

Original Research Article

In Vitro Antibacterial Activity of Ginger Extract (*Zingiberofficinale*) on Bacteria Isolated from Diabetic Patient with Urinary Tract Infections in Shendi Locality, Sudan

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Article History: | Received: 09.01.2023 | Accepted: 21.02.2023 | Published: 25.02.2023 |

Abstract: Background: Urinary tract infections frequently occur in diabetic patients due to an impaired immune status and increased glucose content in the urine among other reasons. This makes UTIs very important to investigate. Complicated cases of UTI may be frequent but are more common in diabetics with more severe consequences. And so warrant further investigations. The proper management of UTI in diabetics is crucial as prompt diagnosis and correct use of antibiotics are vital for treatment. Finding alternative antimicrobial agents from plant extracts has received growing interest. Ginger (*Zingiberofficinale*) is a safe, non-toxic, cheap spice that has been reported to have antimicrobial effects against various pathogenic bacteria. **Objectives:** This study aimed to evaluate the effectiveness of ginger extract on different types of bacteria isolated from diabetic patients suffering from urinary tract infections. **Methodology:** A cross-sectional and hospital-based study has been conducted at the University of Shendi –faculty of medical laboratory sciences- department of microbiology from May to November 2018. Following informed consent, 100 diabetic patients suffering from UTI of different ages were enrolled in this study. Sixty-two bacteria were isolated, different Gram- positive and Gram-negative bacteria, in vitro sensitivity testing using a well diffusion technique against ginger extract. **Results:** The main causative agent of UTI in the study population was *E. coli* 32.3% then *S. aureus* 29%, *S. saprophyticus* 29%, and *E. faecalis* 9.7%. The largest diameter of the inhibition zone appeared in Gram-positive *S. saprophyticus* (13.4mm). The concentrations of ginger extract used were 100, 50, 25, and 12.5 mg/ml. mean of inhibition zone of chloramphenicol for isolated bacteria *S. aureus* 31mm, *S. saprophyticus* 20.2 mm, *E. coli* 17.7mm, and *faecalis* 24.6mm. **Conclusion:** The antimicrobial activity of the crude extract was compared with that of standard antimicrobial chloramphenicol based on the mean diameter of the inhibition zone. The extract exhibited maximum relative percentage inhibition against *S. saprophyticus* (42.3%) and minimum relative percentage inhibition against *S. aureus* (6.3%).

Keywords: Ginger, Extracts, Inhibition zone, Diabetic Patient, Antibacterial, UTIs.

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INTRODUCTION

Urinary tract infections are caused by microorganisms such as bacteria overcoming the body's defenses in the urinary tract. They can affect the kidneys, bladder, and the tubes that run between them. I'm here. The urinary tract can be divided into the upper urinary tract and the lower urinary tract. The upper

urinary tract consists of the kidneys and ureters, and the lower urinary tract consists of the bladder and urethra [1].

Bacterial infections of the bladder (cystitis) and kidneys (pyelonephritis) are more common in women, and the incidence of infection increases with

Citation: Ibtihal Ibrahim M. Ahmed, Leila Mohamed.AAbdelgader, Ghanem Mohammed Mahjaf, Tibyan Abd Almajed Altaher, Mosab Nouraldein Mohammed Hamad (2023). *In Vitro* Antibacterial Activity of Ginger Extract (*Zingiberofficinale*) on Bacteria Isolated from Diabetic Patient with Urinary Tract Infections in Shendi Locality, Sudan. *SAR J Pathol Microbiol*, 4(1), 11-14.

age. Factors that predispose to UTI include instrumentation (eg, catheterization, cystoscopy), pregnancy, anatomical abnormalities of the genitourinary tract, and diabetes mellitus [2]. Most urinary tract infections rise from the entrance to the urethra. Most pathogens that cause community-acquired urinary tract infections are part of the patient's normal intestinal flora. *E. coli* is the most common isolate. Colonization of the vaginal and periurethral mucosa may precede urinary tract infection in women. Bacteria with pili that can attach to epithelial cells are more likely to cause UTIs, and individuals whose epithelial cells attach to these pili may be at increased risk of infection. Longer and better protection may explain the lower incidence of urinary tract infections in men. Motile bacteria can swim upstream, and reflux of urine from the bladder into the ureters can predispose to the development of kidney infections [2].

A ginger plant with petioles and yellow-green flowers, ginger spice is derived from the root of the ginger plant, which is native to temperate regions of Asia and is commonly used to treat many types of problems [3].

One active ingredient may help fight infections. Gingerol, a bioactive compound found in raw ginger, also lowers the risk of infection. It can also significantly lower blood sugar levels. Ginger extract can inhibit the growth of many types of bacteria [4].

