Biological Sciences Section

Pakistan J. Sci. Ind. Res., Vol. 30, No. 8, August 1987

ANTIMICROBIAL ACTIVITY OF ESSENTIAL OILS OF UMBELLIFERAE FAMILY

Part VI. *Stewartiella baluchistanica, Psammogeton canescens* and *Ducrosia anethifolia*

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(Received June 2, 1987)

The essential oils of *Stewartiella baluchistanica, Psammogeton canescens,* and *Ducrosia anethifolia* were studied for their inhibitory activity against *Staphgloccus aureus , E.coli, Salmonella typhi, Shigella dysentery,* and *Vibrio cholera* in emulsified broth by spectrophotometric method. All the oils showed inhibitory effect but the oil of *P. canescens* was found to be the most effective.

Key words: Stewartiella baluchistanica, Psammogeton canescens, Ducrosia anethifolia.

INTRODUCTION

In continuation of our studies of the antimicrobial activity of the essential oils of N.O. Umbelliferae [1], we report here the results of three more species, namely *Stewartiella baluchistanica, Psammogeton canescens,* and *Ducrosia anethifolia*. The chemical analysis of these species has been reported previously [2-4].

The genus *Stewartiella* comprises only one species, i.e. *Stewartiella baluchistanica,* which is endemic to the Baluchistan region. Bhatty *et. al.* [2] were the first to determine the chemical and physical properties of its essential oil and the first ever antimicrobial properties of this oil are being reported in this paper. *P. canescens* (*Khushbue*) is one of the seven species of the genus *Psammogeton* found in the deserts of Iran, Central Asia, Afghanistan, Pakistan and India. The oil of this high yielding plant has a very pleasant fruity smell and its composition was also reported by Bhatty and co-workers [3] for the first time.

The third genus, *Ducrosia* comprises only 5-6 species. *Ducrosia anethifolia* (*gwartkh*) grows wild in the NWFP and Baluchistan and is now being successfully cultivated in Quetta, Murree and Lahore. The major constituent of this oil is chrysanthenyl acetate [4], quite uncommon in the Umbelliferae family. The oil has been reported to be active only against gram-positive bacteria [5,6]. The activity of the essential oils of these species against grampositive, as well as gram-negative bacteria, viz. *S. aureus , E. coli, S. typhi, S. dysentery,* and *Vibrio cholera* is being reported in the paper.

MATERIAL AND METHOD

Materials.

1. *Cultures.* Pure standard cultures of *S.aureus ATCC 6538-P, E. coli-M/200, S. typhi, S. dysentery,* and *V. cholera* were provided by the National Institute of Health, Islamabad, and the Drug Testing Laboratories, Lahore.

2. *Media.* Merck's agar medium was used for stock culture slants, and Oxoid's Antibiotic Medium No. 3 was used for liquid broth.

3. *Essential oils.* The essential oils from the stalks and leaves of *S. baluchistanica* and from the seeds of *P. canescens* and *D. anethifolia* were obtained by steam distillation.

Preparation of media and inoculum.

The method for the preparation of media and inoculum has been reported earlier [1]. The tubes were incubated for 20 hr. at 35^{o} and the optical density taken as index of bacterial growth, was measured at 530 nm on Hitachi Model 100-20 UV-Vis., spectrophotometer, and was plotted against quantity of essential oil in ppm.

RESULTS AND DISCUSSIONS

The optical density of growth medium against the quantity of essential oil used in ppm. has been shown in Tables 1-5 and Fig. 1-5. The concentration of oil that caused an eightfold inhibition of growth of the bacteria was taken as its Minimum Inhibitory Concentration (MIC). The bacterium-wise results are presented below.

1. *S. aureus . S. baluchistanica* actively inhibited *S. aureus* at 400 ppm. (Table 1, Fig. 1). This activity was

Table 1. Activity of essential oils against *S. aureus*.

