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# Antibacterial activity of isoquinoline isolated from *Andrographis serpyllifolia*

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***Abstract***---The medicinal herb *Andrographis serpyllifolia* is used in various ethnobotanical preparations due to its high therapeutic value. In this study, the antibacterial activity of aqueous, hexane, chloroform and methanol extract of *A. serpyllifolia* extracts were tested against human pathogenic bacteria *Campylobacter jejuni*- ATCC 29428, *Neisseria gonorrhoeae*- ATCC 49226, *Haemophilus influenzae*- ATCC 10211, *Enterobacter aerogenes*- ATCC 13048 and *Mycobacterium tuberculosis*- MTCC 300. Among the extracts tested aqueous and methanol extract recorded significant inhibitory activity. Methanol extract was further subjected to bioactivity directed fractionation coupled with isolation and characterization. Purification of the bioactive principle was done by subjecting the crude extract to thin layer, column and HPLC analysis. The fraction exhibiting the antibacterial activity with highest purity and yield was further subjected to $^{1}H$ and $^{13}C$ NMR and LC-MS analysis to elucidate its structure. The compound was identified as $C_{17}H_{27}NO$ with IUPAC name 8-(3, 4- dihydroisoquinolin-2(1*H*)-yl) octan-1-ol. Further MIC of the isolated compound against *C. jejuni*, *H. influenza* and *M. tuberculosis* was 500, 500 and 250 µg/ml respectively. The present study is successful in isolating a plant bioactive principle responsible for the antibacterial activity.

***Keywords***---Andrographis serpyllifolia, Antibacterial activity, Isoquinoline compound.

## Introduction

Plants are treasure house of medicinally important biological compounds and because of their therapeutic values; they are used as herbal medicine since ancient times (Ali, 2020). Long established practices of traditional medicine in many countries across the world, make use of these medicinal plants. The conventional medicine methods are based on the theories, beliefs, and experiences of different cultures across eras, which are known to maintain, improve the health and also helpful in the prevention, diagnosis and treatment of various diseases (Firenzuoli and Gori, 2007; Castronovo et al., 2021). Among the plant diversity, the family Acanthaceae is mainly consisting of shrubs with 250 genera and 2500 species. The *Andrographis serpyllifolia* of Acanthaceae family is a tall herb found in South India's foothills and damp woodlands. Every part of this plant has been significantly used in the Indian traditional medicine system and Chinese herbal medicine system against fever, cancer, inflammation, snake bites, malaria, digestive disorders, dysentery and diabetes (Damu et al., 1999; Ignacimuthu et al., 2006). *Review of literature on A. serpyllifolia revealed that aqueous and methanolic extract of the plant has antiproliferative and antioxidant properties. The leaves and stem decoctions have been known for their excellent biomedical applications such as* anti-bacterial, antidiabetic, anticancer, antiulcer and anti-inflammatory activities. It is a traditionally used herbal medicine against malaria and dysentery in India. The leaf extract is effective against jaundice, cures fever and wounds (Palithya et al., 2018).

Phytochemical profiles and their possible correlation with antibacterial and antioxidant properties of this plant have been evaluated. Andrographolide, apigenin, 7, 4, 1- dimethyl ether, techtochrysin and serpyllin are reported to be the phytochemical in *A. serpyellifolia* (Venkateshaiah et al., 2009). The anticancer and hypolipidemic activity of *A. serpyliifolia* was proved with respect to its leaf and root extracts by several researchers (Govindachari et al., 1968; Chelluboina and Manga, 2010). The anti-inflammatory property on rat models was also demonstrated by Shankar and Rao (2016). Its inhibitory action of *A. serpyllifolia* against several diseases viz., cancer, diabetes, jaundice, malaria, typhoid etc., was depicted (Rao et al., 2014). The presence of compounds with antimicrobial activity, namely, E-2-Tetradecen-1-01; Pentadecanal; 1, 15-Pentadecanediol; 2-Tetradecanone; 2 – Tetradecanone ($C_{14}H_{28}O$ and Pentadecanal ($C_{15}H_{32}O$), was confirmed via GS/MS chromatogram of *A. serpyllifolia* ethanolic extract (Hemalatha et al., 2017).

