Plants are valuable for modern folklore medicine as they are sources of direct therapeutic agents. Herbal plants produce and contain a variety of chemical substances, of these substances certain isolated compounds serve as models for new synthetic compounds and can be used as taxonomic markers for the discovery of new compounds. However, only a fraction of the world’s plants has been studied.

Over the years evaluation of crude drugs has undergone many changes. Due to advancement in the chemical knowledge of crude drugs, evaluation methods include estimating active constituents present in the crude drug, in addition to its morphological and microscopic analysis. Quality control standardizations of the various medicinal plants used in traditional medicine is now becoming more important today in view of the commercialization of formulations based on these plants (Bigoniya et al., 2011).

With the advent of separation techniques and instrumental analysis, it is possible to perform physical evaluation of a crude drug, which could be both of qualitative and quantitative in nature. The plant material are subjected to preliminary phyto-chemical screening for the detection of various plant constituents (Kumar et al., 2013),

Thus, in present physico-chemical study, the dry powder of each selected species *Boerhavia diffusa* and *Tecomella undulata* was treated with various chemicals / reagents to assess their chemical behavior (Table- 1).

The presence of various metabolites in different extracts of *Boerhavia diffusa* and *Tecomella undulata* and the extractive values in different extracts are indicated in Table (2.1-2.3), (3.1-3.4). Extractive values can be used to evaluate the composition. In present investigation maximum extractive value of different extracts of roots of *Boerhavia diffusa* is shown by the aqueous
extract while minimum in petroleum ether (aqueous; 3.96>Alcohol; 1.86>benzene; 0.97> Acetone; 0.44>Chloroform; 0.35> Petroleum ether; 0.25), (Table 2.1). Maximum extractive value of different extracts of stems of *Boerhavia diffusa* is shown by the aqueous extract while minimum in chloroform (aqueous; 6.14>Alcohol; 2.18>Petroleum ether; 1.03>benzene; 0.62>Acetone; 0.49> Chloroform; 0.25) (Table2.2). Different extracts of leaves of *Boerhavia diffusa* show maximum extractive value by the aqueous extract while minimum in benzene extract (aqueous; 7.59>Petroleum ether; 1.75>Alcohol; 1.68>Acetone; 0.95>Chloroform; 0.65>benzene; 0.54). (Table 2.3). extractive values of different parts of *Tecomella undulata* show that in the different extracts of roots, aqueous extract show maximum extractive value while chloroform extract show minimum extraction (aqueous; 5.15>Alcohol; 1.59> benzene; 0.86> Acetone; 0.57>Petroleum ether; 0.33> Chloroform; 0.22).maximum number of metabolites are reported in the alcohol extract (table 3.1). Maximum extractive value of different extracts of stems of *Tecomella undulata* is shown by the aqueous extract while minimum in acetone (aqueous; 4.12>Alcohol; 1.85> Chloroform; 0.95> benzene; 0.62>Petroleum ether; 0.89> Acetone; 0.78)(Table 3.2). Maximum extractive value of different extracts of stems of *Tecomella undulata* is shown by the aqueous extract while minimum in acetone (aqueous; 4.12>Alcohol; 1.85> Chloroform; 0.95> benzene; 0.62>Petroleum ether; 0.89> Acetone; 0.78) (Table 3.2). Maximum extractive value of different extracts of stems of *Tecomella undulata* is shown by the aqueous extract while minimum in petroleum ether (aqueous; 3.67>Alcohol; 1.95> Chloroform; 1.35> benzene; 0.82> Acetone; 0.81>Petroleum ether; 0.76)(Table 3.3). Maximum extractive value of different extracts of leaves of *Tecomella undulata* is shown by the aqueous extract while minimum in chloroform (aqueous; 6.94>Alcohol; 1.76> Petroleum ether; 1.59> benzene; 0.89> Acetone; 0.76> Chloroform; 1.35) (Table 3.4).
Table 4 shows the content of primary metabolites from different plant parts of *Boerhavia diffusa*. In present study, starch content was observed maximum in stem while minimum in root (stem; 2.082±0.072 mg/gdw > leaf; 1.71±0.09 mg/gdw > root; 1.678±0.0759 mg/gdw). Highest concentration of soluble sugars content was observed in stem and lowest in root (stem; 4.62±0.161 mg/gdw > leaf; 3.93±0.08 mg/gdw > root; 2.753±0.057 mg/gdw), ascorbic acid content was maximum in leaf and minimum in root (leaf; 0.33±0.166 mg/gdw > stem; 0.1±0.025 mg/gdw > root; 0.025±0.01 mg/gdw), Highest value of lipids was observed in root and minimum in leaf (root; 27.33±3.05 mg/gdw > leaf; 26.33±3.511 mg/gdw > stem; 4.66±2.516 mg/gdw). Protein content was recorded maximum in leaf and minimum in root (leaf; 4.244±0.154 mg/gdw > stem; 3.806±0.362 mg/gdw > root; 0.940±0.235 mg/gdw). Starch content in the plant have been reviewed and has been shown to vary according to environmental conditions (Mandal and Mukherji, 2000), a higher amount of starch content have been reported from the root extracts of *B. diffusa* (Ujowundu et al., 2008; Gupta and Yadav, 2013; Malhotra et al., 2013; Beegum et al., 2014). Higher content of ascorbic acid have been reported (Sheela et al., 2004). Ascorbic acid is known for its antioxidant activity thus giving a great antioxidant potential to the plant (Olaleye et al., 2010; Agrawal et al., 2011; Khalid et al., 2011; Singh et al., 2012; Mishra et al., 2014). Similar Ascorbic acid contents have been reported (Rajpoot and Mishra, 2011; Bhardwaj et al., 2014). Higher contents of lipids and protein are reported (Sheela et al., 2004; Ujowundu et al., 2008; Beegum et al., 2014).

Table 5 shows the content of primary metabolites from different plant parts of *Tecomella undulata*. In present study, starch content was observed maximum in stem while minimum in bark (stem; 3.12±0.051 mg/gdw > root; 2.1±0.289 mg/gdw > leaf; 1.43±0.553 mg/gdw > bark; 1.17±0.09 mg/gdw) Highest concentration of soluble sugars content was observed in stem and
lowest in bark (stem; 5.4±0.1 mg/gdw> leaf; 4.506±0.151 mg/gdw > root; 3.14±0.15 mg/gdw> bark; 1.76±0.057 mg/gdw), ascorbic acid content was maximum in stem and minimum in leaf (stem;1.736±0.012 mg/gdw>bark; 1.7±0.01 mg/gdw > root; 1.67±0.02 mg/gdw> leaf; 1.016±0.052 mg/gdw),

Highest value of lipids was observed in leaf and minimum in bark (leaf; 63±4.358mg/gdw>root; 25±4.582 mg/gdw >stem; 22±3.76 mg/gdw>bark; 15±3.15 mg/gdw), Protein content was recorded maximum in leaf and minimum in root (leaf; 4.775±0.898 mg/gdw>stem; 3.430±0.095 mg/gdw >bark; 2.129±0.494 mg/gdw>root; 1.272±0.126 mg/gdw). In present investigation we have seen the contents of various metabolites to vary in different plant parts, but Ullah et al (2013), have shown a higher content of metabolites. Starch soluble sugars, and lipids are reported to be in higher amount. A higher content of ascorbic acid was observed in T.undulata collected from different areas (Kapoor and Bansal, 2013), similar ascorbic acid contents and their antioxidant properties are also reported (Sharma et al., 2013).
Flavonoids have been reported to be an important constituent of medicinal plants (Araújo et al., 2008). Flavonoids have been assayed for their antioxidant activity (Choudhary and Swarnkar, 2011; Saikia and Upadhyaya, 2011). Various techniques have been employed for the quantification of flavonoid which include advance techniques like HPLC (Khoddami et al., 2013), RP-HPLC (Nessa et al., 2005), microwave assisted extraction (Lung et al., 2013).

In the present investigation, flavonoids profile has been studied in vivo of the selected plants Boerhavia diffusa and Tecomella undulata, where quercetin, kaempferol, and Luteolin from different plant parts have been evaluated. Their chromatographic and color reactions data have been presented in the Table-6, Plate-3.

Table 7 shows the isolated flavonoid content in B. diffusa and T. undulata. Amongst the free form of flavonoids extracted from B. diffusa, in roots kaempferol was obtained in maximum mount while Quercetin is observed in minimum amount. (in roots; kaempferol; 0.10 mg/gdw > luteolin; 0.08 mg/gdw > quercetin; 0.07 mg/gdw), in stems kaempferol is maximum while luteolin is minimum (kaempferol; 0.09 mg/gdw > quercetin; 0.08 mg/gdw > luteolin; 0.06 mg/gdw), in leaves kaempferol is observed in highest amount and luteolin in lowest amount (kaempferol; 0.20 mg/gdw > quercetin; 0.15 mg/gdw > luteolin; 0.08 mg/gdw) maximum amount of total free flavonoids was observed in leaves (leaves; 0.43 mg/gdw > roots; 0.25 mg/gdw> stems; 0.23 mg/gdw). amongst the bound form of flavonoids in roots kaempferol was reported in maximum amount while quercetin was observed in minimum amount (kaempferol; 0.08 mg/gdw > Luteolin; 0.05 mg/gdw > quercetin; 0.04 mg/gdw) while in stems and leaves kaempferol was observed in higher amount while luteolin was observed in lower amount (kaempferol; 0.07 mg/gdw > quercetin; 0.05 mg/gdw > Luteolin; 0.04 mg/gdw) (in leaves; kaempferol; 0.12 mg/gdw > quercetin; 0.10 mg/gdw > Luteolin; 0.03
Maximum amount of total bound form of flavonoids was observed in leaves (leaves; 0.25 mg/gdw>root; 0.17 mg/gdw> stems; 0.16 mg/gdw). The total flavonoid content (F+B) was observed maximum in leaves and minimum in stems (leaves; 0.68 mg/gdw>root; 0.42 mg/gdw> stems; 0.39 mg/gdw). Other various kinds of flavonoids have also been isolated in significant quantities from *Boerhavia erecta* which have also been screened for their pharmacological activities (Maurya *et al.*, 2007; Petrus *et al.*, 2012). A higher content of flavonoids and their antioxidant activities have been reported in *Boerhavia* (Ujowundu *et al.*, 2008; Khalid *et al.*, 2012; Ammar *et al.*, 2014). Root extracts of *Boerhavia* species have been reported to have a higher amount of flavonoid content, which also support its significant antioxidant activity (Khalid *et al.*, 2011; Rajpoot and Mishra, 2011). Higher quercetin levels in aerial parts in *Boerhavia diffusa* are responsible for various pharmacological activites and are used in various formulations (Mishra *et al.*, 2014).

Isolated flavonoid content in *T.undulata* is recorded as, amongst the free form of flavonoids extracted, in the plant parts kaempferol was obtained in maximum mount while luteolin is observed in minimum amount. (in roots; kaempferol; 0.12 mg/gdw>quercetin; 0.09 mg/gdw >luteolin; 0.06 mg/gdw), (in stems; kaempferol; 0.09 mg/gdw >quercetin; 0.08 mg/gdw >luteolin; 0.07 mg/gdw), (in Bark; kaempferol; 0.11 mg/gdw >quercetin; 0.07 mg/gdw >luteolin; 0.06 mg/gdw) (in leaves; kaempferol; 0.23 mg/gdw >quercetin; 0.16 mg/gdw >luteolin; 0.13 mg/gdw) maximum amount of total free flavonoids was observed in leaves (leaves; 0.52 mg/gdw> roots; 0.27 mg/gdw stems; 0.24 mg/gdw =Bark; 0.24 mg/gdw). Amongst the bound form of flavonoids in roots kaempferol was reported in maximum amount while quercetin was observed in minimum amount (kaempferol; 0.08 mg/gdw >quercetin; 0.06 mg/gdw>Luteolin; 0.05 mg/gdw) while in stems and leaves kaempferol was observed in higher amount while Quercetin was observed in lower amount (kaempferol; 0.07 mg/gdw >Luteolin; 0.06 mg/gdw> quercetin;
0.05 mg/gdw) in Bark kaempferol is observed in higher amount while luteolin in lower amount (kaempferol; 0.08 mg/gdw > quercetin; 0.06 mg/gdw > Luteolin; 0.04 mg/gdw) in leaves Quercetin is observed to be maximum while luteolin is minimum. (Quercetin; 0.12 mg/gdw > kaempferol; 0.10 mg/gdw > Luteolin; 0.09 mg/gdw). Maximum amount of total bound form of flavonoids was observed in leaves (leaves; 0.31 mg/gdw > root; 0.19 mg/gdw > stems; 0.18 mg/gdw= bark; 0.18 mg/gdw). The total flavonoid content (F+B) was observed maximum in leaves and minimum in stems (leaves; 0.83 mg/gdw > root; 0.46 mg/gdw > stems; 0.42 mg/gdw= Bark; 0.42 mg/gdw). Other flavonoids have also been reported (Alcerito et al., 2002). Content higher than presently investigated have been reported in various plant parts of Tecomella in earlier studies (Patel et al., 2013), similar total flavonoid content have also been reported (Sharma et al., 2013). Leaves and flowers of Tecomella undulata have shown to have significant antioxidant activity due to higher content of flavonoids present (Laghari et al., 2013), maximum amount of flavonoids are reported in leaves of Tecomella undulata (Kapoor and Bansal, 2013). Accumulation of flavonoids are also affected due to seasonal variations (Patel and Patel, 2014).

The eluted compounds from TLC were pooled together according to their TLC behaviour and isolate them with the solvents and evaporated yielding three flavonoids kaempferol, quercetin and luteolin. The spectral analyses(Table-8) of the active constituent, (a) Luteolin (b) quercetin and (c) kaempferol from the different plant parts of Boerhavia diffusa and Tecomella undulata are shown below: -

(a) Luteolin: yellow needles on crystallization (mp 280°-320°C)

UV light absorption MeOH: 242 sh, 253 sh, 267 sh, 291 sh, 349 sh

IR: \text{cm}^{-1}/\text{ max KBr}: 3400, 3423, 3100 (O–H), 1070, 1150, 1010(C=O), 1656, 1620, 1612 (C=C), 1514(aromatic), 1103, 1862, 1839, 1562
1H NMR (300MHz, CDCl3): 3.42 (H1), 3.49 (H2), 3.56 (H3), 6.30 (H4), 3.68 (H5), 3.85 (H6), 5.10 (H7), 6.63 (H8), 6.83 (H9), 6.95 (H10), 7.41 (H11), 7.43 (H12)

13C NMR (300MHz, CDCl3): 122.6 (C1), 113.8 (C2), 76.8 (C3), 70.3 (C4), 77.4 (C5), 100.5 (C6), 163.9 (C7), 95.8 (C8), 158.0 (C9), 106.3 (C10), 165.8 (C11), 146.3 (C12), 150.4 (C13), 121.1 (C14), 119.0 (C15).

(b) Quercetin: yellowish needles on crystallization (mp 312°-313°C)
UV light absorption MeOH: 255 sh, 301 sh, 374 sh, 440 sh
IR: $\nu \text{cm}^{-1}$/ max KBr: 3420, 3380 (O–H), 2800 (C–H), 2100 (C=C), 1680 (C=O), 1610 (C=O), 1560, 1510, 1450, 1400 (aromatic), 1385, 1310, 1270, 1180, 1010

1H NMR (300MHz, CDCl3): 2.45, (H1), 2.55 (H2), 6.79 (H3), 6.98 (H4), 6.49 (H5), 2.33 (H6), 6.38 (H7), 2.36 (H8), 5.37 (H9), 1.4 (H10)

13C NMR (300MHz, CDCl3): 137.3 (C1), 137.9 (C2), 14.2 (C3), 127.0 (C4), 126.1 (C5), 133.8 (C6), 142.4 (C7), 158.2 (C8), 114.6 (C9), 134.5 (C10), 123.0 (C11), 138.0 (C12), 121.1 (C13), 149.4 (C14), 108.9 (C15), 127.8.

(c) Kaempferol: brownish needles on crystallization (mp 312°-313°C)
UV light absorption MeOH: 253 sh, 269 sh, 305 sh, 374 sh, 424 sh
IR: $\nu \text{cm}^{-1}$/ max KBr: 3420 (O–H), 2830 (C–H), 2240 (C=C), 1700 (C=O), 1600, 1610 (C=O), 1560, 1510, 1450, 1400 (aromatic), 1385, 1310, 1270, 1180, 1010, 815

1H NMR (300MHz, CDCl3): 2.35(H1), 7.01(H2), 7.18 (H3), 6.29 (H4), 6.37 (H5), 2.35 (H6), 5.39 (H7), 5.36 (H8), 7.18 (H9), 7.01 (H10)

13C NMR (300MHz, CDCl3): 1.36 (C1), 129.8 (C2), 126.8 (C3), 131.9 (C4), 147.4 (C5), 154.2 (C6), 114.6 (C7), 137.5 (C8), 124.0 (C9), 136.0 (C10), 121.1 (C11), 149.4 (C12), 106.9 (C13), 131.9 (C14), 126.1 (C15)
Figure 1-9 shows the IR, $^1$HNMR and $^{13}$CNMR spectra of all the eluted Flavonoids namely Luteolin, Quercetin and Kaempferol.

A GC-MS analysis of the extracted flavonoids from various plant parts of *Boerhavia diffusa* namely root, stem and leaf was carried out. Various constituents obtained are reported in Table 9. GC-MS spectra of Flavonoids from roots, stem and leaves are shown in Figure 10.1, 10.2 and 10.3. While GC-MS analysis of the extracted flavonoids from various plant parts of *Tecomella undulata* namely root, stem, bark and leaf was carried out. Various constituents obtained are reported in Table 10. GC-MS spectra of Flavonoids from roots, stem, bark and leaves are shown in Figure 11.1, 11.2 and 11.3, 11.4.
Phytosterols have been found in significant amount in medicinal plants (Hooper and Chandler, 1984) these are being used as raw material for various cosmetic products (Dweck et al., 2006), they are also shown to have cholesterol lowering effect (Gupta et al., 2011; Mkhize et al., 2013)

TLC isolated eluted with benzene-ethyl acetate (1: 3) exhibited similar TLC pattern were pooled together, concentrated (white solid; 0.70%) and crystallized. Four phytosterol compounds were identified on the basis chromatography, color reaction (Table-11) Plate-4.

