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Stream Water Quality Assessment: Antibiotic Resistance of Lac-Positive Enteric Bacterial Isolates

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Abstract

The increasing prevalence of antibiotic-resistant enteric bacterial species in stream water poses a significant threat to public health, potentially leading to waterborne outbreaks and complicating treatment options. This study aims to assess the antibiotic resistance patterns of enteric bacterial species isolated from stream water, informing strategies to mitigate the spread of antibiotic resistance and protect public health. A total of 100 stream water samples were collected, and screened for lactose-positive enteric bacterial isolates using standard microbiological techniques. The results revealed four bacterial species: *Escherichia coli* O157:H7, *Escherichia coli* JKHS016, *Klebsiella pneumoniae* 2014C06-125, and *Klebsiella pneumoniae* Kp2092. The antibiotic susceptibility testing showed that 42.76% of the isolates were resistant to conventional antibiotics, while 57.24% were susceptible. Notably, 34.48% of the resistant strains exhibited single antibiotic resistance, and 65.52% displayed multiple antibiotic resistance (MAR). Statistical analysis using the student "t" test, correlation coefficient and one-way analysis of variance (ANOVA) confirmed the significance ($p \leq 0.05$) of these findings. This study highlights the significant prevalence of antibiotic-resistant Enteric bacterial species in stream water, with 42.76% of isolates resistant to conventional antibiotics and 65.52% displaying multiple antibiotic resistance. The findings emphasize the need for strategies to mitigate the spread of antibiotic resistance, protect public health, and ensure safe water sources to prevent waterborne outbreaks.

***Keywords**: Microbiological, Susceptible, Lactose-positive, Strains.*

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1. Introduction

The prevalence of multidrug-resistant enteric bacterial isolates is a serious public health threat, due to its high alarming rate of morbidity and mortality globally, especially in most African countries that have not fully developed (Neunhoeffer *et al*., 2017). Some of the enteric bacteria that have been widely studied due to their involvement in infectious diseases associated with multiple drug resistance are *Kebsiella pneumoniae*, *Salmonella* spp., and *Enterobacter* spp.

In a general note, enteric bacteria are aerobic or facultative anaerobic, Gram negative, non-spore forming, rod shaped bacteria that are found in the gastrointestinal tract of both animals and humans (Dulm van *et al*., 2019). The gastrointestinal tract of human is natural habitat for various bacterial species, and most of them are involved in metabolic processes that restore energy and absorbable nutrients, thereby shielding the host against invasion by foreign microbes. The gastrointestinal tract harbours numerous numbers of aerobic and anaerobic bacteria, which may be in symbiotic relationship with the host, but can confer negative impact via food borne gastroenteritis in humans, which poses threat to healthful living as often shown in debilitating health condition of an infected patient (Patolla *et al*., 2019). These problems ensue due to emergence of antibiotics resistance to conventional antibiotics (Patolla *et al*., 2019).

Research has shown that enteric bacterial species, which is one of the potent enteric bacteria that inhabits water bodies such as stream (Mesele *et* al*.,* 2023). Stream is often a small water body with minimal flow rate, which provides a low current for inhabitation of aquatic bacteria such as enteric bacterial species. The presence of this pathogenic bacterium in stream poses a threat to individuals that optimize the water for domestic purposes such as drinking, bathing, and cooking (Mesele *et al.,* 2023). The bacterium causes several debilitating illnesses in man when consumed such as bloodstream infection, urinary tract infections, wound infections, and pneumonia (Mesele *et al*., 2023).

Several researchers have worked on the isolation and characterization of enteric bacteria from stream water such as Abera *et al*. (2016) and Wognin *et al.* (2024) but few studies are available on survey of degree of antibiotic resistance associated with enteric bacterial species isolated from stream water samples. Hence, the aim of this study is to survey the degree of antibiotic resistance associated with enteric bacterial species isolated from stream water samples.

