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Full Length Research Paper

Antibacterial, antifungal and insecticidal activities of some selected medicinal plants of polygonaceae

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The antibacterial, antifungal and insecticidal activities of the crude extract of *Polygonum persicaria*, *Rumex hastatus*, *Rumex dentatus*, *Rumex nepalensis*, *Polygonum plebejum* and *Rheum australe* have been studied. Six bacterial species were used, of which C*itrobacter frundii*, *Escherichia coli*, *Enterobacter aerogenes* and *Staphylococcus aureus* were the most susceptible bacterial species to crude extract with MICs 16, 5.0, 25 and 0.156 µg/ml, respectively. Among the tested fungal species *Fusarium solani*, *Aspergillus flavus* and *Aspergillus niger* were more susceptible to crude extracts with MICs 0.75, 2.15, and 1.75 µg/ml, respectively. The crude extracts of *R. dentatus* and *R. nepalensis* show significant insecticidal activity against *Sitophilus oryzae; P. persicaria* and *P. plebejum* show significant insecticidal activities against *Tribolium castaneum*, respectively. The above selected plants were shown by *in vitro* assays to be a potential source for natural antifungal, antibacterial and insecticidal agents.

Key words: *Polygonum persicaria*, *Rumex hastatus*, *Rumex dentatus*, *Rumex nepalensis*, *Polygonum plebejum*, *Rheum australe*, antibacterial, antifungal, insecticidal.

INTRODUCTION

Globalization interferes with infectious disease control at the national level while microbes move freely around the world, unhindered by borders, human responses to infectious diseases and are conditioned by jurisdictional boundaries (Stepanovic et al., 2003). According to WHO, important progress has been made in controlling major infectious diseases. About 43% of total deaths occurred in developing countries due to infectious diseases in recent years (Carballo et al., 2002). Similarly, freedom from insect infestation and contamination has become an important consideration in storage of grain and to maintain high quality food product by preventing them from attack of the most frequently invading organisms (Coolins, 1998). Nearly one thousand species of insects have been associated with store products throughout the world, of which the majority belong to Coleoptera (60%) and Lepidoptera (8 - 9%) (Champ, 1981). Some species of the plant family Polygonaceae were used in folk medicine. The leaves and shoots of *Rumex hastatus* and *Rumex dentatus* are diuretic, refrigerant and used as cooling agent (Islam et al., 2006; Hussain et al., 2006). The roots of *Rumex nepalensis* are purgative (Chopra et al., 1986; Manandhar, 2002). The leaves of *Polygonum persicaria* are astringent, rubefacient and vermifuge (Foster and Duke, 1990). The roots of *Polygonum plebejum* are used in bowel complaints and dried plant powder is taken internally for pneumonia (Baquar, 1989; Arshad et al., 1998). The antibacterial activity of *R. nepalensis* was found against some species of bacteria and its methanolic extract of roots showed significant concentration-dependent antibacterial activity (Ghosh et al., 2003). This study was aimed at investigating the antibacterial, antifungal and insecticidal activities of the selected plants to explore the scientific basis for their folk use in infectious diseases.

MATERIALS AND METHODS

Plant materials and preparation of plant extracts

Fresh aerial parts of *P. persicaria*, *R. hastatus*, *R. dentatus*, *R. nepalensis* (roots), *P. plebejum* and *Rheum australe* (rhizomes)