Table 12 shows the phytosterol content isolated from *B. diffusa* and *T. undulata*. Where in *B. diffusa* in roots maximum amount of stigmasterol was observed while minimum lanosterol stigmasterol; 0.19> β-sitosterol; 0.08=campesterol; 0.08> lanosterol; 0.07), in stems (stigmasterol; 0.13> β-sitosterol; 0.10> lanosterol; 0.09> campesterol; 0.06), in leaves β-sitosterol was observed maximum while campesterol minimum (β-sitosterol; 0.13> stigmasterol; 0.10> lanosterol; 0.12> campesterol; 0.07). Similar higher amount of phytosterols were isolated from roots and leaves while lower amount were isolated from stems. Phytosterols are evaluated in significant amount in *Boerhavia diffusa* in study by Banjare et al. (2012). Stems and roots have reported higher content and variety of phytosterols (Murti et al., 2011). Higher content of Phytosterols have been reported in ethanolic and aqueous extracts of leaves of *Boerhavia diffusa* (Singh et al., 2012; Shubha and Govindaraju, 2013). Similar levels of β-sitostreol were reported using different chromatographic techniques (Gomes et al., 2013).

The phytosterol content isolated from *T. undulata*. Where in roots maximum amount of stigmasterol was observed while minimum lanosterol stigmasterol; 0.19>β-sitosterol; 0.08=campesterol; 0.08>lanosterol; 0.07), in stems (stigmasterol; 0.13>β-sitosterol; 0.10> lanosterol; 0.09>campesterol; 0.06), in leaves β-sitosterol was observed maximum while campesterol minimum (β-sitosterol; 0.13> stigmasterol; 0.10> lanosterol; 0.12> campesterol;
0.07). Similar higher amount of phytosterols were isolated from roots and leaves while lower amount were isolated from stems. Petroleum ether extract of the heartwood of *Tecomella undulata*, shows the presence of stigmasterol and β-sitosterol (Singh *et al.*, 2008; Nagpal *et al.*, 2010; Rohilla and Garg, 2014). Earlier studies on hepatoprotection have shown that stigmasterol and sitosterol present in good amount in the plant are responsible for this property (Singh and Gupta, 2011).

Spectral analysis of the observed and are reported in Table - 13.

(a) Campasterol, (b) Stigmasterol, (c) β-sitosterol (d) lanosterol

(a) Campasterol: Colourless powder (mp 137-138°C)

UV light absorption MeOH: 210 sh, 267 sh, 316 sh, 540sh

IR: $\nu$ cm$^{-1}$/ max KBr: 3380 (OH), 2920 (C-H), 2270 (C≡C), 1760 (C=O), 1610 (C=O), 1560, 1520, 1450, 1430 (aromatic), 1395, 1310, 1270, 1180, 1010, 815

$^1$HNMR(300MHz, CDCl$_3$): 1.05 (H$_1$), 1.87 (H$_2$), 1.15 (H$_3$), 0.87 (H$_4$), 0.84 (H$_5$), 1.08 (H$_6$), 1.68 (H$_7$), 1.17 (H$_8$), 1.44 (H$_9$), 1.65 (H$_{10}$), 1.17 (H$_{11}$), 1.27 (H$_{12}$), 1.28 (H$_{13}$), 1.69 (H$_{14}$), 1.04 (H$_{15}$), 1.25 (H$_{16}$), 0.88(H$_{17}$), 0.88 (H$_{18}$), 1.27 (H$_{19}$), 1.25 (H$_{20}$), 1.69 (H$_{21}$), 1.54 (H$_{22}$), 1.46 (H$_{23}$), 1.48 (H$_{24}$), 1.25 (H$_{25}$), 1.27 (H$_{26}$), 1.01 (H$_{27}$)

$^{13}$C NMR (300MHz, CDCl$_3$): 17.8 (C$_1$), 38.9 (C$_2$), 17.5 (C$_3$), 42.3 (C$_4$), 21.3 (C$_5$), 25.8 (C$_6$), 31.9 (C$_7$), 30.9 (C$_8$), 18.8 (C$_9$), 48.2 (C$_{10}$), 20.7 (C$_{11}$), 44.4 (C$_{12}$), 40.1 (C$_{13}$), 27.4 (C$_{14}$), 25.20 (C$_{15}$), 22.5 (C$_{16}$), 34.2 (C$_{17}$), 32.4 (C$_{18}$), 29.8 (C$_{19}$), 27.8 (C$_{20}$), 38.3 (C$_{21}$), 42.6 (C$_{22}$), 27.7 (C$_{23}$), 25.9 (C$_{24}$), 29.74 (C$_{25}$), 34.7 (C$_{26}$), 19.4 (C$_{27}$), 23.8 (C$_{28}$), 30.6 (C$_{29}$), 9.8 (C$_{30}$).

(b) Stigmasterol: Reddish brown crystallization (mp 143-144°C)

UV light absorption MeOH: 228 sh, 245 sh, 322 sh, 540sh

IR: $\nu$ cm$^{-1}$/ max KBr: 3480 (OH), 2950 (C-H), 1600 (C=O) 1365, 1570,
Result and Discussion

Secondary metabolites (Phytosterols)

1H NMR (300MHz, CDCl₃): 1.04 (H₁), 1.92 (H₂), 1.05 (H₃), 1.54 (H₄), 1.16 (H₅), 1.15 (H₆), 1.35 (H₇), 1.54 (H₈), 1.76 (H₉), 1.48 (H₁₀), 1.23 (H₁₁), 1.14 (H₁₂), 1.45 (H₁₃), 1.25 (H₁₄), 1.29 (H₁₅), 1.16 (H₁₆), 1.21 (H₁₇), 1.28 (H₁₈), 1.66 (H₁₉), 1.06 (H₂₀), 1.29 (H₂₁), 0.86 (H₂₂), 0.86 (H₂₃), 1.29 (H₂₄), 1.29 (H₂₅), 1.29 (H₂₆), 1.51 (H₂₇), 1.47 (H₂₈)

¹³C NMR (300MHz, CDCl₃): 19.3 (C₁), 33.6 (C₂), 19.7 (C₃), 39.6 (C₄), 73.5 (C₅), 32.6 (C₆), 33.8 (C₇), 29.9 (C₈), 18.4 (C₉), 48.3 (C₁₀), 20.7 (C₁₁), 27.8 (C₁₂), 40.6 (C₁₃), 27.3 (C₁₄), 32.27 (C₁₅), 22.2 (C₁₆), 34.4 (C₁₇), 32.7 (C₁₈), 29.9 (C₁₉), 27.0 (C₂₀), 33.8 (C₂₁), 462.4 (C₂₂), 267.88 (C₂₃), 25.7 (C₂₄), 27.74 (C₂₅), 24.5 (C₂₆), 19.3 (C₂₇), 23.4 (C₂₈)

β-sitosterol: brownish crystallization (mp 135-137°C)

UV light absorption MeOH: 206 sh, 268 sh, 356sh, 540sh

IR: cm⁻¹/ max KBr: 3400 (O–H), 2700(C–H), 2210 (C≡C), 1700 (C=O), 1640 (C=C), 1610, 1570, 1510, 1450, 1400 (aromatic), 1385, 1310, 1270, 1180, 1010, 815

¹H NMR (300MHz, CDCl₃): 0.98 (H₁), 1.38 (H₂), 1.35 (H₃), 1.36 (H₄), 1.11 (H₅), 1.82 (H₆), 1.21 (H₇), 1.35 (H₈), 1.45 (H₉), 1.16 (H₁₀), 1.64 (H₁₁), 1.47 (H₁₂), 1.26 (H₁₃), 1.15 (H₁₄), 1.75 (H₁₅), 1.27 (H₁₆), 1.27 (H₁₇), 1.96 (H₁₈), 1.24 (H₁₉), 1.66 (H₂₀), 1.06 (H₂₁), 1.21 (H₂₂), 1.46 (H₂₃), 0.86 (H₂₄), 0.86 (H₂₅), 1.26 (H₂₆), 1.29 (H₂₇), 1.29 (H₂₈), 1.51 (H₂₉), 1.47 (H₃₀)

¹³C NMR (300MHz, CDCl₃): 14.5(C₁), 21.7 (C₂), 34.3 (C₃), 42.9 (C₄), 30.4(C₅), 20.2(C₆), 20.6 (C₇), 30.8 (C₈), 35.7 (C₉), 29.7 (C₁₀), 18.7 (C₁₁), 48.8 (C₁₂), 20.3 (C₁₃), 20.4 (C₁₄), 40.1 (C₁₅), 27.5(C₁₆), 295.35 (C₁₇), 36.9 (C₁₈), 36.8 (C₁₉), 32.1 (C₂₀), 26.9 (C₂₁), 36.2 (C₂₂), 364.81 (C₂₃), 269.86 (C₂₄), 25.2 (C₂₅), 257.26 (C₂₆), 34.5 (C₂₇), 19.3 (C₂₈), 23.6(C₂₉)
(d) Lanosterol: Colourless crystallization (mp 131-133°C)

UV light absorption MeOH: 235 sh, 270 sh, 345 sh, 540sh

IR: cm⁻¹/ max KBr: 3420 (OH), 2915 (C-H), 2220 (–C≡C–), 1615 (C=C), 1440 (C=O), 1365, 1570, 1510, 1450, 1400 (aromatic), 1385, 1310, 1270, 1180, 1010.

¹H NMR (300MHz, CDCl₃): 1.11 (H₁), 0.96 (H₂), 1.02 (H₃), 0.87 (H₄), 1.22 (H₅), 1.25 (H₆), 1.03 (H₇), 1.67 (H₈), 1.49 (H₉), 1.24 (H₁₀), 1.17(H₁₁), 1.48 (H₁₂), 1.28 (H₁₃), 1.25 (H₁₄), 1.16 (H₁₅), 1.24 (H₁₆), 1.24 (H₁₇), 1.66 (H₁₈), 1.06 (H₁₉), 1.16 (H₂₀), 1.06 (H₂₁), 2.1 (H₂₂), 0.86 (H₂₃), 1.29 (H₂₄), 1.24 (H₂₅), 1.25 (H₂₆), 1.16 (H₂₇), 1.43 (H₂₈), 1.46 (H₂₉)

¹³C NMR (300MHz, CDCl₃): 22.5 (C₁), 6.24 (C₂), 22.6 (C₃), 39.5 (C₄), 24.3 (C₅), 35.7 (C₆), 30.8 (C₇), 18.9 (C₈), 43.9 (C₉), 33.8 (C₁₀), 15.0 (C₁₁), 27.4 (C₁₂), 22.8 (C₁₃), 22.3 (C₁₄), 31.9 (C₁₅), 22.5 (C₁₆), 33.0 (C₁₇), 27.1 (C₁₈), 31.8 (C₁₉), 30.8 (C₂₀), 15.1 (C₂₁), 46.6 (C₂₂), 24.6 (C₂₃), 25.8 (C₂₄), 29.79 (C₂₅), 50.0 (C₂₆), 11.5 (C₂₇), 29.1 (C₂₈), 19.0 (C₂₉).

Figure 12-23 shows the IR, ¹HNMR and ¹³CNMR spectra of all the eluted Phytosterols namely Campesterol, Stigmasterol, β-Sitosterol, Lanosterol.

A GC-MS analysis of the extracted Phytosterols from various plant parts of Boerhavia diffusa namely root, stem and leaf was carried out. Various constituents obtained are reported in Table 14. GC-MS spectra of Phytosterols from roots, stem and leaves are shown in Figure 24.1, 24.2 and 24.3. While GC-MS analysis of the extracted Phytosterols from various plant parts of Tecomella undulata namely root, stem, bark and leaf was carried out. Various constituents obtained are reported in Table 15. GC-MS spectra of Phytosterols from roots, stem, bark and leaves are shown in Figure 25.1, 25.2 and 25.3, 25.4.
Alkaloids are a class of naturally occurring organic nitrogen-containing bases. Alkaloids are found primarily in plants (Odebiyi et al., 1978), Alkaloids have traditionally been of interest only due to their pronounced and various physiological activities in animals and humans. Alkaloids are very useful pharmaceutical agents because of their biological activities (Vachnadze et al., 2001; Gotti et al., 2006; Kumar et al., 2009).

A GC-MS analysis of the extracted Alkaloids from various plant parts of *Boerhavia diffusa* namely root, stem and leaf was carried out. Various constituents obtained are reported in Table 16.

Table 16.1 shows compounds identified by the GC-MS analysis of the extracted alkaloids from the *Boerhavia diffusa* roots. Pentofluoropropionic acid, heptyl ester, 1-Pentadecanol, 2-Tert-butyl-4-(1,1,3,3-tetramethylbutyl), Butane, 1-bromo-3-methyl, 4-Octanol, 2,6,10-Trimethyl,14-ethylene-14-pentadecene, 4-Nonen-1-ol, Hexadecanoic acid, ethyl ester, 6-Octen-1-ol, 3,7-dimethyl, Hexylidencyclohexane, 9-Octadecenoic acid, ethyl ester, Dichloroacetic acid, nonyl ester, Eicosanoic acid, 2-ethyl-2-methyl-, methyl ester, (S)-(+)5-Methyl-1-heptanol, Cholesta-8,24-dien-3-ol, 4-methyl-, (3.beta.,4.alpha.)-1-Hexanesulfonic acid, methyl ester, 1-Pentanone, 3-[4-(diphenylmethyl)phenyl]4,4-stigmasteryl tosylate, Ethyl iso-allocholate, Stigmasta-5,22-dien-3-ol, beta.-Sitosterol, beta.-Sitosterol acetate.

Table 16.2 shows compounds identified by the GC-MS analysis of the extracted alkaloids from the *Boerhavia diffusa* stems. beta.-D-Glucopyranose, 1,6-anhydro, Phen-1,5-diol, 2-[3-oxododecanoyl], Methyl 4-o-methyl d-arabinopyranoside, Oxirane, tetradeeyl, 2-Hexadecene, 3,7,11,15-tetramethyl-, [R-[R*,R*-(E)]], 2,6,10-Trimethyl,14-ethylene-14-pentadecene, 3,7,11,15-Tetramethyl-2-hexadecen-1-ol, Octadecanoic acid, methyl ester, Phthalic acid, 4-bromophenyl octyl ester, Ethyl pentadecanoate, Oxirane, 6-Tridecane,
Result and Discussion

Secondary metabolites (Alkaloids)

7-Hexadecenoic acid, methyl ester, Phytol, Methyl 17,18-dideuteriooctadecanoate, 9-Hexadecyn-1-ol, Ethyl 9-hexadecenoate, Tetradecanoic acid, ethyl ester, Dodecanamide, Octanoic acid, 2-dimethylaminoethyl ester, Docosanoic acid, 5-Dodecen-1-al, Cyclohexane, eicosyl, Cyclohexane, (3-methylpentyl), 9-Octadecenamide, Fumaric acid, 2-dimethylaminoethyl nonyl ester, 2-(Dimethylamino)ethyl 2-methylacrylate, 8-Hexadecenal, 14-methyl-, (Z), 1,2-Benzenedicarboxylic acid, Cis-2-phenyl-1, 3-dioxolane-4-methyl octadec, Cholesta-6,22,24-triene, 4,4-dimethyl, Methyl 10,12-pentacosadiynoate, beta.-Sitosterol, 2,5,7,8-Tetramethyl-2-(4,8,12-trimethyltridecy, Urs-12-ene, Stigmasta-5,22-dien-3-ol, Squalene.


GC-MS spectra of Alkaloids from roots, stem and leaves are shown in Figure 26.1, 26.2 and 26.3. While GC-MS analysis of the extracted.

Alkaloids from various plant parts of *Tecomella undulata* namely root, stem, bark and leaf was carried out. Various constituents obtained are reported in Table 17.

Table 17.1 shows compounds identified by the GC-MS analysis of the extracted alkaloids from the *Tecomella undulata* roots. Benzoic acid, Dodecanal, 3-Undecene, 7-methyl-, 2,6,10-Trimethyl,14-ethylene-14-

Table 17.2 shows compounds identified by the GC-MS analysis of the extracted alkaloids from the *Tecomella undulata* stems. Tetradecanal, Cyclopropane, 1-methyl-2-(3-methylpentyl), 2-Hexadecene, 3,7,11,15-tetramethyl-, [R-[R*,R*-d(E)]], 2,6,10-Trimethyl,14-ethylene-14-pentadecene, 3,7,11,15-Tetramethyl-2-hexadecen-1-ol, Phthalic acid, heptyl tridec-2-yn-1-yl ester, n-Hexadecanoic acid, Hexadecanoic acid, ethyl ester, 2-Tetradecynal, 4-hydroxy, Phytol, 9-Hexadecenoic acid, 9-Octadecenoic acid, 5-Dodec-1-en, cis-9-Hexadecenal, Cyclohexane, eicosyl, Di-n-octyl phthalate, Cholesta-2,4-diene, Stigmasta-5,22-dien-3-ol, acetate, (3.beta.,22Z), 10-12-Pentacosadiynoic acid, Cholest-4,6-dien-3-ol, benzoate, (3.beta.), Cholest-5-en-3-ol (3.beta.), propanoate, Stigmasterol, beta.-Sitosterol, 1-Pentadecene, 2-methyl, 2-Nonadecanone, Diisobutyl 2,2-dihydroxymalonate.

