Antidermatophytic, the anticancer and antioxidant activity of *Cassia alata* ethanolic extract and its phytochemical analysis

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**ABSTRACT**

*Cassia alata* is used traditionally to cure various diseases like ulcers, stomach pain and fever. The potential of antidermatophytic, free radical scavenging and cytotoxic activity of ethanol leaves extracts of *C. alata* was studied. The preliminary phytochemical screening assay elucidates that presence of carbohydrates, tannin, phenol, saponin, flavonoid, steroid, terpenoids, glycosides, and alkaloids. Further phytochemical extraction was done by GC-MS, HPLC and FTIR. GC-MS analysis confirms that the presence of two major compounds namely Hexadecanoic acid and Oleic acid with four minor compounds. HPLC techniques revealed that the presence of two major compounds observed in two different retention time. FTIR spectrum revealed that the presence of carboxylic groups, alkanes, aldehydes and aliphatic amines in the ethanol extract of *C. alata* leaves. Cytotoxic effect of ethanol extract was assayed at different concentrations like 10, 25, 50 and 100 μg/ml against human epithelial carcinoma (A431). At100 μg/ml of ethanol concentration, 93.26±5.44 (%) and 82.45±2.44 (%) percentage of cancer cells were inhibited by ethanol extract and standard drug, respectively. Microscopic images of cancer cells treated with ethanol extract confirm the morphological changes and shrinkages of cells leads to cell death. These results were suggesting that Cassia alata exhibit high potential antioxidant, antidermatophytic and cytotoxic activity and also it could serve as alternative new resources for manufacturing new drugs against newly evaluating diseases.

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**INTRODUCTION**

Dermatophytes are mostly fungi that are causing infection in hair nail and skin by producing keratinases enzymes. These proteolytic enzymes are able to hydrolyze keratins which are main protein constituents of hair, nails and skin (Akcgalar *et al.*, 2011). Dermatophytes were colonizing on the host, and an ability to cause an infection leads to enzymatic degradation of keratin (Erbaçi *et al.*, 2004; Simpanya, 2000; Abdel-Rahman, 2001; Macêdo *et al.*, 2005; Baeza *et al.*, 2007). Dermatophytes are cosmopolitan, and it also causes infection in several animal species by creating generally dry, smoothed and usually non-pruritic lesions, distributed on the skin (Pereira and Meireles, 2001). This infection is the most common and most probably caused skin disease in developing countries of tropical regions (Walsh and Groll 1999; Jain and Sharma 2003). These dermatophytes are otherwise known as superficial mycosis causes infections on millions of people and animals. Dermatophytes are a group of highly specialised filamentous fungi, the dermatophytes, which only infect keratinized structures (Burmester *et al.*, 2011). Fungal infections of the skin and nails are frequent...
(Havlickova et al., 2008). The large dermatophytes groups are mostly filamentous keratinophilic fungi genera are Trichophyton, Microsporum and Epidermophyton (Seebacher et al., 2008). They are the members of the class Euscomycetes.

Natural products like plants have served as a research resource for most drugs inventions, providing a basis for chemical research and discovery of new drugs (Chin et al., 2006). The search for plants with healing powers for various diseases dates back many years. Plants are being used in a medicinal system for a long time. Plants are an important source of biologically active compounds, many of which are models for the synthesis of a large number of drugs (Yunes and Calixto, 2001; Simões et al., 2003). Many antifungal agents are derived from plants resources like polyenes and griseofulvin, and they are having a broad spectrum of antifungal activity and not cause toxicity to the host (Carrillo-Muñoz et al., 2006; Butler, 2005). Plants are highly utilized and great attention in the medical system due to the presence of a large number of secondary metabolic compounds found in plants.

The plant Cassia alata belongs to the family Fabaceae. It is the herbaceous plants grow up to 5 m, and it is grown in mostly a tropical climate. It is otherwise described as ringworm shrub, and it is more effective for ringworm diseases. This plant has highly active phytochemicals like alkaloids, anthaquinones responsible for antifungal, antimicrobial activity, abortifacient and analgesic. The single plant is used for curing skin diseases, stomach problems, and ringworm, asthma and aphthous ulcers. It has active components include the yellow chrysophanic acid. In this communication, we demonstrated that phytochemical screening of ethanol extract of C. alata leaves and to determine the ability of its antidermatophytic activity, free radical scavenging activity and cytotoxicity activity.

