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Antibacterial Efficacy of Locally Prepared Erectile Dysfunction Concoctions on *Escherichia Colica* using Urinary Tract Infection

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Abstract

Urinary tract infections (UTIs) are a major global health concern among men and are often associated with complications that may lead to erectile dysfunction (ED), which in turn can cause low self-esteem, depression, anxiety, and a range of psychological challenges. Conventional treatments for UTIs and ED typically involve synthetic drugs that can produce significant side effects, thereby driving interest in traditional medicinal alternatives. In this study, we randomly selected locally prepared ED concoctions and evaluated their antibacterial efficacy against selected Escherichia coli isolates from male UTI patients. The isolation and antibacterial activity of the E. coli isolates were carried out using standard phenotypical and microbiological techniques. Additionally, qualitative phytochemical screening and GC-MS analysis were employed to profile the bioactive compounds present in the concoctions. The antibacterial activity was assessed by measuring zones of inhibition, with some samples exhibiting zones up to 26 mm, indicating promising activity. Our results further revealed a complex chemical composition that included both natural compounds, such as fatty acids with documented antibacterial properties, and synthetic agents, including bipyridine and triazine derivatives, which are not typically found in conventional ED medications like sildenafil citrate. These findings suggest that while the traditional ED concoctions are primarily derived from plant sources, they are not entirely natural; synthetic compounds appear to be incorporated, possibly to enhance efficacy. Overall, our study underscores the need for further quantitative and toxicological analyses to establish the pharmacological basis and safety profile of these alternative remedies.

Keywords: Urinary tract infections, Erectile dysfunction, Traditional medicine, Antibacterial activity, Phytochemicals.

INTRODUCTION

Urinary tract infections (UTIs) are a widespread health concern, recognized as one of the most common bacterial infections globally, affecting individuals throughout their lifespan (Sheerin, 2011; Sheerin & Glover, 2019). These infections result from a complex interplay of host biological and behavioral factors, as well as the virulence of uropathogens. While Escherichia coli is the predominant causative agent, responsible for 75–90% of cases in both community and hospital settings (Sheerin, 2011; Kasper *et al.*, 2018; Sheerin & Glover, 2019), other significant pathogens include Candida albicans, Enterococcus faecalis, Pseudomonas aeruginosa, Klebsiella pneumoniae, and Proteus mirabilis (Kasper *et al.*, 2018). Annually, UTIs affect approximately 150 million people worldwide, resulting in substantial healthcare and economic burdens (Bischoff *et al.*, 2018). The high prevalence of UTIs imposes a substantial financial burden on healthcare systems (Karam *et al.*, 2019). In Nigeria, UTIs present a significant public health challenge, exacerbated by inadequate sanitation, limited healthcare access, and a growing problem of antibiotic resistance (Sheerin, 2011; Sheerin & Glover, 2019). Recent Nigerian studies have highlighted this issue. Okeke et al. (2023) reported that acute uncomplicated UTIs occur at a rate exceeding 0.5 episodes per year in individuals aged 18–30, with a 6.1% prevalence among male urology patients. Bassey *et al.* (2023) found significant bacteriuria in 28.6% of 240 urine samples, with *E. coli* accounting for 12.3% of cases. Furthermore, Julius *et al.* (2023) observed a 50% overall prevalence of UTIs in male cohorts, with E. coli being among the most frequently isolated pathogens. Demographic analyses by Iwodi *et al.* (2023) and Garga *et al.* (2024) further revealed that the highest isolation rate of *E. coli* (36.4%) was observed in patients

aged 80–89 years, and among male patients, 44.87% had *E. coli*-associated UTIs, with peak prevalence in the 31–40-year age group.

The pathogenicity of *E. coli* is attributed to fimbrial adhesins that facilitate attachment to glycolipids and glycoproteins on epithelial surfaces, enabling it to resist urine flow and persist in the urinary tract (Garga *et al.*, 2024). Additionally, *E. coli* produces toxins, hemolysins, and colony-necrotizing factors that compromise epithelial integrity, facilitating bacterial invasion and increasing the risk of infection (Garga *et al.*, 2024). A significant challenge in treating *E. coli*-related UTIs is the increasing prevalence of antimicrobial resistance (AMR) among *E. coli* strains. Resistance mechanisms include ß-lactamase production, structural modifications that prevent antibiotic binding, and efflux pumps that expel antibiotics from bacterial cells (Farid *et al.*, 2023). Beyond the direct health implications, emerging research highlights a potential link between UTIs and erectile dysfunction (ED), a prevalent and often underdiagnosed condition with profound psychosocial and physiological implications (Kaltsas *et al.*, 2025). The National Institutes of Health defines ED as the inability to achieve or maintain sufficient penile rigidity for satisfactory sexual activity (Teoh *et al.*, 2016). ED affects men across various age groups, ethnicities, and cultural backgrounds, with prevalence estimates as high as 52% among men aged 40-70 years (Schnatz *et al.*, 2010). In the United States alone, approximately 10 million men experience impotence (Chen *et al.*, 2019). In Nigeria, a study found that the overall prevalence of male sexual dysfunction was 60.5%, with ED and premature ejaculation affecting 45.7% and 36.7% of men, respectively (Umuerri *et al.*, 2021). The condition is exacerbated by modern societal pressures, including unrealistic sexual expectations fueled by social media and pornography, leading many men to seek alternative remedies (Lucumi *et al.*, 2024; Leisegang & Finelli, 2021). UTIs have been implicated in ED due to their impact on endothelial function and systemic inflammation (Kaltsas *et al.*, 2025). Intimacy is a fundamental aspect of human relationships, and ED-related psychological distress affects not only men but also their partners (Gbaranor *et al.*, 2024). Men experiencing weak erections often suffer significant psychological trauma, including depression (83.3%), shame (83.3%), isolation (60.4%), negative self-esteem (83.3%), embarrassment (83.3%), and cognitive impairment (72.92%) (Gbaranor *et al.*, 2024). Emerging research highlights the role of gut microbiota, including *E. coli*, in the pathogenesis of ED. *E. coli*-induced systemic inflammation contributes to endothelial dysfunction, impairing nitric oxide (NO) bioavailability, which is crucial for vascular relaxation and erectile function. Additionally, *E. coli* influences metabolic and hormonal pathways by promoting insulin resistance, glucose dysregulation, and disruption of testosterone synthesis. Its lipopolysaccharides (LPS) activate inducible nitric oxide synthase (iNOS), increasing oxidative stress and exacerbating inflammatory and metabolic pathways associated with ED (Kaltsas *et al.*, 2025).