2. Materials and Methods

Study Area

Uli is a town located at the end southeast angle of Ihiala local government area of Anambra state in Nigeria. Its closest neighboring towns are Ohakpu, Ihiala, Amorka, Ubulu, Ozara, and Egbuoma.Uli communities stretch westward over Usham Lake to the lower Niger region and to the confluence of the Atamiri and Enyinja rivers. Its coordinates are 5.783°N 6.687°E and 5°47'N 6°52'E. It occupies a landmass of 99square miles (256-kilometer square). The people of Uli are basically traders and farmers. The climate of the town is typically and equatorial rainforest type characterized by two main seasons; the rainy, which lasts between April and October and the dry season which lasts between November and march, with temperature which is usually high throughout the year and average minimum temperature at about 32℃ and 25℃ respectively.

Sample Collection, Handling and Transportation

The samples used for this study were drawn from different streams at Uli community. The samples were collected using sterile containers. The containers were thoroughly washed using detergent, rinsed with water, then rinsed with 70% ethanol and final rinsed three times with distilled water. The containers were placed inverted in order to drain the water inside them. The container was inverted and lowered 5 cm below the river water sample, then placed vertically for the water sample to refill the sample container. This sample was covered immediately and kept in a cooler containing ice block, and this transported to the laboratory for immediate analysis.

Culture and Isolation of Enteric Bacteria

The water samples were plated on Petri dishes (60 mm OD × 55 mm ID × 13mm high containing Mac Conkey agar medium (MA/Biotech). All the plates in triplicates were incubated in inverted at 37±2˚C for 24-48 h. (Cheesbrough, 2010; Ekesiobi *et al*. , 2025a; Ekesiobi *et al*., 2025b; and Ekesiobi *et al*., 2025c)

Characterization and Identification of the Isolates

The isolates were subcultured on nutrient agar (Biotech), incubated in an inverted position at 37±2˚C for 24 h. The isolates were characterized and identified using their colonial and morphological descriptions (Cheesbrough, 2010), biochemical reactions (Cheesbrough,2010) and molecular characterization (Iheukwumere *et al*., 2018; and Ekesiobi *et al*., 2025d). The colonial description was carried out to determine the colours of the isolates on agar media plates, their sizes, edges, consistencies and optical properties of the isolates

Susceptibility Patterns of the Pathogenic Bacterial Isolates against Conventional Antibiotics

Preparation of test isolate: The test isolates were prepared using the method described by Cheesbrough (2010), Ekesiobi *et al*. (2025e) and Ekesiobi *et al*. (2025f). The isolates were aseptically subcultured into a broth culture and incubated at 35 + 2^0C for 24 h. The broth culture of each isolate was centrifuged using an electric centrifuge. The sediment from each culture was diluted to a turbidity that matched 0.5 MacFarland standard that was prepared by mixing 0.5 mL of 1.175% $BaCl_2$ $2H_2O$ and 99.5 mL of 1% Conc. H_2SO_4. The prepared isolates were standardized by comparing the absorbance with that of 0.5 McFarland standards at 640 nm using UV/visible spectrophotometer.

***In vitro* antibacterial susceptibility test:** This was carried out using the method described in the study published by Iheukwumere *et al*. (2018). Each labeled plate was uniformly inoculated with the test organism using pour plate method. An antibiotic sensitive disk (MAXI Disk) was aseptically placed on the surface of the seeded plate, labeled and then incubated at 37±2ºC for 24 h. Antibacterial activity was determined by measuring the diameter of the zones of inhibition (mm) produced after incubation.

Statistical Analysis

The results of the data generated were expressed as mean, percentage and Table, Data were analyzed by two-way Analysis of Variance (ANOVA) to determine the significance of the study at 95 % confidence level. Pair wise comparison of mean was done by Student "t" test sa described in the study published by Iheukwumere *et al* (2018), Ekesiobi *et al*. (2017), Abiodum *et al*. (2024a), Abiodum *et al*. (2024c), Ekesiobi *et al*. (2025g), Iheukwumere *et al*. (2025c), Iheukwumere *et al*. (2025d), Iheukwumere *et al*. (2025e), Iheukwumere *et al*. (2025f), Iheukwumere *et al*. (2025g), Iheukwumere *et al*. (2025h), Iheukwumere *et al*. (2025i), Iheukwumere *et al*. (2025j), Iheukwumere *et al*. (2025k), Egbe *et al*. (2025a) and Egbe *et al*. (2025b).