Amount of oil (ppm.)	Optical density (mean)*		
	S.baluchistanica	*P. canescens*	*D. anethifolia*
0	440	446	487
400	66	26	179
800	46	0	15
1200	32	0	0
1600	18	0	0
2000	12	0	0
2400	7	0	0

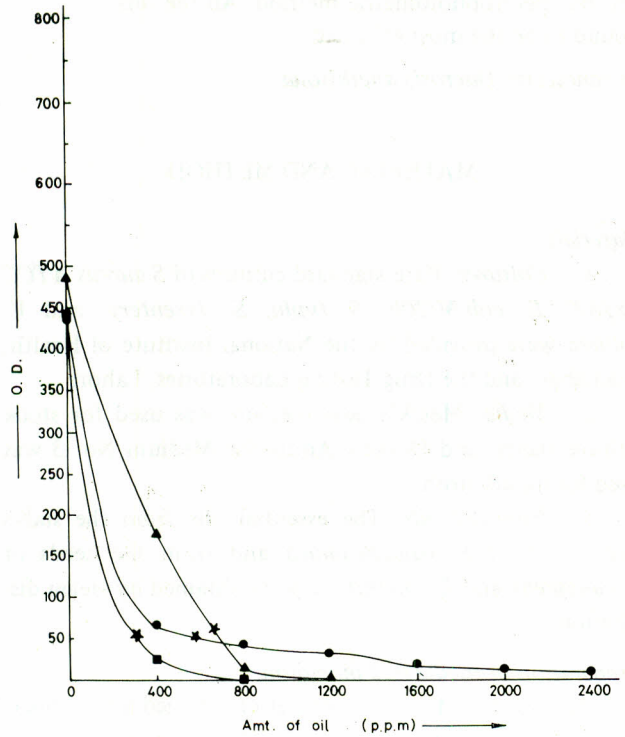

Fig. 1. Antimicrobial activity of the essential oils of –●– *Stewertiella baluchistanica* –■– *Psammogeton canescens;* –▲– *Ducrosia anethifolia*, against *Staph. aureaus.* ★MIC.

greater than that of *Coriandrum sativum* [1] and less than that of *Cuminum cyminum* [1]. Its MIC was 600 ppm where as *Psammogeton canescens* was equal to *Cuminum cyminum* [1], both in activity and MIC, i.e. 300 ppm. *Ducrosia anethifolia* had a dose-dependent inhibition against *S. aureus.* At about 300 ppm it caused twofold inhibition of the organism, whereas at 800 ppm there was complete inhibition. Its MIC was about 650 ppm and it resembled *F. vulgare* [1] in activity.

2. *E. coli. S. baluchistanica* at 400 ppm showed a 25% inhibition of *E. coli.* However at 800 ppm nearly 75 % inhibition was achieved, with a 90 % inhibition at 1200 ppm. The activity increased further with increase in the concentration. The MIC level was nearly 1000 ppm (Table 2, Fig. 2). This activity was greater than that of *Coriandrum sativum* [1]. The oil of *P. canescens* also caused a rapid inhibition against this organism i.e. more than 90 % inhibition at 400 ppm. Its MIC was about 350 ppm. The activity of this oil against this urinary tract infectious bacterium was far more than the activity of other oils reported previously [1,7-9], with the exception of *C. cyminum* [1] and *Trachyspermum* ammi [7], which had

Table 2. Activity of essential oils against *E. coli*.

Amount of oil (ppm.)	Optical density (mean)*		
	S.baluchistanica	*P. canescens*	*D. anethifolia*
0	402	439	460
400	304	39	304
800	116	11	218
1200	42	0	133
1600	18	0	104
2000	5	0	79
2400	2	0	42

* Average of four readings.

