

Antifungal Activity of Ethanolic and Aqueous Leaf Extracts of *Taraxicum officinale* and *Mentha arvensis* on the Growth of Some Selected Fungal Species under *In vitro* Conditions

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ABSTRACT

Antifungal activities of different solvent extracted samples of *Taraxacum officinale* Weber ex Wiggers and *Mentha arvensis* L. were carried out through agar well diffusion assay at three concentrations (25 μ l, 50 μ l and 75 μ l) against seven fungi, viz. *Penicillium expansum*, *Aspergillus niger*, *Mucor plumbeus*, *Alternaria alternata*, *Penicillium chrysogenum*, *Trichothecium roseum* and *Rhizoctonia solani* causing rot of tomato and brinjal. It was revealed from the present study that the ethanolic extract of *Taraxicum officinale* Weber ex Wiggers showed maximum antimycotic activity against *Rhizoctonia solani* and least activity against *Mucor plumbeus*. However, the aqueous extract of *Taraxicum officinale* Weber ex Wiggers showed maximum antimycotic activity against *Rhizoctonia solani* and least activity against *Penicillium expansum* and *Aspergillus niger*. It was observed from the present study that the ethanolic extract of *Mentha arvensis* L. showed maximum antimycotic activity against *Alternaria alternata* and least activity against *Mucor plumbeus*. While as the aqueous extract of *Mentha arvensis* L. showed maximum antifungal activity against *Rhizoctonia solani* and least activity against *Trichothecium roseum*.

Key words: Antifungal assay, *Taraxacum officinale*, *Mentha arvensis*, Agar well diffusion.

INTRODUCTION

Medicinal plants are the main and rich source of different activity especially antimicrobial agents. Plants have been used in many countries medicinally and as a source of many potent and powerful drugs¹⁵. *T. officinale* belongs to the family Asteraceae. It grows to a height of about 12 inches; traditionally *T.*

officinale is commonly used as food. The leaves are used in salads and tea while the roots are often used as a coffee substitute. Leaf and root extracts of *T. officinale* have been used for different human ailments like treatment of liver, gall bladder, kidney, and joint problems, blood purifier, for treatment of poor digestion and other ailments^{8,12}.

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Likewise, *Mentha Arvensis* L belongs to the family Lamiaceae, has been found major source of antimicrobial compound and used in pharmaceutical, cosmetics and flavoring industries and different human ailments⁶. Many plants and their extracts have been evaluated for their antimycotic activity and are known to have good antifungal activity against plant pathogenic fungi causing diseases in plants^{28,29}. Plant metabolites and plant based pesticides appear to be one of the better alternatives as they are known to have minimal environmental impact and danger to consumers in contrast to synthetic pesticides²⁷. Extracts of many higher plants have been reported to exhibit antifungal properties under laboratory trials^{3,5,6,10,16,19}. Therefore, the aim of present study was to evaluate antifungal activities of ethanolic and aqueous extracts of leaves of two important medicinal plants, *T. officinale* (dandelion) and *Mentha arvensis* L. against some pathogenic fungi

MATERIALS AND METHODS

Plant collection and identification

The fresh plant material of *Taraxicum officinale* Weber ex Wiggers and *Mentha arvensis* L. were collected from Pulwama, Jammu and Kashmir, India. The authenticity of the plant was confirmed in Plant Taxonomy Department of Botany University of Kashmir.

Preparation of plant extracts

Fresh plant material of leaves of two test plants were washed under running tap water, shade dried or sun dried for 24 hours and then homogenized to fine powder and stored in airtight bottles. About 20g of coarsely powdered leaves (20g/100mL) were extracted separately in a soxhlet extractor for 8 to 10 hours (30-50°C) sequentially with ethanol and water separately in order to extract non-polar and polar compounds⁹.

