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PRELIMINARY RESEARCH ON AN ASSESSMENT OF THE EFFECT OF MINT AND EUCALYPTUS OIL ON SELECTED PLANT PATHOGENIC FUNGI

WSTĘPNE BADANIA NAD OCENĄ ODDZIAŁYWANIA OLEJKU MIĘTOWEGO I EUKALIPTUSOWEGO NA WYBRANE GRZYBY CHOROBOTWÓRCZE ROŚLIN

Abstract: The research compared the effect of peppermint oil (*Mentha x piperita* L. var. *Officinalis*) and Tasmanian blue gum (*Eucalyptus globulus* Labill.) oil and their doses on linear growth, biomass and sporulation of *Fusarium culmorum* (W.G.Sm.) Sacc., *F. solani var. coeruleum* (Sacc.) Booth and *Sclerotinia sclerotiorum* (Lib.) de Bary Schlecht. The research has shown that the fungistatic activity of ethereal oils under conditions *in vitro* depends on the kind of plant oil, its dose and fungus species. Among the tested pathogenic microorganisms, *Sclerotinia sclerotiorum* fungus is more sensitive to the presence of mint and eucalyptus oil. On the other hand, higher oil doses (0.8 and 1.0 mm/cm^3) reveal a better fungistatic effect on *Fusarium* fungi.

Keywords: plant oils, phytopathogenic fungi, laboratory tests

The harmful impact of synthetic pesticides on the environment has evoked an interest in seeking plant protection materials of natural origin based on microorganisms and compounds isolated from plants [1–3]. Application of preparations based on natural compounds allows for elimination or reduction of the use of plant protection chemicals, improvement of the quality of plant materials used for organic food production, protection of the environment owing to their weaker effect and easier biodegradation [4]. Currently, several plant preparations have been registered and attempts are made to extend the assortment of these substances. Various plant species are potential sources of natural compounds revealing fungistatic properties [5]. Compounds with an antibacterial and antifungal character comprise glycosides, alkaloids, phenols, saponines and essential oils [5, 6]. According to Łakota et al [5] the number and quality of these

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compounds in plants depend on many factors: plant species, its development stage, weather and soil conditions.

Some authors [7–9] think that extracts from oil-bearing plants show bactericidal and fungicidal properties. These plants include among others: peppermint (*Mentha* x *piperita* L. var. *officinalis*) and Tasmanian blue gum (*Eucalyptus globulus* Labill.). These plants produce ethereal oils which are used by pharmaceutical industry [9, 10]. According to Ożarowski and Jaroniowski [11] an essential oil, in which menthol dominates, is the basic component of peppermint. Besides, mint raw material contains also tannins, flavonoids, phenol acids and mineral salts. The chemical composition of Tasmanian blue gum aromatic oil is similar to oils from myrtle family plants [10]. According to Strzelecka and Kowalski [12] eucalyptus oil contains mainly cineole (ca 80–90 %) and also cymene, pinene, limonene, camphene and geraniol.

There are few publications [8, 13, 14] which point to potential use of antibacterial properties of ethereal oils obtained from aromatic plants (oregano, thyme, rosemary, coriander, dill or others) for plant pathogenic bacteria and fungi control.

The research aimed at comparing, in laboratory conditions, the effect of peppermint oil (*Mentha* x *piperita* L. var. *officinalis*) and Tasmanian blue gum oil (*Eucalyptus globulus* Labill.), as well as their doses on linear growth, biomass and sporulation of *Fusarium culmorum* (W.G.Sm.) Sacc., *F. solani var. coeruleum* (Sacc.) Booth and *Sclerotinia sclerotiorum* Schlecht.

