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Antibacterial Effect of Allium Sativum and Zingiber Officinale Extracts on Some Urinary Tract Infection Causing Bacteria

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Abstract: Urinary tract infections (UTIs) are an age old problem in the human civilization. UTIs are generally caused by several pathogens, amongst them the most commons are *Candida albicans*, *Enterococcus faecalis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Staphylococcus saprophyticus*. UTI pathogens are gradually becoming drug resistant for the indiscriminate use of synthetic drug and also for self medication. A number of medicinal plants may have potential effect on this disease. The present study was carried out to investigate the antibacterial activities of two medicinal plants viz. *Allium sativum*, *Zingiber officinale* against three UTI causing bacteria such as *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*. The antimicrobial activity of the plant extracts were carried out by agar well diffusion assay. The study indicated that the diameter of inhibition zones (DIZ) ranging from 9 to 29 mm with the highest zone observed against *E. coli* of *Z. officinale* and *A. Sativum*. Preliminary phytochemical analysis of the plant parts showed the presence of active compounds such as phenolics, steriods, alkaloids, glycosides, and flavonoids. This study clearly indicated that there are some human edible plants in the worlds, having antimicrobial properties nearly similar to that of the market available drug.

Key words: Antibacterial activity; Diameter of inhibition zones; Phytochemicals; Urinary Tract Infection

I. INTRODUCTION

Urinary tract infections (UTIs), accounting for 25% of all infections^[1], are caused by a range of pathogens, most commons are *Candida albicans*, *Enterococcus faecalis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Staphylococcus saprophyticus*^[2-5]. UTIs are commonly caused by the bacteria which enter through the urethra^[6]. UTIs commonly develop in the bladder and spread to renal tissues^[6]. This can occur in any part of the urinary tract such as bladder, kidney, ureters, and urethra^[6]. UTIs affect nearly 150 million people each year worldwide and cost the global economy in more than 6 billion US dollars.^[7] UTIs can occur in any populations and in any age groups but more prevalent among the females of reproductive age group.^[1,8] some recent study reported that 40-50% women suffer at least one clinical episode during their lifetime.^[9] The risk factors of UTIs are personal hygiene, lower socio economic status, increased parity, increased age, sickle cell trait and anaemia, lack of prenatal care, diabetes mellitus and the functional urinary tract abnormalities.^[10,11] It is responsible for poor self-esteem, impaired quality-of-life, social isolation, and depression.^[12,13]

Up till now, there are so many antimicrobial agents that have beneficial role on UTIs. However, most of them cause different adverse effects and therefore, much attention has been paid to the search for effective therapeutic agents with negligible adverse effects.^[6] Moreover, most of the isolated UTI pathogens are now resistant to most of the commonly used antibiotics especially the ampicillin, amoxicillin, cotrimoxazole, amoxicillin-clavulinate, floxacillin because of unwarranted use.^[14,15] Drug resistance among gram-negative pathogens is a risk factor for inappropriate empiric treatment (IET), which in turn increases the risk for mortality.^[16]

So, there is some urgent need to restrict the unnecessary use of antibiotics and also to search out some new drugs which are inexpensive, non-invasive and side-effect less. In this regard, the traditional medicines are the best alternatives, as these medicines are used from the time of immemorial with same efficacy.^[17-19] The antimicrobial efficacy of some plants for the treatment of UTIs has been beyond belief. The plants bio-constituents have been a good source of antimicrobial agents but still many of the plant species remained unexplored. A recent study reported that there are nearly 500,000 plant species in the world, of which only 1% has been phytochemically investigated.^[20]

Keeping this in view, the present study was initiated with an aim to study the antibacterial effect of *Allium sativum* and *Zingiber officinale* extracts on some urinary tract infection causing bacteria.

II. MATERIALS AND METHODS

A. Plant Materials

Allium sativum L. (rhizome) and *Zingiber officinale* Roscoe (rhizome), commonly human edible medicinal plants, were used in this study. The plants used in this study were taxonomically identified in the Dept. of Botany, Raja N.L. Khan Women's College, Midnapore, West Bengal.

B. Preparation of Plant Extract

The collected plant materials were rinsed with sterile distilled water and kept at an incubator for 24h. The plant materials were dried (air-dry) and powdered by grinder by maintaining the standard protocol.^[21] 60 g of dried powder of each plant parts were taken and mixed separately with water and ethanol solvent respectively in 1:5 ratio. The extraction procedure was carried out in a Rotary Shaker at 37°C for 24 h. Then the extracts were filtered using Whatman No. 1 filter paper. The extracts were concentrated to dryness by a rotary evaporator at 50°C and those are kept at 4°C for drying.

C. Bacterial Strains

Three UTI causing bacterial strains (*Escherichia coli* [MTCC No. 40], *Staphylococcus aureus* [MTCC No. 3160] and *Pseudomonas aeruginosa* [MTCC No. 424]), collected from IMTECH, Chandigarh, were used in this study. All the microorganisms were incubated into Mueller-Hinton broth for 24 h at 37°C. All the cultures were kept at 4°C until further use.