Preparation of inoculums

Seven fungal cultures such as *Penicillium expansum* Link ex Thorn., *Aspergillus niger* Van Tiegh, *Alternaria alternata* (Fr) Keissler, *Mucor plumbeus* Fisher, *Penicillium chrysogenum* Thorn, *Trichothecium roseum* (Pers.) Link and *Rhizoctonia solani* Kuhn

were grown at 27°C on potato dextrose agar (PDA) medium. Spores of the each fungal species were collected from cultures on agar plates after 7 days⁴. PDA broth prepared by transferring a loop full of cells from the stock cultures was diluted with fresh potato dextrose broth. The sporangial suspension concentration was adjusted to 2×10^5 (CFU/mL) spores as per the method by Abril, et al.¹

Antifungal activity

Antifungal assay for ethanolic and aqueous extracts was performed by agar well diffusion method as described by Ahmad et al.² with some modification. 100 μ l of standardized inoculum of each test fungi were inoculated on sterile molten Sabouraud Dextrose Agar, homogenised and poured onto a sterile Petri plate to yield a uniform depth of 4 mm. The petriplates were allowed to solidify inside the laminar hood. Sterile cork borers of 5 mm in diameter were used to make three wells at periphery of each Petriplate. Different concentrations (25 μ l, 50 μ l and 75 μ l) of each plant extract, prepared in respective solvents were loaded into four different peripheral wells. FLU-25 {(standard antifungal disc (20mcg/disc)} was loaded into the sterile molten Sabouraud Dextrose Agar in the same Petri plate at periphery. The plates were then incubated at 26 ± 2 °C for 24 to 36 hours. After incubation period, the plates were observed for the zones of inhibition. Antifungal potential was evaluated by measuring inhibition zone diameters in millimeters (mm) with the help of standard measuring scale.

Statistical analysis

The antifungal activity of *Taraxicum officinale* and *Mentha arvensis* leaf extracts was indicated by zones of growth inhibition. All experiments were performed in triplicates and the results are presented as mean \pm SD (Standard Deviation) according to New Duncan's Multiple Range Test¹¹.

RESULTS

It was revealed from the present study that the ethanolic extract of *Taraxicum officinale*

Weber ex Wiggers showed maximum activity at 25 μ l, 50 μ l and 75 μ l with zone of inhibition of 18.66 ± 0.57 , 20.00 ± 1.00 and 22.00 ± 1.00 mm against *Rhizoctonia solani* respectively. While as *Mucor plumbeus* showed least activity with zone of inhibition of 9.00 ± 1.00 , 10.00 ± 1.00 and 10.66 ± 1.15 mm at 25 μ l, 50 μ l and 75 μ l concentrations respectively. The moderate activity of ethanolic extract was shown against *Alternaria alternata* with zone of inhibition of 16.33 ± 0.57 , 18.33 ± 0.57 and 20.33 ± 0.57 mm and *Trichothecium roseum* with zone of inhibition of 15.00 ± 1.00 , 17.00 ± 1.00 and 19.00 ± 1.00 mm at 25 μ l, 50 μ l and 75 μ l respectively. Antimycotic activity was also observed by the ethanolic extracts of *Taraxicum officinale* against *Penicillium chrysogenum* and *Aspergillus niger* with zone of inhibition of 13.66 ± 0.57 , 15.66 ± 0.57 , 17.66 ± 0.57 mm and 12.66 ± 0.57 , 14.66 ± 0.57 , 15.66 ± 0.57 mm at 25 μ l, 50 μ l and 75 μ l concentrations respectively. Likewise antimycotic activity of leaf extracts was found against *Penicillium expansum* with zone of inhibition of 11.33 ± 0.57

± 1.15 , 12.33 ± 0.57 and 13.33 ± 0.57 mm at 25 μ l, 50 μ l and 75 μ l concentrations (Table 1). The aqueous extract of *Taraxicum officinale* Weber ex Wiggers showed maximum antifungal activity at 25 μ l, 50 μ l and 75 μ l with zone of inhibition of 20.66 ± 0.57 , 22.66 ± 0.57 and 24.66 ± 0.57 mm against *Rhizoctonia solani*. Moderate antifungal activity was recorded against *Trichothecium roseum*, *Mucor plumbeus* and *Alternaria alternata* with zone of inhibition of 18.33 ± 0.57 , 20.00 ± 1.00 , 21.00 ± 1.00 , 18.33 ± 1.52 , 19.33 ± 1.52 , 19.66 ± 0.57 and 18.00 ± 1.00 , 20.00 ± 1.00 , 22.00 ± 1.00 mm at 25 μ l, 50 μ l and 75 μ l respectively. The aqueous extract of *Taraxicum officinale* also showed active antifungal activity against *Penicillium expansum* and *Aspergillus niger* with zone of inhibition of 11.00 ± 1.00 , 11.66 ± 0.57 , 13.00 ± 1.00 mm and 11.00 ± 1.00 , 11.33 ± 1.52 , 13.33 ± 1.52 mm at 25 μ l, 50 μ l and 75 μ l respectively. Similarly, aqueous extract of *T. officinale* against *Penicillium chrysogenum* was observed with zone of inhibition of 12.33 ± 0.57 , 14.00 ± 1.00 and 15.66 ± 0.57 at 25 μ l, 50 μ l and 75 μ l respectively (Table 2).