MATERIALS AND METHODS

Preparation of plant extract

Ethanolic extract of C. alata leaves was prepared by soxhlet extract method. In this method, the fresh leaves of C. alata were collected and washed with water and shade dried at room temperature for 3–4 days. Then the dried leaves were ground into powder and through a fine mesh to get uniform sized powder. A 50 g of powdered leaf sample was packed with filter paper and inserted into soxhlet apparatus. A 200 ml of ethanol was taken in a bottom flask contains 200 ml of ethanol and the sample containing apparatus was boiled at 45°C for 24 hrs. Various phytoconstituents were extracted with ethanol and collected the solution. After boiling the filtrate was collected and evaporated with a rotatory evaporator to get the crude extract. This crude extract was further used to study the phytochemical characterization, DPPH scavenging activity, antidermatophytic activity and cytotoxicity assay.

Preliminary Phytochemical analysis

In this analysis, the extract was diluted at the concentration of 10mg/10 ml using double distilled water. The standard procedures were followed to analysis alkaloids, glycosides, carbohydrates, quinines, saponins, phenols, tannins, flavonoids, steroids, terpenoids, proteins and sugars compounds present in the ethanol extract of C. alata leaves described by Debiyi and Sofowora (1978), Trease and Evans (1989), Sofowora (1993) and Roopashree et al., (2008).

Analytical techniques

Presence of phytoconstituents in ethanol crude extract with its molecular weight is determined by using Gas chromatography attached with Mass spectrometer. Molecular structure was performed using a Perkin-Elmer GC Clarus 500 system. HPLC system is used to a characterization of secondary metabolites present in the plant extract. The crude ethanol extract was injected into the HPLC column using the mobile phase containing 30:70 ml of acetoniitrile and 0.1% of phosphoric acid. The bioactive functional groups present in the crude ethanol extract were characterized by FTIR spectrum at the wave number from 4000 to 500 cm⁻¹.

DPPH Free radical scavenging assay

The DPPH free radical scavenging activity of crude ethanol extract was analyzed at different concentrations. DPPH scavenging assay is a discoloration assay which is evaluated by addition of plant extract to a DPPH solution and measured in the absorbance at 517 nm (Halliwell 1994; Subhasree et al., 2011) with slight modifications. The free radical DPPH was prepared in methanol at the concentration of 1 mM. A 500 µl of methanolic DPPH was taken in six test tubes. To this solution, 3 ml of different concentrations (5-50 µg/ml) of ethanol plant extract in each test tube and incubated at 30 min at room temperature in dark conditions. After incubation, the ability to scavenging the stable DPPH free radical was recorded by measuring absorbance at 517 nm. The percentage of scavenging activity against the different concentrations of plant extract was plotted graph to determine the 50% inhibition concentration (IC₅₀) value. The percentage of DPPH inhibition by hexane solvent extracts of C. alata leaves was calculated by following the equation:

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The inhibition concentration to scavenge 50% free radical (IC$_{50}$) is determined by plotting a graph of concentration (µg/ml) against percentage (%) of free radical inhibition.

**An anti-dermatophytic activity of ethanol extracts of C. alata leaves**

**Collection of dermatophytes**

Cultures of dermatophytes such as *Trichophyton mentagrophytes* (MTCC-7687), *Trichophyton rubrum* (MTCC-7859), *Epidermophyton floccosum* (MTCC-7880), *Microsporum audouinii* (MTCC-8197), and *Microsporum Canis* (MTCC-3270) were collected from MTCC, Chandigarh.

**Determination of Minimum Inhibitory Concentration (MIC)**

The minimum inhibition concentration of ethanol extract against dermatophytes was determined by performing agar well diffusion. The media Sabouroud Dextrose Agar (SDA) was used to the assay of minimum inhibition concentration. The medium was prepared and sterilized in an autoclave and poured into Petri plates. Petri plates were allowed to solidify, and 0.1 ml of fungal inoculums spores was uniformly spread on media. 3 wells were punched with the diameter 6 mm using gel puncture and add different concentrations (25-75 µl/ml) of ethanol extract into each well. Minimum concentration required to inhibit the growth of fungi is known as minimum inhibition concentration (MIC). The all the plates were incubated at 24 to 48 hrs and measure the zone of growth inhibition around the well. The difference between the activity of control and test sample ethanol extract is regarded as a percentage on inhibition. Terbinafine was used as a positive control against fungal dermatophytes, and its activity was considered as 100% of inhibition;

\[
\text{Percentage of Inhibition} (\%) = \frac{C - T}{C} \times 100
\]

