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ANTIMICROBIAL ACTIVITY OF *SALVIA SPLENDENS*

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The antimicrobial activity of the aqueous, ethanolic and acetone extracts of the aerial parts, flowers and roots of *Salvia splendens* (Labiateae family) has been studied against Gram positive and Gram negative bacteria and compared with nitrofurazone. Aqueous extracts exhibited very little activity while alcoholic and acetone fractions exhibited promising activity. Root fractions, however, exhibited maximum activity in all solvents.

Key words: *Salvia splendens* Ker.-Gawl., Labiateae family, Antimicrobial activity.

Introduction

S. splendens commonly known as "Red Sage" or Scarlet Salvia, is an ornamental plant [1]. It belongs to the family "Labiateae" which comprises of 300 genera and over 3300 species found abundantly in Mediterranean region and also in mountaneous countries of subtropics [2]. *Salvia,* derived its name from a latin word "Salvare" meaning to heal, therefore, most of the members of Labiateae are all round healers [2].

A review of literature citation on *S. splendens,* Ker.-Gawl does not give much knowledge regarding its biological activity and chemical constituents, but an ample data regarding other *Salvia* species [3-5] is available which indicates that they are used as a remedy for snake bite, cold, fever, liver, kidney troubles and in epilepsy. The members of this family are well known flavouring agents in beverages and culinary, possess antiseptic and astringent activity which can be attributed to the presence of essential oils. Therefore, they are used in many preparations meant for healing lesions, mouth washes, gargling agents, tooth pastes, snuffs and in toilet preparations [2]. Phytochemical screening of this family indicates the presence of sterols, diterpenes, triterpenes, cumarins, hydrocarbons and essential oils. Presence of these constitutents has been indicated in *Salvia splendens* [6-8].

Keeping in mind the diversity of uses and medicinal applications related to this family, *S. splendens* being so far less exploited was taken to evaluate its different parameters. Considering the folk-lore reputation of *Salvia* species as antiseptics and astringent, it was thought worthwhile to evaluate this plant for its antibacterial activity.

Materials and Methods

Preparation of samples. Seeds of *S. splendens* were obtained from local market and were cultivated under observation. After six months fully grown, matured flowering plants were removed from their beds, washed, dried and cut into three different parts i.e. aerial parts (leaves, twigs and branches), flowers and roots. Weighed amount (500 g) of all the three parts were soaked separately in alcohol, acetone and water (1.7 litres each), for five days with continuous agitation. Solvents were decanted and then concentrated under reduced pressure at room temperature to have semi-solid mass.

Antibacterial activity. All 27 microbial strains, 13 gram positive (Table 1) and 14 gram negative (Table 2) were obtained from Microbiology Department, University of Karachi. Inocula were prepared by using 24 hours old broth culture. Antimicrobial activity was evaluated by agar cup plate method [9]. Sterile petri dishes of 60 mm diameter were taken, 15 ml molten sterile nutrient agar was poured in each petri dish aseptically and was allowed to solidify. Then by means of a sterile cork borer a cavity of 6 mm diameter was made in the centre of each plate. Plates were then swabbed with 20 hours old broth culture. Cavities were then filled with extract solutions having strength of 4 mg/ml. Each cavity received 0.25 ml or 1 mg of test material. Simultaneously a control was also run using nitrofurazone, an antimicrobial agent [10,11]. Each cavity contained 1 mg of control material i.e. nitrofurazone. Test and control were run in triplicates. Plates were then incubated at 37° for 24 hours and then the zone of inhibitions were measured in mm. All the above mentioned experiments were repeated thrice in each case to confirm the results.

Results and Discussion

The aqueous, alcoholic and acetone extracts of *Salvia splendens* (aerial parts, flowers and roots) showed varied degree of antibacterial activity against a wide range of gram positive any gram negative organisms as shown in Table 1 and 2 respectively. The aqueous extract was found to have very little activity while the activity was much more enhanced/ pronounced in alcoholic and acetone extracts. The roots were found to have maximum activity.

The results shown in Table 1 and 2 revealed that the plant is more active against gram negative group of organism. Furthermore, it was also assessed that aqueous extract of the

plant exhibited less activity in both gram positive and gram negative groups as compared to alcoholic and acetone extracts.

The aqueous extract of aerial part of *S. splendens* was found to be totally inactive against all the gram positive organisms, flowery portion was found to inhibit the growth of *Streptococcus faecalis* and that too in "E" category while the aqueous extract of roots was found to be effective against *Corynebacterium xerosis*, "E", *Streptococcus lactis* 'B" and *Streptococcus viridans* "C" categories respectively.

In gram negative group, aerial part was found to be active only against *Salmonella para typhi A* in "E" category, flowers against *E. coli* and *Salmonella para typhi* "E" and roots against *Branhamella catarrahalis* and *Aeromonas* species "F", *E. coli* and *Salmonella typhi A* in "E" categories respectively.

Salmonella para typhi A was the only organism which was found to be active against the aqueous extracts of all the three parts (aerial parts, flowers and roots) (Table 2).

Aerial part was found to be active against *Citrobacter freundii* "B", *Corynebacterium xerosis* and *Staphylococcus citreus* in "D" category. Flowery part was found to be active

TABLE 1. ANTIMICROBIAL ACTIVITY OF *SALVIA SPLENDENS* AGAINST GRAM POSITIVE ORGANISM/BACTERIA.