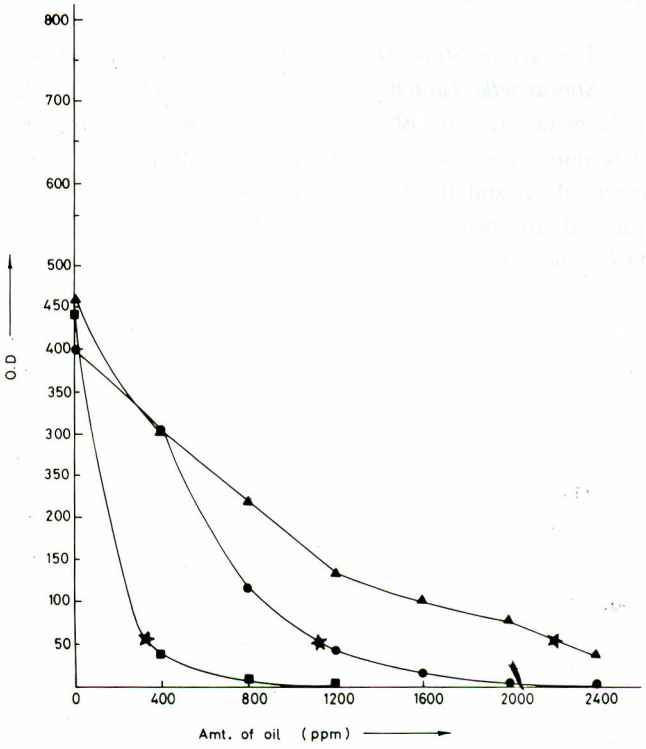

Fig. 2. Antimicicrobial activity of the essential oil of –●– *Sterwartiella baluchistanica;* –■–*Psammogeton canescens,* –▲– *Ducrosia anethifolia*; against *E. coli.* ★MIC.

greater activities. *D. anethifolia* showed a linear rate of inhibition. Its activity resembled that of *B. persicum* [1]. The MIC of this oil against *E. coli* was 2200 ppm. which was close to that of *Anethum graveolens* [7].

3. *Salmonella typhi.* Like *Apium graveolens* [7], the oil of *S. baluchistanica* showed a dose -dependant linear rate of inhibition (Table 3, Fig. 3). About 50 % inhibition occurred at 1200 ppm. The activity then increased rapidly and about 94 % inhibition was achieved at 1600 ppm with an MIC of 1550 ppm. Both *P. canescens,* and *B. persicum* [1] were equally active against this human pathogen. Both caused 50 % inhibition at 400 ppm, and about 94 % inhibition at 800 ppm, with an MIC of 700 ppm. *Ducrosia anethifolia* had a linear rate of inhibition. 400 ppm of this oil caused a 25 % inhibition. A 50 % inhibition was observed at 1200 ppm and about 95 % inhibition at 2400 ppm. The MIC was 2200 ppm. The activity of this oil, against this organism, was more than that of *A. graveolens* [7].

4. *Shigella dysentery.* Against *S. dysentery,* the oil of *S. baluchistanica* resembled *D. carota* [7] in activity. At 1900 ppm., a 50 % inhibition was achieved and increased upto 85 % at 2400 ppm. (Table 4, Fig. 4). Although *P. canescens* was not much effective at 400 ppm, yet at 800

Table 3. Activity of essential oils against *S. typhi*

Amount of oil in ppm.	Optical Density (mean)*		
	S.baluchistanica	*P. canescens*	*D. anethifolia*
0	419	440	483
400	325	227	395
800	278	36	306
1200	201	12	227
1600	36	0	168
2000	29	0	93
2400	13	0	32

Table 4. Activity of essential oils against *S. dysentery.*

Amount of oil (ppm.)	Optical density (mean)*		
	S.baluchistanica	*P. canescens*	*D. anethifolia*
0	592	678	626
400	516	585	405
800	465	224	37
1200	408	17	0
1600	365	5	0
2000	279	0	0
2400	118	0	0

* Average of four readings.