The increasing preference for traditional medicines in the treatment of ED, often due to their perceived low side effects and natural origins, is supported by recent studies on botanical therapies (Sin et *et al.*, 2021). According to Kebede *et al.* (2021), four out of five individuals rely on traditional medicine for their primary healthcare needs. However, the scientific basis underlying the efficacy of these herbal remedies remains insufficiently explored. Specifically, while many plant extracts used in these concoctions contain phytochemicals with documented antimicrobial activity (Gadisa & Tadesse, 2021) and are expected to enhance physiological functions by improving blood flow and sustaining erection (Sin *et al.*, 2021), most of these formulations have not undergone rigorous pharmacological testing. Additionally, there is a lack of standardized dosing and regulatory oversight, which raises concerns regarding product quality, potential adulteration, and the inclusion of synthetic compounds that are not typically found in conventional ED drugs (Orimisan, 2022). Consequently, it remains unclear whether the observed therapeutic effects are due to direct physiological modulation or are indirectly mediated through the antibacterial properties of these formulations against underlying UTIs.

Given the rising prevalence of UTIs and their association with ED, coupled with the increasing use of traditional medicinal concoctions that are marketed as safe and effective alternatives, there is an urgent need to elucidate their pharmacological basis. This study aims to evaluate the efficacy of different locally prepared ED concoctions against *E. coli* strains isolated from male UTI patients, to analyze their phytochemical compositions, and to investigate their chemical profiles via GC–MS. The objective

is to determine whether these formulations are genuinely derived from natural plant ingredients or if they incorporate synthetic compounds, which are commonly used as scaffolds in pharmaceutical formulations. The lack of standardized dosing and proper regulatory oversight further underscores the potential risks associated with their consumption, necessitating further research and regulatory scrutiny to ensure both safety and efficacy for consumers. This study aims to (1) assess the efficacy of different erectile dysfunction concoctions against *E. coli* strains isolated from male UTI patients. (2) Analyze the phytochemical composition of these concoctions to determine if they are truly plant-based. (3) Investigate the chemical composition of the concoctions to identify any compounds that are also present in conventional ED drugs and antibiotics.

MATERIAL AND METHOD

Sample Collection and Extract Preparation

A total of ten (10) locally made erectile dysfunction (ED) remedies were randomly sampled from vendors in Dutse LGA, Jigawa State, Nigeria. Samples were collected from high-traffic areas, including Hakimi Street, Dutse New Market, and the Dutse Investment Complex. Product labels and usage directions were noted. Powdered samples, meant to be dissolved in hot water, were prepared using freshly boiled, distilled, and deionised water. Liquid samples were used as instructed. All were passed through 0.22 µm syringe filters to maintain sterility and nutritional value..

Sources and Screening of *Escherichia coli* Isolates

Urine samples from male UTI patients at Rasheed Shekoni Teaching Hospital, Dutse, Jigawa State, were used to isolate *Escherichia coli*. The isolates were identified through colony morphology, Gram staining, and biochemical assays (Indole, Methyl Red, Voges-Proskauer, Citrate, motility, catalase, and sugar fermentation) following the methods described by Whitman *et al*. (2015).

Antibiotic Susceptibility Testing

Antibiotic susceptibility was tested using Abtek Gram-negative discs containing OFX, PEF, CN, AU, CPX, SXT, S, CH, SP, and AM. Three highly resistant strains (A, B, and C) were selected for further testing with local ED herbal preparations. Pure *E. coli* cultures in sterile nutrient broth were adjusted to 1.5×10^6 CFU/mL, matching a 0.5 McFarland standard (CLSI, 2024). Using aseptic techniques, the standardized suspension was streaked evenly over Mueller-Hinton agar plates with sterile swabs. The antibacterial activity of the ED concoctions was tested using agar well diffusion, in accordance with CLSI guidelines. Wells (6 mm) were created in the agar and filled with 25%, 50%, and 100% (v/v) extract concentrations. Distilled water served as a negative control. Plates were allowed to diffuse for 30 minutes, then incubated at 37°C for 24 hours. Zones of inhibition were measured as indicators of antibacterial effect. Data analysis was performed using R software (R Core Team, 2024) through the RStudio interface (Posit, PBC, 2024).

Phytochemical Analysis

Qualitative phytochemical screening of the erectile dysfunction (ED) concoction extracts was conducted using established chemical techniques to identify the presence of bioactive constituents. The analysis targeted major classes of phytochemicals, including phenols, flavonoids, steroids, terpenoids, tannins, proteins, alkaloids, and glycosides, in accordance with the methods described by Oke *et al*. (2020).

