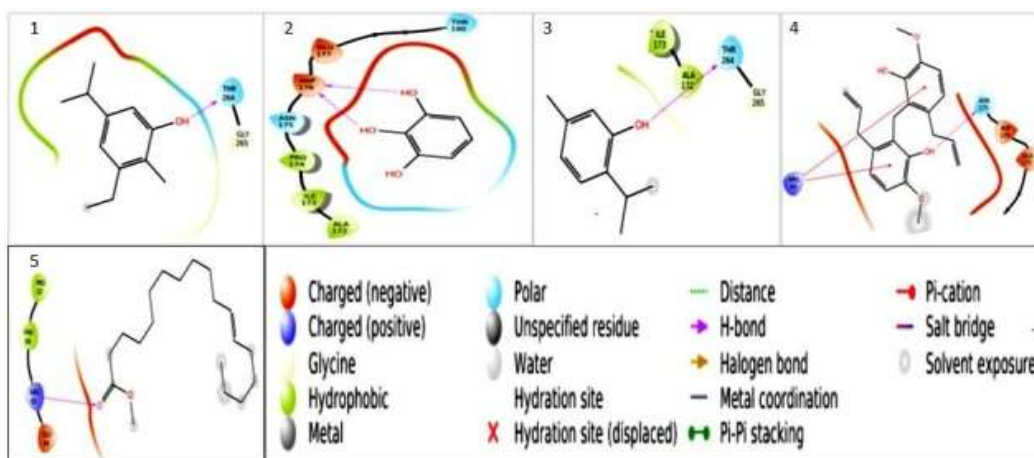
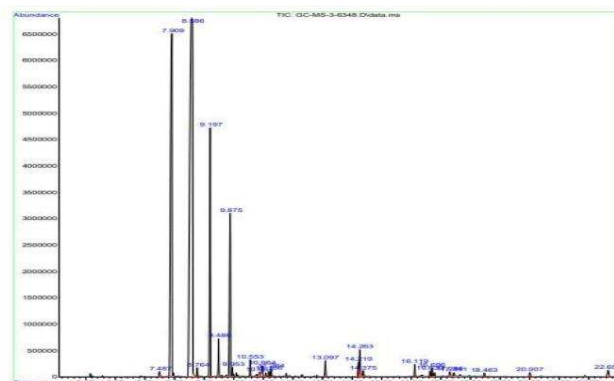
Antibiotic	Total <i>E. coli</i> . Isolates		
	Susceptible%	Intermediate%	Resistant no.
gentamycin	140(80)	6(3.42)	29(14.85)
imipenam	130(74.28%)	8(4.57)	37(21.14)
norfloxacin	146(83.42)	4(2.28)	25(14.28)
nitrofurantoin	116(66.28%)	2(1.14)	57(32)
colistin	175(100)	0(0)	0(0)
trimethoprim	106(60.57)	4(2.28)	65(37.14)

Qualitative analysis of phyto constituents found in the aqueous and ethanolic extracts of *S.aromaticum* and *T.ammimixture*

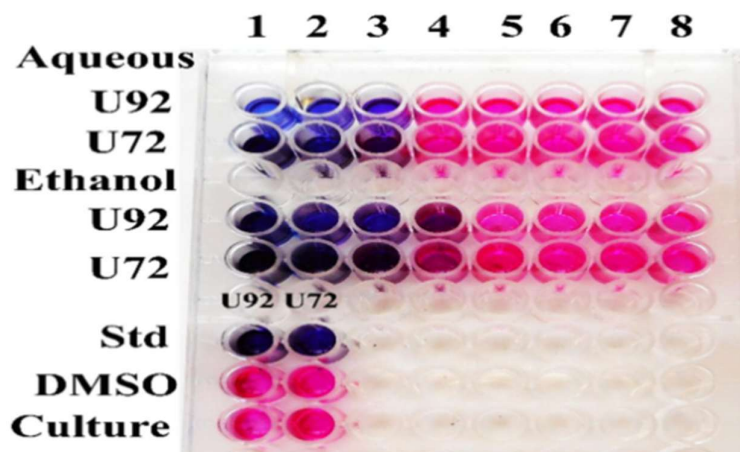
CONTENTS	AQUEOUS	ETHANOL
TANNINS	+	+
SAPONINS	+	+
FLAVONOIDS	+	+
ALKALOIDS	+	+
PROTEINS	+	+
STEROIDS	+	+
QUINONES	+	+
TERPENOIDES	+	+
PHENOLS	+	+
CARDIAC GLYCOSIDES	-	+