## Materials and Methods

### Collection of plant materials

*Aerial parts of A. serpyllifolia* were collected from Hassan district, Karnataka. India and identified. The collected plant materials were washed several times with water and shade dried. The stem and leaves of *A. serpyllifolia* were coarse powdered by using waring blender and stored in air tight container for further use.

**Plant material extraction**
**Aqueous extraction**

The aerial plant material was macerated in a Waring blender (Waring International, New Hartford, CT, USA) for 10 minutes with 100 mL of sterile distilled water. Before being centrifuged for 30 minutes at 4000 rpm, the macerate was first filtered through two layers of muslin fabric. After sterilization at 120 °C for 30 minutes, the supernatant was filtered using Whatman filter paper No. 1. The extract was stored aseptically at 5 oC until use in a brown container. It was then put through an antibacterial activity test (Raghavendra et al., 2006).

**Solvent extraction**

25 gms of powdered raw material was dissolved in methanol, chloroform and hexane. Samples were kept in water bath for 4 h for extraction at 50 °C. All the solvent extracts were filtered by using Whatman filter paper No.1 and the extracted solvents were evaporated to dryness using rotary flash evaporator, weighed and preserved for further studies (Harborne 1998; Abubakar and Haque 2020). By using the well diffusion technique, all crude extracts were tested for their ability to inhibit the growth of Neisseria gonorrhoeae (ATCC 49226), Haemophilus influenza (ATCC 10211), Campylobacter jejuni (ATCC 29428), Enterobacter aerogenes (ATCC 13048), and Mycobacterium TB (MTCC 300).

**Antibacterial activity assay**

Agar plates containing Soya bean casein digestion were injected with the bacterial solution. Hexane, chloroform and methanol crude extracts were dissolved in methanol. Standard is prepared by dissolving Ciprofloxacin in water which serves as positive control. *E. aerogenes* and *H. influenzae* inoculated plates were incubated chamber for 24 h at 37 °C in aerobic., whereas plates inoculated with *N. gonorrhoeae, M. tuberculosis* and *C. jejuni* were incubated in an anaerobic chamber for 24 h at 37 °C. The plates were observed after incubation for inhibition zone if any (Sen and Batra, 2012). Experiments were carried out in triplets and results were recorded as mean of triplicates ± standard error (ANOVA).

**Minimum Inhibitory Concentration (MIC)**

Bacterial cultures grown on peptone broth were taken to prepare the cell suspension of 1 x $10^8$cells / mL. The peptone broth bacterial culture without solvent extract served as control. Different concentrations of plant extracts (3000, 1500, 750, 375, 187, 93.75 and 46.87µg/ml) were dissolved in 90 µL of solvent and were mixed in 96 well plates. Cultures were incubated at 37 °C, broth was observed after 24-48 h and O.D at 590 nm was measured in plate reader. The MIC was determined as the minimum concentration of extract with 50% inhibition as compared with control.

**Phytochemical Analysis**

The presence of flavonoids, phenols, alkaloids, steroids, saponins, carbohydrates, oils, fats and terpenoids were recorded as described by Harborne (1998). The analysis was made by visual examination of colour change / development of a precipitate following the addition of reagents (Yadav and Agarwala, 2011).