Table 1: Antifungal activity of ethanolic leaf extracts of *Taraxicum officinale* Weber ex Wiggers

Fungal Pathogens	Conc.	Zone of Inhibition (mm)			
		25 μ l	50 μ l	75 μ l	Control
<i>Penicillium expansum</i>	11.33 ± 1.15	12.33 ± 0.57	13.33 ± 0.57		14.66 ± 0.57
<i>Aspergillus niger</i>	12.66 ± 0.57	14.66 ± 0.57	15.66 ± 0.57		18.33 ± 1.52
<i>Alternaria alternate</i>	16.33 ± 0.57	18.33 ± 0.57	20.33 ± 0.57		21.33 ± 0.57
<i>Mucor plumbeus</i>	9.00 ± 1.00	10.00 ± 1.00	10.66 ± 1.15		12.00 ± 1.00
<i>Penicillium chrysogenum</i>	13.66 ± 0.57	15.66 ± 0.57	17.66 ± 0.57		18.66 ± 0.57
<i>Trichothecium roseum</i>	15.00 ± 1.00	17.00 ± 1.00	19.00 ± 1.00		20.00 ± 1.00
<i>Rhizoctonia solani</i>	18.66 ± 0.57	20.00 ± 1.00	22.00 ± 1.00		23.00 ± 1.00

Values were performed in triplicates and represented as mean \pm SD

Mean values followed by different superscript in a column are significantly different ($p \leq 0.05$)

Table 2: Antifungal activity of aqueous leaf extracts of *Taraxicum officinale* Weber ex Wiggers

Fungal Pathogens	Conc.	Zone of Inhibition (mm)			
		25 μ l	50 μ l	75 μ l	Control
<i>Penicillium expansum</i>	11.00 ± 1.00	11.66 ± 0.57	13.00 ± 1.00		14.00 ± 1.00
<i>Aspergillus niger</i>	11.00 ± 1.00	11.33 ± 1.52	13.33 ± 1.52		13.66 ± 0.57
<i>Alternaria alternate</i>	18.00 ± 1.00	20.00 ± 1.00	22.00 ± 1.00		23.00 ± 1.00
<i>Mucor plumbeus</i>	18.33 ± 1.52	19.33 ± 1.52	19.66 ± 0.57		21.33 ± 0.57
<i>Penicillium chrysogenum</i>	12.33 ± 0.57	14.00 ± 1.00	15.66 ± 0.57		17.00 ± 1.00
<i>Trichothecium roseum</i>	18.33 ± 0.57	20.00 ± 1.00	21.00 ± 1.00		22.00 ± 1.00
<i>Rhizoctonia solani</i>	20.66 ± 0.57	22.66 ± 0.57	24.66 ± 0.57		25.66 ± 0.57

Values were performed in triplicates and represented as mean \pm SD, Mean values followed by different superscript in a column are significantly different ($p \leq 0.05$)

