The Journal of Phytopharmacology 2025; 14(3):170-176
Online at: www.phytopharmajournal.com

Research Article

ISSN 2320-480X
JPHYTO 2025; 14(3): 170-176
May- June
Received: 05-05-2025
Accepted: 12-07-2025
Published: 31-07-2025

doi: 10.31254/phyto.2025.14307

Dickson Aboagye
Department of Pharmaceutical Sciences, School of Pharmacy, Central University, Accra, Ghana

Caleb Ofori Bandoh
Department of Pharmaceutical Sciences, School of Pharmacy, Central University, Accra, Ghana

Kingsley Ofolikwei Quaye
Department of Pharmaceutical Sciences, School of Pharmacy, Central University, Accra, Ghana

Josephine Frimpomaa Oppong
Department of Pharmaceutical Sciences, School of Pharmacy, Central University, Accra, Ghana

Justice Yao Akakpo
Department of Pharmaceutical Sciences, School of Pharmacy, Central University, Accra, Ghana

Emmanuel Ogwoh Chisom
Department of Pharmaceutical Sciences, School of Pharmacy, Central University, Accra, Ghana

Kelvin Amankwah Sarfo
Department of Pharmaceutical Sciences, School of Pharmacy, Central University, Accra, Ghana

Prince Nartey-Addy Amoyaw
Department of Pharmaceutical Sciences, School of Pharmacy, Central University, Accra, Ghana

Correspondence:
Dr. Dickson Aboagye
Department of Pharmaceutical Sciences, School of Pharmacy, Central University, Accra, Ghana
Email: dicksonaboagye184@gmail.com

Extraction, isolation, and antimicrobial evaluation of bioactive compounds from the ethanolic extract of *Allium cepa* L.

Dickson Aboagye, Caleb Ofori Bandoh, Kingsley Ofolikwei Quaye, Josephine Frimpomaa Oppong, Justice Yao Akakpo, Emmanuel Ogwoh Chisom, Kelvin Amankwah Sarfo, Prince Nartey-Addy Amoyaw

ABSTRACT

Background: *Allium cepa* (onion) is a widely cultivated plant, known for its rich phytochemical composition and diverse medicinal properties. As global antibiotic resistance continues to rise, there is an increasing interest in exploring natural sources, such as medicinal plants, for the discovery of novel bioactive compounds. This study investigated the extraction, isolation, and antimicrobial activity of chemical constituents from the ethanolic extract of Allium cepa. **Aims and Objectives:** This study aimed to extract and isolate bioactive compounds from the ethanolic extract of Allium cepa and evaluate their antimicrobial activities against *Escherichia coli* and *Staphylococcus aureus*. **Materials and Methods:** Fresh *Allium cepa* bulbs were obtained from Aburi, Ghana. A total of 316 g of dried powdered bulbs were extracted via cold maceration using 95% ethanol and 5% water. The extract was filtered and concentrated using a rotary evaporator, and then analyzed by TLC, revealing three spots (Rf: 0.29, 0.33, and 0.5). Further purification using flash column chromatography and HPLC yielded the pure compound AC (Rf = 0.5). Compound AC's antimicrobial activity was evaluated using the micro broth dilution method against *E. coli* and *S. aureus*, using ciprofloxacin and clindamycin as controls. **Results:** Phytochemical screening of the crude extract confirmed the presence of alkaloids, tannins, flavonoids, quercetin, and saponins. TLC analysis of the crude extract yielded three spots, and flash chromatography isolated AC with Rf = 0.5. The isolated compound, AC, had a melting point of 317°C and was soluble in DMSO and methanol. The MIC values of compound AC were 0.5 mg/mL against *S. aureus* and 3.91 mg/mL against *E. coli*, which are comparable to standard antibiotics such as ciprofloxacin (MICs:< 0.1 mg/mL and <0.1 mg/mL respectively) and clindamycin (MICs: <0.1 mg/mL and <0.5 mg/mL respectively). **Conclusion:** The ethanolic extract of *Allium cepa* contained bioactive compounds with significant antimicrobial activity, particularly against *S. aureus*. The isolated compound AC showed promising results, supported by TLC, flash chromatography, HPLC, and MIC determination.

Keywords: *Allium cepa*, Anti-microbial activity, Natural products, Chromatography, Phytochemicals, Spectroscopy.