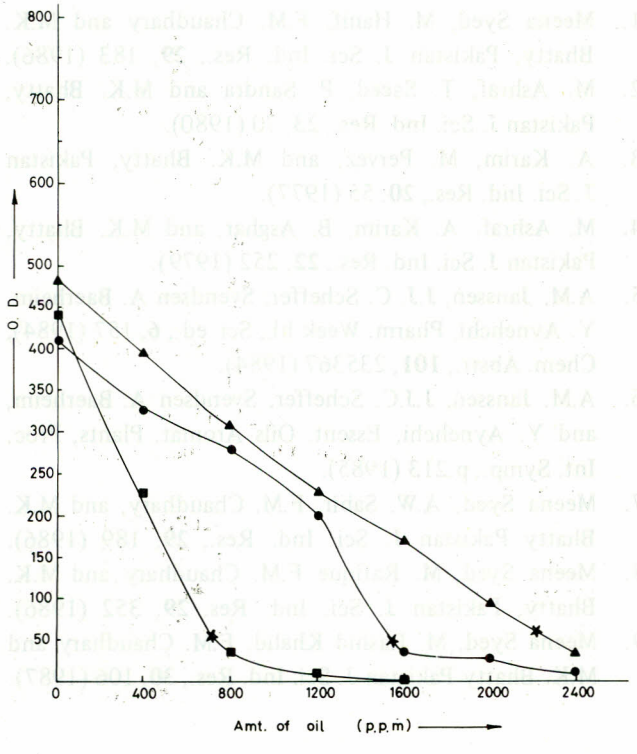

Fig. 3. Antimicrobial activity of the essential oils of —●— *Stewartiella baluchistanica;* —■— *Psammogeton canescens* —▲— *Ducrosia anethifolia;* against *Salmonella typhi.* ★MIC.

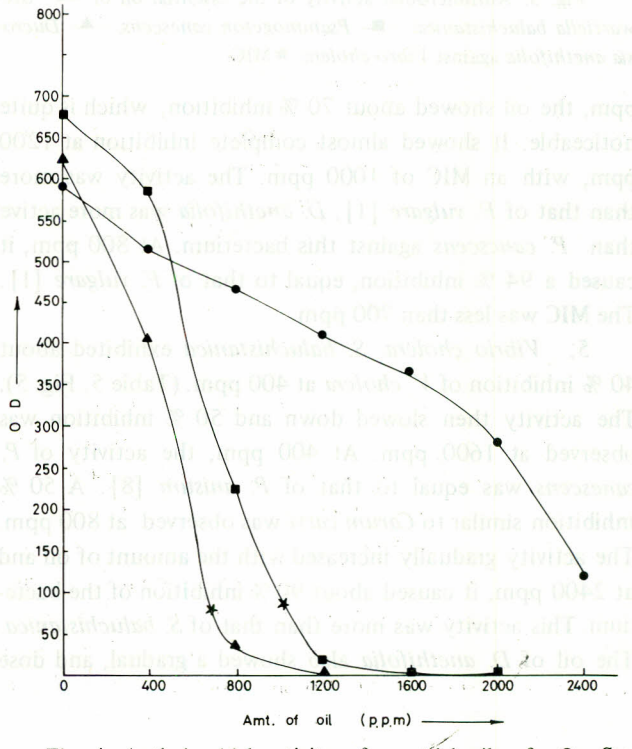

Fig. 4. Antimicrobial activity of essential oils of —●— *Stewartiella baluchistanica,* —■— *Psammogeton canescens;* —▲— *Ducrosia anethifolia;* against *Shigella dysentry.* ★MIC.