Diabetes mellitus is a disease caused by a deficiency or reduced effectiveness of endogenous insulin and is characterized by hyperglycemia, metabolic disturbances and sequelae that primarily affect the vasculature [5].

MATERIALS AND METHODS

Study Area

The study was conducted in the Nile State of Shendi Village, Sudan. Shendi is a city in northern Sudan on the eastern bank of the Nile River, 150 km northeast of Khartoum (16°41'N, 33°25'E).

Study Population

A diabetic patient at Shendi Hospital.

Inclusion Criteria

Diabetics of various ages with urinary tract infections.

Exclusion Criteria

Samples from on-treatment diabetic patients who were negative for urinary tract infections were excluded.

Sample Size: 100 samples.

Data Collection

Data were collected by questionnaire.

Sampling

A midstream urine (MSU) was collected as follows. Patients were given a sterile, dry, leak-proof jar and asked to collect a 10-20 mL urine sample. The container was labeled with the date, patient name and number, and time of collection. If immediate delivery to the laboratory was not possible, patients were asked to refrigerate the urine at 4–6 °C within 24 hours prior to delivery.

Culture of Urine Samples

Urine samples were well-mixed by rotating the urine container several times. A urine container was opened next to the open Bunsen burner, and after flame sterilization, a nichrome loop was inserted. A small urine sample was taken from the loop, first making wells in cystine-lactose electrolyte deficient agar (CLED) medium, then from the wells to the primary line, then from the primary line to the secondary line, then from the secondary line. A tertiary line was created and inoculated. , last row, cubic row, and finally zigzag. The inoculated plates were incubated under aerobic conditions at 37° C. in an incubator for 24 hours.

Cultural Growth Interpretation

Plates were examined for significant bacterial growth. Isolated bacteria were identified by colony morphology, Gram staining, and biochemical examination.

Ethical Considerations

The study proposal got approval from the University of Shendi Faculty of Graduate Studies and the Faculty of Medical Laboratory Science. Verbal consent was taken from all participants or their guardians before being enrolled in the study. All participants were informed about the research's importance and all of them accepted to be part of it.

Data Analysis

Data were analyzed by using the statistical package for social sciences (SPSS) computer program Version19, Independent T-test and Correlation were used for analysis.

RESULTS

In this study, 100 samples were taken from a diabetic patient who had her UTI, 62% thrived and 38% did not thrive. Also, the frequency and proportion of sampling recording the age groups (Table 1). The analysis showed that of the 62 cultures that were positive for bacterial growth, 42 were Gram-positive (67.7%) and 20 were Gram-negative (32.3%) (Table 2).

Table-1: The frequency and percentage of sampling recording the age group

Age group	Frequency	Percent %
30 – 40	10	16.13
41 – 50	16	25.81
51 – 60	17	27.40
61 – 70	14	22.60
71 – 80	4	6.45
> 80	1	1.61
Total	62	100.0

Table-2: The frequency and percentage of Gram stain for isolated bacteria species.

Gram reaction	Frequency	Percent %
Gram positive	42	67.7
Gram negative	20	32.3
Total	62	100.0%

Table-3: The frequency and percentage of isolated bacteria.

Bacteria isolated	Frequency	Percent %
<i>S. aureus</i>	18	29
<i>S. saprophyticus</i>	18	29
<i>E. faecalis</i>	6	9.7
<i>E.coli</i>	20	32.3
Total	62	100.0

Table-4: Mean of inhibition zone diameter for isolated organisms in different concentration (100mg/dl, 50mg/dl, 25mg/dl, 12.5mg/dl) of Ginger extraction

Bacteria isolated	100	50	25	12.5
<i>S. aureus</i>	7.8	8.2	8.1	9.6
<i>S. saprophyticus</i>	13.4	10.7	10.1	10
<i>E. faecalis</i>	7	7	10.6	10.3
<i>E.coli</i>	9.5	8.5	7	7

Table-5: Antimicrobial susceptibility of ginger extract compared to chloramphenicol

Organism	Mean of inhibition zone diameter (mm)	
	Ginger extract 100mg/ml	Positive control chloramphenicol
<i>S. aureus</i>	7.8	31
<i>S. saprophyticus</i>	13.4	20.6
<i>E. faecalis</i>	7.0	17.7
<i>E.coli</i>	9.5	24.6

Table-6: The relative percentage inhibitions of ginger extract compared to chloramphenicol

Test organism	Relative percentage inhibition
<i>S. aureus</i>	29
<i>S. saprophyticus</i>	29
<i>E. faecalis</i>	9.7
<i>E.coli</i>	32.3
Total	100.0