INTRODUCTION

Medicinal plants have long served as a foundational resource for traditional healing practices across civilizations [1]. With a rich history spanning thousands of years, plant-based therapies continue to be crucial for health management, particularly in resource-limited settings. Their importance stems from their accessibility, affordability, and diverse phytochemical profiles, which offer therapeutic benefits with minimal side effects [2]. As the modern pharmaceutical industry faces challenges, such as antimicrobial resistance and adverse drug reactions, the search for safer and more effective alternatives has intensified [3,4]. Medicinal plants, owing to their complex and unique chemical constituents, offer promising leads for drug discovery and development [5,6].

Among these botanicals, *Allium cepa*, commonly known as onion, stands out not only as a staple culinary ingredient but also as a plant with a well-documented history of medicinal use [7]. Figure 1 shows the whole plant and parts of *A. cepa* plants. Belonging to the Amaryllidaceae family, *A. cepa* has been traditionally used to treat conditions such as infections, inflammation, diabetes, and cardiovascular disorders [8]. Its therapeutic properties are attributed to a wide array of bioactive compounds, including flavonoids (notably quercetin), organosulfur compounds (such as allicin and thiosulfinates), tannins, saponins, and phenolic acids. These compounds have been shown to possess antioxidant, antimicrobial, antidiabetic, anticancer, and anti-inflammatory activities, supporting the plant's ethnopharmacological relevance [9,10].

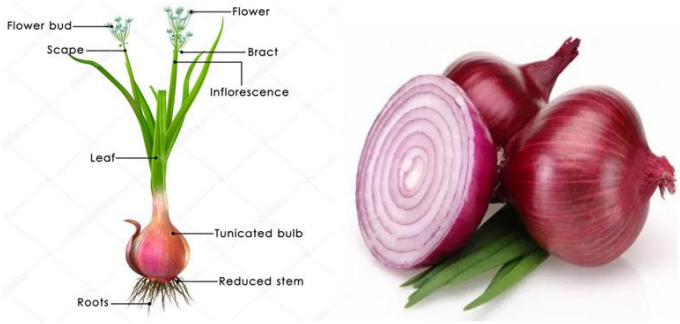

Figure 1: Whole plant and parts (bulb) of *Allium cepa*

Although whole plant extracts have shown considerable pharmacological activity, the therapeutic use of crude preparations can be limited due to variability in composition, potential toxicity, and the presence of inactive or interfering substances. Therefore, isolating and characterizing individual bioactive compounds is essential for understanding their specific mechanisms of action, optimizing dosage, ensuring consistency, and guiding the development of standardized formulations or lead compounds for drug development [11]. In the context of *Allium cepa*, isolating pure compounds offers an opportunity to dissect its therapeutic potential more precisely. Bioactive components such as quercetin and sulfur-based compounds, have been implicated in disrupting bacterial cell membranes, inhibiting DNA synthesis, and modulating oxidative stress responses [12,13]. These mechanisms suggest a valuable role of onion-derived compounds in the management of infections, especially those caused by resistant microbial strains [14]. However, comprehensive studies involving compound purification, structural elucidation, and targeted bioassays have been limited.

Numerous scientific investigations have highlighted the antimicrobial potential of *Allium cepa* (onion) extracts against a wide range of pathogenic microorganisms, particularly *Staphylococcus aureus* and *Escherichia coli*. These studies primarily utilized crude aqueous or ethanolic extracts and have consistently confirmed the presence of bioactive phytochemicals through preliminary screening methods and standard *in vitro* assays [15-17]. These findings provide a strong foundation for appreciating the medicinal value of *Allium cepa*; however, they are often limited in scope and depth. One of the most significant limitations of these studies was the general absence of purified compounds. Rather than isolating the specific constituents responsible for antimicrobial activity, most research relies on complex, unrefined mixtures, which complicates the identification of active compounds. Moreover, the applications of advanced analytical techniques are limited [18].

Recently, chromatographic and spectroscopic techniques have advanced the study of plant secondary metabolites, making it possible to isolate pure compounds and elucidate their structures. Thin Layer Chromatography (TLC) and Flash Column Chromatography are effective separation methods used in phytochemical analysis, allowing for the purification of individual compounds from complex plant extracts [19,20]. Further characterization can be achieved through a combination of spectroscopic techniques such as Infrared Spectroscopy (IR), Ultraviolet-Visible Spectroscopy (UV-Vis), Mass Spectrometry (MS), and Nuclear Magnetic Resonance (NMR). These techniques provide comprehensive structural insights crucial for the identification and potential pharmaceutical development of novel compounds [21-23].