**Chromatographic separation of the crude extracts**

100 mg of methanol extract was used for Liquid –Liquid (L-L) partition to obtain chloroform, methanol and hexane fractions using separating funnel. TLC plates were prepared using silica gel 0.25 mm with fluorescent indicator $F_{254.}$ Sample containing 10 mg / mL of L-L fractions were prepared with respective solvents, 2.5 µL of samples were spotted on TLC plate and allowed to dry. Samples were eluted using chloroform: methanol (9.5; 0.5) mobile phase. Plates were removed after optimal development time then dried and spots were detected at visible light, 366 nm and 254 nm. By using standard formula, Rf values were calculated (Shahverdi, et al., 20017). The HPLC analysis was carried out in Shimadzhu LC-Prominence 20 AT using C18 column 250 mm x 4.6 mm, 5µ particle. Samples (10 mg/mL) were prepared from stock respectively in HPLC grade solvents i.e., methanol, chloroform and water. Mobile phase was prepared using mixture of HPLC grade methanol (50%) and 50% HPLC grade water. The flow rate of 1 mL/ min was used for separation.

**Column fractionation**

Sample was prepared by dissolving 1.5 g of MLLCF (Methanol Liquid Liquid Chloroform Fraction; Chloroform fraction obtained from methanol extract)) in 4.5 mL of 5% methanol in chloroform. 4 g silica gel H bed was prepared in chromatographic column (300 mm x 15 mm) in chloroform. The prepared sample was loaded to the column and eluted with 120 mL 5% methanol chloroform mixture. 5 mL to 15 mL of fractions were collected in each test tube based on the colour. Fractions with similar pigments were pooled based on the TLC. Column fractions were kept for evaporation. Further, the fractions were analysed by HPLC to check the purity (Bucar et al., 2013).

**Spectral analysis**

Extracted final compound was subjected to elemental analysis and molecular weight determination as per the standard methods. The structure of the compound was established by $^{1}$HNMR $^{13}$CNMR and LC-MS (Cos, et al., 2006). To conduct quantitative studies, the 1HNMR approach was carried out on a 600 MHz NMR spectrometer with optimal acquisition settings. (Yin, et al., 2021. Chemical structure was drawn using ChemDraw.

## Results and Discussion

### Yield summary of plant material after crude extraction

2.86 g, 71.8 mg and 154.7 mg of dried extracted material were obtained by methanol, hexane and chloroform solvents respectively.

### Antibacterial activity of different extracts against test pathogens

All the test pathogens were found to be susceptible against aqueous extracts. Among the pathogens tested *C. jejuni* (18 mm) was found highly susceptible followed by *H. influenzae* (16 mm), *N. gonnorrhoeae* (15 mm), *E. aerogenes* (12 mm) and *M. tuberculosis* (12mm). It was observed that the inhibitory activity is not significant compared to positive control against all the test pathogens. Among the different solvent extracts tested, only methanol extract recorded significant inhibitory activity against all the test pathogens. Significant increase in activity was observed compared to aqueous extract. Susceptibility among the test pathogens was also varied. *C. jejuni* (21 mm) was fond highly susceptible followed by other pathogens (Table 1).

### Minimum inhibitory activity of methanol crude extract

The results confirmed the inhibitory activity of the methanol extract with MIC of 3000, 3000, 1500, 1500 and 750 µg/ml against *E. aerogenes*, *N. gonorrhoeae, C. jejuni*, *M. tuberculosis* and *H. influenza* respectively. The hexane and chloroform extracts didn't show inhibitory activity against all the test pathogens (Table 2). 3000, 3000, 1500, 1500 and 750 µg/ml against *E. aerogenes*, *N. gonorrhoeae, C. jejuni*, *M. tuberculosis* and *H. influenza* respectively.

### Phytochemical analysis

Presence of fats and oils was observed for hexane and chloroform extract along with stain formation whereas it was absent in the methanol extracts. The presence of carbohydrates, alkaloids, terpenoids, steroids, glycosides and phenols in hexane, chloroform and methanol extracts were confirmed. Aminoacids and proteins, oils and fats were present in hexane and chloroform extracts. Saponins and flavonoids tests were positive in methanol extract. Methanol crude extract was selected for Liquid-Liquid extraction as it recorded significant antibacterial activity and MIC against the test pathogens when compared to chloroform and hexane extract.