GCMS Analysis

GC-MS analysis was performed using a Shimadzu GCMS-QP2010 Plus system equipped with an AOC-20i autosampler. Samples were injected in split mode at 250.0°C. The column oven temperature program was initiated at 80.0°C for 2.00 min, then increased to 200.0°C at 13.3°C/min (9.00 min hold), followed by a further increase to 280.0°C at 8.0°C/min (10.00 min hold). Helium was used as the carrier gas at a constant column flow of 1.58 mL/min, with a split ratio of 1.0. The mass spectrometer operated with the ion source at 200 °C and the interface at 250 °C. Data were acquired in scan mode from m/z 40 to 800, with a solvent cut time of 2.50 minutes. These parameters ensured efficient separation and identification of the compounds (Shimadzu, 2010).

RESULTS

The antibiotic susceptibility profiles of the bacterial isolates is presented in Table 1. Ciprofloxacin (CPX) was the most effective antibiotic, as all 10 isolates were susceptible to

it. Tarivid (OFX) and Pefloxacin (PEF) also showed high effectiveness, with eight isolates susceptible to each. Gentamicin (CN) and Sparfloxacin (SP) demonstrated moderate effectiveness, with a mix of susceptible and resistant isolates. In contrast, Ampicillin (AM) was the least effective, with only two isolates showing susceptibility while eight were resistant. Septrin (SXT) was completely ineffective, as all isolates were resistant, and Augmentin (AU) also showed poor performance, with six resistant isolates, one intermediate isolate, and only three susceptible isolates. Streptomycin (S) and Chloramphenicol (CH) also exhibited low effectiveness, as most isolates were resistant or intermediate, with only a few showing susceptibility.

The antibacterial activity of the locally prepared ED concoctions was assessed against three *E. coli* strains (A, B, and C), with inhibition zones measured in millimeters (mm) as shown in Table 2. The most potent sample, **J3**, exhibited the highest zone of inhibition (26 mm) against *E. coli* strain A at 100% concentration, and maintained superior activity across other strains—12 mm and 26 mm for strains B and C at 50% and 100%, respectively. Samples **J5** and **J7** also demonstrated strong activity, with inhibition zones ranging from 20 mm to 26 mm. On the other hand, **J9** and **J10** showed the weakest antibacterial effects, with inhibition zones ranging from 0 to 9 mm across all concentrations and strains. Moderate activity was observed in **J2, J4, J6**, and **J8**, with inhibition zones ranging from 9 mm to 21 mm.

Analysis of variance (ANOVA) test revealed that extract concentration had a statistically significant effect on antibacterial activity ($F(2,85) = 65.37$, $p < 0.001$), while **bacterial strain** had no significant effect ($p = 0.984$). Tukey's HSD post hoc test confirmed significant differences between all concentration levels (25%, 50%, 100%) ($p< 0.01$). Grouping analysis showed a dose-dependent increase in mean inhibition zones: 1.17 mm at 25%, 5.30 mm at 50%, and 14.67 mm at 100%. Figure 1 illustrates this trend, showing a clear increase in antibacterial activity as the concentration increases. Median inhibition zones increased from approximately 1.2 mm (25%) to 14.7 mm (100%), with each concentration significantly different from the others (groups A, B, and C). Despite minor variations across *E. coli* strains, the overall pattern was consistent with the ANOVA results, which found that strain type had no significant effect.

Table 1: Antibiotic Susceptibility Profiles of *E. coli* isolates

Isolates	Antibiotics/Zone of Inhibition(mm)									
	AM	SP	CH	S	SXT	CPX	AU	CN	PEF	OFX
1	0(R)	20(S)	0(R)	0(R)	0(R)	25(S)	0(R)	0(R)	23(S)	17(S)
2	0(R)	19(S)	0(R)	0(R)	0(R)	25(S)	0(R)	0(R)	25(S)	25(S)
3	23(S)	23(S)	5(R)	16(S)	5(R)	25(S)	24(S)	20(S)	20(S)	25(S)
4	0(R)	10(R)	0(R)	0(R)	0(R)	0(R)	0(R)	0(R)	20(S)	20(I)
5	5(R)	16(I)	7(R)	15(S)	10(R)	20(S)	15(I)	0(R)	25(S)	22(S)
6	0(R)	25(S)	5(R)	17(S)	0(R)	25(S)	18(S)	23(S)	23(S)	25(S)
7	5(R)	18(S)	0(R)	0(R)	0(R)	25(S)	18(S)	0(R)	22(S)	24(S)
8	25(S)	0(R)	14(S)	10(R)	0(R)	25(S)	0(R)	10(R)	20(S)	25(S)
9	0(R)	23(S)	0(R)	0(R)	0(R)	25(S)	13(I)	12(R)	0(R)	13(I)
10	25(S)	25(S)	25(S)	25(S)	0(R)	25(S)	25(S)	25(S)	25(S)	25(S)

Key: I- Intermediate, R-Resistant, S-Sensitive

Qualitative chemical analysis was performed on the ED concoction extracts to screen for bioactive phytochemicals, particularly those with known antibacterial properties. The screening of samples J1–J10 revealed varying compositions of secondary metabolites, including alkaloids, flavonoids, tannins, glycosides, terpenoids, steroids, phenols, and proteins.

Among the samples analyzed, J4, J5, J6, and J8 displayed the richest phytochemical profiles, each containing six different compounds. Conversely, J10 had the fewest detected phytochemicals, testing positive for only alkaloids, tannins, and terpenoids. Notable similarities in composition were observed between J3 and J7, both possessing alkaloids, tannins, terpenoids, phenols, and proteins. Additionally, J4 and J6 exhibited identical profiles, containing alkaloids, flavonoids, tannins, glycosides, terpenoids, and phenols. The detailed qualitative screening results are summarized in Table 3.

