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ANTIMICROBIAL ACTIVITY OF THE ESSENTIAL OILS OF UMBELLIFERAE FAMILY

Part IV. *Ferula narthex, Ferula ovina* and *Ferula oopoda*

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The essential oils of *Ferula narthex, F. ovina* and *F. oopoda* were tested in liquid media against the standard cultures of *Staph. aureus, Escherichia coli, Salmonella typhi, Shigella dysentery* and *Vibrio cholera.* The optical density taken as an index of growth was measured spectrophotometrically at 530 nm. All oils showed more or less good inhibitory activity, which was, however, different from each other and cannot be referred to as genera related. The oils of *F. narthex* and *F. ovina* were more active against *Staph. aureus*, while the growth of the pathogens of dysentery and cholera was inhibited more by the *F. oopoda* oil.

Key words: Antimicrobial activity, Umbelliferae, *Ferula.*

INTRODUCTION

Kaminski *et al* [1] investigated the chemical composition of some 171 species of N.O. Umbelliferae and out of these, 156 were found to contain coumarins. More than three coumarins were detected in 90 species. Many species in the genus *Ferula* contain coumarin like juniferin, epoxyjuniferin, ferocinin, xeroferol, fexerin [2], lehmferidin and lehmferin [3]. However, the presence of coumarins is not genera related [1]. Similar is the case as regards the antimicrobial activity of these plants. *F. foetidissima,* tested by Alimbaeva and coworkers [4], has been found to contain the highest content of physiologically active substances, whereas *F. jaeschkeana*, when tested against some dermatoohytes like *Nannizzia fulva, N. gypsea* and *N. incurvata,* did not show any inhibitory activity [5]. *F. assafoetida* which contains some sulphur compounds [6] in its essential oil can be used as a medicine, and *F. narthex* is reported to be both a bacteriocidal as well as bacteriostatic agent [7]. *F. narthex* contains 13 % coumarins and tarry materials in its oil [8]. The extracts of some *Ferula* roots contain galbanic acid and its derivatives, which have antibiotic activity [9].

While investigating different species of Umbelliferae family these authors came across some species belonging to the same genera like *Pimpinella* [10] and *Ferula.* It was an interesting proposition to observe whether the antibiotic activity of these plants was related to their genera. The chemistry of these genera has already been reported [8].

We investigated three species of the genus *Ferula,* namely, *F. narthex, F. ovina*, and *F. oopoda* against five pathogenic gram positive and gram negative bacteria, *viz., Staph, aureus, E. coli, Salmonella typhi, Shigella dysentery* and *Vibrio cholera* by the spectrophotometric method.

MATERIALS AND METHOD

Material

1. *Cultures:* The standard strains of American type culture collection of *Staph. aureus 6538-P, E. coli M/200 S. typhi, S. dysentery* and *V. cholera* were obtained from the National Institute of Health, Islamabad and the Drug Testing Laboratories, Lahore.
2. *Media:* Merck's agar medium for stock culture slants and Oxoid Antibiotic Medium No. 3 (liquid broth) were utilized.
3. *Essential oils:* The essential oils of the seeds of *F. narthex, F. ovina,* and *F. oopoda* were obtained by steam distillation.

Preparation of media and inoculum.

The procedure for the preparation of media and inoculum, as already reported in Part I of these series [11] was followed. After incubation of the tubes for 20 hr at 35°, the absorbence was measured at 530 nm using Hitachi Model 100-20, UV-Vis spectrophotometer. The optical density was taken as an index of bacterial growth.

RESULTS AND DISCUSSION

The means of optical density are shown in Tables 1-5 and Figs. 1-5. The concentration of oil which causes an eightfold inhibition of the growth of an organism is taken as its Minimum Inhibitory Concentration (MIC). Following are the bacterium wise results.