3. Results

The characteristics of the enteric bacterial isolates are shown in Table 1. The results revealed that the isolates varied in appearances on MacConkey agar. Isolate C1 appeared pink, isolate C2 appeared red and isolates D1 and D2 showed similar appearance, whereby they appeared red and mucoid. Isolate C1 and C2 had convex elevation, and isolates D1 and D2 were slightly raised. They were all Gram-negative rods. All the isolates were catalase positive. Isolate C1 and C2 were citrate negative, whereas isolates D1 and D2 were citrate positive; isolates C1 and C2 were indole positive, and only isolates D1 and D2 were methyl red negative. The isolates showed complete utilization of glucose and maltose but varied in the utilization of xylose, sorbitol, inositol and Dulcitol.

The molecular characteristics of the enteric bacterial isolates revealed the presence of *Escherichia coli* 0157:H7 strain NE1127 chromosome with complete genome (ECNE11), *Escherichia coli* strain JKHS016 (ECJ6), *Klebsiella pneumoniae* strain 2014C06-125 (KP2) and *Klebsiella pneumoniae* strain KP2092 (KPK2) as shown in Table 2.

The susceptibility of bacterial isolates to conventional antibiotics revealed that isolate D2 was the most susceptible strain with a percentage of 63.64% followed by isolate C1 (61.54%), isolate C2 (40.91%) and then isolate D1 (0.00%) as shown in Table 3.

The degree of resistance exhibited among the isolates revealed that isolate D1 showed the highest resistance with a percentage of 100.00% followed by isolate C1 (80.00%), Isolate D2 (75.00%) and then isolate C2 (38.46%) as shown in Table 4.

Table 1: Characteristics of the enteric bacterial isolates

Parameter	C1	C2	D1	D2
Appearance on MacConkey agar	Pink	Red	Red and Mucoid	Red and Mucoid
Elevation	Convex	Convex	Slightly raised	Slightly raised
Motility	+	+	-	-
Gram reaction	-	-	-	-
Cell morphology	Rods	Rods	Rods	Rods
Catalase	+	+	+	+
Citrate	-	-	+	+
Indole	+	+	-	-
MR	+	+	-	-
VP	-	-	+	+
Glucose	+	+	+	+
Maltose	+	+	+	+
Xylose	+	+	+/-	+/-
Sorbitol	-	+	+/-	-
Inositol	+/-	+/-	+	+/-
Dulcitol	+/-	+	+/-	+/-

Table 2: Molecular characteristics of the enteric bacterial isolates

Isolate code	Max score	Toal score	Query cover (%)	E-value	Percent identity (%)	Accession Number	Description
C1	1681	1681	100	0.0	100	CP038321.1	*Escherichia coli* 0157:H7 strain NE1127 chromosome complete genome (ECNE11)
C2	1936	1936	100	0.0	100	CP147059.1	*Escherichia coli* strain JKHS016 (ECJ6)
D1	1552	1552	100	0.0	100	CP170972.1	*Klebsiella pneumoniae* strain 2014C06-125 (KP2)
D2	1552	1552	100	0.0	100	CP141801.1	*Klebsiella pneumoniae* strain Kp2092 (KPK2)

Table 3: Susceptibility of the bacterial isolates to conventional antibiotics

Isolate	N	Susceptible Strain (%)	Resistance Strain (%)	Implicated antibiotics
C1	13	8 (61.54)	5 (38.46)	S, PN, CEP, SXT, AU, CN
C2	12	9 (40.91)	13 (59.09)	AMX, AU, CEP, S, PN, SXT, CN
D1	7	0 (0.00)	7 (100.00)	PN, S, CEP, SXT, AU
D2	11	7 (63.64)	4 (36.36)	AU, PN, S, CEP, SXT, CN
Total	53	24 (45.28)	29 (54.72)	

Table 4: Degree of resistance among the isolates

Isolates	NR	Single resistant strain (%)	Multiple resistant strain (%)
C1	5	1 (20.00)	4 (80.00)
C2	13	8 (61.54)	5 (38.46)
D1	7	0 (0.00)	7 (100.00)
D2	4	1 (25.00)	3 (75.00)
Total	29	10 (34.48)	19 (65.52)