Given the global health imperative to discover new antimicrobial agents [3]. This study was designed to extract, isolate, and assess the antimicrobial activity of bioactive compounds present in the ethanolic extract of *Allium cepa*. This integrated phytochemical and microbiological approach not only aims to validate the traditional use of *Allium cepa* as an antimicrobial agent, but also contributes to the broader field of natural product drug discovery. The findings of this study are expected to offer insights into the potential of onion-derived compounds as alternative or adjunctive treatments to combat antibiotic-resistant infections. Furthermore, by extracting and isolating specific compounds, this study sets the foundation for future mechanistic and preclinical investigations, including cytotoxicity studies, synergistic effects with existing antibiotics, and *in vivo* efficacy.

MATERIALS AND METHODS

Materials, Chemicals and Reagents

Methanol, Ethyl acetate, acetic acid, and ethanol were purchased from Dae-Jung Chemicals (South Korea). The reagents and materials were obtained from the Chemistry and Pharmacology Laboratory of the School of Pharmacy, Central University. All the other solvents and chemicals used in this study were of analytical grade. Equipment such as analytical balance (Model ALE-223), Chroma Tank, Econo-glass flash chromatography columns, Perkin Elmer HPLC B00023586 (Singapore), VEEGO melting apparatus (India), hot air oven (Electric Constant Temperature Blant Drying Oven, Model DGT-G500-X), Autoclave (Model CJ-18LDJ), and other apparatuses such as petri dishes, beakers, pipettes, and an iodine chamber were also used in the study.

Experimental Design

This study was a laboratory-based experimental investigation aimed at extracting, isolating, and assessing the antimicrobial activity of bioactive compounds found in the ethanolic extract of *Allium cepa*. The bacterial strains used for the tests were obtained from the Microbiology Laboratory of the Department of Pharmaceutical Sciences at the Central University, Ghana. This research was conducted across both chemistry and microbiological laboratories within the same department. The plant extract was subjected to phytochemical screening to identify its constituents, after which the bioactive compounds were isolated, purified, and evaluated for antimicrobial efficacy using the serial broth dilution method. The experimental procedure is illustrated in Figure 2.

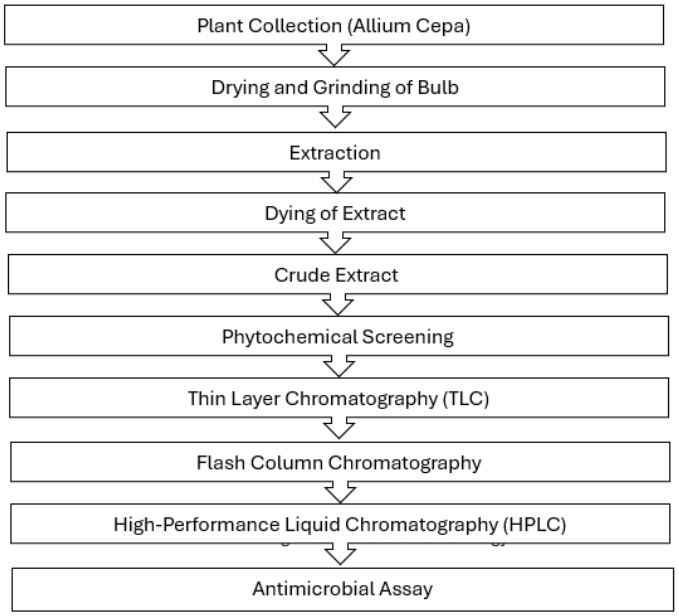

Figure 2: Flowchart of experimental procedure

Plant Collection and Authentication

Fresh bulbs of *Allium cepa* were collected from Aburi, eastern Ghana. The plant material was authenticated by Dr. Asafo Yeboah Adjei at the Center for Plant Medicine Research (CPMR), Mampong-Akuapem, Ghana. A voucher specimen was deposited with the identification number CPMR5200/2024. The bulbs were washed,

sliced, and air-dried at room temperature for two weeks until a constant weight of 369 g was obtained. The dried sample was milled into a fine powder, yielding 316 g of the powdered material.

Extraction Method

Powdered *Allium cepa* samples were extracted using cold maceration as described by [24] with slight modification. The plant material was soaked in 2500 mL 95% ethanol and 5% distilled water for 72 h with intermittent shaking. The mixture was first filtered through cotton wool and then through Whatman No. 1 filter paper using vacuum filtration. The filtrate was concentrated using a rotary evaporator under reduced pressure at 40–45°C, yielding a brown crude extract weighing approximately 22 g (Figure 3). The extract was stored in an amber bottle at 4°C until further use.