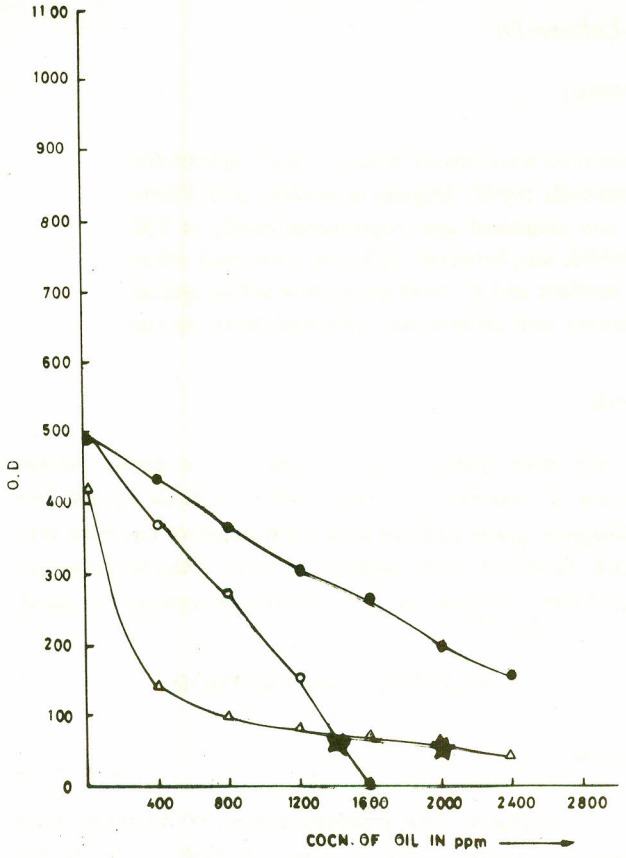

Fig. 1. Activity of –△– *Ferula narthex;* –○– *Ferula ovina;* –●– *Ferula oopoda;* against *Staphylococcusaureus.* MIC ★

1. *Stap. aureus. F. narthex* effectively inhibits *Staph. aureus.* At 400 ppm it shows about threefold inhibition (Table 1, Fig. 1) and slowly reaches the MIC level at 2000 ppm. Its activity is less than that of *Cuminum cyminum, Coriandrum sativum* [11], *Trachyspermum ammi* and *Daucus carota* [12], but more than that of *Pimpinella anisum, P. acuminata* and *P.stewartii.* [10] *F. ovina* shows a linear rate of inhibition against this organism. Initially its activity is slower than that of *F. narthex.* At 1200 ppm concentration, its activity equals that of 400 ppm of *F. narthex.* However, its MIC (1400 ppm) is lower than that of *F. narthex.* The oil of *F. oopoda* also shows a linear rate of inhibition against *Staph. aureus,* but its activity is less than that of *F.ovina* and *F.narthex.*

2. *E. coli. F. narthex* shows a twofold inhibition at 400 ppm and fourfold inhibition at 700 ppm. The activity then becomes more or less static (Table 2, Fig. 2) slowly reaching MIC level at 2400 ppm. Initially its activity is greater than that of *Coriandrum sativum* [11]. *F.ovina* also has good inhibitory effect against *E.coli.* It is better than that of *Bunium persicum* [11]. Initially its activity is slower than that of *F.narthex.* Its MIC is 1800 ppm which is nearly equal to that of *B.persicum* [11], but less than that of *F.narthex.* The activity of *F.oopoda* against *E.coli* is very similar to its activity against *Staph. aureus,* but the former is slightly lesser. At 1600 ppm its activity is the same against both the organisms, but at 2000 ppm. *Staph. aureus* are killed faster than *E.coli* by the oil of *F.oopoda.*

3. *S. typhi. F.narthex* shows a twofold inhibition of *S.typhi* at 600 ppm and a fourfold inhibition at 1000 ppm. after which the activity slows down reaching an MIC level at 2400 ppm. The activity is greater than that of

Table 1. Antimicrobial activity against *Staph. aureus.*

Amount of essential oil (ppm.)	Optical density (mean)		
	F. narthex	*F. ovina*	*F. oopoda*
0	421	496	498
400	146	422	433
800	96	276	365
1200	82	156	305
1600	71	4	267
2000	61	0	204
2400	46	0	155

Table 2. Antimicrobial activity against *E. coli.*

Amount of essential oil (ppm.)	Optical density (mean)		
	F. narthex	*F.ovina*	*F.oopoda*
0	407	417	488
400	200	271	426
800	84	126	367
1200	76	88	302
1600	72	56	281
2000	65	38	243
2400	52	23	201

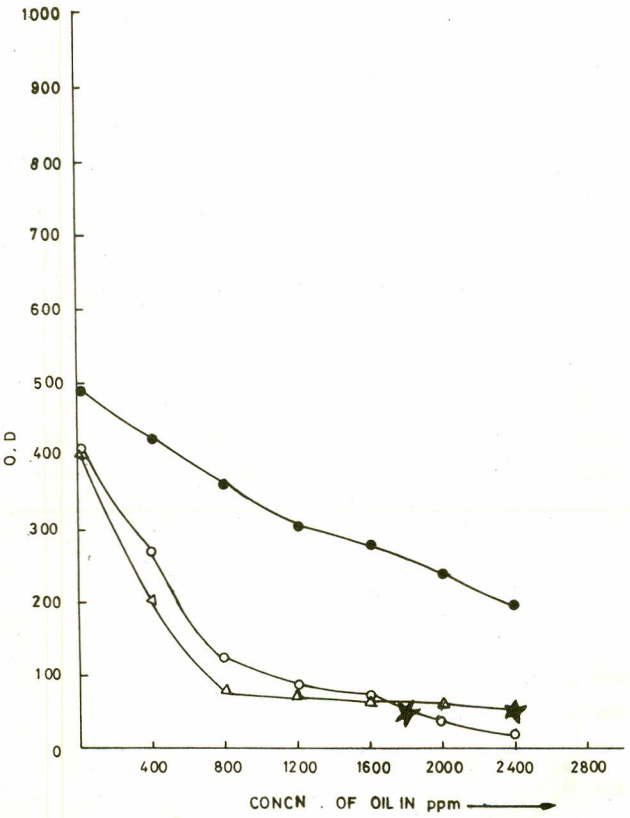

Fig. 2. Activity of –△– *Ferula narthex;* –○– *Ferula ovina;* –●– *Ferula oopoda;* against *Escherichia coli.* MIC ★