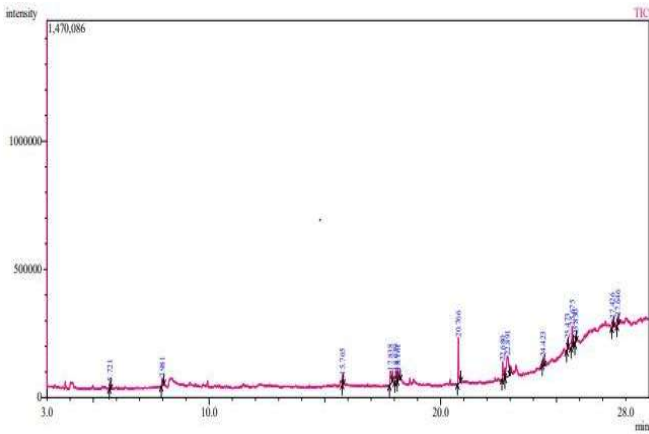


Chromatogram of aqueous extract of spices

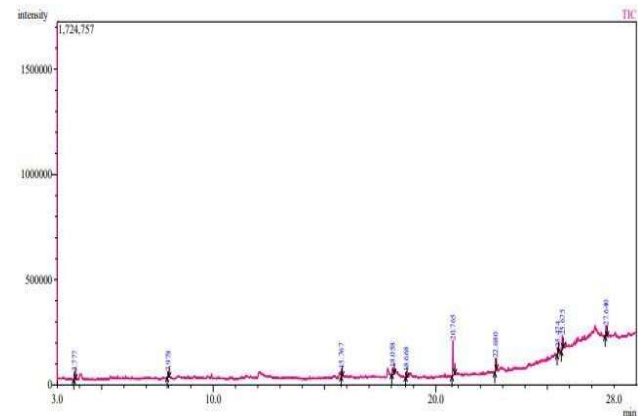


DETERMINATION OF MINIMUM, INHIBITORY CONCENTRATIONS



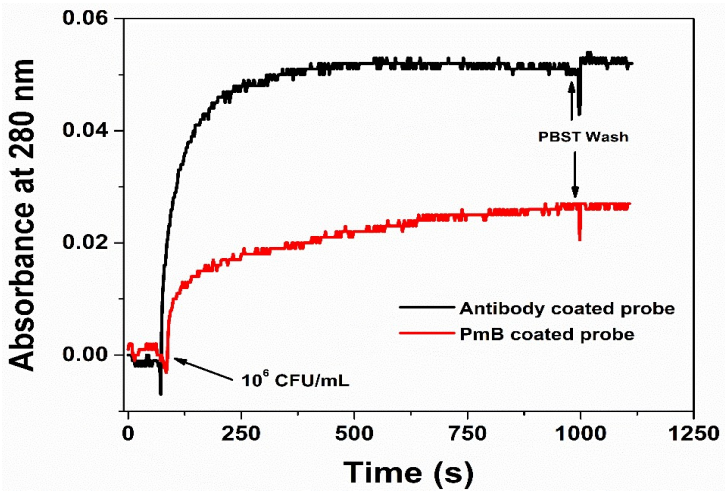


GC-MS spectra of cell-free culture supernatant of SqA4 culture



GC-MS spectra of cell-free culture supernatant of SqA4 live *E. coli*

DETECTION OF *E. COLI* FROM UTI SAMPLES



DISCUSSION

Since UTI is one of the most of ten diagnosed conditions in clinical and hospital settings, better detection and therapy could have a significant influence on patient quality of life. Determining the microbiological origin of the UTI upfront would help to prevent the issues brought on by delayed diagnosis by culture and sensitivity, since quick diagnosis would lessen the duration of persistent UTI symptoms brought on by the in effective treatment of resistant uro pathogens. In cases of recurrent UTI and UTIs brought on by ESBL-producing *E. coli* strains, rapid identification and antibiotic susceptibility testing boosted the use of precise, narrow-spectrum antibiotics. [13] developed aU-bent polymer optical fiber (POF) for *E. coli* detection by measuring the refractive index of peptone water containing different concentrations of *E. coli*. [14] developed an evanescent wave absorbance-based fiber optic biosensor for label free detection of *E. coli* at a wavelength of 280 nm.

REFERENCES

- [1] Foxman B. Urinary tract infection syndrome occurrence, recurrence, bacteriology, risk factors, and disease burden. *sInfectious Disease Clinics*, 2014;28:1–13.
- [2] Yang X, Chen H, Zheng Y, Qu S, Wang H, *et al.* Disease burden and long-term trends of urinary tract

infections a worldwide report. *Front Public Health*.2022;10:888205.

- [3] Sussman M. Urinary tract infections a clinical overview. *Molecular Medica; Microbiology*. 2002;1507–1513.
- [4] Gupta K, Stamm WE. Outcomes associated with trimethoprim/sulphamethoxazole (TMP/SMX) therapy in TMP/SMX resistant community-acquired UTI. *International Journal of Antimicrobial Agents*. 2002;19:554–556.