It was observed from the present study that the ethanolic extract of *Mentha arvensis* L. showed maximum antifungal activity at 25 μ l, 50 μ l and 75 μ l with zone of inhibition of 26.00 \pm 1.00, 27.00 \pm 1.00 and 31.33 \pm 0.57 mm against *Alternaria alternata* respectively. Likewise ethanolic extract of *Mentha arvensis* L. showed maximum antifungal activity against *Penicillium chrysogenum* and *Aspergillus niger* with zone of inhibition of 25.33 \pm 0.57, 27.00 \pm 1.00, 29.00 \pm 1.00 mm and 24.33 \pm 1.52, 32.33 \pm 1.52, 34.66 \pm 1.52 mm at 25 μ l, 50 μ l and 75 μ l respectively. The moderate antifungal activity was observed due to ethanolic extract of *Mentha arvensis* against *Penicillium expansum* with zone of inhibition of 23.33 \pm 0.57, 26.33 \pm 1.52, 28.00 \pm 2.00 mm, against *Rhizoctonia solani* with zone of inhibition of 23.33 \pm 0.57, 24.33 \pm 0.57, 26.00 \pm 2.64 mm at 25 μ l, 50 μ l and 75 μ l respectively and against *Trichothecium roseum* with zone of inhibition of 21.00 \pm 1.00, 22.33 \pm 0.57, 25.33 \pm 0.57 at 25 μ l, 50 μ l and 75 μ l. While least fungal activity was observed against *Mucor plumbeus* with zone of inhibition of 16.00 \pm 1.00, 17.00 \pm 1.00 and 19.00 \pm 1.00 mm at 25 μ l, 50 μ l and 75 μ l concentration of ethanolic extracts of *M. arvensis* (Table 3).

The aqueous extract of *Mentha arvensis* L. showed maximum antifungal activity at 25 μ l, 50 μ l and 75 μ l with zone of inhibition of 21.00 \pm 1.00, 22.00 \pm 1.00 and 23.00 \pm 1.00 mm against *Rhizoctonia solani*.

Moderate antifungal activity was recorded due to aqueous extract of *Mentha arvensis* against *Alternaria alternata* with zone of inhibition of 20.00 \pm 1.00, 21.33 \pm 1.52, 23.66 \pm 1.52, against *Penicillium expansum* with zone of inhibition of 19.66 \pm 1.52, 21.00 \pm 1.00, 22.66 \pm 1.52, and against *Penicillium chrysogenum* with zone of inhibition of 18.66 \pm 0.57, 21.00 \pm 1.00, 23.00 \pm 1.00 at 25 μ l, 50 μ l and 75 μ l concentrations respectively. Likewise, aqueous extract of *Mentha arvensis* showed antifungal activity against *Aspergillus niger* and *Mucor plumbeus* with zone of inhibition of 15.00 \pm 1.00, 17.66 \pm 1.52, 19.66 \pm 1.52 and 15.00 \pm 1.00, 18.00 \pm 1.00, 20.00 \pm 1.00 mm at 25 μ l, 50 μ l and 75 μ l respectively and against *Trichothecium roseum* with zone of inhibition of 14.66 \pm 0.57, 16.66 \pm 0.57 and 18.66 \pm 0.57 mm at 25 μ l, 50 μ l and 75 μ l respectively (Table 4). However, least effect in zone of inhibition was observed against *Trichothecium roseum*.

It was revealed from the present study that the aqueous extract of *Taraxicum officinale* Weber ex Wiggers are more effective in showing antifungal activity against selected fungi except *Alternaria alternata*, *Mucor plumbeus* and *Rhizoctonia solani* in which ethanolic extract shows more effectiveness. Likewise, the aqueous extract of *Mentha arvensis* L. is more effective than ethanolic extract against the isolated fungi except *Mucor plumbeus* respectively.

Table 3: Antifungal activity of ethanolic leaf extracts of *Mentha arvensis* L.

Fungal Pathogens \ Conc.	Zone of Inhibition (mm)			
	25 μ l	50 μ l	75 μ l	Control
<i>Penicillium expansum</i>	23.33 \pm 0.57	26.33 \pm 1.52	28.00 \pm 2.00	28.00 \pm 1.00
<i>Aspergillus niger</i>	24.33 \pm 1.52	32.33 \pm 1.52	34.66 \pm 1.52	35.00 \pm 1.00
<i>Alternaria alternata</i>	26.00 \pm 1.00	27.00 \pm 1.00	31.33 \pm 0.57	32.33 \pm 0.57
<i>Mucor plumbeus</i>	16.00 \pm 1.00	17.00 \pm 1.00	19.00 \pm 1.00	20.00 \pm 1.00
<i>Penicillium chrysogenum</i>	25.33 \pm 0.57	27.00 \pm 1.00	29.00 \pm 1.00	29.33 \pm 0.57
<i>Trichothecium roseum</i>	21.00 \pm 1.00	22.33 \pm 0.57	25.33 \pm 0.57	26.33 \pm 0.57
<i>Rhizoctonia solani</i>	23.33 \pm 0.57	24.33 \pm 0.57	26.00 \pm 2.64	27.00 \pm 1.00

