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Antimicrobial potential and phytochemical screening of different extracts of *Rumex dentatus* and *Saussurea lappa* from Kashmir Himalaya, India

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Abstract

In the present study, antimicrobial and phytochemical activities of the two important medicinal plants viz. *Rumex dentatus*, *Saussurea lappa* was carried out with the help of Agar well diffusion method. The pharmacological activity of *Rumex dentatus*, *Saussurea lappa* against *Escherichia coli*, *Bacillus amyloliquefaciens*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* was tested. It was recorded in our study that aqueous extract has shown the significant antibacterial activity in all the plant extracts against all the tested bacterial strains. Aqueous extract of *Rumex dentatus* was found to be very effective against *Pseudomonas aeruginosa* (35 ± 0.44 mm) whereas aqueous extract of *Saussurea lappa* has been recorded with highly effective against *Bacillus amyloliquefaciens* (31 ± 0.44 mm). Further, ethanol, methanol, and aqueous extract of *Saussurea lappa* have shown the promising antibacterial activity against *Bacillus amyloliquefaciens*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* except in case of methanol against *Escherichia coli*. Further, methanol extract of *Rumex dentatus* has shown great antimicrobial activity that other. Methanolic extract of *Rumex dentatus* extracts inhibited none of the tested bacterial strains in our study. The phytochemical investigation of the various extract of *Saussurea lappa* showed a positive result for Saponin, Tanin, and Phenol in methanol and ethanol extract. Terpenoid, Carbohydrate, and phenol were tested positive in all the solvents for *Rumex dentatus* and *Saussurea lappa* whereas steroid, Phlobatannin, Starch, Flavonoid, Napthoquinone, and Insulin were absent in all the extract of *Rumex dentatus* and *Saussurea lappa*. We can conclude from the study that *Rumex dentatus* and *Saussurea lappa* can be used as a potential source of treating different diseases due to their great antimicrobial and biological activity along with various phytoconstituents.

Keywords *Saussurea lappa*, *Rumex dentatus*, Medicinal Plants, Antimicrobial Activity

Introduction

India is well known for its great biodiversity and cultural mosaic. Kashmir is an essential part of India which supports a large number of medicinal plant diversity. *Rumex dentatus*, *Saussurea lappa* are important medicinal plants which traditionally utilized as a source of various medicines in different human diseases. Plants and plant-based products have been used as a source of medicine for millions of years ago. New complimentary products have been obtained from plants by using modern scientific technology (Sarin, 1996). Today, various biological agents have been obtained from plants that treating different human diseases. Plants are a great

source of drugs in the modern medicine system. They are also providing food supplements, nutraceuticals, and various pharmaceuticals which have great efficiency for curing the diseases (Girach et al., 2003; Khanahmadi et al., 2010). Further, adopting the traditional medicinal system as an alternate form for curing different diseases has led to novel drug development through all the previous knowledge (Qureshi et al., 2009). As synthetic compounds have caused severe adverse effects on human health so strong restrictions should be followed while using a plant in any particular disease. Due to the adverse effects of synthetic drugs, high restrictions are being placed on these novel compounds which tend to be a substitute for old traditional plants (Knight, 1997).

The antimicrobial and antioxidant product of medicinal plants has made a significant contribution to disease prevention (Drehe, 1996). In India, these two plants are commonly found in Kashmir, Jammu, along with the Western Ghats. *Rumex dentatus* belongs to the family Polygonaceae and *Saussurea lappa* belongs to the family Asteraceae occurs within the altitude of 6000-12000 ft (Gutteridge, 1985). These two plants have great antimicrobial potential along with highly active biological compounds. *Saussurea lappa* is continuously disappearing due to maximum demand for medicinal purposes and careless handling (Ahmad et al., 2007, Madhuri et al., 2012). In the Ayurveda system, its root is used to treat asthma, rheumatism, dysentery, skin problems, ringworm, and epilepsy (Akash et al., 2020; Shah, 1982) whereas in the Unani medicinal system it is used for treating asthma, old fever, headache, ophthalmic, paralysis and inflammation (Akash et al., 2020; Kritikar et al., 1987).