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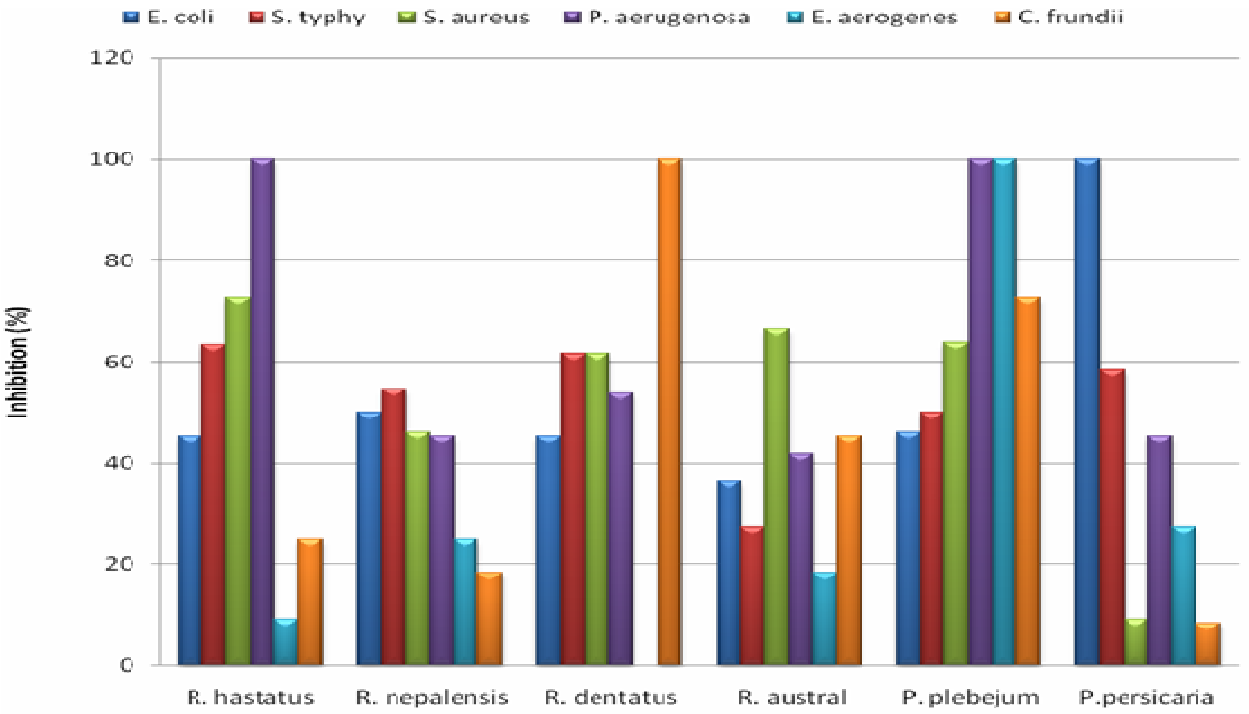

Figure 1. Antibacterial activity (percentage inhibition) of the selected plants. Standard drug: Ampicillin at concentration of 1 mg/ml.

were collected from Peshawar University Campus, Pakistan and *R. australe* was collected from Gharam Chasma (Chitral) in March - November, 2005. These plants were identified with the help of Prof. Dr. Abd-ur-rashid, a plant taxonomist in the Department of Botany, University of Peshawar, Pakistan.

The plants were shade dried at room temperature for 20 days. Then they were grounded to 60 mesh diameter powder using an electric grinder. Fifty grams of each plant were soaked in 250 ml 70% methanol and were filtered through whatmann filter paper No. 1823 after macerating for three days. This process was repeated 3 times and the extracts were combined and concentrated using rotary evaporator. These extracts were stored at 4°C. The methanolic extracts of the plants were dissolved in dimethyl sulphoxide (DMSO) at the concentration of 10 mg/ml.

The tested bacteria, fungi and insects

Both gram negative and gram positive bacterial species *Escherichia coli*, *Salmonella typhi*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterobacter aerogenes* and *Citrobacter freundii* have been used. Nutrient agar medium was used for the growth of bacteria for agar diffusion method (Mariam et al., 1993) and nutrient broth medium for serial dilution method (Spooner and Sykes, 1972).

Fungal species *Fusarium solani*, *Aspergillus flavus*, *Aspergillus niger*, *Alternaria solani* and *Helminthosporium maydis* were obtained from Department of Mycology and Plant Pathology, University of Punjab, Lahore, Pakistan and Department of Pathology, Agriculture University, Peshawar, Pakistan. Sabouraud dextrose agar (SDA) was used for the growth of fungi for agar dilution method following Mariam et al. (1993).

The insect species *Tribolium castaneum*, *Sitophilus oryzae*, *Rhyzopertha dominica*, *Callosbruchus analis* and *Trogoderma granarium* were obtained from Divisions of Entomology, Nuclear Institute for Food and Agriculture (NIFA), Peshawar, Pakistan.

Bioassays

The antibacterial, antifungal and insecticidal activities were performed as previously reported (Ahmad et al., 2009).