Values were performed in triplicates and represented as mean \pm SD

Mean values followed by different superscript in a column are significantly different ($p \leq 0.05$)

Table 4: Antifungal activity of aqueous leaf extracts of *Mentha arvensis* L.

Conc. Fungal Pathogens	Zone of Inhibition (mm)			
	25 μ l	50 μ l	75 μ l	Control
<i>Penicillium expansum</i>	19.66 \pm 1.52	21.00 \pm 1.00	22.66 \pm 1.52	24.00 \pm 1.00
<i>Aspergillus niger</i>	15.00 \pm 1.00	17.66 \pm 1.52	19.66 \pm 1.52	22.00 \pm 1.00
<i>Alternaria alternata</i>	20.00 \pm 1.00	21.33 \pm 1.52	23.66 \pm 1.52	25.00 \pm 1.00
<i>Mucor plumbeus</i>	15.00 \pm 1.00	18.00 \pm 1.00	20.00 \pm 1.00	21.00 \pm 0.57
<i>Penicillium chrysogenum</i>	18.66 \pm 0.57	21.00 \pm 1.00	23.00 \pm 1.00	24.00 \pm 1.00
<i>Trichothecium roseum</i>	14.66 \pm 0.57	16.66 \pm 0.57	18.66 \pm 0.57	19.66 \pm 0.57
<i>Rhizoctonia solani</i>	21.00 \pm 1.00	22.00 \pm 1.00	23.00 \pm 1.00	24.33 \pm 0.57

Values were performed in triplicates and represented as mean \pm SD

Mean values followed by different superscript in a column are significantly different ($p \leq 0.05$)

DISCUSSION

In the present study some plant extracts *Taraxicum officinale* Weber ex Wiggers and *Mentha arvensis* L. were evaluated for their antifungal activity against the some fungi causing fungal rot of tomato and brinjal. It was clear from the results that all the tested plant extracts proved highly effective in reducing the mycelial growth of fungi under in-vitro conditions indicating their antifungal activity. In a similar study, Pawar²⁴ reported the antifungal activity of nine plant extracts against five phytopathogenic fungi, viz. *Alternaria alternata*, *Aspergillus niger*, *Curvularia lunata*, *Fusarium moniliforme* and *Trichoderma viride*. Hassanein et al.¹³ studied the effectiveness of leaf extracts of neem and china berry against two tomato pathogenic fungi *Alternaria solani* and *Fusarium oxysporum*, the causal agent of early blight and wilt disease of tomato plants respectively. Mondall et al.¹⁷ reported the antifungal activity of aqueous and alcoholic neem leaf extracts on some fungi, viz. *Aspergillus*, *Rhizopus* and reported that the alcoholic extracts of neem leaf was most effective in comparison to aqueous extract for reducing the growth of *Rhizopus* and *Aspergillus*. The crude aqueous and alcoholic leaf extracts of neem was more effective in inhibitions of growth of *Aspergillus* in comparison to inhibitory effects on *Rhizopus* growth in culture medium. Taskeen-Un-Nisa et al.²⁶ tested plant extracts of three plants, onion (*Allium cepa*), garlic (*Allium sativum*) and mint (*Mentha arvensis*) for their antifungal activity against *Alternaria*