C = Zone of inhibition activity of control
T = Zone of inhibition activity of ethanol extract

**Determination of Minimum Fungicidal concentration**

Invitro assay of the fungicidal effect of ethanol extract was determined at different concentrations (Espinell-Ingloff *et al.*, 2001 and 2002). 1 ml of fungal inoculums was inoculated into sterilized fresh Sabouroud Dextrose broth. The ethanol extract was added into the broth at different concentrations from 10-100 µg/ml. The sample mixed broth was incubated at 37°C for 24 to 48 hrs. After the incubation, the number of colonies were counted on Petri plate containing molten Sabouraud dextrose agar and incubated at 37°C for 72 h. The numbers of colonies were measured to calculate the minimum fungicidal concentration (MFC). MFC is defined as the lowest concentration that showed less than three colonies or visible growth on the plates is determined as 100% or 99% inhibition activity.

**Cytotoxicity study**

Cytotoxicity effect of ethanol extract was examined by MTT (3-(4,5 – dimethyl thiazol -2-yl)-5-diphenyltetrazolium bromide) assay (Francis and Rita 1986). The A431 cell lines were trypsinised and diluted using phosphate buffer. The 0.1 ml of diluted cell suspension was added into 96 well plates and incubated for 24 hrs in a CO$_2$ incubator. After the incubation, the cell culture was washed with MEM (minimum essential medium) medium containing 10% FBS (fetal bovine serum). Then add 100 µL of different concentrations of ethanol extract (10-100 µg/mL) were mixed to the cells in microtiter plates and the plates were then incubated at 37°C for 3 days in 5% CO$_2$ incubator. After 3 days, the sample drug was removed from wells and added 50 µL of MTT in PBS (phosphate buffered saline) into each well. The 96 well microtiter plate was incubated for 3 hours at 37°C in 5% CO$_2$ atmosphere. Finally, formazan crystals were formed which was dissolved by adding 100 µL of propanol and the plates were gently shaken. The synthetic drug 5-fluorouracil was used as positive control instead of plant extract. The absorbance intensity of solubilized formazan was measured using a microplate reader at the wavelength of 540 nm. Morphological analysis of test sample drug (ethanol extract) treated cells were examined under microscopic observations was noted every 24 hours of the time interval. The percentage growth inhibition was calculated using the following formula and concentration of test drug needed to inhibit cell growth by 50% (IC$_{50}$) values is generated from the dose-response curves for each cell line.

\[
\text{% of Inhibition} = \frac{\text{Absorbance of control-Absorbance of test sample}}{\text{Absorbance of control}} \times 100
\]

**RESULTS AND DISCUSSION**

**Phytochemical screening and antioxidant activity of C. alata leaves**

**Preliminary screening assay:** The phytochemical analysis of ethanol leaf extract of *Cassia alata* was analysed for the compounds such as carbohydrates, tannin, phenol, saponin, flavonoid, steroid, terpenoids, glycosides, and alkaloids. All the active...
phytoconstituents were present in the ethanol extract except quinines and proteins. Among the twelve phytochemicals, most of the phytochemicals (10/12) were present in the ethanol leaf extract (Table 1).

**Table 1: Phytochemical screening of different solvents extract of C. alata leaves**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Phytochemicals</th>
<th>Ethanol Extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alkaloids</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Glycosides</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>Carbohydrates</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>Quinines</td>
<td>_</td>
</tr>
<tr>
<td>5</td>
<td>Saponins</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>Phenols</td>
<td>+</td>
</tr>
<tr>
<td>7</td>
<td>Tannins</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>Flavonoids</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>Steroids</td>
<td>+</td>
</tr>
<tr>
<td>10</td>
<td>Terpenoids</td>
<td>+</td>
</tr>
<tr>
<td>11</td>
<td>Proteins</td>
<td>_</td>
</tr>
<tr>
<td>12</td>
<td>Sugars</td>
<td>+</td>
</tr>
</tbody>
</table>