RESULTS AND DISCUSSION

Antibacterial activity

The methanol extract of the leaves of *R. hastatus* showed low antibacterial activity against *S. typhi*, *E. coli*, *S. aureus*, *P. aeruginosa* and *E. aerogenes* and highest antibacterial activity against *C. freundii* (Figure 1). *R. dentatus* leaf extract shows low antibacterial activity against *C. freundii* and *S. typhi;* moderate against *S. aureus*, *P. aeruginosa* and *E. aerogenes;* while highest against *E. coli* (Figure 1). The root of *R. nepalensis* shows low antibacterial activity against *P. aeruginosa*; moderate against *S. typhi*, *E. aerogenes* and *C. freundii;* and highest antibacterial activity was observed against *E. coli* and *S. aureus* (Figure 1). The methanol extract of the *R. nepalensis* roots showed significant concentration-dependent antibacterial activity (Ghosh et al., 2003). The crude extract of *R. australe* exhibited moderate activity against *S. typhi*, *S. aureus*, *P. aeruginosa* and *C. freundii* and showed highest antibacterial activity against *E. coli* and *E. aerogenes* (Figure 1). *Rheum officinale* root showed significant activity and the purified active substance was identified as rhein. The *Rheum emodi* rhizomes contain antibacterial constituents (Babu et al., 2003). *P. plebejum*

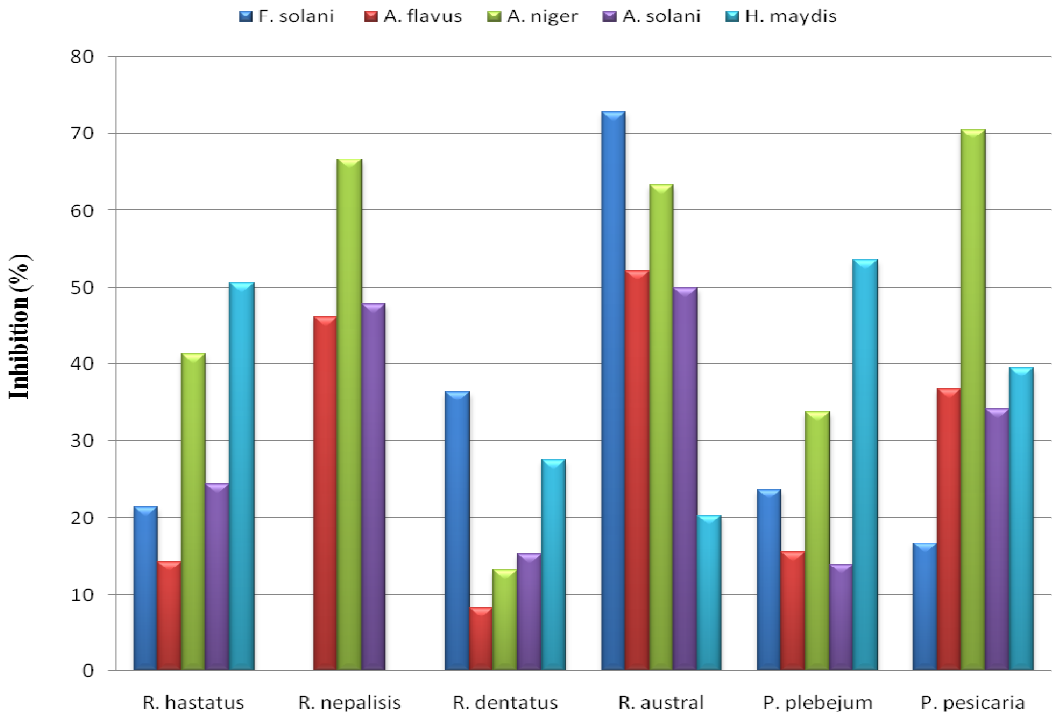

Figure 2. Antifungal activity (percentage inhibition) of selected plants. Standard drug: Miconazole at concentration of 1 mg/ml.