Materials and methods

Plants like *Rumex dentatus*, *Saussurea lappa* plant were collected from Union territory ie., Srinagar, and identified from Botanical Survey of India. The herbarium was deposited in the department of life Science, Himalayan University, Itanagar. India.

Extraction of plant material

The plant was dried (about 50 g) and converted into dried form. The crude extraction was done with ethanol, methanol, and aqueous solvent in Soxhlet assembly to get the extract which dried and kept for further analysis.

Table: 1. Description of the plants

S. No	Botanical name	Common name	Family	Part used
1	<i>Rumex dentatus</i>	Abuj	Polygonaceae	Root
2	<i>Saussurea lappa</i>	Kuth	Asteraceae	Rhizome



Fig. 1 *Rumex dentatus*

Saussurea lappa

Tested Microorganism

In the present study, *Escherichia coli*, *Bacillus amyloliquefaciens*, *Pseudomonas aeruginosa*, *Staphylococcus*

aureus were used. Plant extract with 200mg/ml of concentration was used in testing on Mullar Hinton Agar plate.

Antimicrobial activity

The microbial assay was done with the help of the disc diffusion method (Kaul, 1997).

Phytochemical analysis

All the plant extract was tested for Phytochemical analysis in which major phytoconstituents were determined by using the standard method (Baue et al., 1966; NCCLS, 1990). All the plant extracts were tested for the absence or presence of biologically active compounds such as Tanin, Saponin, Steroid Flavonoid, Terpenoid, Napthoquinone, Phenol, Carbohydrate, Carbohydrate, and starch.

Result and discussion

Antimicrobial activity

Plants are the source of natural products that offer various medicinal properties. The result from the present study recorded that aqueous extract of both plants showed significant antimicrobial activity than other solvents against thus inhibited high bacterial strains. This might be due to the presence of phenolic and polyphenolic compounds in the extract (Cowan, 1999). A similar finding was observed by different workers with high antimicrobial activity of *Rumex* sp. (Aboaba et al., 2001, Karou et al., 2006). The antimicrobial activities were tested in 200 mg/ml concentrations of different crude extract of *Saussurea lappa* and *Rumex dantatus* was determined against different bacteria like *Escherichia coli*, *Bacillus amyloliquefaciens*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*. Inhibitory zone of bacteria was recorded in mm and Gentamycin as a positive control for bacteria. Further, in the present study, ethanol, methanol, and aqueous extract of *Saussurea lappa* have shown promising antibacterial activity against *Bacillus amyloliquefaciens*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* except in the case of methanol against *Escherichia coli*. Further, methanol extract of *Rumex dentatus* has shown great antimicrobial activity than other extracts. Methanolic extract of *Rumex dentatus* extracts inhibited none of the tested bacterial strains in the present study. There was no concentration activity-dependent of all extract in the present study as we have tested all the plant extract of 200 mg/ml. It was observed from different studies that plant extract also showed different activities in various concentrations. At lower concentrations, lesser antimicrobial compounds resulting in low activity. Although in the present study, we have tested all the plant extract of 200 mg/ml against the selected pathogens in which aqueous extract both the plants have shown great antibacterial activity. The antimicrobial activity of plant extracts effected by the permeability barrier of the membranous structure of bacteria (Hayek, 2012) resulting in a different zone of inhibition. In the present study, an aqueous extract of *Rumex dentatus* was very effective against