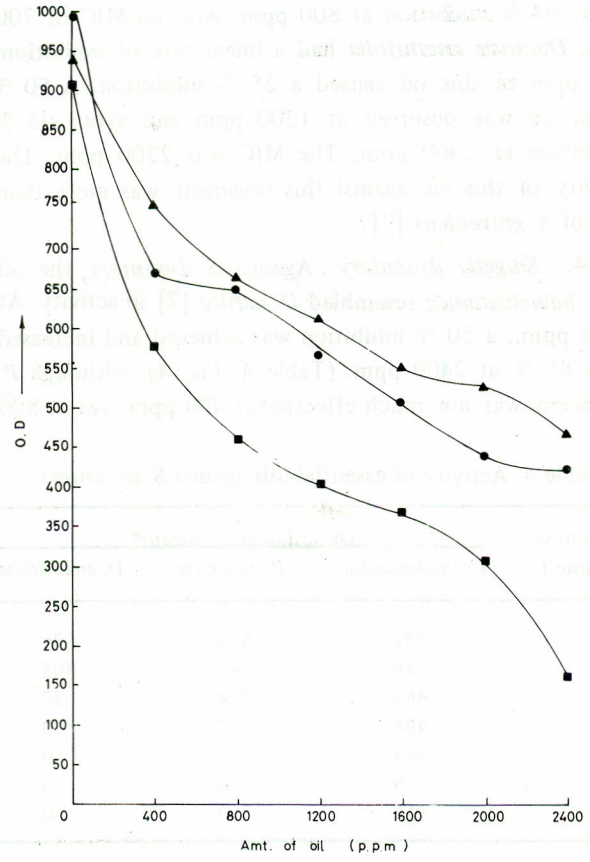

Fig. 5. Antimicrobial activity of the essential oil of —●— *Stewartiella baluchistanica;* —■— *Psammogeton canescens;* —▲— *Ducrosia anethifolia* against *Vibro cholera.* ★MIC.

ppm, the oil showed about 70 % inhibition, which is quite noticeable. It showed almost complete inhibition at 1200 ppm, with an MIC of 1000 ppm. The activity was more than that of *F. vulgare* [1]. *D. anethifolia* was more active than *P. canescens* against this bacterium. At 800 ppm, it caused a 94 % inhibition, equal to that of *F. vulgare* [1]. The MIC was less than 700 ppm.

5. *Vibrio cholera. S. baluchistanica* exhibited about 40 % inhibition of *V. cholera* at 400 ppm. (Table 5, Fig. 5). The activity then slowed down and 50 % inhibition was observed at 1600 ppm. At 400 ppm, the activity of *P. canescens* was equal to that of *P. anisum* [8]. A 50 % inhibition similar to *Carum carvi* was observed at 800 ppm. The activity gradually increased with the amount of oil and at 2400 ppm, it caused about 90 % inhibition of the bacterium. This activity was more than that of *S. baluchistanica.* The oil of *D. anethifolia* also showed a gradual, and dose

Table 5. Activity of essential oils against *V. cholera.*

Amount of oil (ppm.)	Optical density (mean)*		
	S.baluchistanica	*P. canescens*	*D.anethifolia*
0	996	906	938
400	759	576	755
800	647	458	664
1200	565	401	608
1600	506	367	548
2000	437	306	526
2400	421	162	463

* Average of four readings.

dependant activity against this organism. The activity was less than that of *S. baluchistanica.*

It has been observed that all three oils possessed effective inhibitory activity against the studied pathogenic bacteria. Whereas *P. canescens* was the most inhibitory of the three. Quite contrary to the previous observations [5,6] *D. anethifolia* very effectively inhibited gram-negative bacteria as well, especially *S. dysentery.* These results are much more encouraging than the previous reports.

REFERENCES

1. Meena Syed, M. Hanif, F.M. Chaudhary and M.K. Bhatty, Pakistan J. Sci. Ind. Res., **29**, 183 (1986).
2. M. Ashraf, T. Saeed, P. Sandra and M.K. Bhatty, Pakistan J. Sci. Ind. Res., **23**, 70 (1980).
3. A. Karim, M. Pervez, and M.K. Bhatty, Pakistan J. Sci. Ind. Res., **20**, 55 (1977).
4. M. Ashraf, A. Karim, B. Asghar, and M.K. Bhatty, Pakistan J. Sci. Ind. Res., **22**, 252 (1979).
5. A.M. Janssen, J.J. C. Scheffer, Svendsen A. Baerheim, Y. Aynehchi, Pharm. Week bl., Sci. ed., **6**, 157 (1984), Chem. Abstr., **101**, 235367 (1984).
6. A.M. Janssen, J.J.C. Scheffer, Svendsen A. Baerheim, and Y. Aynehchi, Essent. Oils Aromat. Plants, Proc. Int. Symp., p.213 (1985).
7. Meena Syed, A.W. Sabir, F.M. Chaudhary, and M.K. Bhatty Pakistan J. Sci. Ind. Res., **29**, 189 (1986).
8. Meena Syed, M. Rafique F.M. Chaudhary, and M.K. Bhatty, Pakistan J. Sci. Ind. Res. **29**, 352 (1986).
9. Meena Syed, M. Rashid Khalid, F.M. Chaudhary and M.K. Bhatty Pakistan J. Sci. Ind. Res., **30**, 106 (1987).