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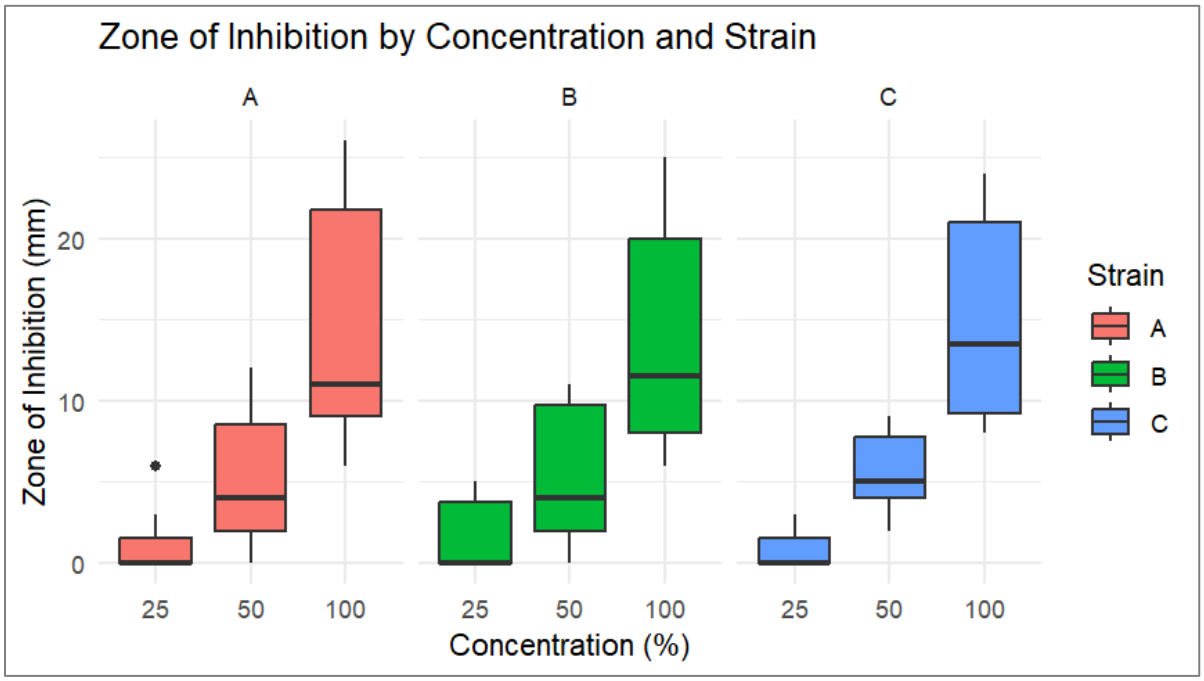

Figure 1: Zone of Inhibition for *E. coli* Strains at Varying ED Extract Concentrations

Table 2: Zones of Inhibition (mm) for ED Concoction Extracts Against *E. coli* Strains

Sample	Concentration (%)	E. coli A	E. coli B	E. coli C
J1	25	0^{c}	0^{c}	0^{c}
	50	5^{b}	6^{b}	6^{b}
	100	12^{a}	14^{a}	17^{a}
J2	25	0^{c}	0^{c}	0^{c}
	50	3^{b}	0^{c}	4^{b}
	100	10^{a}	9^{a}	9^{a}
J3	25	6^{b}	4^{b}	0^{c}
	50	12^{a}	10^{a}	7^{b}
	100	26^{a}	25^{a}	24^{a}
J4	25	0^{c}	0^{c}	0^{c}
	50	2^{b}	2^{b}	2^{b}
	100	9^{a}	8^{a}	8^{a}
J5	25	2^{b}	5^{b}	3^{b}
	50	9^{a}	11^{a}	9^{a}
	100	21^{a}	20^{a}	21^{a}
J6	25	0^{c}	0^{c}	0^{c}
	50	0^{c}	0^{c}	3^{b}
	100	6^{b}	6^{b}	8^{a}
J7	25	0^{c}	3^{b}	2^{b}
	50	7^{b}	9^{a}	8^{a}
	100	22^{a}	20^{a}	21^{a}
J8	25	3^{b}	4^{b}	3^{b}
	50	9^{a}	10^{a}	9^{a}
	100	24^{a}	23^{a}	23^{a}
J9	25	0^{c}	0^{c}	0^{c}
	50	2^{b}	2^{b}	4^{b}
	100	9^{a}	8^{a}	10^{a}
J10	25	0^{c}	0^{c}	0^{c}
	50	2^{b}	2^{b}	4^{b}
	100	9^{a}	8^{a}	10^{a}

Keys: Letters a, b, c indicate statistically significant groups based on Tukey HSD post-hoc test for concentration, a=Highest zone of inhibition (100%), b= Moderate zone (50%), c= No or minimal zone (25%), same letters mean no significant difference, different letters mean significant difference, strain had no significant effect (p=0.984) so grouping is only by concentration.

Table 3: Qualitative Phytochemical Screening of ED Concoction Extracts

Code	Alkaloid	Flavanoid	Tannins	Glycoside	Terpenoid	Steriod	Phenols	Protein
J1	-	-	+	-	+	-	+	+
J2	+	-	+	-	+	+	+	-
J3	+	-	+	-	+	-	+	+
J4	+	+	+	+	+	-	+	-
J5	+	-	+	+	+	-	+	+
J6	+	+	+	+	+	-	+	-
J7	+	-	+	-	+	-	+	+
J8	+	+	+	+	-	-	+	+
J9	+	-	+	+	-	-	+	-
J10	+	-	+	-	+	-	-	-

Key: +=Positive, -=Negative.