Material and methods

Preliminary research on the effect of selected oils on phytopathogenic fungi under conditions *in vitro* were undertaken at our Department of Agricultural Environment Protection. The experiment used essential oils of Dr Beta series, made by Pollena Aroma. Mint oil was obtained from peppermint (*Mentha* x *piperita* L. var. *officinalis*) and the eucalyptus oil from Tasmanian blue gum (*Eucalyptus globulus* Labill.).The method used was described in a paper by Daferer et al [8]. The oils were added into PDA medium in doses of 0.1; 0.25; 0.5; 0.8 and 1.0 mm^3. Petri dishes with pure PDA medium were the control. The prepared media were inoculated with a 5 mm agar ring, overgrown with a two-week old mycelium of *Fusarium culmorum* (W.G.Sm.) Sacc., *F. solani var. coeruleum* (Sacc.) Booth and *Sclerotinia sclerotiorum* (Lib.) Schlecht. Pathogenic microorganisms tested in the experiment originated from the own collection of the Department of Agricultural Environment Protection. The fungi were cultured in a thermostat at 23 $^{o}C \pm 1\ ^{o}C$) in five replications.

Linear growth of the analyzed microorganisms was presented as a difference between fungus growth on the control dishes and on dishes containing media with added plant oils. After three weeks since the experiment outset conidial sporulation of the test fungi was assessed by means of counting the number of macroconidia in Bürker haemocytometer.

The tested fungi biomass was grown in 300 dm^3 Erlenmayer flasks on 100 cm^3 of modified medium (without agar) with the use of ethereal oils, the same as in the experiment on fungi linear growth. In the inoculation chamber the fungi inoculum was

added to the medium prepared in flasks. The fungi were cultured for 21 days at room temperature of ca 22 ^{o}C and afterwards the culturing liquid with mycelium was filtered through filter paper. Subsequently the mycelium was dried in a sterile glass at 80 ^{o}C to constant weight.

Results and discussion

The present research revealed stronger activity of peppermint oil in inhibiting linear growth of plant pathogenic fungi than of eucalyptus oil (Fig. 1, 2). A different response of phytopathogenic organisms was observed not only to the kind of plant oil applied but also to its dose in the PDA medium. Authors of other publications are of similar opinion

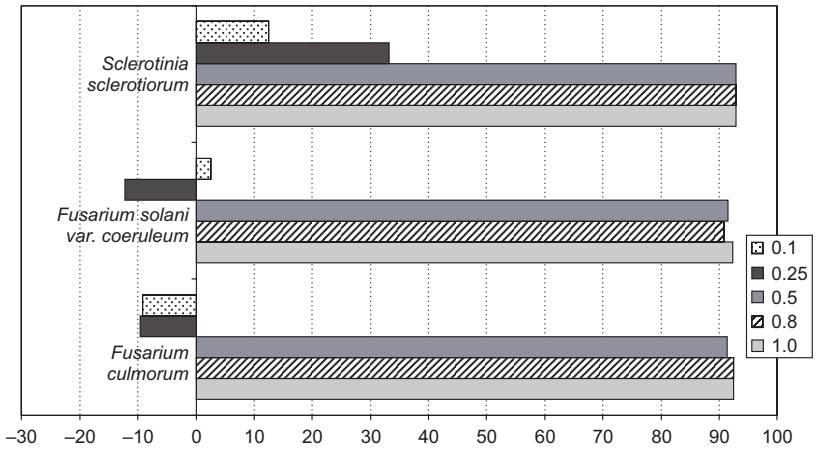

Fig. 1. Effect of mint oil on tested fungi linear growth inhibition [%]

