5- Discussion

The valley of Kashmir has been a hub for medicinal plants. The people there are using these medicinal plants for the cure and prevention of various ailments since many decades. A total of 937 plant species from to 129 families have so far been reported to possess medicinal properties and used by indigenous communities of Jammu and Kashmir for cure of various ailments. However these days there are new and different medicines for these diseases, which are accompanied by various toxic effects. So there is a need to identify and explore various phytoconstituents of natural origin which can be used for the treatment and/or prevention of diseases/infections with no side effects.

Plants are a rich source of secondary metabolites such as tannins, terpenoids, alkaloids, flavonoids, phenols, steroids, glycosoids, and volatil oils. Therefore it is necessary to identify and explore these phytochemical components of local medicinal plants in the treatment of various diseases. In addition studies into antimicrobial activities of local medicinal plants will explore the plants as potential sources of therapeutic agents (Ebena et al., 1991). The extracts of Rheum emodi and its active ingredients such as alkaloids, flavonoids, saponins, tannins, phenols were used to act as antioxidants, anticancer, antibacterial, antifungal and antiviral (Kren et al., 2003; Raj kumar et al., 2010; Hatano et al., 1999; Agarwal et al., 2000; Babu et al., 2003). The extract of Podophyllum hexandrum its constituents have been reported to possess anticancer, antiviral, antihelminthic, antifungal and in the treatment of rheumatoid arthritis (Kao et al., 1992; Chang et al., 1992; Mayeaux et al., 1995; White et al., 1997).

Qualitative and quantitative estimation of phytochemical constituents revealed the presence of various phytochemicals present in plant responsible for various pharmacological activities. The investigation revealed the presence of glycosides, flavonoids, saponins, tannins, terpenes, alkaloids, steroids and anthraquinones. The amino acids were found to be absent. Qualitative estimation also revealed the presence of carbohydrates and anthraquinones in Rheum emodi. Srinivasarao et al., 2015 also reported the presence of glycosides, flavonoids, terpens, alkaloids, saponins, terpenoids, steroids, carbohydrates, and anthraquinones in Rheum emodi extracts however our study contradicts with Srinivasarao et al., 2015 in that they reported the presence of amino acids in the Rheum emodi extract while in the present study no amino acids were found. Wani et al., 2013, Tabin et al., 2016 Towseef and Salam 2015 also reported the absence of amino acids in the extract of Rheum emodi and presence of other phytochemical constituents so
the present findings are in concurrence with the findings of Wani et al., 2013, Tabin et al., 2016 and Towseef and Salam 2015.

The preliminary phytochemical screening of Podophyllum hexandrum revealed the presence of terpenoids, steroids, flavonoids, saponins, tannis, glycosides, amino acids and the absence of alkaloids, carbohydrates and anthraquinones. Kumar and Dhillon 2015 also have reported the presence of flavonins, terpenes, glycosides and saponins however they have also reported the presence of alkaloids and carbohydrates. In present study no carbohydrates and alkaloids were detected. Wani et al., 2012 and Sultan et al., 2008 also have reported the absence of carbohydrates, alkaloids and anthraquinones from Podophyllum hexandrum rhizome extract so present findings are in concurrence with the findings of Wani et al., 2012 and Sultan et al., 2008.

The antimicrobial activities of aqueous and methanolic extract of Rheum emodi against the bacteria and fungi strains used were assessed by the presence of inhibition zones. The aqueous extract of Rheum emodi at minimum inhibitory concentrations (MICs) of 2.5 mg/ml, 5 mg/ml, 7.5 mg/ml and 10 mg/ml inhibited Bacillus megaterium MTCC 1684 and Pseudomonas aeruginosa MTCC 3541 with zone of inhibition ranging from 7.5-11mm while methanolic extracts of same concentrations inhibited the growth of bacterial strains ranging from 8-12.3 mm. The aqueous and methanolic extract of same concentrations of Rheum emodi also inhibited the growth of fungi strains Aspergillus flavus and Fusarium solani. The aqueous extract of Rheum emodi inhibited the growth of fungi strains between the ranges of 4-5.2 mm while methanol extract inhibited the growth of fungi strains in the range of 6 mm to 11.3 mm. The antibacterial and antifungal properties of Rheum emodi has also been reported by many workers. Hussain et al., 2010 reported that fungal strain Fusarium solani was susceptible to crude extracts with MICs of R. emodi at 0.75 and 2.15µg/ml. They also reported that bacterial strains Citrobacter freundii, Escherichia coli, Enterobacter aerogenes and Staphylococcus aureus were susceptible to crude extract with MICs 16, 5.0, 25 and 0.156 mg/ml, respectively. Agarwal et al., 2000 reported that rhizomes of Rheum emodi exhibited antifungal activity against Candida albicans, Cryptococcus neoformans, Trichophyton mentagrophytes and Aspergillus fumigates at 25-50 µg/ml. Rehman et al., 2014 has also demonstrated the antimicrobial activityof Rheum emodi against Bacillus subtilis and Pseudomonas aeruginosa.