Figure 3: Crude Extract of *Allium cepa*

Phytochemical Screening

Preliminary phytochemical analysis was conducted on A. cepa extracts using the standard methods described by Trease and Evans [25]. Tannins, flavonoids, saponins, and alkaloids were screened qualitatively.

Thin Layer Chromatography (TLC)

Thin Layer Chromatography was performed using silica gel-coated TLC plates (0.25 mm thickness) as described by [26] with minor modifications. A solvent system comprising methanol and ethyl acetate in a 6:4 ratio was used. The crude extract was dissolved in the same solvent mixture and spotted onto a thin-layer chromatography (TLC) plate using capillary tubes. The plates were developed in a chroma tank, dried, and visualized under UV light at 365 nm. Three distinct spots were observed with retention factor (Rf) values of 0.29, 0.33, and 0.50 were observed.

Flash Column Chromatography

Flash Column Chromatography was employed to isolate pure compounds as described by [27]. The set-up is shown in figure 4 below. A 250 mL glass column was packed with silica gel (40–63 µm) preconditioned with a methanol: ethyl acetate solvent system. 6 g of the crude extract were pre-adsorbed onto silica, dried, and applied to a column. Elution was performed under pressure (2 psi), and fractions were collected, analyzed via TLC, and pooled based on identical Rf values. The isolate corresponding to Rf = 0.5 was collected, dried, and stored for further analysis as shown in Figure 6b.

High Performance Liquid Chromatography

High-performance liquid chromatography (HPLC) was used to assess the purity of the compound isolated from the ethanolic extract of *Allium cepa*. The process followed the method described by [28] with slight changes. The analysis was conducted using a Perkin Elmer HPLC system equipped with a C18 reverse-phase column, which is highly effective in separating organic compounds based on their polarity. A mixture of methanol and ethyl acetate was used as the mobile phase, which was selected because of its prior success in TLC and flash chromatography. The choice of analytical technique and instrumentation reflects the rigorous standards applied in the investigation to confirm the identity, integrity, and homogeneity of the purified compound.

Antimicrobial Assessment and MIC Determination

To evaluate the pharmacological potential of the isolated compound AC, its antimicrobial activity and Minimum Inhibitory Concentration (MIC) were evaluated against *Escherichia coli* and *Staphylococcus aureus* using the microbroth dilution method combined with the MTT assay [29]. The procedure was performed in a sterile 96-well microplate to ensure the experimental accuracy. Each well was filled with 75 µL of nutrient broth, followed by 75 µL of serially diluted compound AC at concentrations ranging from 50 mg/mL to 0.39 mg/mL, prepared from a 200 mg/mL stock solution. Test organisms (5 µL each) were aseptically added to one row of wells, resulting in a total volume of 155 µL per well. After incubation at 37°C for 24 h, the MTT reagent was added, and the plate was incubated for an additional 10 min. The presence of bacterial growth was indicated by a color change from yellow to purple, whereas wells with no growth remained yellow. The MIC was defined as the lowest concentration at which no color change (no bacterial growth) occurred. Nutrient broth served as the negative control, whereas ciprofloxacin and clindamycin were used as positive standards for comparison.

RESULTS

Phytochemical Screening

The results of phytochemical screening of *Allium cepa* are presented in Table 1. The extracts contained alkaloids, flavonoids, tannins, and saponins.

Thin Layer Chromatography (TLC) of Crude Extract

The calculated RF values of the spots observed on TLC plates, as illustrated in Figure 5, are presented in Table 2.

Flash Column Chromatography

Six separate eluents (E1-E6) were collected at different intervals and analyzed together on a single TLC plate. Each eluent produced the same distinct spot, indicating the presence of an identical compound across all eluents (Figure 6a). The RF values for the spots were calculated and are listed in Table 3.

High Performance Liquid Chromatography

High-Performance Liquid Chromatography (HPLC) was used to assess the purity of the isolated compound AC. The analysis revealed a single prominent peak at 17.678 min, indicating that the compound was highly pure (Figure 7).

Antimicrobial Assessment and MIC Determination

The Minimum Inhibitory Concentrations (MICs) of the isolated compound AC and the reference antibiotics were determined against *Escherichia coli* and *Staphylococcus aureus* using the microbroth dilution method alongside the MTT assay. The results are presented in Table 5.