4. Discussion

Globally, antimicrobial resistance has been a threat to man, as revealed in the high rate of morbidity and mortality. Several conventional antibiotics emerge daily in the quest to curtail the effects of multiple antibiotic resistance but little success has been achieved, due to the continuous emergence of antibiotic-resistant genes globally. The bacteria species isolated in this study corroborate to the bacterial species isolated by other researchers (Abera *et al*., 2016; Neunhoeffer *et al*., 2017; Patolia *et al.*, 2018; Wognin *et al.*, 2022).

The pathogenic bacteria isolated in this study correspond to the pathogenic bacteria isolated by several researchers (Austin and Austin, 2016; Gufe *et al*., 2019; Wanja *et al*., 2020) who evaluated bacterial species found in fish. The pathogenic activity exhibited by the bacterial isolates in this study is in conjunction with the pathogenic profile of bacterial species isolated by several researchers (Abera *et al*., 2016; Neunhoeffer *et al*., 2017; Patolia *et al*., 2018; Wognin *et al.*, 2022) who isolated pathogenic bacteria from fish.

The bacterial resistance observed in this study corresponds to the bacterial resistance reported by other researchers (Abera *et al*., 2016; Neunhoeffer *et al*., 2017; Patolia *et al.*, 2018; Wognin *et al.*, 2022) who investigated bacterial species found in different forms of fishes. Molecular characterization of the bacterial isolates revealed certain bacterial strains such as *Escherichia coli* 0157:H7 strain NE1127, *Escherichia coli* strain JKHS016, *Klebsiella pneumoniae* strain 2014C06-125, and *Klebsiella pneumoniae* strain Kp2092. However, there was variation in the bacterial isolates reported by other researchers (Murad *et al*., 2014; Adzitey *et al.*, 2015; Kunad, 2018), which could be attributed to the degree of contamination by the handlers and climatic conditions of the study area. Furthermore, the antibiotics that were implicated in the resistant menace are Streptomycin, Amoxicillin, Ciprofloxacin, Augmentin, Ceporex, Penicillin, and Trimethoprim. Similar antibiotics were reported by other researchers (Elshebrawy *et al.*, 2022; Hossain *et al*., 2022), but there was deviation in the antibiotics documented by Enayat *et al*. (2012), which could be attributed to efficacy of the active pharmaceutical ingredients.

5. Conclusion

This study highlights the significant prevalence of antibiotic-resistant enteric bacterial species in stream water, with 42.76% of isolates resistant to conventional antibiotics and 65.52% displaying multiple antibiotic resistance. The findings emphasize the need for strategies to mitigate the spread of antibiotic resistance, protect public health, and ensure safe water sources to prevent waterborne outbreaks.

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References

Abera, B., Kibret, M. and Mulu, W. (2016). Extended-spectrum beta-lactamases and antibiogram in Enterobacteriaceae from clinical and drinking water sources from Bahir Dar city, Ethiopia. *PLoS One* 2:11 – 17

Abiodun, M. O., Ekesiobi, A. O., and Onyenweife, L. C. (2024a). Anti-Trypanosoma Activities, Histological and Kidney Function Effect of Garcinia kola Seed Extract and Standard Drug (Diaminizene Aceturate) in Trypanosomiasis Disease Induced Albino Wister rat. Adeleke University Journal of Science, 3(1): 238-259.

Abiodun, M. O., Ekesiobi, A. O., Onyenweife, L. C., and Bankole, O. T. (2024c). Hepatotoxicity effect of Gongronemal latifollium aqueous leave extract on some biomarker liver enzyme of albino

Wister rats. Dutse Journal of Pure and Applied Sciences, 10(4a): 343-348.

Cheesbrough, M. (2010). *Microbiological test: District laboratory practice in tropical countries*. In Cremer, A., & Evan, G. (Eds.), Cambridge University Press, U.K, pp. 211–226.