### Yield after L-L Extraction

1.25 gms, 1.32 gms and 20.5 gms of yield were obtained after L-L extraction with methanol, chloroform and hexane respectively from the crude methanol extract.

**HPLC Chromatogram**

A total of 10, 11 and 13 peaks were observed in methanol, hexane and chloroform extracts respectively; while in MLLMF, a total of 12 peaks were observed, similar number of peaks was noticed in MLLCF. In MLLHF, 13 peaks are observed.

**Antibacterial Assay of the Bioactive Principle**

Isolated compound exhibited the inhibitory activity against *C. jejuni, H. influenzae and M. tuberculosis*, whereas, no inhibitory activity was noticed against *E. aerogenes* and *N. gonorrhoeae* (Table 3). The bacterium *M. tuberculosis* showed high susceptibility followed by *H. influenzae* and *C. jejuni*. MIC of the isolated compound was found to be 500, 500 and 250 µg/ml against *C. jejuni, H. influenzae and M. tuberculosis* respectively (Table 4).

**Spectral Analysis**

The $^{1}$H-NMR spectra showed signals at δ 1.27 due to methylene groups, the multiple signals at δ 2.03 may be due to methylene group attached to unsaturated system. The bunch of signals at δ 2.88, 3.39 and 3.91 suggest the presence of a glycoside or an alkaloid type molecule. The signals at δ 6.94, 7.36, 7.48 and 7.53 suggest the presence of aromatic protons. In the $^{13}$C-NMR spectra of CL-5AF the signals at δ 14.12 is due to methylene group carbon. Along with this the signals at δ 22.70, 25.75, 29.44, 29.63, 29.68, 29.71, 31.94 and 32.81 may be assigned for a number of methylene carbons. The signal at δ 63.11 suggests the presence of a -$CH_2O$ - group. The positive mode ESI-MS spectra showed a pseudo molecular ion peak at m/z 401. The elemental analysis data suggest an empirical formula of $C_{17}$ $H_{27}$ NO

**Proposed structure and details of the isolated compound**

$^{1}$HNMR (300MHz, $CDCl_3$) δ =0.0883 (s, 2H,$CH_2$), 1.27 (m, 2H,$CH_2$), 2.86-2.88 (t,8H,4$CH_2$), 2.89-3.39 (m,16H,8$CH_2$), 3.50 (t,2H,$CH_2$), 3.91-3.96 (m,12H,6$CH_2$), 7.53-7.28 (4H,ArH) ppm, $^{13}$CNMR (300MHz,$CDCl_3$) = 152.2, 135.5, 130.0, 128.5, 127.3, 127.0, 126.2, 77.3, 77.0, 76.7, 63.1, 32.8, 31.9, 29.7, 29.68, 29.63, 29.3, 25.7, 22.7, 14.1 ppm; :m/z=401(M). Based on the predictions the compound was identified as 8-(3, 4- dihydroisoquinolin-2(1*H*)-yl) octan-1-ol. The compound was amorphous with melting point 435.26 K. The other parameters observed were critical volume 874.5 $cm^3$ /mol., Gibbs energy 237.46 kJ / mol., CMR; 8.1348, exact mass 261.21 and molecular weight; 261.4, C- 78.11, H-10.41, N-5.36, O-6.12.

**Discussion**

*A. serpyllifolia* is already reported to possess antibacterial activity against *Escherichia coli, Staphylococcus aureus, Vibrio cholera, Pseudomonas aeruginosa, Shigella sonnei, Enterococcus faecalis, Klebsiella pneumoniae, Salmonella typhi, Candida albicans, Shigella flexneri, Bacillus cereus, Shigella boydii*, *Shigella dysenteriae*, *Sternbergia lutea*, *Vibrio parahaemolyticus* and *Vibrio mimicus* (Khurana et al., 2019), *Staphylococcus aureus, Streptococcus pneumoniae,*