Sr. No.	Name of organisms	Water			Alcohol			Acetone			Nitro-furazone
		A.Part	Flowers	Roots	A.Part	Flowers	Roots	A.Part	Flowers	Roots	
1	*Bacillus subtilis*	—	—	—	—	E	D	—	E	E	E
2	*Citrobacter freundii*	—	—	—	E	—	D	D	—	D	E
3	*Corynebacterium diphtheriae*	—	—	—	—	—	C	D	D	—	E
4	*Corynebacterium hofmannii*	—	—	—	—	E	D	E	D	C	E
5	*Corynebacterium xerosis*	—	—	E	D	—	D	E	—	C	E
6	*Klebsiella pneumoniae*	—	—	—	—	—	—	—	—	—	E
7	*Micrococcus lysodecticus*	—	—	—	—	E	—	—	E	—	E
8	Staphylococcus *aureus*	—	—	—	—	E	D	—	E	D	E
9	*Staphylococcus citreus*	—	—	—	D	D	C	A	A	A	E
10	*Staphylococcus epidermidas*	—	—	—	—	—	—	D	—	E	E
11	*Streptococcus faecalis*	—	E	—	—	E	E	—	E	E	E
12	*Streptococcus lactis*	—	—	B	—	—	D	—	E	C	E
13	*Streptococcus viridans*	—	—	E	—	—	E	E	E	E	E

Categorization of zone of inhibition 50—59 mm = A, 40—49 mm = B, 30—39 mm = C, 20—29 mm = D, 10—19 mm = E, Below 9mm = F

TABLE 2. ANTIMICROBIAL ACTIVITY OF *SALVIA SPLENDENS* AGAINST GRAM NEGATIVE ORGANISMS.

Sr. No.	Name of organisms	Water			Alcohol			Acetone			Nitro-furazone
		A.Part	Flowers	Roots	A.Part	Flowers	Roots	A.Part	Flowers	Roots	
1	*Aeromonas* species	—	—	F	E	C	B	E	B	A	E
2	*Branhamella catarrhalis*	—	—	F	—	E	D	—	E	E	E
3	*Enterobacter aerogenes*	—	—	—	—	—	—	—	—	—	E
4	*Escherichia coli*	—	E	E	D	E	B	C	D	A	E
5	*Proteus mirabilis*	—	—	—	—	—	E	—	E	E	E
6	*Proteus vulgaris*	—	—	—	—	—	D	E	—	E	E
7	*Pseudomonas aeroginosa*	—	—	—	E	—	E	—	E	E	E
8	*Salmonella typhi*	—	—	—	E	—	E	—	—	C	E
9	*Salmonella para typhi A*	D	E	E	E	D	D	A	A	A	E
10	*Salmonella para typhi B*	—	—	—	—	—	C	—	D	D	E
11	*Serratia species*	—	—	—	C	—	C	D	C	B	E
12	*Shigella dysenteriae*	—	—	—	C	E	D	C	—	B	E
13	*Shigella sonnei*	—	—	—	—	D	—	—	—	—	E
14	*Yersinia pseudotuberculosis*	—	—	—	D	B	E	C	D	B	E

Categorization of zone of inhibition, 50—59 mm = A, 40—49 mm = B, 30—39 mm = C, 20—29 mm = D, 10—19 mm = E, Below 9mm = F.

against 6 organisms, mostly in "E" category while roots were found to be active against 10 out of 13 gram positive organism (Table 1). Whereas in case of gram negative group aerial part was found to be active against 8 organisms, flowers against 7, in which *Yersinia pseudotuberculosis* was the only organism which exhibited "B" category zone. In case of roots, "B" category was exhibited by *Aeromonas* species and *E. coli*, whereas no activity was exhibited by *Enterobacter aerogenes* and *Shigella soonei*.

Acetone extract of aerial part was found to be active against 7 organisms, flowers against 9, and roots against 10 gram positive organisms. *Staphylococcus citreus* was the only organism which exhibited "A" category zone. In case of gram negative group, aerial part was found to be active against 7 organisms, flowers against 9 and roots against 12 organisms out of 14 gram negative organisms. Here again *S. para typhi A* was found to exhibit "A" category zones in all parts.

Klebsiella pneumoniae was the only gram positive organism which failed to exhibit antibacterial activity in any part and in any solvent. Flowers of *S. splendens* in both alcohol and acetone were able to inhibit the growth of *M. lysodecticus*. On the other hand nitrofurazone, a well known antibacterial agent was able to inhibit 100% growth of both groups i.e. gram positive and gram negative. All the parts of *S. splendens* in all the solvents were found to inhibit the growth of *S. para typhi A* as shown in Table 2, whereas only alcoholic part (flowers) were able to inhibit the growth of *S. sonnei*.

From the data recorded in Table 1 and 2 it is evident that antibacterial activity is solvent dependent. Aqueous part was found to be least active, alcoholic part moderately active and maximum activity was exhibited by acetone part in both the groups. Furthermore root portion was found to be more potent as compared to other parts in all solvents. From the above observations, it can be safely concluded that *S. splendens*, like other members of Labiateae, possesses antibacterial activity.

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