DISCUSSION

This study explored the extraction, isolation, and antimicrobial assessment of bioactive compounds from the ethanolic extract of *Allium cepa* (onion), a plant renowned for its culinary uses and

traditional medicinal applications [8]. These findings offer valuable insights into the antimicrobial potential of onion-derived compounds,

Figure 4: Flash Clumn Chromatography of the Crude Extract

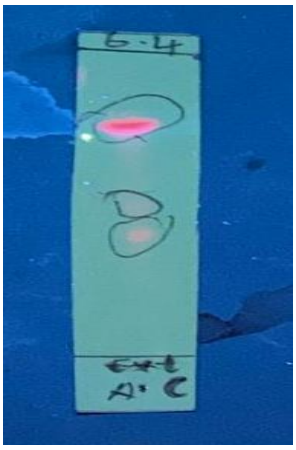

Figure 5: Three distinct spots developed from TLC

a b

Figure 6: (a) TLC of Isolates from Flash Column chromatography, (b) Pure Compound, AC Isolated from *Allium cepa*

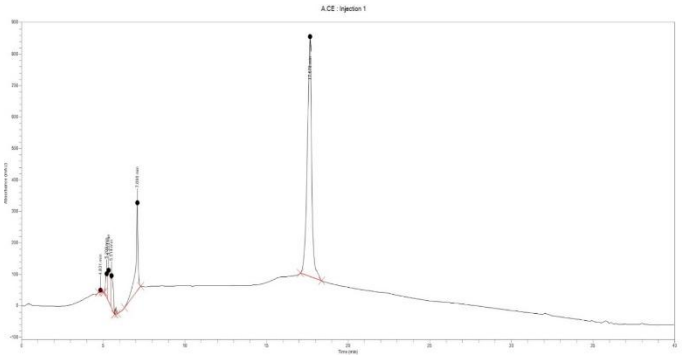

Figure 7: Chromatograph of HPLC Analysis of Compound AC

Table 1: Phytochemical Analysis of *Allium cepa* Extracts

Phytochemicals	Results
Alkaloids	Positive
Flavonoids	Positive
Tannins	Positive
Saponins	Positive

Table 2: RF-Values of Spots from TLC of Crude Extracts

Spot	RF Value
1	0.29
2	0.33
3	0.5

Table 3: RF-Values of Eluents from Flash Column Chromatography

Eluents	Number of Spot	RF Value
E1	1	0.49
E2	1	0.49
E3	1	0.50
E4	1	0.50
E5	1	0.49
E6	1	0.49

Table 4: Melting Point and Solubility of Isolated Compound AC

Sample	Melting Point	Solubility in DMSO	Solubility in Methanol
Compound AC	317°C	Soluble	Soluble

particularly in the context of increasing antibiotic resistance, and contribute meaningfully to the ongoing exploration of medicinal plants as sources of new therapeutic agents. Antimicrobial resistance remains a major global public health concern, driving the demand for novel, effective, and safe antimicrobial agents [4]. In this context, plant-derived phytochemicals are gaining recognition as promising candidates for the development of next-generation antimicrobial drugs. Medicinal plants such as *Allium cepa* are of particular interest because of their availability, affordability, and long-standing use in traditional medicine. The presence of a wide array of bioactive phytochemicals makes them attractive candidates for pharmaceutical research.

Phytochemical screening of A. *cepa* ethanolic extract revealed the presence of alkaloids, flavonoids, tannins, and saponins (Table 1). These classes of compounds are well-documented for their broad-spectrum pharmacological effects. Flavonoids, particularly quercetin,

which is abundant in onions, are recognized for their ability to disrupt microbial membranes, inhibit nucleic acid synthesis, and modulate immune responses. Tannins are known for their astringent properties, and can inactivate microbial adhesins, enzymes, and cell envelope transport proteins. Similarly, alkaloids and saponins contribute to antimicrobial and surface-active properties, respectively, and often work synergistically with other phytochemicals to enhance their bioactivity [30]. The detection of these compounds in the extract supports the observed antimicrobial effects and validates the traditional use of *A. cepa* for treating infections.

The separation and purification of bioactive compounds were achieved by thin-layer chromatography (TLC) and Flash Column Chromatography. TLC analysis of the crude extract revealed three distinct spots, with RF values of 0.29, 0.33, and 0.50, indicating the presence of multiple phytoconstituents. Flash Column Chromatography facilitated the isolation of a consistent compound (compound AC) across the six eluents, all of which showed identical RF values (~0.49–0.50). This reproducibility suggests that AC was the predominant active constituent of the extract. The isolated compound demonstrated physicochemical properties characteristic of stable organic molecules, including a melting point of 317°C and good solubility in both DMSO and methanol as indicated in Table 4. These attributes support its suitability for further pharmacological testing and formulation development.