*Pseudomonas fluorescens* and *Escherichia coli* (Madhankumar et al., 2020). It was further examined for its inhibitory action against *Campylobacter jejuni* (ATCC 29428), *Neisseria gonorrhoeae* (ATCC 49226), *Haemophilus influenzae* (ATCC 10211), *Enterobacter aerogenes* (ATCC 13048), and *Mycobacterium tuberculosis* (MTCC 300) in light of its broad-spectrum inhibitory activity. In the earlier experiments, these bacteria weren't employed as test organisms. The methanol extract in the current investigation had little inhibitory action against the pathogens that were tested, however hexane and chloroform extracts didn't exhibit any inhibitory activity at all. The previous findings support the present result (Jamuna Bai et.al. 2011).

Hullatti and Rai (2004) stated that after screening *M. malabaricum* leaf extracts in petroleum ether, chloroform, and methanol, only the methanolic extract had antibacterial activity. Their study supports the methanolic extract of *M. malabaricum* leaves' antibacterial activity. There is evidence of broad-spectrum action in the methanolic extract of the leaves against both human and plant diseases. The widespread use of these medications for treating skin conditions is justified by their effective action against *S. aureus*. These may be utilized in the control of plant diseases since the activity was substantial against plant infections as well. In vitro testing of ethanol chloroform, and acetone extracts of *C. religiosum* revealed antibacterial activity, according to Goud et al. (2005). It is obvious that the plant has antibacterial properties when taking into account the earlier research and the most recent findings.

The antibacterial and phytochemical screening of the methanolic extract of *A. serpyllifolia* leaves has not been extensively studied. The methanolic extract of *A. serpyllifolia* leaves, according to Jamuna Bai et al. (2011), had no effect on the other test organisms but had a considerable inhibitory effect on *S. aureus*, *S. typhi* and *X. oryzae* pv oryzae. This demonstrates the presence of antibacterial elements in the methanolic extract of the leaves. Venkata S. Kotakadi et.al. 2021 demonstrate a quick and easy approach for creating zinc oxide nanoparticles (ZnONPs) utilizing sodium hydroxide, zinc acetate dehydrate, and a leaf extract of the significant anti-diabetic herb *Andrographis serpelifolia* (As). The findings show that As-ZnONPs have both efficient antibacterial action against gram-positive bacteria and possible antioxidant activity. Additionally, the As-ZnONPs may exhibit in vivo anti-diabetic action (rat model). As-ZnONPs' equivalent antidiabetic effectiveness to that of the conventional medication glibenclamide was shown by a number of biochemical indicators, including HbA1C, serum lipid profiles, and liver and kidney functional markers.

*Further phytochemical analysis carried out in the present study is in confirmation with the results published by Palithya et al., (2018).* Present study confirms the presence of carbohydrates, alkaloids, terpenoids, steroids, glycosides, phenols in hexane, chloroform, and methanol extracts by the spectral analysis. Amino acids and proteins, oils and fats were present in hexane and chloroform extracts. Saponins and flavonoids tests were positive in methanol extract. Since different phytochemicals had an affinity and solubility in different solvents, the plant extracts showed differences in phytochemical composition. *In general, these constituents of plants are known to have anti*bacterial, antidiabetic, anticancer, antiulcer, and anti-inflammatory properties. Additionally, this plant also contains

important chemical constituents such as serpyllin, apigenin 7, 4' – dimethyl ether and tectochrysin which are known for their high medicinal value (Palithya et al., 2018).

The presence of numerous secondary metabolites identified in the earliest phytochemical research may be responsible for these medicinal plants' therapeutic properties. The phytochemical features of the plant extracts may account for the variations in their antibacterial activities. It's likely that some of the plants that weren't effective against specific bacteria still had antibacterial components, but in insufficient amounts to be of any benefit. The findings of the current research are somewhat consistent with how the plants have traditionally been used. Plant-based antimicrobials have tremendous therapeutic promise since they can accomplish the same goals as synthetic antimicrobials while causing fewer negative effects. Plant extracts may also be utilized as biocontrol agents in the treatment of plant diseases since they have shown strong action against plant infections. To identify the antibacterial chemicals found in these plants and to ascertain the range of their activity, further investigation is required. The current investigation of the in vitro antibacterial efficacy of the chosen plants serves as the foundation for further phytochemical and pharmacological investigations.