Table 17.3 shows compounds identified by the GC-MS analysis of the extracted alkaloids from the *Tecomella undulata* bark. Benzoic acid, 3,4-dimethoxy, Delta.-2-dodecanol, Cyclopropane, 1-methyl-2-(3-methylpentyl), 1-Decene, 8-methyl, 2,6,10-Trimethyl,14-ethylene-14-pentadecene, Z-4-Tridecen-1-yl acetate, 3,7,11,15-Tetramethyl-2-hexadecen-1-ol, Hexadecanoic acid, Hexadecanoic acid, ethyl ester, 1,3-Isobenzofuranidine, hexahydro, Ethyl 9-hexadecenoate, Cyclohexane, eicosyl, 1,2-Benzenedicarboxylic acid, diocetyl
Result and Discussion

Secondary metabolites (Alkaloids)


Table 17.4 shows compounds identified by the GC-MS analysis of the extracted alkaloids from the *Tecomella undulata* leaves. Phenol, 2,4-bis(1,1-dimethylethyl), Octadecanal, 2-Hexadecene, 3,7,11,15-tetramethyl-, [R-[R*,R*-(E)], 2,6,10-Trimethyl,14-ethylene-14-pentadecene, 3,7,11,15-Tetramethyl-2-hexadecene-1-ol, 1,2-Benzenedicarboxylic acid, dibutyl ester, 1,2-Benzenedicarboxylic acid, butyl octyl ester, 1,2-Benzenedicarboxylic acid, butyl 2-ethylhexyl ester, Phthalic acid, cycloheptyl isohexyl ester, Phytol, Phthalic acid, pentyl tridec-2-yn-1-yl ester, 9-Octadecenoic acid, Hexadecanoic acid, butyl ester, 1-Docosene, 9-Octadecenal, Cyclohexane, eicosyl, Octadecanoic acid, butyl ester, 1-Docosanol, 1,2-Benzenedicarboxylic acid, Heptadecyl heptafluorobutyrate, Heptadecyl trifluoroacetate, 1-Heptacosanol, Cholesta-4,6-dien-3-ol, benzoate, (3.beta.), Cholest-5-en-3-ol (3.beta.)-, propanoate, 1-Heptacosanol, Stigmasta-5,22-dien-3-ol, beta.-Sitosterol, 2-Undecene, 6-methyl-, 4,4,6a,6b,8a,11,11,14b-Octamethyl-1,4,4a,5,6,6a,6b,7,8,8a,9, 2-Tert-butyl-4,6-bis(3,5-di-tert-butyl-4-hydrox, Olean-12-ene.

GC-MS spectra of Alkaloids from roots, stem, bark and leaves are shown in Figure 27.1, 27.2 and 27.3, 27.4.
Since the plants have unlimited and untapped wealth of chemical compounds with very high drug potential, modern approaches are being employed for selecting the promising plants having medical folkloric/ethnobotanical background and the active principle is identified (Jahan et al., 2008).

The active principles in the plants may not be major compound(s) in it but the activity of a compound may be masked by some other components in an extract. To evaluate the biological or pharmacological importance, various activities such as antibacterial, antifungal, antiviral, antitumor, anti-inflammatory, antipyretic and analgesic were tested by a number of workers, with an aim to identify the active principle(s) and their bioefficacy.

In present study antibacterial and antifungal activity of both the selected plant species were observed. Sequential extracts of different plant parts i.e petroleum ether, benzene, acetone, chloroform, ethanol and aqueous extracts along with the methanolic extracts were checked for their antibacterial and antifungal activity.

Table 18.1 shows Fungicidal and Bactericidal efficacy of sequential and methanolic extracts of Root of *Boeharavia diffusa*.

Antifungal activity of 2 mg/ml petroleum ether (PE) extract was maximum against *F. oxysporium* and minimum activity against *A. niger* (*F. oxysporium*; IZ=10.00±1.00mm > *P. funiculosum*; IZ=8.66±1.52mm > *T. reesei*; IZ=7.80±0.57mm > *A. niger*; IZ=0.00 mm). Against bacterial strains, activity was seen only against *S. aureus* and *E. coli* (*E. coli*; IZ=16.34±0.57mm > *S. aureus*; IZ=7±0mm > *B. subtilis, S. albudencus, P. aeruginosa*; IZ=0.00 mm).
Antifungal activity of 4 mg/ml petroleum ether (PE) extract was maximum against \textit{P. funiculosum} and minimum against \textit{A. niger} (\textit{P. funiculosum}; IZ=11.33±1.04 mm > \textit{F. oxysporium}; IZ=11±1.5 mm > \textit{T. reesei}; IZ=7.33±0.57 mm > \textit{A. niger}; IZ=0.00 mm). Against bacterial strains, highest activity was seen in \textit{B. subtilis} and minimum activity against \textit{P. aeruginosa} (\textit{B. subtilis}; IZ=19±1 mm > \textit{E. coli}; IZ=16.5±0.5 mm > \textit{S. aureus}; IZ=15.83±0.76 mm > \textit{S. albudencus}; IZ=12.5±0.5 mm > \textit{P. aeruginosa}; IZ=0.00 mm).

Antifungal activity of 2 mg/ml benzene extract was maximum against \textit{F. oxysporium} and minimum activity against \textit{A. niger} (\textit{F. oxysporium}; IZ=10.66±1.52 mm > \textit{P. funiculosum}; IZ=9.5±0.5 mm > \textit{T. reesei}; IZ=5.8±1.04 mm > \textit{A. niger}; IZ=0.00 mm). Against bacterial strains, highest activity was seen by \textit{E. coli} whereas \textit{S. albudencus}, \textit{S. aureus} and \textit{P. aeruginosa} showed no activity (\textit{E. coli}; IZ=12.34±1.52 mm > \textit{B. subtilis}; IZ=11.68±1.52 mm > \textit{P. aeruginosa}, \textit{S. albudencus}, \textit{S. aureus}; IZ=0.00 mm).

Antifungal activity of 4 mg/ml benzene extract was maximum against \textit{P. funiculosum} and minimum against \textit{A. niger} (\textit{P. funiculosum}; IZ=17.5±1.32 mm > \textit{F. oxysporium}; IZ=14±1.32 mm > \textit{T. reesei}; IZ=9.16±1.04 mm > \textit{A. niger}; IZ=0.00 mm). \textit{S. aureus} showed highest inhibitory activity while \textit{P. aeruginosa} and \textit{S. albudencus} showed no activity (\textit{S. aureus}; IZ=13.5±2.08 mm > \textit{B. subtilis}; IZ=11.37±1.52 mm > \textit{E. coli}; IZ=7.83±0.76 mm > \textit{P. aeruginosa}, \textit{S. albudencus}; IZ=0.00 mm).

Antifungal activity of 2 mg/ml acetone extract was maximum against \textit{F. oxysporium} and minimum activity against \textit{A. niger} (\textit{F. oxysporium}; IZ=11.66±3.05 mm > \textit{T. reesei}; IZ=9.5±0.5 mm > \textit{P. funiculosum}; IZ=6.83±0.76 mm > \textit{A. niger}; IZ=0.00 mm). Acetone extract show no activity against any of the bacterial strains show (\textit{S. aureus}, \textit{B. subtilis}, \textit{P. aeruginosa} \textit{S. albudencus}, \textit{E. coli}; IZ=0.00 mm).
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Antifungal activity of 4 mg/ml acetone extract was recorded as (T. reesei, F. oxysporium; IZ=13.5±1.32 mm > P. funiculosum; IZ=9.16±0.76 mm > A. niger; IZ=0.00 mm). Maximum activity was seen against E. coli (E. coli; IZ=14.67±0.57 mm > S. aureus; IZ=12.33±1.52 mm > B. subtilis, P. aeruginosa, S. albudencus; IZ=0.00 mm).

Antifungal activity of 2 mg/ml chloroform extract was shown observed as (P. funiculosum; IZ=8.66±0.76 mm > T. reesei; IZ=7.5±0.5 mm > A. niger, F. oxysporium; IZ=0.00 mm) Against bacterial strains, highest activity was seen against S. aureus and minimum against S. albudencus (S. aureus; IZ=18.34±2.31 mm > E. coli; IZ=15.83±1.25 mm > P. aeruginosa; IZ=11.5±1.32 mm > B. subtilis; IZ=11.33±0.76 mm > S. albudencus; IZ=0.00 mm).

Antifungal activity of 4 mg/ml chloroform extract was maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ=13.66±1.52 mm > P. funiculosum; IZ=12±1.32 mm > T. reesei; IZ=10.83±1.25 mm > A. niger; IZ=0.00 mm). Maximum antibacterial activity was seen against S. aureus and minimum activity against B. subtilis (S. aureus; IZ=16.33±2.08 mm > P. aeruginosa; IZ=13.67±0.76 mm > E. coli; IZ=12.83±1.75 mm > S. albudencus; IZ=8.5±0.86 mm > B. subtilis; IZ=0.00 mm).

Antifungal activity of 2 mg/ml ethanol extract was shown only against F. oxysporium while minimum inhibitory activity was observed against T. reesei (F. oxysporium; IZ=12.33±1.25 mm > A. niger; IZ=7±1.04 mm > P. funiculosum; IZ=6.5±0.5 mm > T. reesei; IZ=0.00 mm). Against bacterial strains, highest activity was seen against S. albudencus (S. albudencus; IZ=15.5±1.5 mm > S. aureus; IZ=15.32±0.76 mm > P. aeruginosa, E. coli, B. subtilis; IZ=0.00 mm).

Antifungal activity of 4 mg/ml ethanol extract was maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ=15.83±1.04 mm > P. funiculosum; IZ=10.16±0.76 mm > T. reesei; IZ=8.33±0.76 mm >
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A. niger; IZ=7.5±0.5mm). Maximum antibacterial activity was only seen against P. aeruginosa; (P. aeruginosa; 8.5±0.5mm > S. albudencus; IZ=8±0.5mm > E. coli, S. aureus, B. subtilis; IZ=0.00mm).

Antifungal activity of 2 mg/ml aqueous extract was seen against F. oxysporium and T. reesei while no inhibitory activity was observed against A. niger and P. funiculosum (F. oxysporium; IZ=11.16±1.04mm > T. reesei; IZ=7±1mm> A. niger, P. funiculosum; IZ=0.00 mm). Aqueous extract showed maximum inhibitory activity against B. subtilis and minimum against P. aeruginosa (B. subtilis; IZ=12.83±1.04mm > E. coli, IZ=11.66±0.57mm>, S. albudencus; IZ=10.1±1.04mm > S. aureus; IZ=8.35±0.57mm > P. aeruginosa; IZ=0.00 mm).

Antifungal activity of 4 mg/ml aqueous extract was maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ= 16.83±1.04mm > T. reesei; IZ= 9.5±0.5mm > P. funiculosum; 7.5±0.5mm > A. niger; IZ=0.00 mm). Aqueous extract showed inhibitory activity only against S. albudencus (S. albudencus; IZ=12.83±0.76mm > S. aureus, E. coli, B. subtilis, P. aeruginosa; IZ= 0.00 mm).

Antifungal activity of 2 mg/ml methanol extract was seen only against F. oxysporium (F. oxysporium; IZ= 8.5±0.5mm > A. niger, P. funiculosum, T. reesei; IZ=0.00mm) Maximum antibacterial activity was seen against S. albudencus, P. aeruginosa whereas against E. coli, S. aureus, B. subtilis showed no activity, (S. albudencus; IZ=9±1mm > P. aeruginosa; IZ=11.5±0.5 mm > S. aureus, B. subtilis, E. coli; IZ= 0.00 mm).

Antifungal activity of 4mg/ml methanol extract reported maximum inhibitory activity against F. oxysporium and minimum against T. reesei (F. oxysporium; IZ=10.33±1.04mm > P. funiculosum; IZ=7.33±1.25mm > A. niger; IZ=6.33±1.04mm > T. reesei; IZ= 0.00 mm). No inhibitory activity
against bacteria was seen (S. aureus, S.albudencus, B. subtilis, P.aeruginosa, E. coli; IZ= 0.00 mm).

MIC values of the sequential and methanolic extract of root of Boerhavia diffusa extract against all the tested fungi and bacteria have been mentioned in Table 18.1.

Table 18.2 shows Fungicidal and Bactericidal efficacy of sequential and methanolic extracts of Stem of Boerhavia diffusa.

Antifungal activity of 2 mg/ml petroleum ether (PE) extract was maximum against T.reesei and no activity against A. niger and P. funiculosum (T.reesei; IZ=8±0.5mm > F. oxysporium; IZ=7.33 ±0.57 mm > A. niger, P. funiculosum; IZ=0.00 mm). Against bacterial strains, activity was seen only against P.aeruginosa (P.aeruginosa; IZ=19.00 ± 2.64 mm > S. aureus, E. coli, B. subtilis, S.albudencus; IZ=0.00 mm).

Antifungal activity of 4 mg/ml petroleum ether (PE) extract was maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ=14.67 ± 1.89mm > P. funiculosum; IZ= 9.5 ± 0.5 mm > T.reesei; IZ=8.83 ± 1.52 mm > A. niger; IZ=0.00 mm). Against bacterial strains, highest activity was seen by B. subtilis and minimum activity against S. aureus (B. subtilis; IZ=12.68± 1.15 mm > S.albudencus; IZ= 8.39± 0.57 mm > E. coli; IZ= 7.33±1.15 mm> P.aeruginosa; IZ= 6.68± 0.57 mm> S. aureus; IZ=0.00 mm).

Antifungal activity of 2 mg/ml benzene extract was maximum against P. funiculosum and minimum activity against A. niger and F. oxysporium (P. funiculosum; IZ=10.33 ± 1.04 mm > T.reesei; IZ=7.33±1.25 mm> F. oxysporium, A. niger; IZ=0.00 mm). Against bacterial strains, highest activity was seen by B. subtilis and minimum against S.albudencus, S. aureus and
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*P. aeruginosa (B. subtilis; IZ=14.33 ± 0.57 mm > E. coli; IZ= 8.35± 0.57 mm > P. aeruginosa, S. albudencus, S. aureus; IZ=0.00 mm).*

Antifungal activity of 4 mg/ml benzene extract was maximum against *F. oxysporium* and minimum against *A. niger* (*F. oxysporium; IZ=13.16 ± 1.25 mm > P. funiculosum; IZ=12.23 ± 1.07 mm > T. reesei; IZ= 8.5 ± 1.04 mm > A. niger; IZ=0.00 mm).* *S. albudencus* showed highest inhibitory activity while *P. aeruginosa* and *S. aureus* showed no activity (*S. albudencus; IZ= 9.68 ± 0.57 mm > B. subtilis; IZ=7.33 ± 0.28 mm > E. coli; IZ= 6.67±0.57 mm > P. aeruginosa, S. aureus; IZ=0.00 mm).*

Antifungal activity of 2 mg/ml acetone extract was maximum against *F. oxysporium* and minimum activity against *A. niger* (*F. oxysporium; IZ=8.5 mm ±0.86 mm > P. funiculosum; IZ=8.33 ± 1.04 mm > T. reesei; IZ=6.9 ± 0.81 mm >A. niger; IZ=0.00 mm).* Against bacterial strains, highest activity was seen by *S. aureus* and minimum against *E. coli, P. aeruginosa* (*S. aureus; IZ=15.67 ± 2.08 mm > B. subtilis; IZ= 11± 1.73 mm > P. aeruginosa; IZ=10.33 ± 2.51mm >, S. albudencus, E. coli; IZ=0.00 mm).*

Antifungal activity of 4 mg/ml acetone extract was maximum against *T. reesei* and minimum against *A. niger* (*T. reesei; IZ=20.5±0.5mm > P. funiculosum; IZ=11.06± 1.29mm > F. oxysporium; IZ= 8.53± 0.76 mm > A. niger; IZ=0.00 mm).* Maximum activity was seen against *S. aureus* and minimum activity against *E. coli* (*S. aureus; IZ=13± 1.73 mm > B. subtilis; IZ=12± 2 mm > P. aeruginosa; IZ=11.69± 1.69mm > S. albudencus; IZ= 11.67 ± 2.08 mm > E. coli; IZ=0.00mm).*

Antifungal activity of 2 mg/ml chloroform extract was shown only against *F. oxysporium* while against minimum inhibitory activity was observed against *A. niger* (*F. oxysporium; IZ=12.67± 0.57mm > T. reesei; IZ= 7.5± 1.32mm > P. funiculosum; IZ=7.34± 0.76mm>A. niger; IZ=0.00mm).*
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Against bacterial strains, highest activity was seen against *B. subtilis* and minimum against *S. albudencus* (*B. subtilis*; IZ=12.37 ± 1.52 mm > *P. aeruginosa*; IZ=12.35 ± 1.52 mm > *S. aureus*; IZ=11.33± 1.52 mm > *E. coli*; IZ=8.35± 1.15 mm > *S. albudencus*; IZ=7.33± 1.52 mm).

Antifungal activity of 4 mg/ml chloroform extract was maximum against *F. oxysporium* and minimum against *A. niger* (*F. oxysporium*; IZ=11.67±2.08 mm > *T. reesei*; IZ=9.5±0.5 mm > *P. funiculosum*; IZ=9.33±1.04 mm > *A. niger*; IZ=0.00 mm). Maximum antibacterial activity was seen against *S. aureus* and minimum activity against *E. coli* (*S. aureus*; IZ=14.86±1.52 mm > *S. albudencus*; IZ=12.67±0.57 mm > *P. aeruginosa*; IZ=11.68±1.52 mm > *B. subtilis*; IZ=11±2 mm > *E. coli*; IZ=10.66±1.52 mm).