GC-MS analysis was performed on four selected ED concoction samples (J3, J7, J8, and J10) chosen for their varying antibacterial activities. J3 exhibited the highest activity, followed by J7, J8 (moderate activity), and J10 (least activity). The analysis of Sample J7, with its strong antibacterial activity, revealed a predominant composition of 1,3,5-Triazine-2,4-diamine (86.63%), alongside 9-Octadecenoic acid (8.34%), n-Hexadecanoic acid (2.33%), and Nonadecanoic acid (1.44%). Trace amounts of halogenated alkanes, specifically n-Decyl chloride, n-Dodecyl chloride, and n-Nonyl chloride, were also detected in this sample.

Sample J3, which demonstrated the highest antibacterial efficacy, contained several significant bioactive compounds. Key fatty acids identified were n-Hexadecanoic acid (Palmitic acid, 9.33%), 9-Octadecenoic acid (Oleic acid, 12.8%), Dodecanoic acid (Lauric acid, 4.42%), and Octadecanoic acid (Stearic acid, 2.04%). Furthermore, bipyridine derivatives, notably 2,4′-Bipyridine (15.69%), and triazole derivatives, such as 4H-1,2,4-Triazole-4-amine, N-[(2-nitrophenyl)methylene], were present. Other compounds included Hexatriacontane (7.8%, 5.39%), 3-Hexanamine (9.15%), and 2-Methyl-Z,Z-3,13-octadecadienol (10.59%). As with J7, trace halogenated alkanes like n-Dodecyl chloride, n-Decyl chloride, and n-Nonyl chloride were also found in J3.

Sample J8, showing moderate antibacterial activity, was characterized by the presence of 2,4′-Bipyridine (29.59%) and the triazole derivative 4H-1,2,4-Triazole-4-amine, N-[(2-nitrophenyl)methylene]. Other compounds detected included n-Nonyl chloride (1.49%), N,N-Dimethyloctylamine (10.88%), 1-Tetradecanamine (12.14%), and Tetradecanoic acid (Myristic acid, 5.79%). Trace amounts of 2,2′-Bipyridine, Pyridine, 3-methyl-, 1-Dodecanol, 1-Dodecene, and n-Decylmethylphosphonofluoridate (5.51%) were also identified. Sample J10, which exhibited the least antibacterial activity, primarily contained bipyridine derivatives, including 2,4′-Bipyridine (24.12%) and 2,2′-Bipyridine (3.12%). Fatty acids such as n-Hexadecanoic acid (Palmitic acid, 3.12%) and Octadecanoic acid (Stearic acid, 1.56%) were also detected. Compounds unique to J10 were Octadecane (27.44%), 1-(ethenyloxy) (8.23%), and 4-(dimethylamino)-3-methyl (2.20%).

An analysis of common compounds across the samples revealed that n-Decyl chloride and n-Dodecyl chloride were present in both J7 and J3, while n-Nonyl chloride was identified in J7, J3, and J8. Bipyridine derivatives (2,4′-Bipyridine and 2,2′-Bipyridine) were common to J3, J8, and J10. Triazole derivatives were observed in both J3 and J8, and J3 and J10 shared fatty acids such as n-hexadecanoic acid and Octadecanoic acid. Conversely, some compounds were unique to individual samples. Pentadecanoic acid and Dodecanoic acid were found exclusively in J3. Similarly, Pyridine, 3-methyl-, 1-Dodecanol, 1-Dodecene, and Tetradecanoic acid were detected only in J8.

DISCUSSION

Our findings on antibiotic susceptibility among *E. coli* isolates align with national and global trends of antimicrobial resistance. Ciprofloxacin (CPX) emerged as the most effective antibiotic, with all 10 isolates showing susceptibility, consistent with previous studies in Nigeria (Ali *et al.*, 2018; Nas *et al.*, 2019). This reflects the high usage of this drug in Nigeria, although some studies report higher resistance rates elsewhere (Hutinel *et al.*, 2019). Similarly, Tarivid (OFX) and Pefloxacin (PEF) also demonstrated good efficacy, with eight isolates susceptible to each. On the other hand, Ampicillin (AM) was largely ineffective, with only two isolates susceptible,

mirroring the reported widespread decline in its efficacy against *E. coli* (Ali *et al.*, 2014). The complete resistance observed to Septrin (SXT) across all isolates further highlights the growing ineffectiveness of this commonly used antibiotic, reinforcing earlier reports of high resistance in Nigeria (Odimayo *et al.*, 2016). Streptomycin (S) and Chloramphenicol (CH) showed limited effectiveness, consistent with other local studies (Ahmed *et al.*, 2019). These varying resistance patterns underscore the critical need for region-specific antibiotic guidelines and ongoing surveillance of resistance trends to ensure effective empirical treatment of UTIs, particularly in areas such as Kano and Dutse, which share similar socio-demographic characteristics (Nas *et al.*, 2019; Ali *et al.*, 2018).