**Conclusion**

The present study is successful in reporting the antibacterial activity of 8-(3, 4-dihydroisoquinolin-2(1*H*)-yl) octan-1-ol against five different human pathogenic bacteria having high pathogenicity, mortality, and drug resistance. The structure proposed is based on the spectral analysis and its biological activity was proven with standard procedures. Review of literatures revealed that isolated biomolecule is not reported by earlier workers indicating novelty of the work.

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Table 1
Antibacterial activity of different extracts against test organisms

| Test organisms | Antibiotic/Extracts | Conc. per well (µg/ml) | Zone of inhibition (mm) |
|---|---|---|---|
| *C. jejuni* | Control | - | - |
| | Ciprofloxacin (Standard) | 2.5 | 30 ±0.577 |
| | Aqueous extract | 2500 | 18± 0.290 |
| | Hexane | 2500 | - |
| | Methanol | 2500 | 21± 0.208 |
| | Chloroform | 2500 | - |
| *N. gonorrhoeae* | Control | - | - |
| | Ciprofloxacin (Standard) | 2.5 | 23±0.577 |
| | Aqueous extract | 2500 | 15±0.312 |
| | Hexane | 2500 | - |

| | | | |
|---|---|---|---|
| | Methanol | 2500 | 18±0.301 |
| | Chloroform | 2500 | - |
| | Control | - | - |
| | Ciprofloxacin (Standard) | 2.5 | 24±0.577 |
| *H. influenzae* | Aqueous extract | 2500 | 16±0.280 |
| | Hexane | 2500 | - |
| | Methanol | 2500 | 20±0.208 |
| | Chloroform | 2500 | - |
| | Control | - | - |
| | Ciprofloxacin (Standard) | 2.5 | 25±0.577 |
| *E. aerogenes* | Aqueous extract | 2500 | 12±0.290 |
| | Hexane | 2500 | - |
| | Methanol | 2500 | 15±0.290 |
| | Chloroform | 2500 | - |
| | Control | - | - |
| | Ciprofloxacin (Standard) | 2.5 | 28±0.577 |
| *M. tuberculosis* | Aqueous extract | 2500 | 12±0.310 |
| | Hexane | 2500 | - |
| | Methanol | 2500 | 20±0.312 |
| | Chloroform | 2500 | - |

Values are mean of triplicates ± Standard Error

Table 2
Minimum inhibitory activity of methanol extract

| Sample Conc. | Methanol extract *C .jejuni* | | *H. influenzae* | | *E. aerogenes* | | *M. tuberculosis* | | *N. gonorrhoeae* | |
|---|---|---|---|---|---|---|---|---|---|---|
| (µg/ml) | OD | % Inhibition | OD | % Inhibition | OD | % Inhibition | OD | % Inhibition | OD | % Inhibition |
| 0 | 0.568 | 0.00 | 0.559 | 0.00 | 0.586 | 0.00 | 0.569 | 0.00 | 0.569 | 0.00 |
| 46.87 | 0.508 | 10.57 | 0.498 | 10.99 | 0.533 | 9.02 | 0.504 | 11.31 | 0.520 | 8.73 |
| 93.75 | 0.437 | 23.05 | 0.439 | 21.47 | 0.479 | 18.15 | 0.458 | 19.38 | 0.460 | 19.16 |
| 187.5 | 0.390 | 31.30 | 0.369 | 33.98 | 0.437 | 25.31 | 0.396 | 30.27 | 0.420 | 26.17 |
| 375 | 0.338 | 40.51 | 0.318 | 43.14 | 0.386 | 34.10 | 0.350 | 38.47 | 0.387 | 32.05 |
| 750 | 0.298 | 47.51 | 0.244 | 56.34 | 0.349 | 40.40 | 0.291 | 48.90 | 0.348 | 38.92 |
| 1500 | 0.248 | 56.32 | 0.197 | 64.81 | 0.302 | 48.48 | 0.242 | 57.52 | 0.309 | 45.80 |
| 3000 | 0.179 | 68.46 | 0.158 | 71.75 | 0.257 | 56.08 | 0.198 | 65.26 | 0.276 | 51.55 |
| MIC | 1500µg/ml | | 750µg/ml | | 3000µg/ml | | 1500µg/ml | | 3000µg/ml | |