DISCUSSION

In this study, 100 samples were collected from diabetic patients (62%) with urinary tract infections. The major causative agent of UTIs in the study population was *Escherichia coli* (32.3%), reported to be the most common pathogen in diabetic patients. This is consistent with Professor Khalid's report format. The results showed isolation and identification of the bacterial isolate *E. coli* (58.7%) [6]. Followed by *S. aureus* and *S. saprophyticus* (29%), and finally *E.*

faecalis (9.7%). In this study, the antibacterial susceptibility of the ginger extract showed the highest zone of inhibition against *S. saprophyticus* (13.4 mm) and the lowest zone of inhibition against *E. faecalis* (7 mm), *E. coli* (9.5 mm) and *S. aureus* showed. (7.8mm). The result shows that the extract of ginger has antimicrobial activity against both gram-positive and gram-negative bacteria, this is in agreement with the study of NADA mentioned that: the extract of ginger has antimicrobial activity against both gram-negative

and gram-positive bacteria .this may be caused by a result of the presence of gingerol, and shogaol as an active ingredient within ginger. Also, the results for extract in different concentrations were more effective against the gram-positive bacteria compared to the result for gram-negative. The higher resistance of the gram–negative bacteria could be due to the complexity of the cell wall of this group of microorganisms. Indeed, the external membrane of gram–negative bacteria renders highly hydrophilic surfaces whereas the negative charge of the surface of gram–positive wall may reduce their resistance to antibacterial compounds [7]. The results of the antimicrobial activity of ginger extract were compared with the positive control (standard drug) for evaluating their relative percentage inhibition while the extract exhibited maximum relative percentage inhibition against *S. saprophyticus* (42.3%), and minimum relative percentage inhibition against *S. aureus* (6.3%). The highest inhibition zone of ginger extract 13.4mm in diameter against *S. saprophyticus* at a concentration of 100%, followed by *E.coli* 9.5mm, 7.8mm against *S. aureus*, and 7mm against *E. fecalis*. Mohmoud M. Elaasser found that ginger has antibacterial activity against bacteria (2016) [8]. The herbal medicinal practice could provide a source for new drugs and therefore efforts should be directed to evaluate traditional medicinal practices based on the scientific methodologies available [9].

CONCLUSION

Ginger extract has the ability to inhibit the growth of most bacteria that cause urinary tract infections. The lowest concentration of ginger extract that can inhibit bacterial growth causes a UTI of 12.5 mg/dl. Inhibitory effect of ginger extract on both Gram-negative and Gram-positive bacteria.

ACKNOWLEDGMENTS

The authors are thankful to the Department of Microbiology, Faculty of Medical Laboratory Sciences, Shendi University, Shendi, Sudan, for their support during the study period.

SOURCES OF FUNDING

The budget for this study was from personal contributions from the authors, with no external funding.

CONFLICT OF INTEREST

The author has affirmed that there are no conflicting interests.

REFERENCES

1. Flores-Mireles, A. L., Walker, J. N., Caparon, M., & Hultgren, S. J. (2015). Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nat Rev Microbiol.*, 13(5), 269-84. doi: 10.1038/nrmicro3432. Epub 2015 Apr 8. PMID: 25853778; PMCID: PMC4457377.
2. South wick (. Infectious Diseases A Clinical Short Course, 2nd edition, USA. The Mc Graw-Hill Companies. South wick (2007).
3. Ginger extract (Root).WWW.hemedies .com.
4. Leech, J. (2021). 11 Proven health benefits of ginger [Internet]. Healthline. Available from: <https://www.healthline.com/nutrition/11-proven-benefits-of-ginger>.
5. Diabetes and Intercurrent Illness information. Patient [Internet]. patient.info. Available from: <https://patient.info/doctor/diabetes-and-intercurrent-illness>.
6. Al-zamily, K. Y. (2017). Effect of Watery Ginger Extract on some Bacteria Isolated from Urinary Tract Infections and Compared to Antibiotics. *MJPS*, 4 (1).
7. Hindi, N. K., Yasir, A., Al-Mahdi, Z. K., & Jebur, M. H. (2016). Evaluation of antibacterial activity: anti adherence, anti-biofilm and anti-swarmering of the aquatic extract of black raisins and vinegar of black raisins in Hilla City, Iraq. *Int J Pharmtech Res* , 9(9), 271-280.
8. Mourad, M. H., Abdel-Rahman, S. S., Elaasser, M. M., Safwat, N. A., & Ibrahim, M. Y. (2016). Antibacterial activity of certain medicinal plant and their essential oils on the isolated bacteria from UTI patients. *Int. J. Adv. Res.*, 4(12), 1510-1530.
9. Ghanem, M. M., Leila, M. A., Aisha, I., Nedal, M., Sulafa, M., Salih, M., Mosab, N. M. H., & Naser, B. (2022). *In Vitro* Assessment of Antimicrobial Activity of Honey Bees and Nigella Sativa against Selected Clinical Isolates from Shendi City. *EC Microbiology*, 18(5), 72-81.