Furthermore, the antibacterial activity of the locally prepared ED concoctions revealed significant variations. Samples J3, J5, and J7 demonstrated the highest antibacterial activity against *E. coli*, with inhibition zones reaching up to 26 mm at full strength, aligning with reports on the antibacterial potential of various herbal extracts used for ED (Sandhya *et al.*, 2023; Gadisa & Tadesse, 2021; Kebede *et al.*, 2021; Basit *et al.*, 2024). Specifically, J3 consistently showed superior activity, exhibiting the largest zone of inhibition (26 mm) against *the E. coli strain A, suggesting the presence of* potent antimicrobial constituents. Conversely, samples J9 and J10 displayed minimal activity, with inhibition zones typically ranging from 0 to 9 mm. This differential activity underscores the varied potency among these traditional formulations. To statistically validate these observations, a one-way ANOVA was conducted to evaluate the effects of extract concentration and *E. coli* strain type on the zones of inhibition. Results revealed that extract concentration had a statistically significant effect on antibacterial activity ($F(2,85) = 65.37$, $p < 0.001$), whereas strain type had no significant effect ($p = 0.984$). Post hoc Tukey HSD analysis confirmed that all three concentration levels (25%, 50%, 100%) were significantly different from each other ($p < 0.01$), demonstrating a consistent dose-dependent antibacterial effect. Grouping analysis revealed a progressive increase in inhibition zones with rising concentrations—mean zones of 1.17 mm at 25%, 5.30 mm at 50%, and 14.67 mm at 100%. These findings validate the in vitro efficacy of the tested concoctions, indicating that concentration plays a critical role in their antibacterial performance, while the bacterial strain has a negligible influence within the tested isolates. Figure 1 reinforces these findings, showing a clear concentration-dependent increase in antibacterial activity across all *E. coli* strains. This supports the hypothesis that higher doses enhance the bactericidal effect, consistent with literature emphasizing the role of bioactive compound concentration in the efficacy of plant-based treatments (Gadisa & Tadesse, 2021; Sandhya *et al.*, 2023). The negligible influence of strain variation suggests a **broad-spectrum potential** of the concoctions, validating their traditional use and highlighting the importance of **dosage optimization** in therapeutic applications.

Qualitative phytochemical screening provided insight into the bioactive compounds present in these concoctions. Samples J4, J5, J6, and J8 contained the broadest range of phytochemicals, including alkaloids, tannins, flavonoids, and glycosides—compounds well known for their therapeutic properties. This aligns with previous studies emphasizing the richness of traditional ED treatments in antibacterial phytochemicals that may contribute to both aphrodisiac and antimicrobial effects (Masuku *et al.*, 2020; Togola *et al.*, 2020; Edo *et al.*, 2024). The superior antibacterial activity observed in J3, J5, and J7 supports the potential synergistic effect of these phytochemicals, particularly alkaloids, tannins, and terpenoids, which have been linked to enhanced sexual performance and antibacterial effects (Sin *et al.*, 2021).

Further GCMS analysis of four selected samples (J3, J7, J8, and J10) revealed a complex chemical profile comprising both naturally derived and potentially synthetic compounds. Sample J3, the most active formulation, contained several natural fatty acids—including n-Hexadecanoic acid, Octadecanoic acid, 9-Octadecenoic acid, and Dodecanoic acid—widely recognized for their antibacterial efficacy and safety (Gunstone, 2017). However, J3 also contained 2,4′-bipyridine and triazole derivatives, synthetic compounds frequently used in pharmaceutical contexts (Strzelecka & Świątek, 2021), which may enhance antibacterial activity but pose potential toxicity concerns (Sato *et al.*, 2021). Sample J7, the second most active, was dominated by 1,3,5-Triazine-2,4-diamine (86.63%), a synthetic compound with known toxicological risks (Sato *et al.*, 2021), alongside natural fatty acids. Sample J8, which exhibited moderate activity, featured high proportions of 2,4′-Bipyridine and the synthetic n-

Decylmethylphosphonofluoridate—an organophosphorus compound with established toxicity (Hayes & Kobets, 2023). In contrast, Sample J10, which exhibited the lowest antibacterial activity, had minimal natural fatty acids and was largely composed of synthetic bipyridine derivatives and other potentially hazardous compounds.

Collectively, these results indicate that while the superior antibacterial effects observed in samples like J3 may be attributed to their higher concentrations of natural fatty acids and phytochemicals, reduced activity in samples like J10 could be linked to a dominance of synthetic compounds with questionable safety profiles (Orimisan, 2022; Rai *et al.*, 2018; Enema *et al.*, 2018). These findings challenge the perceived authenticity of such concoctions as purely herbal remedies and suggest that their antimicrobial effects—rather than any direct pro-erectile action—may underlie their traditional use for treating erectile dysfunction, especially in cases where subclinical UTIs are involved.

CONCLUSION

The study reveals critical insights into both antibiotic resistance patterns in *E. coli* isolates from urinary tract infections and the complex nature of locally prepared erectile dysfunction concoctions. We observed continued susceptibility to ciprofloxacin, alongside widespread resistance to ampicillin and septrin, highlighting the urgent need for localized antibiotic stewardship. Furthermore, while certain traditional ED concoctions exhibited notable antibacterial activity against E. coli, attributed to various phytochemicals, our comprehensive chemical analysis definitively identified the presence of synthetic compounds alongside natural constituents. This discovery raises significant concerns regarding the authenticity of these products as purely herbal remedies, their safety due to potentially toxic unlisted ingredients, and their actual mechanism of action, which may involve antimicrobial effects against underlying UTIs rather than direct physiological enhancement of erectile function. These findings collectively underscore the imperative for stringent regulatory oversight, standardized production, and rigorous scientific evaluation of traditional remedies to ensure consumer safety and efficacy.

REFERENCES

Ahmed, H. I., Fagwalawa, L. D., Ahmad, I., Yusha'u, M., & Ali, M. (2019). Determination of antibiotic sensitivity pattern of bacteria associated with urinary tract infection (UTI) among adult males in Kano, Nigeria. *EAS Journal of Parasitology and Infectious Diseases, 1*(5), 127–132.

Ali, B., Taura, D. W., Yahaya, H., & Muhammad, A. B. (2014). Antibiotic biogram of bacterial isolates among patients suspected of urinary tract infection. *International Journal of Microbiology and Application, 1*(4), 36–40. [Crossref]

Ali, M. A., Garba, K. A., & Abdallah, M. S. (2018). Antibiotic susceptibility profile of bacteria responsible for urinary tract infection (UTI). *South Asian Journal of Biological Research, 1*(1), 12–27.