The purity of AC was confirmed via High-Performance Liquid Chromatography (HPLC), which yielded a single sharp peak at 17.678 min (Figure 7). The presence of a single dominant peak indicated a high degree of purity and suggested the successful isolation of a singular compound rather than a mixture. The use of a C18 reverse-phase column and a methanol–ethyl acetate solvent system, previously optimized for TLC and flash chromatography, enhanced the resolution and effectiveness of this analytical step. HPLC is widely regarded as a robust and sensitive tool for qualitative and quantitative analysis of natural products, and its inclusion in this study reinforces the methodological rigor applied throughout.

The antimicrobial activity of compound AC was evaluated using the micro broth dilution method in combination with the MTT assay against two clinically significant bacterial strains: *Escherichia coli* (gram-negative) and *Staphylococcus aureus* (gram-positive). The MIC values were recorded as 3.91 mg/mL for *E. coli* and 0.5 mg/mL for *S. aureus* in Table 5. These results demonstrate that AC possesses considerable antibacterial activity, particularly against *S. aureus* which support previous studies [31,32]. Although the MIC values were higher than those of standard antibiotics, ciprofloxacin and clindamycin (both <0.1 mg/mL against *S. aureus*), it is noteworthy that the compound is a crude isolate from a natural source, and refinement or derivatization could enhance its potency. The method used to determine MIC, the micro broth dilution method with MTT dye, adds robustness and clarity to the antimicrobial assay [33]. MTT, a tetrazolium salt, provides a colorimetric indication of microbial viability, with live cells reducing MTT to purple formazan. Wells that retained the yellow color of MTT indicated inhibition of microbial growth. This method not only provides visual clarity but also allows for the semi-quantitative assessment of antimicrobial activity. Moreover, the inclusion of both negative (nutrient broth) and positive controls (ciprofloxacin and clindamycin) strengthened the reliability of the assay and ensured that the results were not due to contamination or procedural error.

The findings of this study reinforce and extend previous studies on the antimicrobial potential of *Allium cepa* [14]. While most earlier studies have focused on crude extracts, this work distinguishes itself by isolating and characterizing a single bioactive compound and evaluating its efficacy in a controlled setting. The integration of chromatographic purification and standardized antimicrobial testing represents a more rigorous approach, contributing to the development of *A. cepa* as a credible source of therapeutic agents. In an era in which antibiotic resistance poses a growing threat to global health, the discovery of plant-derived compounds with antimicrobial properties is more important than ever [34]. Compound AC, isolated from *Allium cepa*, may serve as a lead compound for the development of new antimicrobial drugs, particularly those targeting Gram-positive pathogens. Additionally, future studies could explore its potential synergistic effects with existing antibiotics, its mechanism of action at the molecular level, and its safety profile through cytotoxicity and in vivo studies.

Beyond antimicrobial applications, the broader phytochemical composition of *A. cepa* suggests its potential anti-inflammatory, antioxidant, and anticancer effects, which could be explored in follow-up studies [35]. It would also be beneficial to investigate the full chemical structure of compound AC using advanced spectroscopic techniques, such as Nuclear Magnetic Resonance (NMR) and Mass Spectrometry (MS), to facilitate synthetic replication or structural optimization. This study provides strong evidence for the antimicrobial activity of a compound isolated from the ethanolic extract of *Allium cepa*. The combination of phytochemical screening, chromatographic purification, and robust antimicrobial evaluation techniques yielded a compound with notable activity against *Staphylococcus aureus*, supporting its traditional use in treating infections. Although further research is needed to fully characterize and optimize the pharmacological properties of the compound, the findings offer a valuable contribution to natural product research and highlight the ongoing relevance of medicinal plants in modern drug discovery.

CONCLUSION

This study successfully demonstrated the extraction, isolation, and antimicrobial activity of a bioactive compound (AC) from the ethanolic extract of *Allium cepa*. Preliminary phytochemical screening confirmed the presence of key secondary metabolites, whereas chromatographic techniques facilitated the isolation of a pure compound with significant antimicrobial activity. Compound AC exhibited a measurable inhibitory effect, particularly against *Staphylococcus aureus*, supporting the traditional medicinal use of *Allium cepa* for treating infections. The use of HPLC, TLC, and MTT-based MIC determinations enhanced the reliability of the results. Future research should focus on the structural elucidation, mechanism of action, toxicity profiling, and in vivo studies to explore its potential as a candidate for novel antimicrobial therapies.

Acknowledgments

The authors are grateful to the technical staff of the Department of Pharmaceutical Sciences, Central University for their assistance in the laboratory.