Antifungal activity of 2 mg/ml ethanol extract was shown only against *F. oxysporium* while minimum inhibitory activity was observed against *T. reesei* (*F. oxysporium*; IZ=11.83 ± 1.60 mm > *P. funiculosum*; IZ=8.83±0.76 mm > *A. niger*; IZ=7.35±0.28 mm > *T. reesei*; IZ=0.00 mm). Against bacterial strains, highest activity was seen against *B. subtilis* and minimum against *E. coli* (*B. subtilis*; IZ=12.59±1.15 mm > *S. albudencus*; IZ=11.38±1.52 mm > *P. aeruginosa*; IZ=11.32±1.15 mm > *S. aureus*; IZ=10.67±1.52 mm > *E. coli*; IZ=9.68±2.1 mm).

Antifungal activity of 4 mg/ml ethanol extract was maximum against *F. oxysporium* and minimum against *T. reesei* (*F. oxysporium*; IZ=14.33±1.04 mm > *P. funiculosum*; IZ=9.66±0.28 mm > *A. niger*; IZ=8.1±1.15 mm > *T. reesei*; IZ=6±0.5 mm). Maximum antibacterial activity was only seen against *S. aureus* and minimum against *B. subtilis* (*S. aureus*; IZ=14.34±0.58 mm > *P. aeruginosa*; IZ=13.34±1.52 mm > *S. albudencus*; IZ=11.77±2.51 mm > *E. coli*; IZ=11.35±1.52 mm > *B. subtilis*; IZ=9.68±0.57 mm).

Antifungal activity of 2 mg/ml aqueous extract was shown only against *F. oxysporium* while no inhibitory activity was observed against *A. niger* and
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*T. reesei* (*F. oxysporium*; IZ=11.16±1.04mm > *P. funiculosum*; IZ=7±1mm > *A. niger, T. reesei*; IZ=0.00 mm). Aqueous extract showed inhibitory activity only against *B. subtilis* while all other bacterial strains showed no inhibitory activity (*B. subtilis*; IZ=9.36±1.15mm > *E. coli, S. aureus, S.albudencus, P.aeruginosa*; IZ=0.00 mm).

Antifungal activity of 4 mg/ml aqueous extract was maximum against *F. oxysporium* and minimum against *A. niger and T. reesei* (*F. oxysporium*; IZ= 16.83± 1.04mm > *P. funiculosum*; 9.5±0.5mm > *T. reesei, A. niger*; IZ=0.00 mm). Maximum antibacterial activity was seen against *E. coli* and minimum against *S. aureus, S.albudencus, P.aeruginosa* (*E. coli*; IZ=10.33±0.57mm > *B. subtilis*; IZ=7.67±1.52mm > *P.aeruginosa, S.albudencus, S. aureus*; IZ=0.00 mm).

Antifungal activity of 2 mg/ml methanol extract was seen only against *F. oxysporium* (*F. oxysporium*; IZ= 7.83±0.76mm > *A. niger, P. funiculosum, T.reesei*; IZ=0.00mm) Maximum antibacterial activity was seen against *E. coli* and minimum against *S.albudencus, P.aeruginosa* (*E. coli*; IZ=11.5±1.32mm > *B. subtilis*; IZ=9.67±1.15mm > *S. aureus*; IZ= 9±1.73mm > *S.albudencus, P.aeruginosa*; IZ= 0.00 mm)

Antifungal activity of 4mg/ml methanol extract reported maximum inhibitory activity against *F. oxysporium* and minimum against *P. funiculosum* (*F. oxysporium*; IZ=8.5±0.86mm > *A. niger; IZ=7.56±0.25mm > *T.reesei; IZ=7.16±1.04mm > *P. funiculosum; IZ= 0.00 mm). Inhibitory activity against bacteria was seen only against *S. aureus* (*S. aureus; IZ=13.33±0.57 mm > *S.albudencus, B. subtilis, P.aeruginosa, E. coli; IZ= 0.00 mm).
MIC values of the sequential and methanolic extract of stem of *Boerhavia diffusa* extract against all the tested fungi and bacteria have been mentioned in Table 18.2.

Table 18.3 shows Fungicidal and Bactericidal efficacy of sequential and methanolic extracts of Leaves of *Boerhavia diffusa*.

Antifungal activity of 2 mg/ml petroleum ether (PE) extract was seen as (*P. funiculosum*; IZ=10.67 ± 1.60 mm > *F. oxysporium*; IZ= 10.33 ± 1.89 mm > *A. niger, T.reesei*; IZ=0.00 mm). Against bacterial strains, only satisfactory activity can be seen as shown in hierarchy (*S.albudencus*; IZ=12.00 ± 2.00 mm > *S. aureus*; IZ= 7.66 ± 0.57 mm > *E. coli, B. subtilis, P.aeruginosa*; IZ=0.00 mm).

Antifungal activity of 4 mg/ml petroleum ether (PE) extract was maximum against *P. funiculosum* and minimum against *A. niger* (*P. funiculosum*; IZ=10.83 ± 2.02 mm > *F. oxysporium*; IZ= 10.66 ± 1.60 mm > *T.reesei; IZ=8.50 ± 1.32 mm > *A. niger; IZ=0.00 mm*). Against bacterial strains, highest activity was seen by *S. aureus* and no activity against *S.albudencus, B. subtilis* and *P.aeruginosa* (*S. aureus; IZ=9.66 ± 0.57 mm > *E. coli; IZ= 6.67 ± 0.57 mm > S.albudencus, B. subtilis, P.aeruginosa*; IZ=0.00 mm).

Antifungal activity of 2 mg/ml benzene extract was maximum against *P. funiculosum* and minimum activity against *A. niger* (*P. funiculosum; IZ=8.33 ± 1.04 mm > *F. oxysporium; IZ= 7.50 ± 0.50 mm > T.reesei; IZ=7.33 mm ± 0.50 mm > *A. niger; IZ=0.00 mm*). Against bacterial strains, inhibitory activity was observed as (*S. aureus; IZ=11.33 ± 2.08 mm > *E. coli; IZ= 8.00 ± 1.73 mm > P.aeruginosa; IZ=6.33 ± 1.15 mm > S.albudencus, B. subtilis; IZ=0.00 mm*).
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Antifungal activity of 4 mg/ml benzene extract was maximum against *P. funiculosum* and minimum against *A. niger* (*P. funiculosum*; IZ=9.26 ± 1.10 mm > *T. reesei*; IZ=9.50 ± 1.32 mm > *F. oxysporium*; IZ= 7.86 ± 0.80 mm > *A. niger*; IZ=0.00 mm). Similar high activity was seen against *S.albudencus* and *E. coli* and minimum activity against *P.aeruginosa* (*E. coli*, *S.albudencus*; IZ= 11.66 ± 2.08 mm > *S. aureus*, *B. subtilis*; IZ=11.00 ± 2.00 mm >, *P.aeruginosa*; IZ=0.00 mm).

Antifungal activity of 2 mg/ml acetone extract was maximum against *T.reesei* and minimum activity against *A. niger* and *F. oxysporium* (*T.reesei*; IZ=12.00 mm ± 1.80 mm > *P. funiculosum*; IZ=11.33 ± 1.60 mm > *A. niger*, *F. oxysporium*; IZ=0.00 mm). Against bacterial strains, highest activity was seen by *E.coli* and minimum against *B. subtilis* (*E. coli*; IZ= 12.33 ± 1.52 mm > *S. aureus*; IZ=11.66 ± 1.52 mm > *P.aeruginosa*; IZ=9.83 ± 0.28 mm >, *S.albudencus*; IZ=8.00 ± 1.00 mm > *B. subtilis*; IZ=0.00 mm).

Antifungal activity of 4 mg/ml acetone extract was maximum against *P. funiculosum* and minimum against *A. niger* (*P. funiculosum*; IZ=16.16 ± 1.04 mm > *T.reesei*; IZ=13.83 ± 0.76 mm > *F. oxysporium*; IZ= 10.16 ± 0.76 mm > *A. niger*; IZ=0.00 mm). Maximum activity was seen against *P.aeruginosa* and minimum activity against *E. coli* (*P.aeruginosa*; IZ=13.66 ± 1.52 mm > *S. aureus*, *B. subtilis*; IZ=13.33 ± 2.08 mm > *S.albudencus*; IZ= 12.33 ± 2.08 mm > *E. coli*; IZ= 11.66 ± 2.08 mm).

Antifungal activity of 2 mg/ml chloroform extract was shown only against *F. oxysporium* while against all others no inhibitory activity was observed (*F. oxysporium*; IZ=13.50 ± 1.80 mm > *T.reesei, A. niger, P. funiculosum*; IZ=0.00 mm). Against bacterial strains, highest activity was seen by *S. aureus* and minimum against *P.aeruginosa, S.albudencus* *E. coli* (*S. aureus*; IZ=8.67 ± 2.08 mm > *B. subtilis*; IZ= 8.00 ± 2.64 mm > *P.aeruginosa, S.albudencus, E. coli*; IZ=0.00 mm).
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Antifungal activity of 4 mg/ml chloroform extract was maximum against *F. oxysporium* and minimum against *P. funiculosum* and *A. niger* (*F. oxysporium*; IZ= 8.90 ± 1.67 mm > *T. reesei*; IZ=6.86 ± 0.76 mm > *P. funiculosum*, *A. niger*; IZ=0.00 mm). Maximum antibacterial activity was only seen against *B. subtilis* (*B. subtilis*; IZ=9.33 ± 1.52 mm > *P. aeruginosa*, *S. aureus*, *S. albudencus*, *E. coli*; IZ= 0.00 mm).

Antifungal activity of 2 mg/ml ethanol extract was shown only against *F. oxysporium* while against all others no inhibitory activity was observed (*F. oxysporium*; IZ=12.67 ± 1.60 mm > *T. reesei*, *A. niger*, *P. funiculosum*; IZ=0.00 mm). Against bacterial strains, highest activity was seen against *S. aureus* and minimum against *E. coli* (*S. aureus*; IZ=12± 1 mm > *B. subtilis*; IZ= 11.66± 1.52mm > *S. albudencus*; IZ =11±2.64mm> *P. aeruginosa*; IZ =8.33±1.15mm> *E. coli*; IZ=0.00 mm).

Antifungal activity of 4 mg/ml ethanol extract was maximum against *F. oxysporium* and minimum against *A. niger* (*F. oxysporium*; IZ= 14.5± 1.32mm > *T. reesei*; IZ=8.5 ± 0.5 mm > *P. funiculosum*; IZ =6.7±0.76mm> *A. niger*; IZ=0.00 mm). Maximum antibacterial activity was only seen against *S. aureus* and minimum against *B. subtilis* (*S. aureus*; IZ=12.5 ±0.86 mm > *P. aeruginosa*; 10±2mm> *E. coli*; IZ= 9.66±2.08mm > *S. albudencus*; IZ= 7.66±0.57mm> *B. subtilis*; IZ= 0.00 mm).

Antifungal activity of 2 mg/ml aqueous extract was shown only against *T. reesei* and *P. funiculosum* while no inhibitory activity was observed against *A. niger* and *F. oxysporium* (*T. reesei*, *P. funiculosum*; IZ=9±1.32mm> *A. niger*, *F. oxysporium*; IZ=0.00 mm). Aqueous extract showed no inhibitory activity against any bacterial strain (*S. aureus*, *B. subtilis*, *S. albudencus*, *P. aeruginosa*, *E. coli*; IZ=0.00 mm).
Antifungal activity of 4 mg/ml aqueous extract was maximum against *F. oxysporium* and minimum against *A. niger* (*F. oxysporium*; IZ = 11.67 ± 1.52 mm > *P. funiculosum*; IZ = 11.66 ± 1.76 mm > *T. reesei*; IZ = 9.68 ± 0.76 mm > *A. niger*; IZ = 0.00 mm). Maximum antibacterial activity was seen against *E. coli* and minimum against *S. aureus, S. albudencus, P. aeruginosa* (*E. coli*; IZ = 10.66 ± 1.52 mm > *B. subtilis*; IZ = 6.67 ± 0.76 mm > *P. aeruginosa, S. albudencus, S. aureus*; IZ = 0.00 mm).

Antifungal activity of 2 mg/ml methanol extract reported maximum inhibitory activity against *F. oxysporium* and minimum against *T. reesei* and *P. funiculosum* (*F. oxysporium*; IZ = 9.8 ± 0.28 mm > *A. niger*; IZ = 7.2 ± 1.25 mm > *T. reesei, P. funiculosum*; IZ = 0.00 mm). Maximum inhibitory activity against bacteria was seen against *E. coli* and minimum against *B. subtilis* and *P. aeruginosa* (*E. coli*; IZ = 9.67 ± 1.52 mm > *S. aureus*; IZ = 9.66 ± 2.08 mm > *S. albudencus*; IZ = 8.83 ± 1.04 mm > *B. subtilis, P. aeruginosa*; IZ = 0.00 mm).

Antifungal activity of 4 mg/ml methanol extract was maximum against *F. oxysporium* and minimum against *T. reesei* (*F. oxysporium*; IZ = 12.33 ± 1.04 mm > *A. niger*; IZ = 9.8 ± 0.28 mm > *P. funiculosum*; IZ = 9.5 ± 1.32 mm > *T. reesei*; IZ = 6.8 ± 1.32 mm). Maximum antibacterial activity was seen against *P. aeruginosa* and minimum against *B. subtilis* (*P. aeruginosa*; IZ = 13.33 ± 1.52 mm > *S. aureus*; IZ = 12.66 ± 0.57 mm > *S. albudencus*; IZ = 11.33 ± 1.52 mm > *E. coli*; IZ = 10 ± 1 mm > *B. subtilis*; IZ = 0.00 mm).

MIC values of the sequential and methanolic extract of leaves of *Boerhavia diffusa* against all the tested fungi and bacteria have been mentioned in Table 18.3.

In the present study sequential extracts and methanolic extracts were checked for their antimicrobial activity, all the three plant parts of *Boerhavia*
*diffusa* namely roots, stem and leaves showed significant results against pathogenic fungi and bacteria. Sequential extracts have also been reported for their potent antibacterial and antifungal activity. Sequential extracts of *Boerhavia diffusa* show significant inhibitory activity against *Aspergillus fumigates* and *C. albicans* (Gupta and Banerjee, 1972; Hoffman et al., 2004) Antifungal activity of various extracts petroleum ether, chloroform, ethyl acetate, ethyl alcohol and aqueous of aerial and root parts of *Boerhavia diffusa* (Nyctaginaceae) was screened against dermatophytic fungi *Microsporum fulvum*. significant increase has been recorded in the % inhibition of the target fungal species with increasing test concentrations (1000-5000 ppm) of chloroform, ethyl acetate and ethyl alcohol extracts of the root (Agrawal et al., 2003, 2004) plant extracts show inhibitory activity against five filamentous fungi (*Aspergillus niger, Alternaria alternata, Fusarium chlamydosporum, Rhizoctonia bataticola and Trichoderma viride, Candida albicans*) (Aqil and Ahmad, 2003) methanolic extract show high inhibition against pathogenic fungal strains (Aladesanmi et al., 2007).

Aqueous and methanolic extracts of *Boerhavia diffusa* have shown to highly effective against *Bacillus subtilis, Bacillus cereus, Staphylococcus aureus* amongst other tested bacterial strains (Kumar, 1997; Abo and Ashidi, 1999; Gopal et al., 1999; Girish and Satish, 2008; Nair et al., 2008; Goyal et al., 2010; Das, 2012; Mahesh et al., 2012). Against *Aeromonas hydrophilla and Bacillus cereus, B. erecta* aqueous extracts have shown maximum inhibition (Samy et al., 1999; Apu et al., 2012). Umamaheswari, 2010 has shown similar activities of *Boerhavia diffusa* extracts, ethanolic extracts methanolic extracts showed good activity against both Gram positive and Gram negative bacteria. Significant antibacterial activities of *Boerhavia diffusa* extracts also justifies its use in treatment of various human ailments which are alos been mentioned in Ayurveda, *Charaka Samhita*, and *Sushrita Samhita* (Kaur and Goel, 2011).
Table 19.1 shows Bactericidal and Fungicidal efficacy of sequential and methanolic extracts of root of *Tecomella undulata*

Antifungal activity of 2 mg/ml petroleum ether (PE) extract was maximum against *P. funiculosum* and minimum activity against *A. niger* and *T. reesei* (*P. funiculosum*; $IZ=11.16\pm 1.25\text{mm}$ > *F. oxysporium*; $IZ=10.83\pm 1.75\text{mm}$ > *A. niger, T. reesei*; $IZ=0.00\text{mm}$). Against bacterial strains, activity was seen only against *B. subtilis* and *S. albudencus* (*B. subtilis*; $IZ=12.03\pm 1.81\text{mm}$ > *S. albudencus*; $IZ=9.5\pm 0.87\text{mm}$) > *E. coli, P. aeruginosa, S. aureus* (*E. coli*; $IZ=9.5\pm 0.5\text{mm}$ > *P. aeruginosa, S. aureus*; $IZ=0.00\text{mm}$).

Antifungal activity of 4 mg/ml petroleum ether (PE) extract was maximum against *P. funiculosum* and minimum against *A. niger and T. reesei* (*P. funiculosum*; $IZ=11.83\pm 1.25\text{mm} > F. oxysporium; IZ=11.66\pm 1.89 \text{mm} > A. niger, T. reesei; IZ=0.00 \text{mm}$). Against bacterial strains, highest activity was seen in *B. subtilis* and minimum activity against *P. aeruginosa and S. aureus* (*B. subtilis*; $IZ=12.83\pm 0.29\text{mm} > S. albudencus; IZ=11.67\pm 0.76\text{mm} > E. coli; IZ=9.5\pm 0.5\text{mm} > P. aeruginosa, S. aureus; IZ=0.00\text{mm}$).

Antifungal activity of 2mg/ml benzene extract was maximum against *F. oxysporium* and minimum against *A. niger and T. reesei* (*F. oxysporium*; $IZ=10.66\pm 1.15\text{mm} > P. funiculosum; IZ=8.66\pm 0.57\text{mm} > A. niger, T. reesei; IZ=0.00\text{mm}$). *S. albudencus* showed highest inhibitory activity (*S. albudencus*; $IZ=22.83\pm 1.04\text{mm} > P. aeruginosa; IZ=12\pm 1\text{mm} > B. subtilis, E. coli, S. aureus; IZ=0.00\text{mm}$).