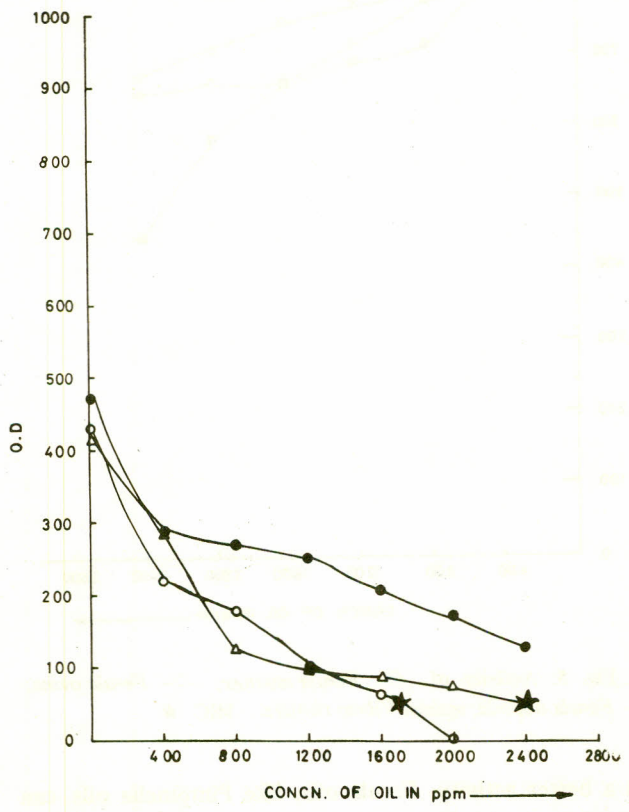

Fig. 3. Activity of –△– *Ferula narthex;* –○– *Ferula ovina;* –●– *Ferula oopoda;* against *Salmonella-typhi.* MIC ★

Table 3. Antimicrobial activity against *S. typhi.*

Amount of essential oil (ppm)	Optical density (mean)		
	F. narthex	*F.ovina*	*F.oopoda*
0	418	442	475
400	281	223	291
800	123	178	272
1200	101	102	254
1600	89	63	210
2000	71	0	170
2400	51	0	131

Daucus carota [12]. *F. ovina* is faster in its activity against this pathogen showing a twofold inhibition at 400 ppm.

At 1200 ppm the activities of both *F.narthex* and *F.ovina* are equal against this organism. (Table 3, Fig. 3). But the MIC level of *F.ovina* is lower, i.e. 1700 ppm. The activity of *F.oopoda* is equal to that of *F.narthex* at 400 ppm, but afterwards *F.oopoda* slows down in its activity showing a twofold inhibition at 1400 ppm and about fourfold inhibition at 2400 ppm.

4. *S. dysentery. F. narthex* shows an effective linear activity against this rapidly growing organism (Table 4, Fig. 4) showing a twofold inhibition at 1600 ppm which gradually increases. *F.ovina* is more inhibitory than *F. narthex* against this organism. At 1200 ppm it shows more inhibition than *F.narthex.* The inhibition rate increases rapidly reaching MIC level at 2000 ppm, which is simillar to *P. anisum* [10]. Unlike its activity against the other three pathogens, *F. oopoda,* is the most active oil against. *S. dysentery* up to a concentration of 1600 ppm. Thereafter its activity becomes slower than that of *F. ovina* and nearly reaches the MIC level at 2400 ppm. Against *V. cholera* the activity of all *Ferula* spp. is better than *P. acuminata,* but less than that of *P. anisum* and *P. stewartii* [10].

5. *V. cholera. V. cholera* is a rapidly growing micro-organism (Table 5, Fig. 5). *F. narthex* shows a linear rate of inhibition upto the concentration of 1600 ppm; the activity then becomes static. *F. ovina* also shows gradual inhibitory activity, while *F. oopoda* again shows highest activity. It shows a twofold inhibition at 2400 ppm.