Dulm van, E., Tholen, A.T., Pettersson, A., Rooijen van, M.S. and Willemsen, I. (-2019). High prevalence of multidrug resistant Enterobacteriaceae among residents of long term care facilities in Amsterdam, the Netherlands. *PLoS One* 2: 14 – 222

Egbe, P. A., Umeaku, C. N., Iheukwumere, I. H., Iheukwumere, C. M., Onwuasoanya, U. F., Ezenwata, I. S., Afulukwe, S. C., Ike, V. E., Ezeumeh, E. N., & Egbuna, C. (2025a). Helicobacter pylori Inhibition by Medicinal Plant Extracts: An In Vitro Assessment. *IPS Journal of Drug Discovery Research and Reviews*, *3*(1), 32–37. https://doi.org/10.54117/ijddrr.v3i1.28.

Egbe, P. A., Umeaku, C. N., Iheukwumere, I. H., Iheukwumere, C. M., Onwuasoanya, U. F., Ezenwata, I. S., Afulukwe, S. C., Ike, V. E., & Ezeumeh, E. N. (2025b). Medicinal Plant Extracts Enhance Conventional Antibiotic Activity against Helicobacter pylori: An In Vitro Assessment. *IPS Interdisciplinary Journal of Biological Sciences*, *4*(2), 93–99. https://doi.org/10.54117/iijbs.v4i2.51.

Ekesiobi, A. O., Iheukwumere, C. M., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Ike, V. E., Okereke, F. O., & Ochibulu, S. C. (2025a). Hyping the Inhibitory Activity of Xylopia aethiopica against Vibrio cholerae using Azithromycin. IPS Journal of Basic and Clinical Medicine, 2(3), 93–98. https://doi.org/10.54117/ijbcm.v2i3.16

Ekesiobi, A. O., Iheukwumere, C. M., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Ike, V. E., Okereke, F. O., & Ochibulu, S. C. (2025b). Natural Product-Based Therapies: Exploring the Potential of Ocimum gratissimum and Vitamin C Combination against Vibrio cholerae Infections. IPS Interdisciplinary Journal of Biological Sciences, 4(3), 119–124. https://doi.org/10.54117/iijbs.v4i3.64.

Ekesiobi, A. O., Iheukwumere, C. M., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Ike, V. E., Dim, C. N., Okereke, F. O., & Ochibulu, S. C. (2025c). Soil Bacterial Dynamics: Assessing the Effects of Urine on Lipolytic and Cellulytic Bacteria. IPS Journal of Advanced and Applied Biochemistry, 1(2), 34–37. https://doi.org/10.54117/ijaab.v1i2.66

Ekesiobi, A. O., Iheukwumere, C. M., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Ike, V. E., … Dim, C. N. (2025d). Public Health Implications of Shigella Contamination in Borehole Water Sources in Uli Community. IPS Journal of Public Health, 5(3), 265–269. https://doi.org/10.54117/ijph.v5i3.48.

Ekesiobi, A. O., Iheukwumere, C. M., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Ike, V. E., Okereke, F. O., Ochibulu, S. C., & Agbaugo, C. F. (2025e). Upshot of Urine on Beneficial Soil Bacteria. Journal of Pollution Monitoring, Evaluation Studies and Control, 4(2), 100–103. https://doi.org/10.54117/jpmesc.v4i2.18

Ekesiobi, A. O., Iheukwumere, C. M., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C.C., Ike, V. E., Ikejiaku, C. C., Okereke, F. O., & Ochibulu, S. C. (2025f). Cross-Sectional Study of Salmonella Species among Ready-To-Eat Fruit Salads. Journal of Pollution Monitoring, Evaluation Studies and Control, 4(2), 104–109. https://doi.org/10.54117/jpmesc.v4i2.19.

Ekesiobi, A. O., Iheukwumere, C.M., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Ike, V. E., Okereke, F. O., & Ochibulu, S. C. (2025g). Combination Therapy: Investigating the Combined Effects of Zingiber officinale and Azithromycin against Vibrio cholerae. IPS Journal of Drug Discovery Research and Reviews, 3(2), 44–50. https://doi.org/10.54117/ijddrr.v3i2.34.