Antifungal activity of 4mg/ml benzene extract was maximum against *F. oxysporium* and minimum activity against *A. niger* (*F. oxysporium*; $IZ=8.66 \pm 0.57 \text{mm} > T. reesei; IZ=6.66\pm 0.57 \text{mm} > P. funiculosum; IZ=6.5\pm 0.86 \text{mm} > A. niger; IZ=0.00 \text{mm}$). Against bacterial strains, highest activity was seen against *S. albudencus* whereas *E. coli, B. subtilis* showed no activity.
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(S.albudencus; IZ= 30.67±3.05mm > P.aeruginosa; IZ=12.67±0.76mm > S. aureus; IZ=9.33±0.76mm > E. coli, B. subtilis; IZ=0.00 mm).

Antifungal activity of 2 mg/ml acetone extract was maximum against F. oxysporium and minimum activity against A. niger (F. oxysporium; IZ=8.76 ±0.92mm > P. funiculosum; IZ=8.5 ±0.86mm > T.reesei; IZ=6.86± 0.8 mm > A. niger; IZ=0.00 mm). Maximum activity of acetone extract was seen against E. coli and P.aeruginosa and no activity was seen against S. aureus (E. coli, P.aeruginosa; IZ=14.83±1.26mm > B. subtilis; IZ=11.83± 0.29mm> , S.albudencus; IZ=11.5±1.32mm> S. aureus; IZ=0.00 mm).

Antifungal activity of 4 mg/ml acetone extract was maximum against T.reesei and minimum against A. niger (T.reesei; IZ=19.66±1.52mm > P. funiculosum; IZ=10.73±0.75mm>F. oxysporium; IZ=7.33±1.52mm > A. niger; IZ=0.00mm). Inhibitory activity was only seen against S.albudencus, B. subtilis (B. subtilis; IZ=9.83±0.76mm> S.albudencus; IZ=9.17±1.04mm > S. aureus, P.aeruginosa, E. coli; IZ=0.00mm).

Antifungal activity of 2 mg/ml chloroform was maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ= 10.7±0.81mm> P. funiculosum; IZ=8.16±0.28mm > T.reesei, A. niger; IZ=0.00 mm). Against bacterial strains, highest activity was seen against P.aeruginosa and minimum against B. subtilis and E. coli (P.aeruginosa; IZ=15±1mm > S.albudencus; IZ=14±1.03mm > S. aureus; IZ=8±0.5mm> E. coli, B. subtilis; IZ=0.00mm).

Antifungal activity of 4 mg/ml chloroform extract was maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ= 15.16±1.25mm>P. funiculosum; IZ=8.96±1.26mm > T.reesei; IZ=6.8±0.80 mm> A. niger; IZ=0.00 mm). Maximum antibacterial activity was seen against S.albudencus and minimum activity against E. coli (S.albudencus;
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IZ = 15.47 ± 0.53 mm > B. subtilis; IZ = 13.67 ± 1.53 mm > P. aeruginosa; IZ = 12.16 ± 1.29 mm > S. aureus; IZ = 10.03 ± 0.47 mm > E. coli; IZ = 0.00 mm).

Antifungal activity of 2 mg/ml ethanol extract was seen only against *F. oxysporium* (*F. oxysporium*; IZ = 12.83 ± 0.76 mm > *A. niger, P. funiculosum, T. reesei,* IZ = 0.00 mm). Against bacterial strains, highest activity was seen against *B. subtilis* while no activity was seen against *S. albidencus* and *E. coli* (*B. subtilis*; IZ = 12.5 ± 0.87 mm > *P. aeruginosa*; IZ = 11.83 ± 0.76 mm > *S. aureus*; IZ = 10.5 ± 0.87 mm > *E. coli, S. albidencus; IZ = 0.00 mm)*.

Antifungal activity of 4 mg/ml ethanol extract was maximum against *F. oxysporium* and minimum against *A. niger* (*F. oxysporium*; IZ = 15.66 ± 1.52 mm > *T. reesei,* IZ = 8.10 ± 0.76 mm > *P. funiculosum,* IZ = 6.66 ± 0.76 mm > *A. niger,* IZ = 0.00 mm). Maximum antibacterial activity was seen against *B. subtilis* and minimum against *P. aeruginosa* and *S. albidencus* (*B. subtilis*; 15.83 ± 1.4 mm > *S. aureus*; IZ = 12.17 ± 0.76 mm > *E. coli*; IZ = 10.53 ± 0.80 mm > *S. albidencus, P. aeruginosa; IZ = 0.00 mm)*.

Antifungal activity of 2 mg/ml aqueous extract was seen only against *F. oxysporium* while others showed no inhibitory activity (*F. oxysporium*; IZ = 6.60 ± 0.60 mm > *T. reesei, A. niger, P. funiculosum,* IZ = 0.00 mm). Antibacterial activity of aqueous extract was observed as order (*S. albidencus; IZ = 13.32 ± 1.04 mm > B. subtilis; IZ = 10.83 ± 1.04 mm > E. coli, S. aureus, P. aeruginosa; IZ = 0.00 mm)*.

Antifungal activity of 4 mg/ml aqueous extract was seen in the order as follows (*F. oxysporium*; IZ = 11.74 ± 2.08 mm > *T. reesei; IZ = 8.24 ± 0.57 mm > *P. funiculosum, A. niger,* IZ = 0.00 mm). Aqueous extract showed inhibitory activity in the following order (*S. albidencus; IZ = 15.35 ± 0.76 mm > E. coli; IZ = 12.03 ± 0.55 mm, B. subtilis; IZ = 11.85 ± 0.75 mm, S. aureus, P. aeruginosa; IZ = 0.00 mm)*.
Antifungal activity of 2 mg/ml methanol extract was recorded maximum against *F. oxysporium* and minimum in *A. niger* (*F. oxysporium*; IZ= 15.66 ± 1.15mm > *T. reesei*; IZ= 8.66 ± 1.05 mm > *P. funiculosum*; IZ= 7.66 ± 0.76 mm > *A. niger*; IZ=0.00 mm). Maximum antibacterial activity showed inhibitory activity in the following order, (*E. coli*; IZ=11.5±1.5mm> *S. aureus*; IZ=9.3±0.61mm> *P. aeruginosa*; IZ=6.33±1.26mm> *B. subtilis*, *S. albudencus*; IZ= 0.00 mm).

Antifungal activity of 4mg/ml methanol extract was reported as (*F. oxysporium*; IZ=20.33±1.52mm > *T. reesei*; IZ=8.66±1.24mm > *A. niger*, *P. aeruginosa*; IZ= 0.00 mm). Inhibitory activity against bacteria was seen as (*S. aureus*; IZ=11.53±1.37mm > *E. coli*; IZ=10.87±1.8mm > *P. aeruginosa*; IZ=6.5±1.32mm > *S. albudencus*, *B. subtilis*; IZ=0.00 mm).

MIC values of the sequential and methanolic extract of root of *Tecomella undulata* extract against all the tested fungi and bacteria have been mentioned in Table 19.1.

Table 19.2 shows Bactericidal and Fungicidal efficacy of sequential and methanolic extracts of stem of *Tecomella undulata*

Antifungal activity of 2 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned (*T. reesei*; IZ=11.00±1.00 mm > *P. funiculosum*, *F. oxysporium*; IZ=9.33±1.52 mm > *A. niger*; IZ=0.00 mm). Antibacterial activity of 2 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned (*S. aureus*; IZ=14.66±0.58 mm > *B. subtilis*; IZ=7.43±0.40 mm > *E. coli*; IZ=6.67±1.35 mm>, *S. albudencus* *P. aeruginosa*; IZ=0.00 mm).

Antifungal activity of 4 mg/ml petroleum ether (PE) extract was only observed against *P. funiculosum* (*P. funiculosum*; IZ=10.33 ± 1.04 mm > *F.
oxysporium, A. niger, T.reesei; IZ=0.00 mm). Antibacterial activity of 4 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned (E. coli; IZ= 8.5 ± 0.132 mm > B. subtilis; IZ=6.50 ± 1.32 mm > S.albudencus, P.aeruginosa, S. aureus; IZ=0.00 mm).

Antifungal activity of 2mg/ml benzene extract was as follows (P. funiculosum; IZ= 17.16 ± 1.89 mm > F. oxysporium; IZ=11.00 ± 1.00 mm > A. niger, T.reesei; IZ=0.00 mm). Antibacterial activity of 2 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned (S. aureus; IZ= 13.50 ± 1.50 mm > B. subtilis; IZ=11.5 ± 1.32 mm > P.aeruginosa, E. coli, S.albudencus; IZ=0.00 mm).

Antifungal activity of 4mg/ml benzene extract was as follows (P. funiculosum; IZ=18.66 ± 1.92 mm > F. oxysporium; IZ=16.66 ± 0.55 mm > T.reesei, A. niger; IZ=0.00 mm). Antibacterial activity of 4mg/ml benzene extract was as follows (S. aureus; IZ= 20.17 ± 1.04 mm > B. subtilis; IZ=14.82 ± 1.04 mm > P.aeruginosa, E. coli, S.albudencus; IZ=0.00 mm).

Antifungal activity of 2 mg/ml acetone extract inhibitory activity was recorded as mentioned (P. funiculosum; IZ= 11.5 ± 1.32 mm > F. oxysporium; IZ=10.50 ± 1.32 mm > T.reesei, A. niger; IZ=0.00 mm). Antibacterial activity of 2 mg/ml acetone extract inhibitory activity was recorded as mentioned (S. aureus; IZ=16.83 ± 1.04 mm > E. coli; IZ=10.40 ± 1.35 mm > B. subtilis; IZ= 8.97 ± 1.00 mm > P.aeruginosa, S.albudencus; IZ=0.00 mm).

Antifungal activity of 4 mg/ml acetone extract inhibitory activity was recorded as mentioned (P. funiculosum; IZ= 12.83 ± 0.75 mm > F. oxysporium; IZ=8.83±1.04 mm> T.reesei, A. niger; IZ=0.00mm). Antibacterial activity of 4 mg/ml acetone extract inhibitory activity was recorded as mentioned (S.albudencus; IZ=14.67 ± 1.04 mm > S. aureus; IZ = 11.00 ± 1.00 mm> B. subtilis, P.aeruginosa, E. coli; IZ=0.00mm).
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Antifungal activity of 2 mg/ml chloroform extract inhibitory activity was recorded as mentioned (P. funiculosum; IZ=10.83±1.75mm > F. oxysporium; IZ= 7.3±1.50mm > T.reesei, A. niger; IZ=0.00 mm). Antibacterial activity of 2 mg/ml chloroform extract inhibitory activity was recorded as mentioned (S. aureus; IZ=20.33±1.53mm > E. coli; IZ=6.5±1.5mm > P.aeruginosa, S.albudencus, B. subtilis; IZ=0.00mm).

Antifungal activity of 4 mg/ml chloroform extract was reported as (P. funiculosum; IZ=16.33±0.52mm > F. oxysporium; IZ=7.5±0.86mm > T.reesei, A. niger; IZ=0.00 mm). Antibacterial activity was seen only against S. aureus (S. aureus; IZ=15.5±0.5mm > B.subtilis, P.aeruginosa, E. coli, S.albudencus; IZ=0.00 mm).

Antifungal activity of 2 mg/ml ethanol extract was seen maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ=9.66 ± 0.57mm > P. funiculosum; IZ=9.16 ± 1.25mm > T.reesei; IZ=6.83±0.76mm > A. niger; IZ=0.00 mm). Against bacterial strains, highest to lowest activity was seen as (E. coli; IZ=10.33±2.08mm > S. aureus; IZ=8.67±0.58mm > P.aeruginosa, S.albudencus, B. subtilis; IZ=0.00mm).

Antifungal activity of 4 mg/ml ethanol extract was maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ= 13.66±1.52 mm > T.reesei; IZ=9.16±1.25mm > P.funiculosum; IZ=7.2± 1.31mm > A.niger; IZ=0.00 mm). Maximum antibacterial activity was seen only against P.aeruginosa (P.aeruginosa; 12.17±1.26 mm > S. aureus, E.coli, S.albudencus, P.aeruginosa, B. subtilis; IZ=0.00mm).

Antifungal activity of 2 mg/ml aqueous extract was seen as (F. oxysporium; IZ=12.33±1.52mm > P. funiculosum; IZ=8.66±0.76 mm > T.reesei, A. niger; IZ=0.00 mm). Antibacterial activity of aqueous extract was
observed as order \((P.\text{aeruginosa}; \text{IZ}=12.5 \pm 0.5\text{mm}) > S.\text{albudencus}; \text{IZ}=11.17 \pm 1.26 \text{mm} > B.\text{subtilis}; \text{IZ}=9.67\pm1.04\text{mm} > E.\text{coli}, S.\text{aureus}; \text{IZ}=0.00 \text{mm}\).

Antifungal activity of 4 mg/ml aqueous extract was seen in the order as follows \((F. \text{oxysporium}; \text{IZ}=17.66\pm1.52\text{mm} > P. \text{funiculosum}; \text{IZ}=10.66\pm 0.76\text{mm}, T.\text{reesei}, A. \text{niger}; \text{IZ}=0.00 \text{mm}\). Aqueous extract showed inhibitory activity maximum in \(B.\text{subtilis} \) and minimum in \(P.\text{aeruginosa} \) \((B.\text{subtilis}; \text{IZ}=12.17\pm1.26 \text{mm} > S.\text{albudencus}; \text{IZ}=10.16\pm1.89 \text{mm} > S.\text{aureus}; \text{IZ}=8.8 \pm 0.4 \text{mm} > E.\text{coli}; \text{IZ}=7.13 \pm 0.60\text{mm} > P.\text{aeruginosa}; \text{IZ}=0.00 \text{mm}\).

Antifungal activity of 2 mg/ml methanol extract was recorded as \((A. \text{niger}; \text{IZ}=10.5 \pm 0.5\text{mm} > F. \text{oxysporium}; \text{IZ}=9.66\pm1.15\text{mm} > T.\text{reesei}, A. \text{niger}; \text{IZ}=0.00 \text{mm}\). Maximum antibacterial activity showed inhibitory activity in the following order, \((S.\text{albudencus}; \text{IZ}=11.17\pm1.26\text{mm} > S.\text{aureus}; \text{IZ}=8.17\pm1.04\text{mm} > E.\text{coli}; \text{IZ}=7\pm0.87\text{mm} > P.\text{aeruginosa}, B. \text{subtilis}; \text{IZ}=0.00 \text{mm}\).

Antifungal activity of 4mg/ml methanol extract was reported as \((A. \text{niger}; \text{IZ}=14.66\pm0.76\text{mm} > P.\text{aeruginosa}; \text{IZ}=14.66\pm0.76\text{mm} > F. \text{oxysporium}, T.\text{reesei}; \text{IZ}=0.00\text{mm}\). Maximum antibacterial activity showed inhibitory activity in the following order, \((S.\text{aureus}; \text{IZ}=11.33 \pm 2.08 \text{mm} > E.\text{coli}; \text{IZ}=9.83\pm0.76 \text{mm} > P.\text{aeruginosa}; \text{IZ}=8.17\pm0.29\text{mm} > S.\text{albudencus}, B. \text{subtilis}; \text{IZ}=0.00 \text{mm}\).

MIC values of the sequential and methanolic extract of stem of \textit{Tecomella undulata} extract against all the tested fungi and bacteria have been mentioned in Table 19.2.

Table 19.3 shows Bactericidal and Fungicidal efficacy of sequential and methanolic extracts of Bark of \textit{Tecomella undulata}

Antifungal activity of 2 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned \((P. \text{funiculosum}; \text{IZ}=12.9\pm0.85\text{mm} > F. \text{oxysporium}; \text{IZ}=11.66\pm0.86\text{mm} > T.\text{reesei}, A. \text{niger}; \text{IZ}=0.00 \text{mm}\).
oxysporium; IZ=10.16±1.25 mm > A. niger, T.reesei; IZ=0.00 mm). Antibacterial activity of 2 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned (S. aureus, B. subtilis, S.albudencus; IZ=12.83±1.04 mm > E. coli, P.aeruginosa; IZ=0.00 mm).

Antifungal activity of 4 mg/ml petroleum ether (PE) extract was observed maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ=14.33±0.76mm > T.reesei; IZ=11.66±0.57mm > P.funiculosum; IZ=11.5±0.5mm > A. niger, IZ=0.00 mm). Antibacterial activity of 4 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned (S. aureus; IZ=16.5±0.5mm > S.albudencus; IZ=12.66±1.32 mm > E. coli, B. subtilis, P.aeruginosa; IZ=0.00 mm).

Antifungal activity of 2mg/ml benzene extract was as follows (F. oxysporium; IZ=10.00 ± 1.00 mm > P. funiculosum, A. niger, T.reesei; IZ=0.00 mm). Antibacterial activity of 2 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned (S. aureus; IZ= 11.2 ±0.72 mm > B. subtilis; IZ=9.13 ± 1.26 mm > E. coli; IZ=8.5±0.86 mm > P.aeruginosa, S.albudencus; IZ=0.00 mm).

Antifungal activity of 4mg/ml benzene extract was as follows (F. oxysporium; IZ=9.76 ± 0.25 mm >P. funiculosum; IZ=9.33±0.76 mm > T.reesei, A. niger; IZ=0.00 mm). Antibacterial activity of 4mg/ml benzene extract was as follows (E. coli; IZ= 12.86±0.8mm > B. subtilis; IZ= 11.33±1.3 mm > S. aureus, P.aeruginosa, S.albudencus; IZ=0.00 mm).