(whole plant) exhibits no activity against *S. aureus*; low activity against *E. coli*, *S. typhi* and *P. aeruginosa* and has a highest activity against *E. aerogenes* (Figure 1). The antimicrobial activities of *Polygonum cognatum* Meissn were studied *in vitro*. The ether and ethanol extracts showed antimicrobial activity against *S. aureus* and *Bacillus subtilis* (Ali et al., 2003). *P. persicaria* leaf extract shows low activity against *E. coli*, *S. typhi* and *C. freundii*; moderate against *P. aeruginosa* and highest activity against *S. aureus* and *E. aerogenes* (Figure 1). Quercetin (a flavonol) has been isolated from *Polygonum equisetiforme,* the antibacterial activity of which was compared with the antibacterial drugs, gentamicin, streptomycin and ampicillin. It had a narrow antibacterial spectrum of activity (Ghazal et al., 1992) (minimum inhibitory concentration MIC = 5.0, 16, 25, 12.5, 2000 and 1.6 µg/ml for *E. coli*, *C. freundii*, *E. aerogenes*, *S. typhi*, *P. aeruginosa* and *S. aureus*, respectively). From the above results it is revealed that the crude extracts of *R. hastatus* and *P. Persicaria* show significant activity against *E. coli*; *R. dentatus* shows significant activity against *C. freundii*; *P. plebejum* shows significant activity against *P. aeruginosa* and *E. aerogenes.*

Antifungal activity

The crude extract of the leaf of *R. hastatus* exhibited moderate inhibitory activity against *H. maydis and A. niger* and showed low activity against *F. solani*, *A. flavus* and *A. solani* (Figure 2). Kim et al. (2004) reported antifungal activities of *Achyranthes japonica* (whole plant) and *Rumex crispus* (root). The crude extract of the leaf of *R. dentatus* showed moderate inhibitory activity against *F. solani* and showed low inhibitory activity against *A. flavus*, *A. niger*, *A. solani* and *H. maydis* (Figure 2). The crude extract of the leaves of *Dodonaea viscosa* and *Rumex nervosus* and root of *Rumex abyssinicus* were tested for anti-microbial and none of them exhibited anti-fungal activity (Getie et al., 2003). The crude extract of *R. nepalensis* root exhibited highest activity against *A. niger*, and shows moderate activity against *A. flavus* and *A. solani* and no activity was noted against *F. solani* and *H. maydis* (Figure 2). The crude extract of *R. australe* (rhizome) exhibited highest activity against *F. solani* and *A. niger* and it showed moderate activity against *A. flavus* and *A. solani* and low activity was noted against *H. maydis* (Figure 2). The crude extract of *P. persicaria* leaf showed highest activity against *A. niger* and showed moderate activity against *A. flavus*, *H. maydis* and A. *solani* and low activity was noted against *F. solani* (Figure 2). The crude extract of *P. plebejum* (whole plant) exhibited moderate activity against *A. niger* and *H. maydis* and low activity was recorded against *F. solani*, *A. flavus* and *A. solani* (Figure 2). Joshi et al. (1997) reported antifungal activity of the *Polygonum chinense.* The dichloromethane extract of the aerial parts of the *Polygonum punctatum* showed strong activity in a bioauto-