**FTIR**

**Figure 1: FTIR spectrum of ethanol extract of C. alata leaves**

**Table 2: FTIR spectrum shows various functional groups present in ethanol extract of C. alata leaves**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Wavenumber (cm⁻¹)</th>
<th>Functional groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3383</td>
<td>N-H stretching amines and amides</td>
</tr>
<tr>
<td>2</td>
<td>2977</td>
<td>C-H stretch alkanes</td>
</tr>
<tr>
<td>3</td>
<td>2965</td>
<td>H-C=O stretching aldehydes</td>
</tr>
<tr>
<td>4</td>
<td>1389</td>
<td>N=O bend nitro groups</td>
</tr>
<tr>
<td>5</td>
<td>1048</td>
<td>C-N stretching aliphatic amines</td>
</tr>
<tr>
<td>6</td>
<td>880</td>
<td>N-H wag 1° and 2° amines</td>
</tr>
</tbody>
</table>

FTIR characterization technique was used to identify chemical bonds in compounds which are present in the ethanol extract of leaf of C. alata. Figure 1 shows the functional groups of ethanol extract of C. alata leave revealed a broad peak was observed at 3383 cm⁻¹ represents N-H stretching amines and amides. The absorption band at 2777 cm⁻¹ corresponds to the presence of C-H stretch alkanes. The small peaks at 2965 and 1389 cm⁻¹ revealed to H-C=O stretching aldehydes and N=O bend nitro groups respectively. Very sharp and narrow peaks were recorded at 1048 and 880 cm⁻¹ characterized to C-N stretching aliphatic amines and N-H wag primary or secondary amines respectively (Table 3).

**GC-MS analysis**

**Figure 2: GC-MS chromatogram analysis of ethanol extract of C. alata leaves**

The characterization technique of GC-MS spectrum of the ethanol extract of C. alata leaves showed 6 peaks indicate the presence of 6 different phytochemical components (Figure 2). The results of GC-MS chromatogram characteristics of ethanol extract revealed that presence of two major compounds namely Hexadecanoic acid and Oleic acid, the four minor compounds such as 2-Hydroxyethylhydrazine, Isopropyl-5-methylcyclohexyl 3-(1-(4-Chlorophenyl)-3-Oxobutyl)-C, Pentadecanoic acid, and cycotrisiloxane, hexamethyl (Table 3).

**HPLC analysis**

**Figure 3: HPLC chromatogram characterization of ethanol extract of C. alata leaves**

HPLC chromatograms showing two phytoconstituents of the ethanol extract of C. alata leaves shown in Figure 3. It appears to contain predominantly two compounds which are eluted at a retention time (Rt) of 2.107 min while the other peak was observed at an Rt of 2.642 min.
Antioxidant activity of chloroform extract of C. alata

The antioxidant activity of ethanol leaf extract of C. alata was determined by DPPH free radical scavenging activity. The activity of leaf extract was determined based on the measurement of the absorbance intensity in the Spectrophotometer at the shortest wavelength in 517 nm. The percentage of inhibition of DPPH free radical was increased with increasing the concentration of plant extract (Figure 4).

Table 3: GC-MS chromatogram analysis of ethanol extract of C. alata leaves shows phytoconstituents at retention time

<table>
<thead>
<tr>
<th>Retention time</th>
<th>Name of the compound</th>
<th>Molecular weight</th>
<th>Molecular formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.13</td>
<td>2-Hydroxyethylhydrazine</td>
<td>76</td>
<td>C2H4O2N2</td>
</tr>
<tr>
<td>17.66</td>
<td>2-Hydroxyethylhydrazine</td>
<td>76</td>
<td>C2H4O2N2</td>
</tr>
<tr>
<td>18.09</td>
<td>Isopropyl-5-methylcyclohexyl 3-(1-{4-Chlorophenyl}-3-Oxobutyl)-C</td>
<td>524</td>
<td>C30H33O6Cl</td>
</tr>
<tr>
<td>19.56</td>
<td>Hexadecanoic acid</td>
<td>256</td>
<td>C16H32O2</td>
</tr>
<tr>
<td>21.30</td>
<td>Oleic acid</td>
<td>282</td>
<td>C18H34O2</td>
</tr>
<tr>
<td>23.79</td>
<td>Pentadecanoic acid</td>
<td>242</td>
<td>C15H30O2</td>
</tr>
<tr>
<td>27.96</td>
<td>cyclotrisiloxane, hexamethyl-</td>
<td>222</td>
<td>C6H10O3Si3</td>
</tr>
</tbody>
</table>