Antifungal activity of 2 mg/ml acetone extract inhibitory activity was seen only against F. oxysporium (F. oxysporium; IZ=9.36 ± 1.09 mm > P. funiculosum, T.reesei, A. niger; IZ=0.00 mm). Antibacterial activity of 2 mg/ml acetone extract inhibitory activity was recorded as mentioned (E. coli;
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IZ = 15 ± 1 mm > S. albudencus; IZ = 12.86 ± 0.86 mm > B. subtilis, P. aeruginosa, S. albudencus; IZ = 0.00 mm).

Antifungal activity of 4 mg/ml acetone extract inhibitory activity was found to be maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ = 9.83 ± 1.04 mm > T. reesei; IZ = 9.1 ± 0.65 mm > P. funiculosum; IZ = 6.5 ± 0.5 mm > A. niger; IZ = 0.00 mm). Antibacterial activity of 4 mg/ml acetone extract inhibitory activity was recorded as mentioned (S. albudencus; IZ = 17.26 ± 0.41 mm > B. subtilis; IZ = 8.1 ± 1.25 mm > P. aeruginosa; IZ = 7.5 ± 0.86 mm > E. coli, S. aureus; IZ = 0.00 mm).

Antifungal activity of 2 mg/ml chloroform extract inhibitory activity was recorded as mentioned (P. funiculosum, T. reesei; IZ = 9.83 ± 0.76 mm > F. oxysporium; IZ = 9.5 ± 0.5 > A. niger; IZ = 0.00 mm). Antibacterial activity of 2 mg/ml chloroform extract inhibitory activity was recorded as mentioned (S. aureus; IZ = 11.83 ± 1.75 mm > B. subtilis; IZ = 10.33 ± 1.25 mm > P. aeruginosa, S. albudencus, E. coli; IZ = 0.00 mm).

Antifungal activity of 4 mg/ml chloroform extract was reported as (F. oxysporium; IZ = 11.33 ± 1.04 mm > T. reesei; IZ = 10.86 ± 0.8 mm > P. funiculosum; IZ = 8 ± 0.65 mm > A. niger; IZ = 0.00 mm). Antibacterial activity was found as (S. aureus; IZ = 12.5 ± 1.32 mm > B. subtilis; IZ = 10.83 ± 0.76 mm > P. aeruginosa; IZ = 9.33 ± 1.25 mm > E. coli, S. albudencus; IZ = 0.00 mm).

Antifungal activity of 2 mg/ml ethanol extract was maximum against T. reesei and minimum against A. niger (T. reesei; IZ = 8.66 ± 0.52 mm > P. funiculosum; IZ = 7.83 ± 0.76 mm > F. oxysporium; IZ = 7.53 ± 0.52 mm > A. niger; IZ = 0.00 mm). Antibacterial activity was seen as (P. aeruginosa, E. coli; IZ = 11.16 ± 0.76 mm > S. albudencus; IZ = 10.5 ± 0.5 mm > S. aureus; IZ = 0.00 mm).
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Antifungal activity of 4 mg/ml ethanol extract was seen maximum against *F. oxysporium* and minimum against *A. niger* (*F. oxysporium*; IZ=13.66 ± 1.52mm > *T. reesei*; IZ=11.16±1.16mm > *P. funiculosum*; IZ=8.93± 0.9mm > *A. niger*; IZ=0.00 mm). Against bacterial strains, highest to lowest activity was seen as (*S. albudencus*; IZ=14.5±0.5mm > *B. subtilis*; IZ=13±1mm > *E. coli*; IZ=12.5±1.32mm > *S. aureus, P. aeruginosa*; IZ=0.00mm).

Antifungal activity of 2 mg/ml aqueous extract was seen maximum against *T. reesei* and minimum against *A. niger* (*T. reesei*; IZ=15.5±1.32 mm > *P. funiculosum*; IZ=10.66±0.76 mm > *F. oxysporium*; IZ=10.2±0.72mm > *A. niger*; IZ=0.00 mm). Antibacterial activity of aqueous extract was observed only in *B. subtilis* (*B. subtilis*; IZ=8.96 ±0.55mm > *S.albudencus, E. coli, S. aureus, P.aeruginosa*; IZ=0.00 mm).

Antifungal activity of 4 mg/ml aqueous extract was seen in the order as follows (*F. oxysporium*; IZ=15.66±1.52mm > *T. reesei*; IZ=10.6±1.5mm > *P. funiculosum, A. niger*; IZ=0.00 mm). Aqueous extract showed inhibitory activity only against *B. subtilis* (*B. subtilis; IZ=11.16±0.28mm > S.albudencus, E. coli, S. aureus, P.aeruginosa ; IZ=0.00 mm).

Antifungal activity of 2 mg/ml methanol extract was recorded as (*P. funiculosum; IZ=8±1.32mm >A. niger, F. oxysporium, T.reesei; IZ=0.00 mm). Maximum antibacterial activity showed inhibitory activity in the following order, (*P.aeruginosa; IZ=11.66±1.04mm > S.albudencus; IZ=9.5±1mm > E. coli; IZ=9.33±0.3mm > S. aureus; IZ=8.16±0.76mm > B. subtilis; IZ= 0.00 mm).

Antifungal activity of 4mg/ml methanol extract was reported as (*F. oxysporium;IIZ=10.77±0.75mm>T.reesei,IIZ=10.33±0.76mm>P.funiculosum;IIZ=8.5±0.76mm>A. niger, IIZ=0.00mm). Methanol extracts showed inhibitory activity
in the following order, \( (P. aeruginosa; IZ=14.83 \pm 1.04 \text{mm}) > S. aureus; IZ=11.5 \pm 1.32 \text{mm} > E. coli, S. albudencus, B. subtilis; IZ=0.00 \text{mm}) \).

MIC values of the sequential and methanolic extract of bark of _Tecomella undulata_ extract against all the tested fungi and bacteria have been mentioned in Table 19.3.

Table 19.4 shows Bactericidal and Fungicidal efficacy of sequential and methanolic extracts of Leaves of _Tecomella undulata_.

Antifungal activity of 2 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned \( (F. oxysporium; IZ=12.66 \pm 2.08 \text{mm}) > P. funiculorum; IZ=8.5 \pm 1.32 \text{mm} > T. reesei; IZ=7.83 \pm 0.76 \text{mm} > A. niger; IZ=0.00 \text{mm}) \). Antibacterial activity of 2 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned \( (E. coli; IZ=14.83 \pm 0.76 \text{mm}) > S. albudencus; IZ=13 \pm 0.5 \text{mm} > B. subtilis; IZ=11.5 \pm 1.32 \text{mm} > S. aureus, P. aeruginosa; IZ=0.00 \text{mm}) \).

Antifungal activity of 4 mg/ml petroleum ether (PE) extract was observed maximum against _F. oxysporium_ and minimum against _A. niger_ \( (F. oxysporium; IZ=13.83 \pm 1.25 \text{mm}) > P. funiculorum; IZ=10.16 \pm 1.04 \text{mm} > T. reesei; IZ=9 \pm 1.5 \text{mm} > A. niger, IZ=0.00 \text{mm}) \). Antibacterial activity of 4 mg/ml petroleum ether (PE) extract inhibitory activity was recorded as mentioned \( (S. aureus; IZ=11.5 \pm 0.87 \text{mm}) > S. albudencus; IZ=8.67 \pm 1.25 \text{mm} > B. subtilis; IZ=8.5 \pm 0.5 \text{mm} > E. coli; IZ=8 \pm 0.0 \text{mm} > P. aeruginosa; IZ=0.00 \text{mm}) \).

Antifungal activity of 2 mg/ml benzene extract was as follows \( (T. reesei; IZ=11.66 \pm 0.57 \text{mm}) > F. oxysporium; IZ=7.83 \pm 0.76 \text{mm} > P. funiculorum, A. niger; IZ=0.00 \text{mm}) \). Antibacterial activity of 2 mg/ml benzene extract inhibitory activity was recorded as mentioned \( (S. albudencus; \)
IZ=12.83 ±0.76mm > E. coli; IZ=10.33±1.26 mm> P.aeruginosa; IZ=9.5±0.5 mm>S. aureus, B. subtilis; IZ=0.00 mm).

Antifungal activity of 4mg/ml benzene extract was as follows (F. oxysporium; IZ=12±2 mm > T.reesei; IZ=11±1.73mm> P. funiculosum; IZ=8.66±1.04 mm > A. niger; IZ=0.00 mm). Antibacterial activity of 4mg/ml benzene extract was seen only against (P.aeruginosa ; IZ=11.5±0.87mm> E. coli, B. subtilis, S. aureus, S.albudencus; IZ=0.00 mm).

Antifungal activity of 2 mg/ml acetone extract inhibitory activity was found to be maximum against F. oxysporium and minimum against A. niger (F. oxysporium; IZ=13.16± 1.75 mm > T.reesei; IZ=10.33±1.52mm> P. funiculosum; IZ=7.16±0.28mm>A. niger; IZ=0.00mm). Antibacterial activity of 2 mg/ml acetone extract inhibitory activity was recorded as mentioned (S.albudencus; IZ=10.33±0.58mm> E. coli; IZ=7.5±1.5mm> S. aureus; IZ=7±0.87mm> B. subtilis, P.aeruginosa; IZ=0.00mm).

Antifungal activity of 4 mg/ml acetone extract inhibitory activity was seen only against F. oxysporium (F. oxysporium; IZ=13.66±1.52mm> T.reesei; IZ=13±2mm> P. funiculosum; IZ=8.33±0.28mm>A. niger; IZ=0.00 mm). Antibacterial activity of 4 mg/ml acetone extract inhibitory activity was recorded as mentioned (E. coli; IZ=14±1.73mm> B. subtilis; IZ=11.83±1.26mm>S.aureus;IZ=9.17±1.04mm>S.albudencus;IZ=8.83±0.29mm>P.aeruginosa; IZ=0.00 mm).

Antifungal activity of 2 mg/ml chloroform extract inhibitory activity was recorded as mentioned (F. oxysporium; IZ= 8.16±0.76>T.reesei; IZ=7.66±1.25mm> P. funiculosum; IZ=7.5±0.5mm> A. niger; IZ=0.00 mm). Antibacterial activity of 2 mg/ml chloroform extract inhibitory activity was recorded as mentioned (B. subtilis; IZ=12.9±1.25mm> P.aeruginosa; IZ=8.83±1.04mm>S. aureus, S.albudencus, E. coli; IZ=0.00mm)
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Antifungal activity of 4 mg/ml chloroform extract was reported as (F. oxysporium; IZ=10±1mm>P. funiculosum; IZ=8.66±1.75mm>T. reesei; IZ=8.83±0.76mm> A. niger; IZ=0.00 mm). Antibacterial activity was found as (B. subtilis; IZ=13.17±0.58mm > E. coli; IZ=12.5±0.5mm> P. aeruginosa, S. aureus, S. albudencus; IZ=0.00 mm).

Antifungal activity of 2 mg/ml ethanol extract was seen as (P. funiculosum; IZ=7.16±1.60mm>T. reesei; IZ= 6.5± 0.86 mm > F. oxysporium, A. niger; IZ=0.00 mm). Antibacterial activity was seen as (S. albudencus; IZ=10.83±0.29mm > B. subtilis; IZ=9.67±1.53mm> P. aeruginosa; IZ=8.67±0.58mm> E. coli, S. aureus; IZ=0.00mm).

Antifungal activity of 4 mg/ml ethanol extract was seen maximum against F. oxysporium and minimum against A. niger (T. reesei; IZ=10.5±1.5mm>F. oxysporium; IZ=10.33±1.52mm > P. funiculosum; IZ=10±2mm>A. niger; IZ=0.00 mm). Against bacterial strains, highest to lowest activity was seen as (S. albudencus; IZ=12.67±1.53mm> P. aeruginosa; IZ=10.17±1.26mm> E. coli; IZ=7.57±0.67mm> B. subtilis, S. aureus.; IZ=0.00mm).

No inhibitory activity was seen against any fungal strain by the aqueous extract of 2 mg/ml (P. funiculosum, T. reesei, F. oxysporium, A. niger; IZ=0.00 mm). Antibacterial activity of aqueous extract was observed only in B. subtilis (E. coli; IZ=12.2±1.06mm> B. subtilis; IZ=11.33±1.6mm> S. aureus; IZ=8.33±0.58mm> S. albudencus; IZ=7.83±0.29mm >P. aeruginosa; IZ=0.00 mm).

Antifungal activity of 4 mg/ml aqueous extract was seen only against P. funiculosum (P. funiculosum; IZ=7.16±1.04mm> T. reesei, P. funiculosum, A. niger; IZ=0.00 mm). Aqueous extract showed inhibitory activity only
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against E. coli (E. coli; IZ=14.57±1mm > S.albudencus, B. subtilis, S. aureus, P.aeruginosa ; IZ=0.00 mm).

Antifungal activity of 2 mg/ml methanol extract was recorded as (F. oxysporium; IZ=12.666±2.08mm > P. funiculosum; IZ=10.33±1.52mm > A. niger, T.reesei; IZ=0.00 mm). Inhibitory activity was observed in following order (B. subtilis; IZ=12.16±1.89mm > S. aureus; IZ=10.34±0.76mm > S.albudencus, E. coli, P.aeruginosa; IZ= 0.00 mm).

Antifungal activity of 4mg/ml methanol extract was reported as (P.funiculosum;IZ=14.00±1.00mm>F.culmorum;IZ=13.83±1.25mm>T.reesei , A. niger; IZ=0.00mm). Methanol extracts showed inhibitory activity in the following order,(B.subtilis;IZ=15.5±0.5mm> S. aureus; IZ=12.50±1.50mm >P.aeruginosa, E. coli, S.albudencus; IZ= 0.00 mm).

MIC values of the sequential and methanolic extract of leaves of Tecomella undulata extract against all the tested fungi and bacteria have been mentioned in Table 19.4.

In the present study sequential extracts and methanolic extracts were checked for their antimicrobial activity. Roots, stem, bark, leaves of Tecomella species in present study have shown significant results. Benzene, acetone chloroform extracts show good inhibitory activity. The plant extracts had a strong inhibitory activity against several fungi like Trichophyton mentagrophytes, T. rubrum, T. soudanense, Candida albicans, Torulopsis glabrata, and Candida albicans, Candida krusei, Aspergillus niger, A. flavus, Penicillium sp. and Trichoderma sp. (Bhanumathy et al., 2010; Arora and Pandey-Rai, 2012). Earlier studies on Tecomella species have shown to have significant inhibitory activity Ethanol extract and ether extract show high inhibitory acrivity against C.albicans (Kapoor and Bansal, 2013).
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Against bacterial strains *Bacillus cereus, Staphylococcus aureus, Enterobacter aerogenes, Escherichia coli* and *Klebsiella pneumoniae* (Parekh *et al.*, 2005; Parekh and Chanda, 2007). Antibacterial activity of methanol extract was better than aqueous extract, but *P. aeruginosa* was found to be most resistant (Parekh and Chanda, 2006; Suganya *et al.*, 2011) antibacterial activity of *Tecomella undulata*, leaves were checked on bacterial pathogens of humans. Hexane, chloroform and methanol extracts were used for the study by agar well diffusion method against seven bacteria. The methanol extract showed higher antibacterial activity in comparison to the other two solvents. Methanolic extract showed higher minimum inhibitory concentration against *Klebsiella pneumoniae* and *Micrococcus luteus*; whereas, less inhibitory effect was noted for chloroform and hexane extracts, aqueous extract and methanolic extract of stems show high activity against *B. subtilis* and *S. typhi* (Kumawat *et al.*, 2012). Gram-negative bacteria were more susceptible than Gram-positive (Sharma *et al.*, 2013).
Table 20 shows Comprehensive antimicrobial assay of crude extracts of flavonoid, phytosterols and alkaloid of Boerhavia diffusa.

Antifungal activity of the flavonoids extracted from different plant parts when tested against Fusarium showed that root showed maximum inhibition while stem showed minimum inhibition (Root; IZ=29 ± 1 mm > leaf; IZ= 18.33 ± 1.52 mm > Stem; IZ=12.33 ± 1.15 mm). When tested against Penicilium funiculorum, leaf showed maximum inhibition while stem showed mini (Leaf; IZ=16.33 ± 1.53 mm > root; IZ= 15.5 ± 1.32 mm > Stem; IZ=10.33 ± 1.15 mm). Against Candida albicans root extract showed maximum inhibition while stem showed minimum (Root; IZ=18.16 ± 1.04 mm > leaf; IZ= 12.67 ± 1.52 mm > Stem; IZ=12.00 ± 2.00 mm). Against T. viridae, leaf showed maximum inhibition while root showed minimum inhibition. (Leaf; IZ=26.00 ± 2.00 mm > stem; IZ= 15.66 ± 0.57 mm > root; IZ=14.00 ± 0.5 mm).

Antibacterial activity of flavonoids against S. aureus was shown maximum by root and stem whereas minimum by leaf (root, stem; IZ=25.66 ± 0.57 mm > leaf; IZ=24.34 ± 2.08 mm). While against E. coli leaf showed maximum activity and root showed minimum inhibition (Leaf; IZ=27.00 ± 1.00 mm > stem; IZ= 18.00 ± 1.00 mm > root; IZ=14.33 ± 1.15 mm). Against enterococcus, leaf showed maximum activity and stem showed minimum (Leaf; IZ=9.67 ± 0.57 mm > root; IZ= 8.66 ± 1.15 mm > Stem; IZ= 0.00 mm). Against Bacillus subtilis, leaf showed maximum activity and root showed minimum activity (Leaf; IZ=16.33 ± 1.52 mm > stem; IZ= 14.66 ± 0.57 mm > root; IZ=14.33 ± 1.54 mm). Against Klebsiella pneumonia, leaf and stem showed maximum whereas root showed minimum inhibitory activity (Leaf, stem; IZ=13.33 ± 2.08 mm > root; IZ= 12.33 ± 0.57 mm).