Pseudomonas aeruginosa (35 ± 0.44 mm) but an aqueous extract of *Saussurea lappa* has been recorded as highly effective against *Bacillus amyloliquefaciens* (31 ± 0.44 mm). Ethanol plant extract of *Rumex dentatus* showed no activity against *Pseudomonas aeruginosa* and *Escherichia coli*, but showed activity against *Bacillus amyloliquefaciens* and *Staphylococcus aureus* with a zone diameter of 18 ± 0.44 mm, 20 ± 0.48 mm respectively but in the case of *Saussurea lappa*, ethanolic extract showed strong activity against *Escherichia coli*, *Bacillus amyloliquefaciens*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* with an inhibitory zone of 12 ± 0.42 mm, 26 ± 0.44 mm, 21 ± 0.42 mm, 18 ± 0.48 mm. The methanol plant extract of *Saussurea lappa* showed a strong inhibitory effect against *Bacillus amyloliquefaciens*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* with 17 ± 0.42 mm, 24 ± 0.44 mm, and 23 ± 0.43 mm but no activity against *Escherichia coli* but in the case of *Rumex dentatus* no activity showed against any of the tested bacterial strains. Aqueous extract of *Saussurea lappa* and *Rumex dentatus* showed high antibacterial activity against the entire tested microorganism. The aqueous extract of *Saussurea lappa* was very effective against *Bacillus amyloliquefaciens*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* with the

inhibitory zone of 28 ± 0.42 mm, 31 ± 0.44 mm, 25 ± 0.42 mm, and 17 ± 0.48 mm whereas in the case of aqueous extract of *Rumex dentatus* showed moderate antimicrobial activity against *Escherichia coli*, *Bacillus amyloliquefaciens*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* with the inhibitory effect of 18 ± 0.44 mm, 13 ± 0.46 mm, 35 ± 0.44 mm and 21 ± 0.48 mm. It was recorded that the Disc diffusion method is one of the most favorable methods of testing the antimicrobial property of medicinal plants. Negi et al., 2013, also tested the antimicrobial activity of *S. lappa* against *B. subtilis*, *S. aureus*, *E. coli*, and *P. aeruginosa* with significant results. Pharmacological aspects in terms of antibacterial activity of *S. lappa* were also tested by Rao et al., 2007 against pathogens which have shown great results. Our study (Table 2) revealed that methanol extract of *Rumex dentatus* failed to exhibit effect against the microorganism while the best antibacterial activity was detected in the aqueous extract of *Rumex dentatus* and *Saussurea lappa*. Workers like Elzaeawely et.al., (2005) recommended that the antibacterial assay of *Rumex* might be the presence of phenolic substances in its extract. Similarly, the study of Kupeli et al., (2004) and Jang et al., (2005) also reported great antimicrobial activity in various parts of *Rumex*.

Table 2. Antimicrobial activity of *Saussurea lappa* and *Rumex dentatus*

Tested microorganism	<i>Saussurea lappa</i>			<i>Rumex dentatus</i>		
	Ethanol 200 mg/ml	Methanol 200 mg/ml	Aqueous 200 mg/ml	Ethanol 200 mg/ml	methanol 200 mg/ml	Aqueous 200 mg/ml
<i>Escherichia coli</i>	12 ± 0.42	-	28 ± 0.42	-	-	18 ± 0.44
<i>Bacillus amyloliquefaciens</i>	26 ± 0.44	17 ± 0.42	31 ± 0.44	18 ± 0.44	-	13 ± 0.46
<i>Pseudomonas aeruginosa</i>	21 ± 0.42	24 ± 0.44	25 ± 0.42	-	-	35 ± 0.44
<i>Staphylococcus aureus</i>	18 ± 0.48	23 ± 0.43	17 ± 0.48	20 ± 0.48	-	21 ± 0.48