D. In Vitro Antibacterial Assay by Agar Well Diffusion Method

Bacterial suspensions were spread on the Mueller-Hinton agar (MHA) plates. The wells were cut on the agar plates using a sterile cork borer. The extracts were poured into the well. To compare the antibacterial potentiality with the plant extracts, one standard antibiotic (Chloramphenicol) was used against three UTI causing bacteria.^[22] The plates were incubated at 37°C for 24 h. The diameter of inhibition zones (DIZ) were measured (in mm) and recorded.^[21]

E. Phytochemical Analysis

The phytochemicals (viz. phenolics, alkaloids, flavonoids, tannins, saponins, steroids and glycosides) present in the plant extracts were determined by following standard methods described by Harborne^[23] and Kolkate et al.^[24]

III. RESULTS

Fig 1 shows the antibacterial activity of aqueous and ethanol extract of *Z. officinale*, *A. Sativum*, against three UTI causing bacteria (viz. *E. coli*, *S. aureus*, *P. aeruginosa*). The study indicated that the DIZ ranging from 9 to 29 mm with the highest zone observed against *E. coli* of *Z. officinale* and *A. Sativum* (Fig - 1). It was also noted that this plant is highly effective in the case of *S. aureus*, but no such effectiveness was observed in the cases of *P. aeruginosa*. Phytochemical studies revealed that alkaloids, steroids, glycosides are present in these selected plants (Table 1).

IV. DISCUSSION

Medicinal plants have been used for traditional treatments of numerous human diseases from ancient to modern times.^[25] Even herbal medicines were used 60,000 years back by Neanderthal man.^[26] But, it has lost its importance in twentieth century because of the advent of modern synthetic treatments.^[27] Recently, multiple drug resistance in both human as well as plant pathogens has been developed due to improper use of synthetic drugs.^[28] To combat the diminishing efficacy of existing antibiotics a diverse arsenal of new antibacterial agents is essentially required.^[29] According to World Health Organization, medicinal plants would be the best source to obtain variety of drugs.^[30] Clinical microbiologists have great interest in screening of medicinal plants for new

therapeutics.^[31] All pharmaceutical industries are now searching for medicinal plants contain some organic bio-active molecules including tannins, alkaloids, carbohydrates, terpenoids, steroids, flavonoids, phenols etc.^[32]

In the present study aqueous and ethanolic plant extracts was exhibited antibacterial activity towards all UTI pathogens, with more activity observed with ethanolic extracts. Ethanol extracts may have the potential role of extracting plant biomolecules that are actually responsible for higher antimicrobial activity than the aqueous one.^[33] Phytochemicals exert this antimicrobial activity through different mechanisms, like act by iron deprivation, hydrogen bonding or non-specific interactions with vital proteins such as enzymes.^[34] Sawyer et al.^[35] demonstrated that the main indoloquinoline alkaloid, cryptolepine, causes cell lysis and morphological changes of *S. aureus*, but the antimicrobial effects of the alkaloid may be through another mechanism, since the compound is known to be a DNA intercalator and an inhibitor of DNA synthesis through topoisomerase inhibition.

V. CONCLUSION

UTIs are an age old problem in the human civilization. UTI pathogens are gradually becoming drug resistant for the indiscriminate use of synthetic drug and also for self medication. The situation becomes worse and phytomedicines are considered to the best useful alternatives. It has low/no side effects, low cost, easily available and used from the time of immemorial with same efficacy. But the young generation has less knowledgeable about the indigenous medicine and this knowledge is going to be lost with the aged people who got this knowledge from their forefathers.

There are some human edible plants in the worlds, having antimicrobial properties nearly similar to that of the market available laboratory use drug. The presence of phytochemicals including phenols, tannins and flavonoids may be responsible for the antibacterial activity. These are the products of secondary metabolism of the plant. The secondary metabolism of the plant can vary considerably depending on factors such as: seasonality, temperature, water availability, UV radiation, nutrients, altitude, air pollution and even induction by mechanic stimuli or attack by pathogens. Further more there are a strict procedure while collecting the plant or plant materials for the phytomedicine as the phytochemicals are altered with the times, age of the plant and diurnal variation. A proper awareness is needed.

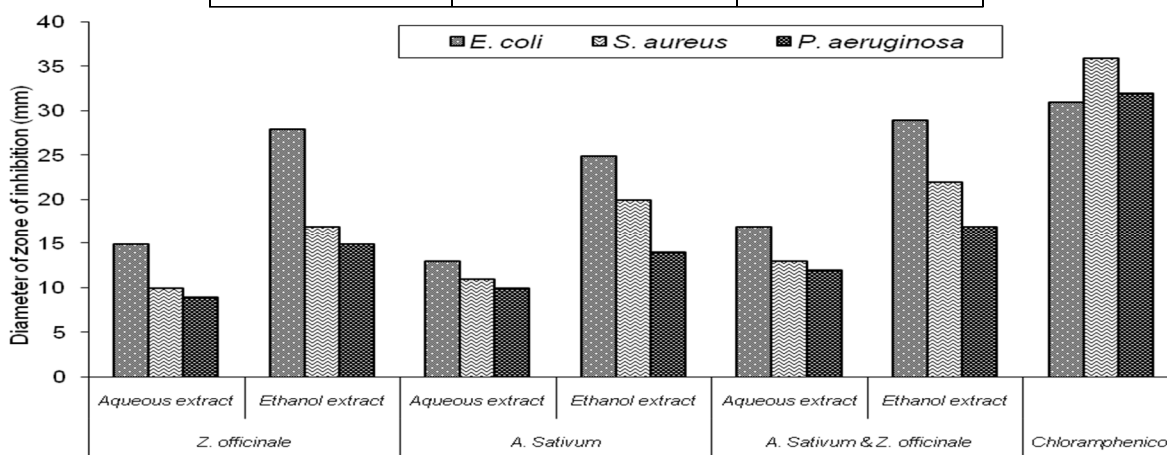
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Table 1. Phytochemical analysis of two medicinal plants in ethanolic extracts

Phytochemicals	<i>Zingiberofficinale</i>	<i>Allium sativum</i>
Phenolics	-	-
Alkaloids	+	+
Flavonoids	-	-
Tannins	-	-
Saponins	-	-
Steroids	+	+
Glycosides	+	+


Fig 1. The yield of extract of *Zingiberofficinale* and *Allium sativum* against three UTIcausing bacteria



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