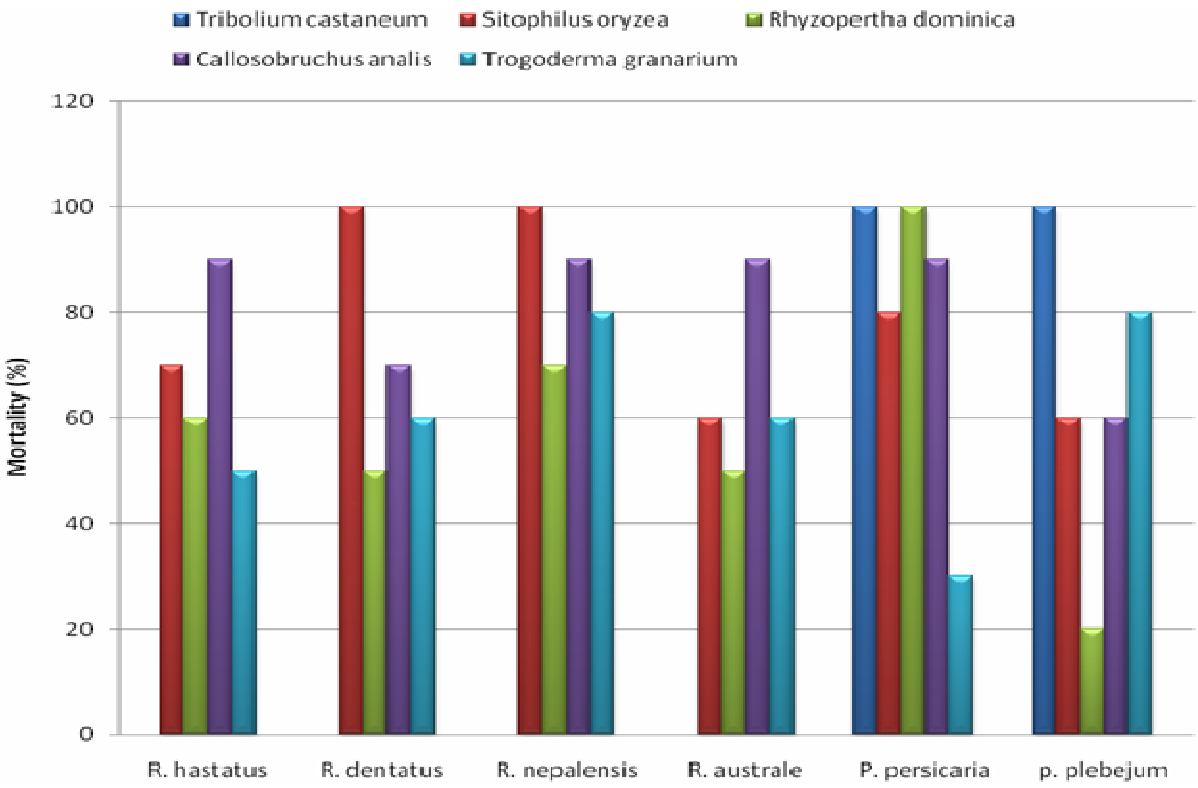

Figure 3. Insecticidal activity (percentage mortality) of the selected plants. Standard drug: Permithrine at concentration of 1 mg/ml.

graphic assay with the fungus, *Cladosporium sphaero-spermum* (Alves et al., 1997). MICs obtained were 0.75, 2.15, 28, 1.75 and 8 µg/ml for *F. solani*, *A. niger*, *A. alternaria*, *A. flavus* and *H. maydis*, respectively. The results show that *R. australe* and *P. persicaria* show significant antifungal activities against *F. solani* and *A. niger*.

Insecticidal activity

Roy et al. (2005) leaf extracts of *Blumea lacera* showed insecticidal activity against lesser grain borers and rice weevil. *R. dentatus* showed high activity against *C. analis* and *S. oryzae* and has low mortality against *T. granarium.* Kabaru and Gichia (2001) revealed the insecticidal activity of extracts from different parts of the mangrove tree, *Rhizophora mucronata* Lam. Haque (2002) analyzed chemically Bankalmi, *Polygonum hydropiper* and evaluated against rice hispa beetle. Hot water extracts of Bankalmi (*Ipomoea sepiaria)* and Bishkatali (*P. hydropiper*) (1:10; w/v) can efficiently be controlled by the hispa beetle and Bankalmi leaf extract with 25-95% ethyl alcohol.

The methanolic extract of *R. hastatus* showed high insecticidal activity against *C. analis* and *S. oryzae;* moderate insecticidal activity against *R. dominica*, *T. granarium* was observed and in case of *T. castaneum* plant extract has no mortality (Figure 3). *R. dentatus* showed high insecticidal activity against *C. analis* and *S. oryzae;* moderate activity against *R. dominica* and has low mortality against *T. granarium.* The mortality of the plant extract against *T. castaneum* was zero (Figure 3). *R. nepalensis* extract showed high mortality rate against *S. oryzae*, *R. dominica*, *C. analis* and *T. granarium;* the mortality rate against *T. castaneum* was zero (Figure 3). *R. australe* rhizome showed high mortality rate against *C. analis;* low mortality rate against *R. dominica*, *S. oryzae* and *T. granarium;* and the mortality rate against *T. castaneum* was zero (Figure 3). The insecticidal activity of the *P. persicaria* was high against *T. castaneum, S. oryzae*, *R. dominica* and *C. analis*; and low mortality was observed against *T. granarium* (Figure 3). In case of *P. plebejum,* the mortality rate of plant extract was high against *T. castaneum* and *T. granarium*; moderate mortality was observed against *S. oryzae* and *C. analis*. The activity was low against *R. dominica* (Figure 3). The results show that crude extracts of *R. dentatus* and *R. nepalensis* show significant insecticidal activity against *S. oryzae*, while *P. persicaria* and *P. plebejum* show significant insecticidal activities against *Tribolium castaneum*.

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