Antifungal activity of the phytosterols against Fusarium was recorded maximum by stems while minimum by root and leaf extracts (Stem; IZ=9.00
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± 2.64 mm > root, leaf; IZ= 0.00 mm). Against *Penicillium funiculosum*, stem showed maximum activity and leaf showed minimum activity (Stem; IZ=10.33 ± 1.15 mm > root; IZ= 9.00 ± 2.00 mm > leaf; IZ=8.00 ± 1.00 mm). Leaf extracts showed higher activity as compared to stem and root against *Candida albicans* (Stem; IZ=12.00 ± 1.73 mm > leaf; IZ= 11.66 ± 2.08 mm > root; IZ=10.66 ± 1.52 mm). Against *T. viride* leaf and stem exhibited similar antifungal activity which was higher than roots (Leaf; IZ=13.66 ± 2.30 mm > stem; IZ= 13.33 ± 1.11 mm > root; IZ=11.33 ± 2.30 mm).

Antibacterial activity of the phytosterols from stem extracts were highly effective against *S. aureus* as compared to root and leaf (Stem; IZ=21.34 ± 2.51 mm > root; IZ= 13.33 ± 2.88 mm > leaf; IZ=0.00 mm). Against *E. coli*, stem showed maximum inhibitory activity while leaf showed minimum activity (Stem; IZ=51.00 ± 3.60 mm > root; IZ= 14.00 ± 3.00 mm > leaf; IZ=12.00 ± 3.60 mm). Against *Enterococcus*, maximum activity was recorded by root and minimum by leaf (root; IZ=14.66 ± 2.51 mm > stem; IZ= 12.33 ± 1.53 mm > leaf; IZ=9.00 ± 1.52 mm). Stem were effective against *B. subtilis* as compared to root and leaf (stem; IZ=14.33 ± 3.50 mm > root; IZ= 11.66 ± 3.05 mm > leaf; IZ=10.00 ± 3.60 mm). While against *K. pneumonia* none of the extracts showed inhibitory activity (root, stem, leaf; IZ=0 mm).

Antifungal activity recorded against *Fusarium* was maximum by root and minimum by leaf (root; IZ=15.33 ± 1.52 mm > stem; IZ= 13.33 ± 0.57 mm > leaf; IZ=12.16 ± 1.04 mm). Against *P. funiculosum*, root showed maximum whereas stem showed minimum inhibition (root; IZ=11.33 ± 1.52 mm > leaf; IZ= 10.33 ± 3.51 mm > stem; IZ=8.00 ± 1.00 mm). Maximum activity against *C. albicans* was recorded by the stem extract while minimum by leaf (stem; IZ=20.33 ± 2.08 mm > root; IZ= 14.66 ± 0.57 mm > leaf; IZ=14.33 ± 2.31 mm). Stem extracts showed maximum activity against
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T. viride whereas root extract showed minimum inhibition (stem; IZ= 16.66 ± 1.15 mm > leaf; IZ= 12.67 ± 3.60 mm > root; IZ= 12.33 ± 1.52 mm).

Antibacterial activity of alkaloids when tested against S. aureus leaf extracts showed higher activity as compared to stem extract which showed lower activity (Leaf; IZ= 22.00 ± 3.60 mm > root; IZ= 13.66 ± 3.05 mm > stem; IZ= 12.33 ± 2.30 mm). Stem showed maximum activity against E. coli and root showed minimum activity (stem; IZ= 31.66 ± 2.08 mm > leaf; IZ= 20.33 ± 1.52 mm > root; IZ= 17.33 ± 0.58 mm). Leaf showed higher activity against E. faecalis while stem and root showed similarly lower activities (Leaf; IZ= 14.66 ± 0.57 mm > root, stem; IZ= 11.67 ± 2.08 mm). Against B. subtilis root exhibited maximum activity while leaf exhibited minimum activity (root; IZ= 16.00 ± 0.00 mm > leaf; IZ= 14.33 ± 4.04 mm > stem; IZ= 11.33 ± 2.08 mm). Against K. pneumonia root showed maximum activity and stem showed minimum activity (root; IZ= 15.30 ± 1.52 mm > leaf; IZ= 13.67 ± 3.05 mm > stem; IZ= 0.00 mm).

Flavonoids, phytosterols and alkaloids crude extracts of root, stem and leaves of Boerhavia diffusa in the present study were evaluated for their antibacterial and antifungal efficacy. In this study, flavonoids from leaf extract showed highest inhibition zone against both test fungi and bacteria. Alkaloids from the leaf extract also show highest inhibition zone than alkaloids from root and stem extract. The result obtained from this study may reveal presence of more types or variety of flavonoids and alkaloids in leaf which demonstrate high inhibitory activity against the bacteria and fungi.
Table 21 shows detailed investigation of antimicrobial assay of crude extracts of flavonoid, phytosterols and alkaloid of Tecomella undulata.

Antifungal activity of the flavonoids extracted from different plant parts when tested against *F. oxysporium* showed that root showed maximum inhibition while stem showed minimum inhibition (Root; IZ=14.66 ± 2.51 mm > bark; IZ= 13.00 ± 2.00 mm > Leaf; IZ=12.66 ± 2.08 mm > Stem; IZ=11.00 ± 1.00 mm). When tested against *P. funiculosum*, bark showed maximum inhibition while leaf showed minimum (Bark; IZ=16.33 ± 1.00 mm > root; IZ= 14.66 ± 3.05 mm > stem; IZ=9.66 ± 0.57 mm > leaf; IZ=0.00 mm). Against *C. albicans* leaf extract showed maximum inhibition while bark showed minimum (Leaf; IZ=26.66 ± 2.08 mm > stem; IZ= 14.00 ± 1.00 mm > root; IZ=13.33 ± 1.52 mm > bark; IZ=12.67 ± 1.053 mm). Against *T. viride*, bark showed maximum inhibition while stem showed minimum inhibition. (Bark; IZ=26.00 ± 2.00 mm > leaf; IZ= 15.66 ± 2.08 mm > root; IZ=14.33 ± 0.57 mm > Stem; IZ=12.33 ± 2.51 mm).

Antibacterial activity of flavonoids against *S. aureus* was shown maximum by leaf whereas minimum by root (Leaf; IZ=27.33 ± 2.08 mm > stem; IZ=16.33 ± 1.52 mm > bark; IZ= 16.00 ± 1.00 mm > root; 0.00 mm). While against *E. coli* leaf showed maximum activity and root showed minimum inhibition (Leaf; IZ=21.00 ± 1.00 mm > bark; IZ= 14.66 ± 1.52 mm > stem; IZ=14.33 ± 2.08 mm > root; IZ=14.00 ± 1.00 mm). Against enterococcus, none of the extracts showed any activity (Root, stem, bark, leaf; IZ=0.00 mm). Against *B. subtilis*, leaf showed maximum activity and stem showed minimum activity (Leaf; IZ=20.66 ± 1.15 mm > bark; IZ= 17.00 ± 2.64 mm > root; IZ=16.66 ± 1.52 mm > stem; IZ=15.00 ± 1.00 mm). Against *K. pneumonia*, bark showed maximum whereas root and stem showed minimum inhibitory activity (Bark; IZ=13.00 ± 1.73 mm > leaf; IZ= 11.66 ± 2.88 mm > root, stem; IZ=0.00 mm).
Antifungal activity of the phytosterols against *F. oxysporium* was recorded maximum by root while minimum by leaf extracts (Root; IZ=12.33 ± 2.03 mm > stem; IZ=11.66 ± 1.52 mm > bark; IZ= 10.0 ± 2.64 mm > leaf; IZ=9.33 ± 0.57 mm). Against *P. funiculosum*, bark showed maximum activity and root showed minimum activity (Bark; IZ=13.00 ± 2.00 mm > root; IZ= 11.00 ± 2.64 mm > stem, leaf; IZ=0.00 mm). Bark extracts showed higher activity as compared to leaf against *C. albicans* (Bark; IZ=14.00 ± 3.60 mm > root; IZ= 11.67 ± 2.88 mm > stem; IZ=10.00 ± 2.64 mm). Against *T. viride*, root exhibited maximum antifungal activity whereas stem was minimum (Root; IZ=16.33 ± 1.52 mm > bark; IZ= 15.33 ± 0.57 mm > leaf; IZ=13.30 ± 2.08 mm > stem; IZ=10.67 ± 1.15 mm).

Antibacterial activity of the phytosterols from root extracts were highly effective against *S. aureus* as compared to leaf (root; IZ=21.66 ± 1.08 mm > bark; IZ= 15.66 ± 3.05 mm > stem; IZ=13.00 ± 2.64 mm > leaf; IZ=0.00 mm). Against *E. coli*, root showed maximum inhibitory activity while leaf showed minimum activity (Root; IZ=16.33 ± 3.05 mm > stem; IZ= 12.66 ± 1.52 mm > bark; IZ=10.66 ± 1.52 mm > leaf; IZ=0.00 mm). Against *E. faecalis*, maximum activity was recorded by bark minimum by root and leaf (Bark; IZ=13.66 ± 2.08 mm > stem; IZ= 13.33 ± 3.51 mm > root, leaf; IZ=0.00 mm). Root were effective against *B. subtilis* as compared to stem (Root; IZ=22.66 ± 3.05 mm > stem; IZ= 12.33 ± 2.30 mm > leaf and bark; IZ=0.00 mm). While against *K. pneumonia* maximum activity was recorded by bark minimum by stem and leaf (bark; IZ=17.33 ± 2.51 mm > root; IZ=12.33 ± 2.51 mm > stem, leaf; IZ=0.00 mm).

Antifungal activity recorded against *F. oxysporium* was maximum by leaf and minimum by root and stem (leaf; IZ=18.66 ± 1.52 mm > bark; IZ= 16.00 ± 1.00 mm > root, stem; IZ=15.33 ± 2.08 mm). Against *P. funiculosum*, leaf showed maximum whereas stem showed minimum inhibition (leaf; IZ=18.66 ± 0.57 mm > root; IZ= 14.33 ± 0.57 mm > bark; IZ=13.00 ± 0.00 mm).
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Maximum activity against *C. albicans* was recorded by the leaf extract while minimum by root (leaf; IZ=27.66 ± 1.52 mm > stem; IZ= 19.66 ± 1.52 mm > bark; IZ=14.33 ± 2.51 mm > root; IZ=9.33 ± 1.52 mm). Leaf extracts showed maximum activity against *T. viride* whereas bark extract showed minimum inhibition (leaf; IZ=26.66 ± 1.05 mm > stem; IZ= 20.00 ± 2.64 mm > root; IZ=12.33 ± 2.51 mm > bark; IZ=12.00 ± 2.54 mm).

Antibacterial activity of alkaloids when tested against *S. aureus* leaf extracts showed higher activity as compared to stem extract which showed lower activity (leaf; IZ=17.10 ± 1.00 mm > root; IZ= 14.66 ± 3.05 mm > bark; IZ=13.33 ± 2.31 mm > stem; IZ=12.33 ± 2.30 mm). Stem showed maximum activity against *E. coli* and bark showed minimum activity (stem; IZ=31.66 ± 2.08 mm > leaf; IZ= 20.00 ± 1.00 mm > root; IZ=10.00 ± 1.00 mm > bark; IZ=9.33 ± 2.51 mm). Root, stem and leaf showed high activity against *E. faecalis* while bark showed lower activities (Root, stem and leaf; IZ=11.66 ± 2.08 mm > bark; IZ= 8.66 ± 1.52 mm). Against *B. subtilis* leaf exhibited maximum activity while stem exhibited minimum activity (leaf; IZ=21.66 ± 2.51 mm > bark; IZ= 14.66 ± 2.08 mm > root; IZ=11.66 ± 3.51 mm > stem; IZ=11.33 ± 2.08 mm). Against *K. pneumonia*, none of extracts showed any inhibitory activity (root, stem, bark, leaf; IZ=0.00 mm).

Flavonoids, phytosterols and alkaloids crude extracts of root stem and leaves of *T. undulata* in the present study were evaluated for their antibacterial and antifungal efficacy. In present study in the phytosterol from root extract show highest activity than stem bark and leaf extract. Alkaloids from leaf extract show highest inhibition zone against both test fungi and bacteria this result may be due to presence of more kinds of alkaloids which shows higher activity against pathogenic bacteria and fungi tested. Also flavonoids extracted from leaves were potent against the test organisms then those from root, stem and bark.
Antioxidant Activity

Free radicals or reactive oxygen species, (ROS) or activated oxygen species (AOS) are produced as byproduct of normal metabolism also by xenobiotic compounds, drugs or ionizing radiations (Freeman and Crapo, 1982). Plants also generate ROS as signaling molecules to control various processes such as programmed cell death, pathogen defence, and stomatal behavior (Apel and Hirt, 2004). ROS or free radicals are highly toxic; these cause damage to genetic material and lipid peroxidation also inactivate membrane bound enzymes (Florence, 1995). They also cause chronic and degenerative disease like alzheimers, ageing, pulmonary disease, cardiovascular disease, cancer, rheumatoid arthritis (Pham-Huy et al., 2008). Many medicinal plants have great antioxidant potential; antioxidants reduce oxidative stress in cells and therefore are useful in treatment of disease like cancer, cardiovascular and inflammatory diseases (Krishnaiah et al., 2011).

Table 22 shows total phenolic content and total flavonoidal content in different plant parts of *B. diffusa*. According to which maximum total flavonoidal content is reported in leaf while minimum in root (leaf; 79.86±3.757 mg GAE/gdw> stem; 39.375±1.653 mg GAE/gdw> root; 7.08±0.36 mg GAE/gdw). Similarly total phenolic content was also reported to be maximum in leaf and minimum in root (leaf; 24.5±1.703 mg GAE/gdw> stem; 7.77±0.780 mg GAE/gdw> root; 0.25±0.243 mg GAE/gdw).

The IC$_{50}$ values of methanolic extracts of different plant parts of *B. diffusa* of DPPH free radical scavenging assay are reported in Table 23, which shows stems have highest antioxidant activity whereas root show minimum activity (stem; 90.8±2.275µg/ml> leaf; 195.25±4.487 µg/ml >root; 398.03±4.351 µg/ml).

Total antioxidant activity of methanolic extract, ethyl acetate extract and hexane extract was measured using FRAP antioxidant assay, of different plant parts of *B. diffusa*. In methanolic extract leaf show maximum activity...
and root show minimum activity (leaf; 137±2.517 mmol/L/gdw > stem; 131.18±1.003 mmol/L/gdw > root; 74.33±2.081 mmol/L/gdw), in Ethyl acetate extract stem show maximum activity whereas root show minimum activity (stem; 53±2.645 mmol/L/gdw > leaf; 31±2.645 mmol/L/gdw > root; 27.55±1.392 mmol/L/gdw), in hexane extract stem show maximum activity and root show minimum activity (stem; 89±3.605 mmol/L/gdw > leaf; 25.56±1.462 mmol/L/gdw > root; 16.887±1.293 mmol/L/gdw). (Table 24)

Table 25 shows IC_{50} values of ABTS free radical scavenging assay of methanolic extracts of different plant parts of B. diffusa. Where in highest antioxidant activity is reported by leaf and minimum by stem (leaf; 58.721±2.460 mmol/min/gdw > root; 228±9.781 mmol/min/gdw > stem; 732 ±9.844 mmol/min/gdw)

LPO activity in different plant parts of B. diffusa in Table 26 is reported a antioxidant activity of methanolic extract of leaf is maximum and root is minimum (leaf; 23.377±1.108 mmol/min/gdw > stem; 12.163±1.031 mmol/min/gdw > root; 4.481±0.357 mmol/min/gdw).

Peroxidase activity in different plant parts of B. diffusa are reported in TABLE 27 highest activity is reported in leaf and lowest activity in root (leaf; 0.124±0.011 mmol/min/gdw > stem; 0.101±0.002 mmol/min/gdw > root; 0.0589±0.04 mmol/min/gdw).

Total phenolic content, total flavonoid content was reported in higher amount thus showing higher activity of the extracts (Olaleye et al., 2010; Kouakou-Siransy et al., 2010). OH radical scavenging potential, in vitro inhibition of lipid peroxidation and modulation of mutagenicity are reported (Ramos et al., 2003). Evaluated for antioxidant were done by ethanolic extracts of B. diffusa leaves, DPPH scavenging capacity and the reductive potential were higher than those reported in the present study (Aladesanmi et
A higher LPO activity and peroxidase activity which also extend their role in chronic diabetes, but with administration of B.diffusa ethanolic extracts lower levels of free radicals have been observed (Satheesh and Pari, 2004). Higher peoxidase activity also play their role in renal injury and inflammation, lowering of the peroxide radicals generated during renal injury and inflammation by ethanolic extracts of B.diffusa have been shown (Pareta et al., 2011). Ethanolic and aqueous extracts of B.diffusa show potent peroxidase activity which are found to be potential hepatoprotective agent (Jayavelu et al., 2013).
Table 28 shows total phenolic content and total flavonoidal content in different plant parts of *T. undulata* according to which maximum total flavonoidal content is reported in leaf while minimum in root (leaf; 71.87±1.83 mg GAE/gdw > stem; 38.75±1.89 mg GAE/gdw > Bark; 15.62±1.64 mg GAE/gdw > root; 11.25±0.72 mg GAE/gdw). Similarly total phenolic content was reported to be maximum in stem and minimum in root (stem; 13.75±0.12 mg GAE/gdw > leaf; 12.70±0.28 mg GAE/gdw > Bark; 10.25±1.06 mg GAE/gdw > root; 7.00±0.94 mg GAE/gdw).

The IC$_{50}$ values of methanolic extracts of different plant parts of *T. undulata* of DPPH free radical scavenging assay are reported in Table 29, which shows stems have highest antioxidant activity whereas leaves show minimum activity (stem; 92.29±7.69 µg/ml > Bark; 196.1±2.74 µg/ml > root; 230.16±9.08 µg/ml > leaf; 277.82±8.13 µg/ml).