Conflict of interest

The authors declared no conflict of interest.

Financial Support

None declared.

ORCID ID

Dickson Aboagye: https://orcid.org/0009-0006-2780-6989

Caleb Ofori Bandoh: https://orcid.org/0009-0000-0297-1677

Kingsley Ofolikwei Quaye: https://orcid.org/0009-0009-9471-2722

Josephine Frimpomaa Oppong: https://orcid.org/0009-0008-1633-6402

Justice Yao Akakpo: https://orcid.org/0009-0004-7507-6277

Emmanuel Ogwoh Chisom: https://orcid.org/0009-0002-4206-6254

Kelvin Amankwah Sarfo: https://orcid.org/0009-0001-2804-9960

REFERENCES

1. Babu R, Begam MA, Chahal KS, Harale AA. Plants and traditional uses and modern applications. J Neonatal Surg. 2025;14(3):162.
2. Jamshidi-Kia F, Lorigooini Z, Amini-Khoei H. Medicinal plants: Past history and future perspective. J HerbMed Pharmacol. 2018;7:1–7.
3. Salam MA, Al-Amin MY, Salam MT, Pawar JS, Akhter N, Rabaan AA, et al. Antimicrobial resistance: A growing serious threat for global public health. Healthcare (Switz). 2023;11(13):1–15.
4. Ahmed SK, Hussein S, Qurbani K, Ibrahim RH, Fareeq A, Mahmood KA, et al. Antimicrobial resistance: Impacts, challenges, and future prospects. J Med Surg Public Health. 2024;2:100081.
5. Chaachouay N, Zidane L. Plant-derived natural products: A source for drug discovery and development. Drugs Drug Candidates. 2024;3(1):184–207.
6. Nguyen MH, Nguyen TYN, Le THN, Le TNT, Chau NTN, Le TMH, et al. Medicinal plants as a potential resource for the discovery of novel structures towards cancer drug resistance treatment. Heliyon. 2024;10(20):e39229.
7. Chakraborty AJ, Uddin TM, Matin Zidan BMR, Mitra S, Das R, Nainu F, et al. Allium cepa: A treasure of bioactive phytochemicals with prospective health benefits. Evid Based Complement Alternat Med. 2022;2022:1–20.
8. Teshika JD, Zakariyyah AM, Zaynab T, Zengin G, Rengasamy KRR, Pandian SK, et al. Traditional and modern uses of onion bulb (*Allium cepa* L.): A systematic review. Crit Rev Food Sci Nutr. 2019;59(Suppl 1):S39–70.
9. Singh N, Gusain A, Nigam M, Mishra AP. The pharmacological and therapeutic versatility of *Allium* species: A comprehensive exploration of bioactive constituents and biological activities. Discov Appl Sci. 2025;7:1–20.
10. Zhao XX, Lin FJ, Li H, Li HB, Wu DT, Geng F, et al. Recent advances in bioactive compounds, health functions, and safety concerns of onion (*Allium cepa* L.). Front Nutr. 2021;8:1–15.
11. Rasoanaivo P, Wright CW, Willcox ML, Gilbert B. Whole plant extracts versus single compounds for the treatment of malaria: Synergy and positive interactions. Malar J. 2011;10:1–12.
12. Marrelli M, Amodeo V, Statti G, Conforti F. Biological properties and bioactive components of *Allium cepa* L.: Focus on potential benefits in the treatment of obesity and related comorbidities. Molecules. 2019;24:119.
13. Chakraborty AJ, Uddin TM, Matin Zidan BMR, Mitra S, Das R, Nainu F, et al. *Allium cepa*: A treasure of bioactive phytochemicals with prospective health benefits. Evid Based Complement Alternat Med. 2022;2022:1–20.
14. Oyawoye OM, Olotu TM, Nzekwe SC, Idowu JA, Abdullahi TA, Babatunde SO, et al. Antioxidant potential and antibacterial activities of *Allium cepa* (onion) and Allium sativum (garlic) against multidrug resistant bacteria. Bull Natl Res Cent. 2022;46(1):1–9.
15. Sagar NA, Pareek S. Antimicrobial assessment of polyphenolic extracts from onion (*Allium cepa* L.) skin of fifteen cultivars by sonication-assisted extraction method. Heliyon. 2020;6(11):e05412.
16. Yash S, Gourav T, Sandhya T. Antimicrobial potential activity of onion (*Allium cepa*) waste extracts prepared in different solvent systems. J Multidiscip Res. 2024;14:14–27.
17. Santas J, Almajano MP, Carbó R. Antimicrobial and antioxidant activity of crude onion (*Allium cepa* L.) extracts. Int J Food Sci Technol. 2010;45(2):403–9.