Although Podophyllum hexandrum has received significant attention for its tumour necrotizing properties (Giri and Narasu 2000) treatment of warty lesions (Kaplan 1942) radioprotective
(Goel et al., 1998). They are used as starting compound for the chemical synthesis of etoposide and teniposide (Baker et al., 1995; Clark and Slevin 1987). Only few studies have been done for its antimicrobial activity. In the present study four concentrations 2.5 mg/ml, 5 mg/ml, 7.5 mg/ml and 10 mg/ml of aqueous and methanolic extracts were used to asses the antibacterial and antifungal of activity of *Podophyllum hexandrum*. The aqueous extract exhibited the zone of inhibition between 3.5 to 5 mm while methanol extract had zone of inhibition between 4.7 to 9.6 mm. Phani et al., 2010 also reported that extracts of *Podophyllum hexandrum* at concentration between 8-250 µg/ml exhibited significant antibacterial effect against *Bacillus subtilis*, *Salvia sclarea* and *Pseudomonas aeruginosa* with MIC of 8 µg/ml. Atta-ur- Rahman et al., 1995 reported that *P. hexandrum* showed strong antifungal activity against *Epidermophyton floccosum*, *Curvularia lunata*, *Nigrospora oryzae*, *Microsporum canis*, *Allescheria boydii* and *Pleurotus ostreatus*. Wani et al., 2013 also reported that rhizome extracts of *Podophyllum hexandrum* have antifungal activity against pure cultures of clinical isolates of *Aspergillus niger* ATCC 1197 and *Candida albicans* ATCC 1023. *Podophyllum hexandrum* leaf has been found to be highly effective against *Bacillus subtilis* (Kumar et al., 2005). So our results are in concurrence with previous findings. The phytochemical analysis of Rheum emodi showed the presence of steroids, flavonoids, saponins, terpenoids, anthraquinones and phenol. *Podophyllum hexandrum* revealed the presence of tannins, steroids, flavonoids, saponins, terpenoids, amino acids and phenol. These results are in concurrence with other findings on *Rheum emodi* and *Podophyllum hexandrum*. The presence of flavonoids, anthrquinones and tannins are indicative of presence of antimicrobial activity. MICs of the aqueous extracts of *Rheum emodi* and *Podophyllum hexandrum* showed inhibitory values less than methanolic extracts. This may be due to the solubility of the antimicrobial compounds in the respective solvents used. Low MIC values with Rheum emodi extracts have been reported against *Candida albicans*, *Cryptococcus neoformans*, Trichophyton mentagrophytes and *Aspergillus fumigatus* (Kumar et al., 2010). Leaf extract of Podophyllum hexandrum was reported to have antimicrobial effect against Bacillus subtilis with MIC 8 µg/ml (Sudhir et al., 2005). In the present study the extracts of *R. emodi* exhibited better antibacterial and antifungal inhibition than *Podophyllum hexandrum*. This may be due to the presence of a number of phytoconstituents. Among all phytoconstituent the major one are free anthraquinones and their glycosides. Agarwal et al., 2000 and Nayak et al., 2006 also reported strong antifungal antibacterial activity of *Rheum*
*emodi*. This strong antimicrobial activity of *R. emodi* may be reported to the phytoconstituents present in it, which may be either due to individual or additive effect.