- [5] Vasudevan R. Urinary tract infection an overview of the infection and the associated risk factors. *JMEN* . 2014;1.
- [6] Paumier A, Asquier-Khati A, Thibaut S, Coeffic T, Lemenand O, *et al.* Assessment of factors associated with community-acquired extended-spectrum β -lactamase-producing *Escherichia coli* urinary tract infections in France. *JAMA Network Open*. 2022;5:
- [7] Suresh, A.; Ranjan, A.; Patil, S.; Hussain, A.; Shaik, S.; Alam, M.; Baddam, R.; Lothar, W.; Ahmed, N. Molecular genetic and functional analysis of pks-harboring, extra-intestinal pathogenic *Escherichia coli* from India. *Front. Microbiol.* **2018**, 9, 2631.

-
- [8] 8.Andriana Y, Xuan TD, Quy TN, Tran HD and Le QT (2019). Biological activities and chemical constituents of essential oils from Piper cubebaBojer and Piper nigrum L. *Molecules*, 24(10): 1876.
- [9] Traditional uses of medicinal plants reported by the indigenous communities and local herbal practitioners of Bajaur Agency, Federally Administrated Tribal Areas, Pakistan. *J. Ethnopharmacol.*, 198(2017): 268
- [10] Srinivasan D, Nathan S, Suresh T and Perumalsamy PL (2001). Antimicrobial activity of certain Indian medicinal plants used in folkloric medicine. *J. Ethnopharmacol.*, 74(3): 217-220.
- [11] Tandogdu Z and Wagenlehner FM. Global epidemiology of urinary tract infections. *Curr. Opin. Infect. Diseases*, 29(1): 73-79.
- [12] Ullah A, Shah SRH, Almugadam BS and Sadiqui S Prevalence of symptomatic urinary tract infections and antimicrobial susceptibility patterns of isolated uropathogens in Kohat region of Pakistan. *Moj. Biol. Med.*, 3(3): 85-89.
- [13] Yattoo M, Gopalakrishnan A, Saxena A, Parray OR, Tufani NA, Chakraborty S, Tiwari R, Dhama K and Iqbal H. Anti-inflammatory drugs and herbs with special emphasis on herbal medicines for countering inflammatory diseases and disorders-a review. *Recent Patient Inflammatory Allergy Drug Discovery.*, journal of pharmaceutical sciences12(1): 39-58.
- [14] Pak. Journal of Pharmaceutical Sciences, Vol.34, No.3(Suppl), May 2021, pp.