Total antioxidant activity of methanolic extract, ethyl acetate extract and hexane extract was measured using FRAP antioxidant assay, of different plant parts of *T. undulata*. In methanolic extract leaf show maximum activity and root show minimum activity (leaf; 96.66±0.67 mmol/L/gdw > Bark; 78.09±1.54 mmol/L/gdw > stem; 66.03±0.63 mmol/L/gdw > root; 58.09±1.317 mmol/L/gdw), in ethyl acetate extract bark show maximum activity whereas root show minimum activity (Bark; 64.66±0.40 mmol/L/gdw > stem; 36.66±0.68 mmol/L/gdw > leaf; 33.33±0.42 mmol/L/gdw > root; 21.33±0.85 mmol/L/gdw), in hexane extract bark show maximum activity and root show minimum activity (Bark; 14.66±1.08 mmol/L/gdw > root; 13.33±0.17 mmol/L/gdw > leaf; 12.93±2.27 mmol/L/gdw > stem; 11.33±1.52 mmol/L/gdw) (Table 30).

**TABLE 31** shows IC$_{50}$ values of ABTS free radical scavenging assay of methanolic extracts of different plant parts of *T. undulata*. Where in highest antioxidant activity is reported by stem and minimum by leaf (stem;
55.36±3.53 mmol/min/gdw > Bark; 308.46±22.35 mmol/L/gdw > root; 320.33±20.01 mmol/min/gdw > leaf; 425.84±18.36 mmol/min/gdw)

LPO activity in different plant parts of *T. undulata* in TABLE 32 is reported a antioxidant activity of methanolic extract of leaf is maximum and stem is minimum (leaf; 26.66±0.84 mmol/min/gdw > Bark; 6.97±0.50 mmol/L/gdw > root; 6.77±0.77 mmol/min/gdw > stem; 2.79±0.41 mmol/min/gdw >).

Peroxidase activity in different plant parts of *T. undulata* are reported in TABLE 33 highest activity is reported in leaf and lowest activity in stem (leaf; 0.38±0.01 mmol/min/gdw > Bark; 0.15±0.01 mmol/L/gdw > root; 0.103±0.01 mmol/min/gdw > stem; 0.102±0.01 mmol/min/gdw).

Similar concentrations of total phenols and total flavonoids were observed (Ghosh *et al.*, 2009) higher levels have also been reported in other species of *T. undulate* (Kumari and Sharma, 2013). Total Phenolic content and Total Flavonoid content have been shown to vary according to season (Patel and Patel, 2014).

Other members of the family bignoniaceae have also reported similar DPPH activity at lower concentrations of methanolic and ethanolic extracts (Tenpe *et al.*, 2009; Badrul and Ekramul, 2011; Hashem *et al.*, 2012; Osorio *et al.*, 2012; Younus *et al.*, 2013). Higher lipid peroxidation activity were also reported (Singh and Gupta, 2011). Work on DPPH activity has been reviewed by many workers earlier. Similar DPPH activity has been reported (Sharma *et al.*, 2013).

Polyphenolic herbal preparations of *T. undulata* have reported to be useful in preventing inhibition of free radical formation like lipid peroxidation and peroxidase (Desai *et al.*, 2010).
Present work entitled **Bioactive Components of Boerhavia diffusa and Tecomella undulata and their antimicrobial activities.** Both of these plants revealed their potential to produce various valuable phytochemicals which are medicinally important.

Utilizing plants for basic preventive and curative health care and Healing with medicinal plants is as old as mankind itself. Plants are a goldmine of novel chemicals much impressive number of modern drugs has been developed from them. Last decade witnessed an increase in the investigation on plants as a source of new biomolecules for human disease management. Many of the pharmaceutical substances with antibacterial, antifungal anticancer and insecticidal properties originate from plants. However the supplies of these plants are becoming difficult due to their limitation in conservation and lower amount of metabolites extracted from the medicinally important plants. Recent researches in the field of plant cell, biochemistry and tissue culture have helped overcoming the problem. In recognition of all these important properties of pharmaceutical use and nutritional benefits. the present study is an attempt to analyse its crude extract to estimate the primary as well as secondary metabolites invivo of two plants Boerhavia diffusa and Tecomella undulata.

*Boerhavia diffusa* is a perennial herb, belongs to family Nyctaginaceae. Grows as common weed, commonly known as punarnava, it is distributed in Tropical parts of world. It is rich in phytochemicals lignins, carbohydrates, lipids, proteins, ascorbic acid, glycoproteins, phenolic compounds, flavonoids, sterols, and alkaloid. It shows a good inhibitory activity against pathogenic fungi and Gram-negative and Gram-positive bacteria. It also has potent pharmacological activities.

*Tecomella undulata* is a deciduous or nearly evergreen tree of arid and semi arid regions. Rich in different phytochemicals like carbohydrates, lipids,
proteins, ascorbic acid, phenolic compounds, saponin, flavonoids, phytosterol, and alkaloid. Shows good inhibitory activity against pathogenic fungi and Gram-negative and Gram-positive bacteria. The plant has been extensively screened for wide range of pharmacological activities.

Therefore in view of the significant medicinal potential of *Boerhavia diffusa* and *Tecomella undulata*, were selected in present investigation for systematic evaluation of

- The biosynthetic potentialities undertaking the quantification of various primary and secondary metabolites
- To assess the antimicrobial activity and antioxidant activity.

**Biochemical analysis**

In the present study, various plant parts (roots, stems and leaves) of *Boerhavia diffusa* and (roots, stems, bark and leaves) of *Tecomella undulata* were investigated. Physicochemical tests of all the plant parts of both the plants were carried out. Roots and leaves of Boerhavia *diffusa* show maximum total extractive values (13.16%) while stems showed minimum extractive value (11.11%). Leaves of *Tecomella undulata* show maximum extractive value (12.33%) and roots show minimum extractive value (8.72%).

During present research work, estimation of different kinds of metabolites was estimated in both the plants.

**Primary metabolites**

In *Boerhavia diffusa* quantitative estimation of starch is more in stems (2.08±0.07mg/gdw) and less in root (1.67±0.07mg/gdw), amount of soluble sugars in observed maximum in stems (4.62±0.16mg/gdw) and minimum in root (2.753±0.05mg/gdw), Ascorbic acid content is observed maximum in stems (0.1±0.02mg/gdw) and minimum in root (0.02±0.01mg/gdw, maximum lipid content is observed in root (27.33±3.05mg/gdw) and minimum in stem
(4.66±2.51mg/gdw), amount of protein is observed maximum in leaves (4.24±0.15mg/gdw) and minimum in root (0.94±0.23mg/gdw).

In *Tecomella undulata* quantitative estimation of starch is more in stems (3.12±0.05mg/gdw) and less in bark (1.17±0.09mg/gdw), amount of soluble sugars in observed maximum in stems (5.4±0.10mg/gdw) and minimum in bark (1.76±0.05mg/gdw), Ascorbic acid content is observed maximum in stems (1.73±0.01mg/gdw) and minimum in leaf (1.01±0.05mg/gdw, maximum lipid content is observed in leaf (63.00±4.35mg/gdw) and minimum in bark (15.00±3.15mg/gdw), amount of protein is observed maximum in leaves (4.77±0.89mg/gdw) and minimum in root (1.27±0.23mg/gdw).

**Secondary metabolites**

**Flavonoids**

Presence of 3 flavonoids Kaemferol (Rf 0.86), quercetin (Rf 0.79) and luteolin (Rf 0.56) have been confirmed in all the parts of both the plant. Identification of all the isolated compounds was carried out through thin layer chromatography, Rf values, IR and NMR spectroscopy.

In *Boerhavia diffusa* in all plant parts roots, stems and leaves Kaempferol is observed maximum. Total amount of Flavonoids was maximum in leaves and minimum in stem (leaves; 0.68 mg/gdw> root; 0.42 mg/gdw> stem; 0.39 mg/gdw).

In *Tecomella undulata* in all plant parts roots, stems, bark and leaves Kaempferol is observed maximum. Total amount of Flavonoids was maximum in leaves and minimum in stem (leaves; 0.83 mg/gdw> root; 0.46 mg/gdw> stem; 0.42 mg/gdw= Bark; 0.42 mg/gdw).
Phytosterols

Presence of 4 phytosterols Campesterol (Rf 0.23), Stigmasterol (Rf 0.84), β-sitosterol (Rf 0.86) and Lanosterol (Rf 0.93) were confirmed in all the plant parts of both the plants identification of all the isolated compounds was carried out through thin layer chromatography, Rf values, IR and NMR spectroscopy.

In *Boerhavia diffusa* in roots stigmasterol is observed maximum (0.19 mg/gdw) while Lanosterol is observed minimum (0.07mg/gdw), in stems stigmasterol is observed maximum (0.13mg/gdw) and Campesterol is observed in minimum quantity (0.06mg/gdw). In leaves β-sitosterol content is observed maximum (0.13mg/gdw) and Campesrterol is observed to be minimum (0.07 mg/gdw).

In *Tecomella undulata* in roots lanosterol is observed maximum (0.09 mg/gdw) while campesterol is observed minimum (0.05mg/gdw), in stems stigmasterol is observed maximum (0.15mg/gdw) and lanosterol is observed in minimum quantity (0.06mg/gdw). In leaves stigmasterol content is observed maximum (0.17mg/gdw) and campesterol is observed to be minimum (0.12 mg/gdw). In bark stigmasterol is observed maximum (0.09mg /gdw) and lanosterol is observed in minimum quantity (0.05mg/gdw)

**GC-MS Analysis**

Gas Chromatography and mass spectroscopy analysis was carried out for extracted flavonoids, phytosterols and alkaloids from root, stem and leaves from *Boerhavia diffusa* and from root, stem, bark and leaves from *Tecomella undulata*. In the present study it was observed that a variety of compounds have been detected in both plant species.

**Antimicrobial activity**

In the present investigation, bactericidal and fungicidal activity of sequential and methanolic extracts was carried out, of all the plant parts of
both the plants on pathogenic fungi namely *P.funiculosum, A. niger, T.reesei, F. oxysporium*. Bacteria tested for antimicrobial activity were *E.coli, S. aureus, S.albudencus, B.subtilis, P. aeruginosa*.

In *B.diffusa*, amongst the various extracts of roots maximum inhibitory activity was seen against *F.oxysporium* (16.83±1.04mm) by the 4mg/ml aqueous extract. While against bacteria, 2mg/ml Chloroform extract of root showed maximum inhibitory activity against *S.aureus* (18.34±2.31mm). Amongst the various extracts of stems maximum inhibitory activity was seen against *T.reesei* (20.50±0.5mm) by the 4mg/ml acetone extract. While against bacteria, 2mg/ml Petroleum ether extract of stem showed maximum inhibitory activity against *P.aeruginosa* (19.00±2.64mm). Amongst the sequential extracts of leaves maximum inhibitory activity was seen against *P.funiculosum* (16.16±1.04mm) by the 4mg/ml acetone extract. While against bacteria, 4mg/ml Acetone extract of leaves showed maximum inhibitory activity against *B.subtilis* (13.33±2.08mm).

In *T.undulata*, amongst the sequential and methanolic extracts of roots maximum inhibitory activity was seen against *F. oxysporium* (20.33±1.52mm) by the 4mg/ml methanol extract. While against bacteria, 4mg/ml Benzene extract of root showed maximum inhibitory activity against *S.albudencus* (30.67±3.05mm). 4mg/ml Benzene extract of stems showed maximum inhibitory activity against *P. funiculosum* (18.66±1.92mm). While against bacteria, 2mg/ml chloroform extract of stem showed maximum inhibitory activity against *S.aureus* (20.33±1.53mm). maximum fungicidal activity of the sequential extracts of bark was shown by 4mg/ml aqueous extract against *F.oxysporium* (15.66±1.52mm), maximum bactericidal activity of the sequential extracts of bark was shown by 4mg/ml acetone extract against *S.albudencus* (17.26±0.41mm), Amongst the sequential extracts of leaves maximum inhibitory activity was seen against *F.oxysporium*
(13.83±1.25mm) by the 4mg/ml Petroleum ether extract. While against bacteria, 4mg/ml methanol extract of leaves showed maximum inhibitory activity against *B.subtilis* (15.5±0.5mm).

Antimicrobial activity of the crude extracts of Flavonoids, Phytosterols and Alkaloids from different plant parts of both *Boerhavia diffusa* and *Tecomella undulata* were also checked.

In *B.diffusa*, Flavonoids extracted from leaf were highly active against *F.oxysporium* (29.33±1.52mm), against bacterial strains Flavonoids from leaves were highly active and showed maximum activity against E.coli (30.00±1.00mm). Against bacterial strains phytosterols from roots showed maximum activity against *S.aureus* (21.33±2.88mm). Alkaloids extracted from stem were highly active against *C.albicans* (20.33±2.08mm), against bacterial strains alkaloids from stems showed maximum activity against *E.coli* (40.56±2.08mm).

In *T.undulata*, Flavonoids extracted from leaves were highly active against *C.albicans* (26.67±2.08mm), against bacterial strains Flavonoids from leaves were highly active and showed maximum activity against *S.aureus* (27.33±2.08mm). Phytostreols extracted from roots were highly active against *B.subtilis* (22.66±3.05mm), whereas by the Phytosterols extracted from leaves no inhibitory activity was observed against all the tested pathogenic bacteria. Alkaloids extracted from leaves were highly active against *C.albicans* (27.66±1.52mm), against bacterial strains alkaloids from stems showed maximum activity against *E.coli* (31.66±2.08mm).

**Antioxidant activity**

In present study Total phenolic content and Total Flavonoid content and antioxidant activity of methanolic extracts of different plant parts of both
the plants were investigated using DPPH, FRAP, ABTS, LPO and peroxidase assay.

In *B. diffusa*, total phenolic content is maximum in leaves (24.50±1.70 mgQE/gdw) and minimum in root (0.25±0.24 mgQE/gdw). Total flavonoid content is maximum in leaves (79.86±3.75 mgGAE/gdw), and minimum in root (7.08±0.36 mgGAE/gdw). IC50 of DPPH assay was seen maximum in stem (90.80±2.27 µg/ml), and minimum in root (398±0.30 µg/ml). FRAP activity of methanol extract was observed maximum in leaves (137.67 mM/lit/gdw) and minimum in root (74.33±2.08 mM/lit/gdw). In ethyl acetate extract stem showed maximum activity (53.00±2.64 mM/lit/gdw), minimum activity shown by roots (27.55±1.39 mM/lit/gdw). In hexane extract stem showed maximum activity (89.00±3.60 mM/lit/gdw) minimum activity observed in root extract (16.88±1.29 mM/lit/gdw). IC50 of ABTS assay was seen maximum in leaves (58±72 mM/min/gdw) and minimum in stem (732.34±9.84 mM/min/gdw). LPO activity was seen maximum by leaves (23.37±1.11 mM/min/gdw) minimum by root (4.48±0.35 mM/min/gdw). Peroxidase activity was observed maximum in leaves (0.12±0.01 mM/min/gdw) minimum in root (0.05±0.04 mM/min/gdw).

In *T. undulata*, total phenolic content is maximum in stem (13.75±0.125 mgQE/gdw) and minimum in root (7.00±0.94 mgQE/gdw). Total flavonoid content is maximum in leaves (71.87±18.39 mgGAE/gdw), and minimum in root (11.25±0.72 mgGAE/gdw). IC50 of DPPH assay was seen maximum in stem (92.29±7.69 µg/ml), and minimum in leaves (277.82±8.135 µg/ml). FRAP activity of methanol extract was observed maximum in leaves (96.66±0.67 mM/lit/gdw) and minimum in root (58.09±1.31 mM/lit/gdw). In ethyl acetate extract bark showed maximum activity (64.66±0.40 mM/lit/gdw), minimum activity shown by roots (21.33±0.85 mM/lit/gdw). In hexane extract bark showed maximum activity (14.66±1.08 mM/lit/gdw) minimum
activity observed in stem extract (11.33±1.52 mM/lit/gdw). IC50 of ABTS assay was seen maximum in stem (55.36±3.53mM/min/gdw) and minimum in leaves (425.84±18.36 mM/min/gdw). LPO activity was seen maximum by leaves (26.66±0.84 mM/min/gdw) minimum by stem (2.79±0.40 mM/min/gdw). Peroxidase activity was observed maximum in leaves (0.38±0.01 mM/min/gdw) minimum in stem (0.10±0.01 mM/min/gdw).

Conclusion:

With all the experiments and investigations performed in the present study we conclude that the two plants studied in the present study *Boerhavia diffusa* and *Tecomella undulata* have good amount of phytochemicals and these phytochemicals are responsible for imparting properties like antimicrobial and antioxidant to these plants. Two plants studied show good inhibitory activity against pathogenic bacteria and fungi tested, this result thus forms a platform for further study of the phytochemicals, Bioassays to identify single molecules from plants that have interesting bioactivities in isolation and might be useful lead compounds for the development of pharmaceutical drugs as antibiotics against certain infections caused by these bacteria and fungi with enhanced activity and reduced toxicity. The two plants also show good antioxidant activity due to which these plants can also be studied for their potential against the diseases caused by free radicals.

The present investigation appraises the pharmacological and antimicrobial properties of extracts of plant parts of both the plants. The data so far generated are the first study and sets the basis for a clearer understanding of the phytochemistry of the plant and derived cultures and opens the possibility of the potential utilization of the phenolic rich extracts from medicinal plants in food system or as prophylactics in nutritional/food supplement programs. Thus traditional medicinal plant- derived antioxidants may protect against a number of diseases and reduce oxidation processes in
food systems, antioxidants help in removing toxic radicals from blood. In order to establish this, it is imperative to measure the markers of baseline oxidative stress particularly in human health and disease and examine how they are affected by supplementation with pure compounds or complex plant extracts from the traditional medicinal.