Iheukwumere, I.H., Chukwura, E.I. and Chude, C. (2018). *In vivo* activities of some selected antimicrobial agents against enteric bacteria isolated from chicken feeds on broiler layers. *Journal of Biology, Agriculture and Healthcare* 9: 21–36.

Iheukwumere, I.H., Olusola, T.O. and Chude, C. (2018a). Molecular characterization and diversity of enteric bacteria isolated from chicken feeds. *Journal of Natural Sciences Research* 8: 21–33.

Iheukwumere, C. M., Ekesiobi, A. O., Iheukwumere, I. H., Okoli, U. O., Dim, C. N., Ejike, C. E., Ilechukwu, C. C., Ike, V. E., Okereke, F. O., Nwankwo, A. K., & Ochibulu, S. C. (2025a). Bacteriological Study of Urine Samples from Obstetric Patients in Onitsha Metropolis: Public Health Implications. IPS Journal of Basic and Clinical Medicine, 2(3), 99–107.https://doi.org/10.54117/ijbcm.v2i3.17

Iheukwumere, C. M., Ekesiobi, A. O., Iheukwumere, I. H., Okoli, U. O., Ejike, C. E., Dim, C. N., Ilechukwu, C. C., Ike, V. E., Okereke, F. O., Nwankwo, A. K. ., & Ochibulu, S. C. (2025b). Waterborne Pathogen Research: Examining Shigella species in Fish Ponds of Uli Community. IPS Interdisciplinary Journal of Biological Sciences, 4(3), 125–129. https://doi.org/10.54117/iijbs.v4i3.65

Iheukwumere, C. M., Ekesiobi, A. O., Iheukwumere, I. H., Okoli, U. O., Ejike, C. E., Ilechukwu, C. C., … Ochibulu, S. C. (2025c). Public Health Risk of Vibrio cholerae Contamination in Streams of Uli Community. IPS Journal of Public Health, 5(3), 270–275. https://doi.org/10.54117/ijph.v5i3.49.

Iheukwumere, C. M., Ekesiobi, A. O., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Dim, C. N., & Ochibulu, S. C. (2025d). Dual Approach Therapy: Assessing Xylopia aethiopica and Ciprofloxacin Synergy against Salmonella enterica Serovar Typhi. IPS Intelligentsia Multidisciplinary Journal, 4(1), 27–31.

Iheukwumere, C. M., Ekesiobi, A. O., Iheukwumere, I. H., Ejike, C. E., Ilechukwu, C. C., Dim, C. N., Ochibulu, S. C., Unegbu, C. C., & Egbuna, C. (2025e). Food Safety Implications: Assessing the Potential of Desmodium velutinum Leaves Extracts to Control the Most Predominant Fungal Contamination in Ready-To-Eat Fried Chicken. IPS Journal of Nutrition and Food Science, 4(3), 494–500.

Iheukwumere, I. H., Iheukwumere, C. M., Iloegbunam, S. O., Obiefuna, O. H., Unaeze, C. B., Obianom, A. O., Onyemekara, N. N., Ike, V. E., Udeagbara, O. E., & Nnadozie, C. H. (2025f). Assessment of Candy Produced from Fermented Pentaclethra macrophylla Seeds. *IPS Journal of Nutrition and Food Science*, *4*(2), 418–423. https://doi.org/10.54117/ijnfs.v4i2.101.

Iheukwumere, I.H., Nwike, M. I., Iheukwumere, C.M., Ike, V.E., Obianom, A.O., Ihenatuoha, U.A., Igboanugo, E.U., Ekesiobi, A.O., Okereke, F.O., Obiefuna, O. H. Nnadozie, C.H., Agbaugo, C.F., Oduoye, O.T., Nwakoby, N.E., Ilechukwu, C. C.,,Ochibulu, S. C. and Ejike, C. E. (2025g). Extraction and Elucidation of Antibiotics from the Mycelia of Aspergillus niger Isolated from Poultry Farm against Enteric Bacterial Pathogens. *IPS Journal of Advanced and Applied Biochemistry*, 1(1), 1–10. https://doi.org/10.54117/ijaab.v1i1.58.