Table 4: Antioxidant activity of ethanol extract of C. alata leaves

<table>
<thead>
<tr>
<th>Concentration of ethanol C. alata extract (µg/ml)</th>
<th>% Inhibition of DPPH free radical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C. alata ethanol extract</td>
</tr>
<tr>
<td>5</td>
<td>17.92±1.56</td>
</tr>
<tr>
<td>10</td>
<td>23.93±1.33</td>
</tr>
<tr>
<td>20</td>
<td>47.68±1.26</td>
</tr>
<tr>
<td>30</td>
<td>55.36±1.29</td>
</tr>
<tr>
<td>40</td>
<td>82.02±1.33</td>
</tr>
<tr>
<td>50</td>
<td>95.45±1.33</td>
</tr>
</tbody>
</table>

Antioxidant activity of chloroform extract of C. alata

The antioxidant activity of ethanol leaf extract of C. alata was determined by DPPH free radical scavenging activity. The activity of leaf extract was determined based on the measurement of the absorbance intensity in the Spectrophotometer at the shortest wavelength in 517 nm. The percentage of inhibition of DPPH free radical was increased with increasing the concentration of plant extract (Figure 4).

Figure 4: DPPH scavenging activity of Cassia alata ethanolic Extract

The IC50 value is defined as a sample that required to inhibiting the 50% of DPPH concentration, was obtained from linear regression graph of mean percentage of the DPPH scavenging activity against the concentration of the ethanol leaf extract of C. alata (Figure 5). The results of linear regression analysis show the IC50 values of ethanol extract of C. alata leaves were found to be 24.56 µg/ml and the standard to be 29.92 µg/ml (Table 4). The total antioxidant activities of the plant extract may be due to the presence of flavonoids (Oyedemi et al. 2010; Laloo and Sahu 2011; Kumar et al. 2014), phenols (López-Vélez et al. 2003; Lim et al. 2007; Bourgou et al. 2008; Jung et al. 2008; Proestos et al., 2013), alkaloids and tannins (Kumaran and Karunakaran 2007) in the leaves. These phytochemical constituents have the ability to reduce DPPH radicals by the pairing of an odd electron with hydrogen which gives the purple colour of DPPH turns into yellow. The reduced DPPH-H was obtained by the action of plant extract which serves as antioxidant agent.

Figure 5: Linear regression analysis of DPPH free radical scavenging activity of ethanol extract of C. alata

The studied phytochemicals in leaves of C. alata ethanol extracts are pharmaceutically important. The phytochemical compounds are widespread in the plants are attractive as natural antioxidants (Sreeramulu and Raghunath 2010; Jaradat et al., 2016). Many secondary metabolites like phenols, polyphenols, and flavonoids serve as important
souces of antioxidants to perform scavenging activity against free radical (Diplock 1997). Hence, this study presumed that the ethanol extract of *C.alata* might have a high amount of antioxidant properties which was comparable to that of the synthetic antioxidant standard used.

**Screening of extracts for antidermatophytic activity**

![Image](74x372 to 298x534)

**Table 6: Percentage of the zone of inhibition, MIC and MFC**

<table>
<thead>
<tr>
<th>Dermatophytic fungi</th>
<th>% Zone of Inhibition</th>
<th>MIC/MFC (µl/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control*</td>
<td>Ethanol extract</td>
</tr>
<tr>
<td><em>M. canis</em></td>
<td>19</td>
<td>12 (63.2%)</td>
</tr>
<tr>
<td><em>T. mentagrophytes</em></td>
<td>17</td>
<td>14 (82.4%)</td>
</tr>
<tr>
<td><em>T. rubrum</em></td>
<td>20</td>
<td>20 (100%)</td>
</tr>
<tr>
<td><em>E. floccosum</em></td>
<td>18</td>
<td>16 (88.9%)</td>
</tr>
<tr>
<td><em>M. audouinii</em></td>
<td>17</td>
<td>16 (94.2%)</td>
</tr>
</tbody>
</table>

*Control is considered as 100% inhibition. Percentage of inhibition was calculated by determining differences between control and extract; Nf<100 – No fungicidal activity below 100 µl/mL.