Basit, A., Khan, K. U. R., Rahman, A. U., Khan, M., Ahmad, T., Arafat, M., Khan, K. U., Nalinbenjapun, S., Sripetthong, S., & Ovatlarnporn, C. (2024). UPLC-Q-TOF-MS profiling of *Viola stocksii* Boiss. and evaluation of aphrodisiac potential and risk factors associated with erectile dysfunction. *Journal of Ethnopharmacology, 321*, 117477. [Crossref]

Bassey, E. E., Mbah, M., Akpan, S. S., Ikpi, E. E., & Alaribe, A. A. (2023). Prevalence of symptomatic bacteriuria and associated risk factors among patients attending major hospitals in Calabar, Nigeria. *medRxiv*. [Crossref]

Bischoff, S., Walter, T., Gerigk, M., Ebert, M., & Vogelmann, R. (2018). Empiric antibiotic therapy in urinary tract infection in patients with risk factors for antibiotic resistance in a German emergency department. *BMC Infectious Diseases, 18*, 56. [Crossref]

Chen, L., Shi, G. R., Huang, D. D., Li, Y., Ma, C. C., Shi, M., ... & Shi, G. J. (2019). Male sexual dysfunction: A review of literature on its pathological mechanisms, potential risk factors, and herbal drug intervention. *Biomedicine & Pharmacotherapy, 112*, 108585. [Crossref]

Clinical and Laboratory Standards Institute. (2024). *Performance standards for antimicrobial susceptibility testing* (34th ed., CLSI supplement M100, pp. 21–22, 49–51).

Edo, G. I., Ugbune, U., Ezekiel, G. O., Nwosu, L. C., Onoharigho, F. O., & Agbo, J. J. (2024). Medicinal plants used for the treatment of sexual dysfunction: Ethnobotanical study and phytochemical analysis. *Ecological Frontiers, 44*(2), 247–256. [Crossref]

Enema, O. J., Umoh, U. F., Umoh, R. A., Ekpo, E. G., Adesina, S. K., & Eseyin, O. A. (2018). Chemistry and pharmacology of aphrodisiac plants: A review. *Journal of Chemical and Pharmaceutical Research, 10*(7), 70–98.

Farid, N., Waheed, A., & Motwani, S. (2023). Synthetic and natural antimicrobials as a control against food borne pathogens: A review. *Heliyon, 9*(6). [Crossref]

Gadisa, E., & Tadesse, E. (2021). Antimicrobial activity of medicinal plants used for urinary tract infections in pastoralist community in Ethiopia. *BMC Complementary Medicine and Therapies, 21*, 74. [Crossref]

Garga, M. A., Ado, A., Mzungu, I., Suleiman, A. K., & Abdullahi, H. (2024). Prevalence, phenotypic characterization and antibiogram of uro-pathogenic *Escherichia coli* among patients attending a tertiary institution teaching hospital in Katsina Metropolis, Nigeria. *Journal of Applied Sciences and Environmental Management, 28*(12), 4135–4142. [Crossref]

Gbaranor, K. B., Imarhiagbe, O. C., Mube, A. W., Pepple, B. G., Ogbonda, N. P., Cookey-Gam, I. F., ... & John, E. E. (2024). Psychological effects arising from weak erection among males in South-South Nigeria. *Scholarly International Journal of Obstetrics and Gynecology, 7*(10), 488–492. [Crossref]

Gunstone, F. D. (2017). Lipid analysis. In C. C. Akoh (Ed.), *Food lipids: Chemistry, nutrition, and biotechnology* (4th ed., pp. 149–174). CRC Press.

Hayes, A. W., & Kobets, T. (2023). *Hayes' principles and methods of toxicology*. CRC Press. [Crossref]

Hutinel, M., Huijbers, P. M. C., Fick, J., Åhrén, C., Larsson, D. G. J., & Flach, C. F. (2019). Population-level surveillance of antibiotic resistance in *Escherichia coli* through sewage analysis. *Eurosurveillance, 24*(37), 1800497. [Crossref]

Iwodi, C., Gberikon, G. M., Ogbonna, I. O., & Agada, E. O. (2023). Prevalence of uropathogenic *Escherichia coli* among adult male patients 40 years and above with haematuria and impaired kidney attending general hospitals in Benue State. *Advances in Microbiology, 13*(12), 588–601. [Crossref]

Julius, O., Oluwasusi, V., & Oyebode, J. (2023). Survey of urinary tract infection among male students residing in the Federal Polytechnic, Ado-Ekiti. *GSC Biological and Pharmaceutical Sciences, 24*(2), 60–66. [Crossref]

Kaltsas, A., Giannakodimos, I., Markou, E., Adamos, K., Stavropoulos, M., Kratiras, Z., ... & Chrisofos, M. (2025). The role of gut microbiota dysbiosis in erectile dysfunction: From pathophysiology to treatment strategies. *Microorganisms, 13*(2), 250. [Crossref]

Karam, M. R. A., Habibi, M., & Bouzari, S. (2019). Urinary tract infection: Pathogenicity, antibiotic resistance and development of effective vaccines against uropathogenic *Escherichia coli*. *Molecular Immunology, 108*, 56–67. [Crossref]

Kasper, D. L., Fauci, A. S., Hauser, S. L., Longo, D. L., Jameson, J. L., & Loscalzo, J. (2018). Urinary tract infections, pyelonephritis, and prostatitis. In *Harrison's Principles of Internal Medicine* (20th ed.). McGraw-Hill Education.