18. Panda SR, Meher A, Prusty G, Behera S, Prasad BR. Antibacterial properties and therapeutic potential of few medicinal plants: Current insights and challenges. Discov Plants. 2025;2(1):21.
19. Sharma P, Modi N, Chaudhary H, Desai K. Techniques used in isolation of secondary metabolites. 2023:179-204. Available from: https://www.researchgate.net/publication/382912203
20. Bajpai VK, Majumder R, Park JG. Isolation and purification of plant secondary metabolites using column-chromatographic technique. Bangladesh J Pharmacol. 2016;11(4):844–8.
21. Lozada-Ramírez JD, Ortega-Regules AE, Hernández LR, De Parrodi CA. Spectroscopic and spectrometric applications for the identification of bioactive compounds from vegetal extracts. Appl Sci. 2021;11(7):1–20.
22. Rakhee, Mishra J, Sharma RK, Misra K. Characterization techniques for herbal products. In: Management of high altitude pathophysiology. Elsevier; 2018. p. 171–202.
23. Gebretsadik T, Linert W, Thomas M, Berhanu T, Frew R. LC-NMR for natural products analysis: A journey from an academic curiosity to a robust analytical tool. Sci. 2019;1(1):31.
24. Chuah PN, Nyanasegaram D, Yu KX, Mohamed Razik R, Al-Dhalli S, Kue CS, et al. Comparative conventional extraction methods of ethanolic extracts of *Clinacanthus nutans* leaves on antioxidant activity and toxicity. Br Food J. 2020;122(10):3139–49.
25. Charles W, Bpharm E, Fibiol D, Frpharms F, London E, York N, et al. Trease and Evans pharmacognosy. 16th ed. London: Elsevier; 2009.
26. Urbain A, Simões-Pires CA. Thin-layer chromatography for the detection and analysis of bioactive natural products. In: Encyclopedia of analytical chemistry. Wiley; 2020. p. 1–29.
27. Kale A, Aher A, Nehete J, Navale N, Morade M. Isolation of phytopharmaceuticals by flash chromatography. Int J Creat Res Thoughts. 2024; 12(2):859-65.
28. Chiu S, Wang T, Belski M, Abourashed EA. HPLC-guided isolation, purification and characterization of phenylpropanoid and phenolic constituents of nutmeg kernel (*Myristica fragrans*). J Chromatogr Sci. 2022;60(10):919–27.
29. Houdkova M, Chaure A, Doskocil I, Havlik J, Kokoska L. New broth macrodilution volatilization method for antibacterial susceptibility testing of volatile agents and evaluation of their toxicity using modified MTT assay in vitro. Molecules. 2021;26(14):1–14.
30. Riaz M, Khalid R, Afzal M, Anjum F, Fatima H, Zia S, et al. Phytobioactive compounds as therapeutic agents for human diseases: A review. Food Sci Nutr. 2023;11:2500–29.
31. I NC, K IE, K AU, C AO, Kenneth U. In-vitro antibacterial and synergistic activities of extracts of *Allium cepa* and *Allium sativum* with selected antibiotics on *Escherichia coli* and *Staphylococcus aureus*. South Asian J Res Microbiol. 2021 Aug 10;32–44.
32. Enejiyon S, Abdulrahman AH, Adedeji A, Abdulsalam R, Oyedum M. Antibacterial activities of the extracts of *Allium sativum* (garlic) and *Allium cepa* (onion) against selected pathogenic bacteria. Tanzan J Sci. 2020;46(3):914–22.
33. Balouiri M, Sadiki M, Ibnsouda SK. Methods for *in vitro* evaluating antimicrobial activity: A review. J Pharm Anal. 2016;6(2):71–9.
34. Angelini P. Plant-derived antimicrobials and their crucial role in combating antimicrobial resistance. Antibiotics. 2024;13(8):746.

35. Prima SR, Elfahmi, Julianti E, Fidrianny I. Update review: Ethnopharmacological, bioactivity and phytochemical of *Allium cepa* L. Pharmacia. 2023;70(3):717–24.

HOW TO CITE THIS ARTICLE
Aboagye D, Bandoh CO, Quaye KO, Oppong JF, Akakpo JY, Chisom EO et al. Extraction, isolation, and antimicrobial evaluation of bioactive compounds from the ethanolic extract of *Allium cepa* L. J Phytopharmacol 2025; 14(3):170-176. doi: 10.31254/phyto.2025.14307