alternata and *R. stolonifer*. They observed that the extract of *A. sativum* at highest concentration proved highly effective in reducing spore germination of *R. stolonifer* and *Alternaria alternata* followed by extract of *A. cepa* and *M. arvensis*. Jeyaseelan et al.¹⁴ reported antifungal activity of organic extracts of leaf, flower and fruit of *Lawsonia inermis* L. against *Aspergillus niger*, *Penicillium notatum*, *Fusarium oxysporum*, *Colletotrichum gloeosporioides* and *Rhizopus stolonifer*. Parveen et al.²⁰ reported the inhibitory activity of five plant extracts, viz. *Artemisia absinthium*, *Rumex obtusifolius*, *Taraxacum officinale*, *Plantago lanceolata* and *Malva sylvestris* against the mycelial growth of three rot fungi, *Alternaria alternata*, *Penicillium expansum* and *Mucor piriformis*, and observed that all concentrations brought about significant reduction in the mycelial growth of these pathogenic fungi. Our results also showed the inhibition of mycelial growth due to plant extracts of *Taraxicum officinale* and *Mentha arvensis* against some pathogenic fungi. Dababneh and Khalil⁷ studied the effect of five different medicinal plant extracts, viz. *Crupina crupinastrum*, *Teucrium polium*, *Achillea santolina*, *Micromeria nervosa* and *Ballota philistaea*, against four pathogenic fungi, viz. *Fusarium oxysporum*, *Rhizoctonia solani*, *Penicillium* sp. and *Verticillium* sp. It is concluded from this study that these plant extracts of *Taraxicum officinale* and *Mentha arvensis* can possibly be exploited in the management of pathogenic fungi to prevent biodeteriorations in an eco-friendly way and

to develop alternative and safe biopesticide. However, further investigation is needed to observe antimycotic activity of these plants.

REFERENCES

1. Abril, M., Curry, K.J., Smith, B.J. and Wedge, D.E., Improved microassays used to test natural product based and conventional fungicides on plant pathogenic fungi. *Plant diseases* **92**: 106-112 (2008).
2. Ahmad, N., Amir, M.K., Ayaz, S., Ahmad, J. A., Antimicrobial profile of the selected medicinal plants. *Int J Chem Lif Sci* **01**: 1039-1041 (2012).
3. Aliero, A.A. and Afolayan, A.J. Antimicrobial activity of *Solanum tomentosum*. *Afr. J. Biotechnol.* **5 (4)**: 369-372 (2006).
4. Broekaert, W.F., Terras, F.R.G., Cammue, B.P.A. and Vanderleyden, J. An automated quantitative assay for fungal growth inhibition. *FEMS Microbiology Letters* **69**: 55-60 (1990).
5. Buwa, L.V. and Staden, J.V. Antibacterial and antifungal activity of traditional medicinal plants used against venereal diseases in South Africa. *J. Ethnopharmacol.* **103(1)**: 139-142 (2006).
6. B. Rachel, madhuri, Sugandhi and Meera bai, Antimicrobial activity of *Mentha Arvensis* L. Lamiaceae. *J. Adv. Lab. Res. Bio* (2011).
7. Dababneh, B.F. and Khalil, A., The inhibitory effect of extracts from Jordanian medicinal plants against phytopathogenic fungi. – *Plant Pathology Journal* **6(2)**: 191-194 (2007).
8. Dearing, M.D., Mangione, A.M. and Karasov, W.H., Plant secondary compounds as diuretics: An overlooked consequence. *Am Zool.* **41**: 890-901 (2001).
9. Elgorashi, E.E. and Staden, J. V., Pharmacological screening of six Amaryllidaceae species. *Journal of Ethnopharmacology* **90**: 27-32 (2004).
10. Ergene, A., Guler, P., Tan, S., Mirici, S., Hamzaoglu, E. and Duran, A., Antibacterial and antifungal activity of *Heracleum sphondylium* subsp. *artvinense*. *Afr. J. Biotechnol.* **5(11)**: 1087-1089 (2006).
11. Gomez, K.A. and Gomez, A. A., Statistical Procedures for Agricultural Research. John Wiley and Sons, New York (1984).
12. Huang, K.C. The pharmacology of Chinese herbs. Boca Raton: CRC Press; (1999).
13. Hassanein, M.M., Abou Zeid, M.A., Youssef, K.A. and Mahmoud, D. A., Efficacy of leaf extracts of neem (*Azadirachta indica*) and chinaberry (*Melia azedrach*) against early blight and wilt disease of tomato. *Aus J Basic Appl Sci* **2**: 763-772 (2008).
14. Jeyaseelan, E.C., Vinuja, T., Pathmanathan, K. and Jeyadevan, J.P., Control of plant pathogenic fungi using organic solvent extracts of leaf, flower and fruit of *Lawsonia inermis* L. *International Journal of Pharmaceutical and Biological Archives* **3(4)**: 783-788 (2012).
15. Mahesh, B., and Satish, S., Antimicrobial Activity of Some Important Medicinal Plant against Plant and Human Pathogens. *W J Agric Sci* **4**: 839-843 (2008).
16. Mohana, D.C., Raveesha, K. A., and Lokanath, R., Herbal remedies for the management of seed-borne fungal pathogens by an edible plant *Decalepis hamiltonii* (Wight & Arn). *Arch. Phytopathol. Plant Protect.* **41(1)**: 38-49 (2008).
17. Mondall, N.K., Mojumdar, A., Chatterje, S.K., Banerjee, A., Datta, J.K. and Gupta, S., Antifungal activities and chemical characterization of neem leaf extracts on the growth of some selected fungal species in vitro culture medium. *Journal of Applied Sciences and Environmental Management* **13(1)**: 49-53 (2009).
18. Oseni, L.A., and Yussif, I., Screening ethanolic and aqueous leaf extracts of *Taraxicum officinale* for in vitro bacterial growth inhibition. *Journal of Pharmaceutical and Biomedical Sciences*, **20(06)**: 1-4 (2012).