Iheukwumere, I. H., Iheukwumere, C. M., Obianom, A. O., Nnadozie, C. H., Okereke, F. O., Onwuasoanya, U. F., … Ihenatuoha, U. A. (2025h). Cross-Sectional Study of Different Strains of Bacillus cereus among Pap Sold in Major Towns in Ihiala LGA, Anambra State. IPS Journal of Public Health, 5(2), 199–204. https://doi.org/10.54117/ijph.v5i2.39.

Iheukwumere, I. H., Ajeh, J. C., Iheukwumere, C. M., Ike, V. E., Obianom, A. O., Ihenatuoha, U. A., Igboanugo, E. U., Onwuasoanya, U. F., Okereke, F. O., Nnadozie, C. H., Agbaugo, C. F., Nwike, M. I., Nwakoby, N. E., & Ilechukwu, C. C. (2025i). Microbial quality and sensory assessment of vinegar from date palm and apple fruits: implications for consumer preference. IPS Journal of Nutrition and Food Science, 4(2), 410–417. https://doi.org/10.54117/ijnfs.v4i2.100.

Iheukwumere, I. H., Ajeh, J. C., Iheukwumere, C. M., Ike, V. E., Obianom, A. O., Ihenatuoha, U. A. ., Igboanugo, E. U., Onwuasoanya, U. F., Okereke, F. O., Nnadozie, C. H., Agbaugo, C. F., Nwike, M. I., Nwakoby, N. E., & Ilechukwu, C. C. (2025j). Exploring the Phytochemical and Antimicrobial Properties of Fruit Vinegar: A Study on Phoenix Dactylifera and Malus Sylvestris. *IPS Journal of Applied Microbiology and Biotechnology*, *4*(1), 115–122. https://doi.org/10.54117/ijamb.v4i1.48

Iheukwumere, I. H., Ajeh, J. C., Iheukwumere, C. M., Ike, V. E., Obianom, A. O., Ihenatuoha, U. A., Igboanugo, E. U., Onwuasoanya, U. F., Okereke, F. O., Nnadozie, C. H., Agbaugo, C. F., Nwike, M. I., Nwakoby, N. E., & Ilechukwu, C. C. (2025k). Microbial Quality and Sensory Assessment of Vinegar from Date Palm and Apple Fruits: Implications for Consumer Preference. *IPS Journal of Nutrition and Food Science*, *4*(2), 410–417. https://doi.org/10.54117/ijnfs.v4i2.100.

Meadow, J.F., Altrichter, A., Kembel, S.W., Moriyama, M., O'connor, T.K., Womack, A.M., Brown, G.Z., Green, J.L. and Bohannan, B.J.M. (2014). Bacterial communities on classroom surfaces vary with human contact. *Microbiome* 2:7 – 13

Mesele, F., Leta, S., Amenu, K. and Abunna, F. (2023). Occurrence of Escherichia coli O157: H7 in lactating cows and dairy farm environment and the antimicrobial susceptibility pattern at Adami Tulu Jido Kombolcha District, Ethiopia. *BMC Veterinary Research* 19: 6 – 14

Neunhoeffer, F., Hölzl, F. and Kumpf, M. (2017). Suspicion of respiratory tract infection with multidrugresistant Enterobacteriaceae: epidemiology and risk factors from a Paediatric Intensive Care Unit. *BMC infectious diseases* 17: 1 – 9

Patolia, S., Abate, G., Patel, N., Patolia, S. and Frey, S. (2018). Risk factors and outcomes for multidrug-resistant Gram-negative bacilli bacteremia. *Therapeutic advances in infectious disease* 5: 1 – 8

Tacconelli E, Carrara E, Savoldi A, Harbarth S, Mendelson M, Monnet D, et al. Discovery, research, and development of new antibiotics—the WHO priority list of antibiotic-resistant bacteria and tuberculosis. Lancet Infect Dis 2018;18(3):318–27

Wognin, A.S., Toulé, A.C., N'guessan, A.E., Koné, N.M. and Kouadio-Guessennd, N. (2024) Study of the Multidrug Resistance of Enterobacteria Isolated from Waters and Tilapia Fishes from Fish Farms in the Sud-Comoé Region, Côte d'Ivoire. *Advances in Microbiology* 14: 567 – 577.

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