Kebede, T., Gadisa, E., & Tufa, A. (2021). Antimicrobial activities evaluation and phytochemical screening of some selected medicinal plants: A possible alternative in the treatment of multidrug-resistant microbes. *PLOS ONE, 16*(3), e0249253. [Crossref]

Leisegang, K., & Finelli, R. (2021). Alternative medicine and herbal remedies in the treatment of erectile dysfunction: A systematic review. *Arab Journal of Urology, 19*(3), 323–339. [Crossref]

Lucumi, Y., Nieva-Posso, D. A., & García-Perdomo, H. A. (2024). Pornography consumption and its effect on sexual performance in young men: Urology point of view. *International Journal of Urological Nursing, 18*(3), e12420. [Crossref]

Masuku, N. P., Unuofin, J. O., & Lebelo, S. L. (2020). Promising role of medicinal plants in the regulation and management of male erectile dysfunction. *Biomedicine & Pharmacotherapy, 130*, 110555. [Crossref]

Nas, F. S., Ali, M., Abdallah, M. S., & Zage, A. U. (2019). Prevalence and antibiotic susceptibility pattern of *Escherichia coli* isolated from urine samples of urinary tract infection patients. *ARC Journal of Urology, 4*(1), 14–20. [Crossref]

Odimayo, M. S., Kadijat, J. A., Nwadioha, S. I., & Enoch, O. O. (2016). Antibiotic profile of urinary pathogens in a tertiary hospital in Ekiti State, Nigeria. *International Journal of Current Microbiology and Applied Sciences, 5*(9), 779–787. [Crossref]

Oke, E. O., Adeyi, O., Okolo, B. I., Adeyi, J. A., Ayanyemi, J., Osoh, K. A., & Adegoke, T. S. (2020). Phenolic compound extraction from Nigerian *Azadirachta indica* leaves: Response surface and neuro-fuzzy modelling performance evaluation with Cuckoo search multi-objective optimization. *Results in Engineering, 8*, 100160. [Crossref]

Okeke, C. J., Jeje, E. A., Obi, A. O., Ojewola, R. W., & Ogbobe, U. U. (2023). The burden of urologic diseases in a tertiary hospital in south-eastern Nigeria: A three-year review. *Journal of West African College of Surgeons, 13*(4), 78–82. [Crossref]

Orimisan, O. A. (2022). Quantification of phytochemical and metabolomics profiling of the Nigerian's botanical aphrodisiac *Microdesmis keayana* (Microdesmis) J. Leonard (Pandaceae) root. *Daagu International Journal of Basic & Applied Research, 4*(1), 1–15.

Posit, PBC. (2024). *RStudio: Integrated development environment for R* (Version 2024.x) [Computer software]. posit.co

R Core Team. (2024). *R: A language and environment for statistical computing* (Version 4.x) [Computer software]. R Foundation for Statistical Computing. R-project.org

Rai, A., Das, S., Chamallamudi, M. R., Nandakumar, K., Shetty, R., Gill, M., ... & Kumar, N. (2018). Evaluation of the aphrodisiac potential of a chemically characterized aqueous extract of *Tamarindus indica* pulp. *Journal of Ethnopharmacology, 210*, 118–124. [Crossref]

Sandhya, S., Kumaran, G. S., & Desai, K. (2023). Homoeopathic insights into the antimicrobial potential of *Tribulus terrestris* for urinary tract infection and male infertility. *Journal of Chemical Health Risks, 13*(3), 620–627.

Sato, D., Wu, Z., Fujita, H., & Lindsey, J. S. (2021). Design, synthesis, and utility of defined molecular scaffolds. *Organics, 2*(3), 161–273. [Crossref]

Schnatz, P. F., Whitehurst, S. K., & O'Sullivan, D. M. (2010). Sexual dysfunction, depression, and anxiety among patients of an inner-city menopause clinic. *Journal of Women's Health, 19*(10), 1843–1849. [Crossref]

Sheerin, N. S. (2011). Urinary tract infection. *Medicine, 39*, 384–389. [Crossref]

Sheerin, N. S., & Glover, E. K. (2019). Urinary tract infection. *Medicine, 47*, 546–550. [Crossref]

Shimadzu Corporation Japan. (2010). *Gas Chromatograph Mass Spectrometer GCMS-QP2010 Ultra / GCMS-QP2010 SE System User's Guide* (2.6), 1–252.

Sin, V. J. E., Anand, G. S., & Koh, H. L. (2021). Botanical medicine and natural products used for erectile dysfunction. *Sexual Medicine Reviews, 9*(4), 568–592. [Crossref]

Strzelecka, M., & Świątek, P. (2021). 1,2,4-Triazoles as important antibacterial agents. *Pharmaceuticals, 14*(3), 224. [Crossref]

Teoh, J. B., Yee, A., Danaee, M., Ng, C. G., & Sulaiman, A. H. (2016). Erectile dysfunction among patients on methadone maintenance therapy and its association with quality of life. *Journal of Addiction Medicine, 11*(1), 40. [Crossref]

Togola, I., Dembélé, J., Daou, C., Dénou, A., Diarra, N., Badiaga, M., ... & Sanogo, R. (2020). Ethnobotanical survey and phytochemical screening of some plants used in the management of erectile dysfunction in Bwatun (Mali). *Journal of Natural Product and Plant Resources, 9*(1), 1–8.

Umuerri, E. M., & Ayandele, C. O. (2021). Prevalence and associations of erectile dysfunction and premature ejaculation among Nigerian men: An online survey. *Highland Medical Research Journal, 21*(2), 24–30.

Whitman, W. B., Goodfellow, M., Kämpfer, P., Busse, H.-J., Trujillo, M. E., Ludwig, W., & Suzuki, K.-i. (2015). *Bergey's Manual of Systematics of Archaea and Bacteria*. Wiley Online Library. [Crossref]