**Percentage of the zone of inhibition:** Terbinafine is used as positive control and its complete antifungal activity against pathogens is considered as 100% of inhibition. It was compared with extract of *C. alata* leaves. Chloroform extract shows 100% of activity against *T. mentagrophytes* and minimum percentage of activity (44.4%) of hexane extract was noted against *E. floccosum*. Ethanol extract has the ability to complete control against all the pathogens above 60% of inhibition (Table 6).

**Minimum Inhibitory Concentration and MFC determination**

The profile of the medicinal plants used in this study is shown in Table 6. The results of antifungal activity of chloroform, ethanol and hexane crude extracts of *C. alata* leaves showed good activity on all the strains of *M. Canis*, *T. mentagrophytes*, *T. rubrum*, *E. floccosum* and *M. audouinii* tested at different concentrations, with ethanol extracts exerting slightly higher activity than water extracts as revealed by mean diameter of zone of inhibition, minimum inhibitory concentration (MIC) and minimum fungicidal concentrations (MFC) (Table 6).

However, MIC and MFC values of 25.0 and 25.0 µl/ml were recorded for ethanol extract respectively against *T. rubrum* strain. MIC and MFC values of 50 and 46 µl/ml were recorded for chloroform extract respectively against *T. rubrum* strain. Likewise, hexane extract showed MIC, and MFC values of 25.0 and 20.0 µl/ml were recorded against *T. mentagrophytes*. From these results, ethanol extract shows more fungicidal activity as minimum concentration compared to other extracts of *C. alata* leaves.

**Cytotoxicity assay**

The result of discoloration MTT assay against A431 cancer cell lines revealed that decreased percent of cell viability was noted while treating with the drug ethanol extract of *C. alata* leaves. It induces
more cytotoxicity towards cancer cell lines human epithelial carcinoma (A431) and its effect also similar to that of the standard drug (5-fluorouracil). Microscopic images confirm that the ethanol extract induces cell death by causing morphological changes and shrinkage of cancerous cells (Figure 7). Cytotoxic effect of ethanol extract was assayed at different concentrations like 10, 25, 50 and 100 µg/ml. At 100 µg/ml of ethanol concentration, 93.26±5.44 (%) and 82.45±2.44 (%) percentage of cancer cells were inhibited by ethanol extract and standard drug, respectively. This assay helps to confirm ethanol extract of C. alata leaves could be better, no toxic to noncancerous cells (Morshed et al., 2011) and alternative source of anticancer drugs than the standard drug. The plant extract has shown remarkable dose-dependent activity against the selected cancer cell line (Figure 7 and Table 7). Among these four concentrations, 100 µg/ml of ethanol extract was the most effective in producing percentage growth inhibition.

Table 7: Determination of percentage (%) inhibition of human epithelial carcinoma by using ethanol plant extract

<table>
<thead>
<tr>
<th>Concentration (µg/ml)</th>
<th>% of inhibition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Plant extract</td>
</tr>
<tr>
<td>10 (µg/ml)</td>
<td>45.09±1.17</td>
</tr>
<tr>
<td>25 (µg/ml)</td>
<td>60.33±2.33</td>
</tr>
<tr>
<td>50 (µg/ml)</td>
<td>72.52±1.47</td>
</tr>
<tr>
<td>100 (µg/ml)</td>
<td>82.45±2.44</td>
</tr>
</tbody>
</table>

± Standard deviation

CONCLUSION

In the present investigation, the ethanol extract of leaves of Cassia alata exhibited effective DPPH scavenging ability, antidermatophytic activity against skin infecting dermatophytes and cytotoxic activity against human epithelial carcinoma cells. In addition, the ethanol extract was containing alkaloids, carbohydrates, flavonoids etc. examined preliminary phytochemical analysis based on chemical reaction. The presence of Hexadecanoic acid and Oleic acid was identified by GC-MS and HPLC. FTIR spectrum of ethanol extract revealed the presence of functional groups of bioactive compounds. Overall, the ethanol extract exhibited the highest antioxidant, antidermatophytic and cytotoxic activity while the standard drug showed better medicinal activities. Therefore, ethanol crude extract from leaves of Cassia alata could serve as promising sources of new drugs.

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