Table 3
Antibacterial activity of isolated compound

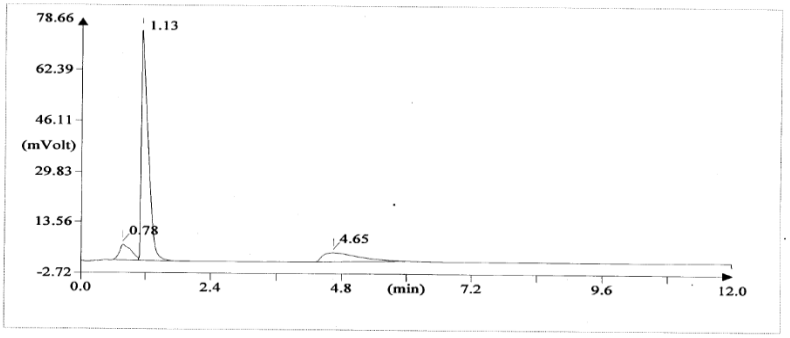
| Test Compounds (Conc. per well 1.0 mg) | Zone of inhibition (mm) | | | | |
|---|---|---|---|---|---|
| | *C.jejuni* | *N. Gonorrhoeae* | *H. influenza* | *Ent. aerogenes* | *M. Tuberculosis* |
| Control(Methanol) | - | - | - | - | - |
| Ciprofloxacin (Standard) (S) | 15±0.577 | 20±0.577 | 18±0.577 | 28±0.577 | 17±0.577 |

| | | | | | |
|---|---|---|---|---|---|
| Isolated Compound | 12±0.318 | - | 14±0.208 | - | 16±0.318 |

Values are mean of triplicates ± Standard Error

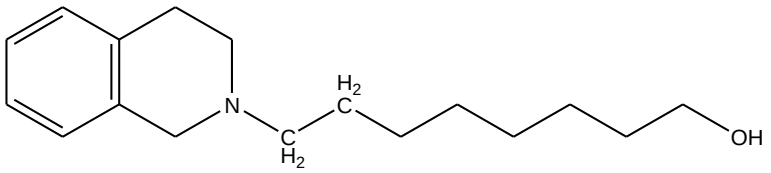
Table 4
Minimum inhibitory activity of isolated compound

| Isolated compound | MIC (µg/mL) | | | | |
|---|---|---|---|---|---|
| | *C. jejuni* | *H. influenzae* | *E. aerogenes* | *M. tuberculosis* | *N. gonorrhoeae* |
| Standard (Ciprofloxacin) | 1 | 0.5 | 1 | 0.5 | 0.5 |
| Isolated compound | 500 | 500 | NA | 250 | NA |




| Element Name | Element % | Ret. Time |
|---|---|---|
| Nitrogen | 3. 78 | 0. 78 |
| Carbon | 40. 32 | 1. 13 |
| Hydrogen | 5. 56 | 4. 65 |

Fig. 1. LC-MS profile chromatography for the eluted purified compound




8-(3,4-dihydroisoquinolin-2(1*H*)-yl)octan-1-ol

Fig. 2. Structure of the bioactive principle