All three species of *Ferula* have either lactones or coumarins in their essential oils. They show more or less good efficacy against both gram positive and gram negative baceria. They tend to show a linear rate of inhibition against these pathogens. But their activity does not seem

Table 4. Antimicrobial activity against *S. dysentery.*

Amount of essential oil (ppm.)	Optical density (mean)		
	F.narthex	*F. ovina*	*F.oopoda*
0	688	688	684
400	625	592	505
800	519	398	451
1200	435	347	206
1600	354	327	196
2000	279	79	148
2400	145	22	96

Table 5. Antimicrobial activity against *V. cholera.*

Amount of essential oil (ppm.)	Optical density (mean)		
	F. narthex	*F. ovina*	*F. oopoda*
0	903	916	938
400	836	821	848
800	784	810	716
1200	729	782	696
1600	677	751	669
2000	673	708	591
2400	654	680	453

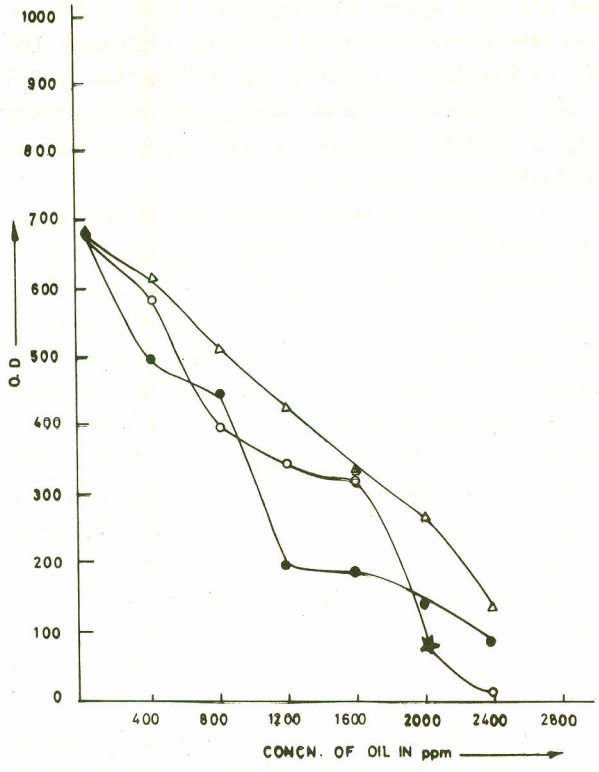

Fig. 4. Activity of –△– *Ferula narthex;* –○– *Ferula ovina;* –●– *Ferula oopoda;* against *Shigella dysentry.* MIC ★

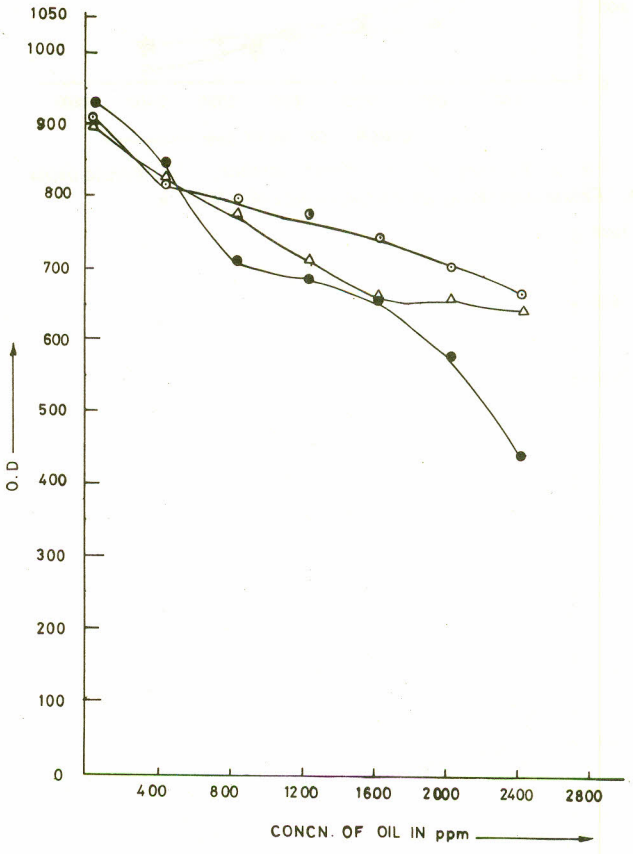

Fig. 5. Activity of –△– *Ferula narthex;* –○– *Ferula ovina;* –●– *Ferula oopoda;* against *Vibrio cholera.* MIC ★

to be genera related as each oil shows different types of activity against each bacterium. The MIC of these oil is also different from each other. The activity of genus *Ferula* as a whole is better than the activity of the genus Pimpinella [10] against *Staph. aureus* and *E. coli,* but against shigella, salmonella, and cholera organisms, *P. anisum* has a better activity. Ferula oils, like Pimpinella oils, can be used as a substitute or as an aid to the existing antibiotics.

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