19. Parekh, J., Karathia, N. and Chanda, S., Evaluation of antibacterial activity and phytochemical analysis of *Bauhinia variegata* L. bark. *Afr. J. Biomed. Res.* **9**: 53–56 (2006).

20. Parveen, S., Wani, A.H., Bhat, M.Y., Koka, J. A. and Wani, F.A., Management of postharvest fungal rot of peach (*Prunus persica*) caused by *Rhizopus stolonifer* in Kashmir Valley, India. *Plant Pathology and Quarantine* **6(1)**: 19-29 (2016).

21. Parveen, S., Wani, A.H., Ganie, A.A., Pala, S.A. and Mir, R.A., Antifungal activity of some plant extracts on some pathogenic fungi. *Archives of Phytopathology and Plant Protection* **47**: 279–284 (2014).

22. Parveen, S., Wani, A.H., Bhat, M.Y. and Koka, J.A., Biological control of postharvest fungal rots of rosaceous fruits using microbial antagonists and plant extracts – a review. – *Czech Mycol.* **68(1)**: 41–66 (2016).

23. Pawar, and B. T., Antifungal activity of some leaf extracts against seed-borne pathogenic fungi. *International Multidisciplinary Research Journal* **1(4)**: 11-13 (2011).

24. Pawar, and B.T., Antifungal activity of some fruit extracts against seed-borne pathogenic fungi. *Advanced Bioresearch*, **4(3)**: 95-97 (2013).

25. Rithish, N. and Sumitra, C., Antimicrobial activity of some medicinal plant of western region of India, phytochemical, pharmacological and microbiological labortory, Department of bioscience, Sourashtra University, Gujarat (2007).

26. Taskeen-Un-Nisa, Wani, A.H. and Mir, R.A., Antimycotic activity of plant extracts on the spore germination of some pathogenic fungi. *Mycopath* **8(2)**: 65–69 (2010).

27. Varma, J. and Dubey, N.K., Prospectives of botanical and microbial products as pesticides of tomorrow. *Curr. Sci.* **76 (2)**: 172–179 (1999).

28. Wilson, C.L., Solar, J.M., Ghaouth, A. El. and Wisniewski, M., Rapid evaluation of plant extracts and essential oils for antifungal activity against *Botrytis cinerea*. *Plant Dis.* **81**: 204-210 (1997).

29. Yeni, I.J., Dele, O.S., Ademola, I.J. and Adeniran, A. J., Allelopathic effect of leaf extracts of *Azardirachta indica* and *Chromolaena odorata* against post harvest and transit rot of tomato (*Lycopersicum esculentum* L.). *Journal of American Sciences* **6(12)**: 1595-1599 (2010).