* Zone of inhibition is in mm

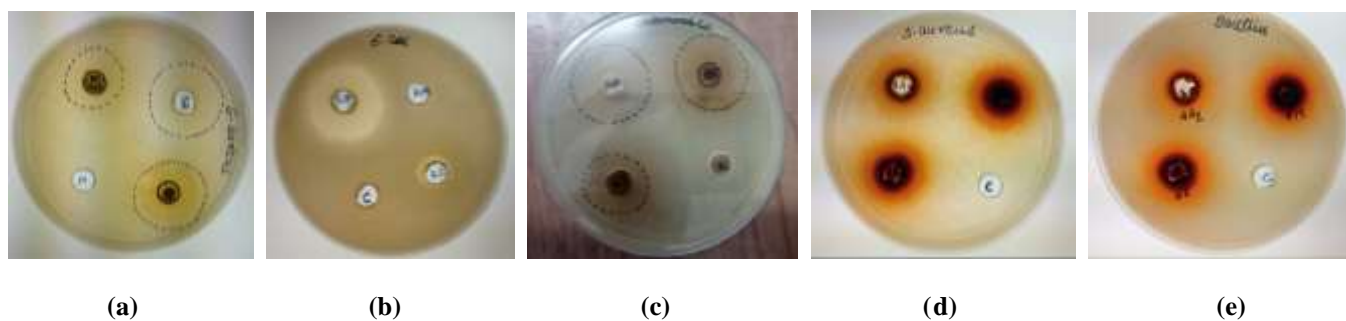


Fig. 2 Antimicrobial activity by disc diffusion assay showing the inhibitory zone induced by Gentamicin (control) (a) *S.aureus* (b) *E.coli* (c) *P. aeruginosa* (d) *S. aureus* (e) *B. amyloliquefaciens* (Note: a-c= *Saussurea lappa*, d-e= *Rumex dentatus*)

Qualitative analysis of phytochemical constituents

Plants have shown great antimicrobial and pharmacological activity in different solvents. Further, awareness regarding phytochemicals is rising due to their good impact on human beings. In the present study, the high content of saponin, tannin, flavonoid, and phenolic compounds. The earlier study of Chandur et al., 2011 in *S. lappa* also showed high content of saponins, alkaloids, carbohydrates, and glycosides. The phytochemical investigation of the various extract of

Saussurea lappa showed a positive result of Saponin, Tanin, and Phenol in methanol and ethanol extract. Terpenoid, Carbohydrate, and phenol were tested positive in all the solvents for *Rumex dentatus* and *Saussurea lappa* whereas steroid, Phlobatannin, Starch, Flavonoid, Napthoquinone, and Insulin were absent in all the extract of *Rumex dentatus* and *Saussurea lappa* (Table 3). Other phytochemical of *Rumex dentatus* and *Saussurea lappa* has shown positive and negative result at the time of screening.

Table 3. Qualitative analysis of secondary metabolites in *Rumex dentatus* and *Saussurea lappa*

S. No	Test	<i>Saussurea lappa</i>			<i>Rumex dentatus</i>		
		Methanol	Ethanol	Aqueous	Methanol	Ethanol	Aqueous
1	Saponin	+	+	-	+	-	-
2	Tanin	+	+	+	+	+	-
3	Steroid	-	-	-	-	-	-
4	Flavonoid	-	-	-	-	-	-
5	Terpenoid	+	+	+	+	-	+
6	Napthoquinone	-	-	-	-	-	-
7	Insulin	-	-	-	-	-	-
8	Phenol	+	+	+	+	+	+
9	Carbohydrate	+	+	+	+	+	+
10	Phlobatannin	-	-	-	-	-	-
11	Starch	-	-	-	-	-	-

Conclusion

R. dentatus and *S. lappa* possess great medicinal properties. These plants are used to cure various human diseases since ancient civilizations. Further, it is now well proved from earlier and presents an experimental study that these two plants have a great pharmacological aspect in terms of antibacterial and phytochemical properties. Aqueous extract of both plants has shown a significant result as compared to other solvents with a maximum inhibitory zone in the present study. Due to the great pharmacological and traditional properties of these two plants, further studies on the bioactive compounds could be done for future biological activities and further research.

Authors' contributions

Mohd. Zakir, Narendra Kumar and Akash have contributed significantly to the conception and design of the study, the interpretation of data, and the drafting and revision of the manuscript. All authors read and approved the final manuscript.

Conflict of Interest

The authors hereby declare no conflict of interest.

Consent for publication

The authors declare that the work has consent for publication.

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