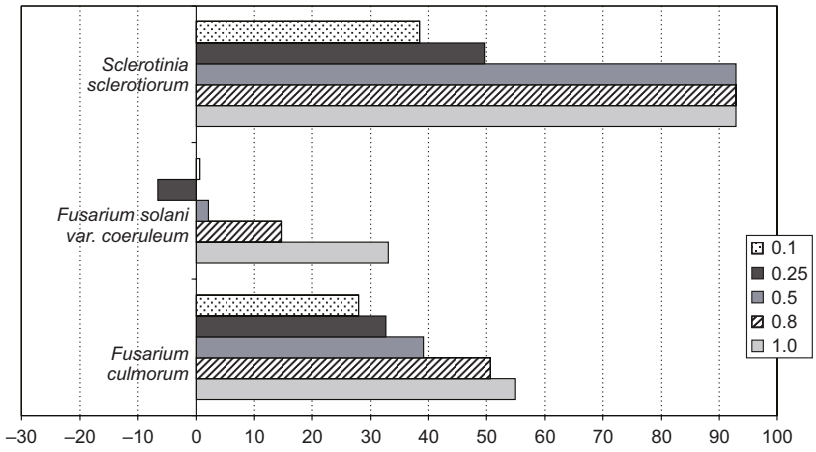

Fig. 2. Effect of eucalyptus oil on tested fungi linear growth inhibition [%]

[8, 14]. Among the tested organisms, *Sclerotinia sclerotiorum* showed greater sensitivity. A supplement of 0.25 cm^3 of mint oil caused a 33 % inhibition of this fungus linear growth. The same dose of eucalyptus oil inhibited the growth of *S. sclerotiorum* in 49 %. The presence of a higher dose (0.5 mm^3/cm^3 PDA) of both analysed oils inhibited the fungus linear growth even in 94 %. Daferera et al [8], who tested essential oils from aromatic plants (oregano, thyme, rosemary and lavender), observed growth inhibition of: *Botritis cinerea* and *Fusarium solani* var. *coeruleum*. On the other hand peppermint oil used in a dose of 0.5 mm^3 revealed stronger fungistatic properties towards *Fusarium* fungi. Introduction of this amount of oil to the medium inhibited *Fusarium culmorum* and *F. solani* var. *coeruleum* growth in 92 %. On the other hand, the fungistatic effect of the eucalyptus oil on *Fusarium* fungi, particularly on *F. solani* var. *coeruleum*, was weak. Diversified results of laboratory experiments obtained are the consequence of the chemical composition of the analysed oils. Other authors [8, 13, 14] are of the same opinion demonstrating that the activity of the isolated oils with respect to micro-organisms is not unanimous.

Biomass and sporulation also depended on the fungus species, plant oil and its dose (Tables 1, 2). Generally, the tested ethereal oils and their doses reduced biomass increments and sporulation of the tested fungi. Among the tested microorganisms the *S. sclerotinium* fungus was more sensitive to the oil presence. Already 0.10 mm^3 of mint and eucalyptus oil supplied to the medium caused inhibition of biomass increment and sporulation of the *S. sclerotiorum* fungus. *Fusarium* fungi and especially *F. solani* var. *coeruleum* revealed smaller sensitivity to the presence of oil in the medium. Reduction of biomass increment and sporulation were observed under the influence of higher

Table 1

Effect of tested ethereal oils on fungi biomass [g]

Oil dose [mm^3/cm^3]	*Fusarium culmorum*	*Fusarium solani*	*Sclerotinia sclerotiorum*
Control	0.266	0.300	0.566
Mint oil			
0.10	0.201	0.456	0.077
0.25	0.204	0.381	0.095
0.50	0.231	0.327	0.112
0.80	0.180	0.300	0.087
1.00	0.186	0.171	0.134
Mean	0.211	0.322	0.178
Eucalyptus oil			
0.10	0.212	0.171	0.074
0.25	0.240	0.313	0.065
0.50	0.183	0.269	0.046
0.80	0.151	0.193	0.084
1.00	0.192	0.158	0.359
Mean	0.207	0.234	0.199

Table 2

Conidial sporulation of fungi under the influence of ethereal oils

Oil dose [mm^3/cm^3]	*Fusarium culmorum*	*Fusarium solani*	*Sclerotinia sclerotiorum*
Control	57.5×10^6	41.2×10^7	39.7×10^7
Mint oil			
0.10	72.5×10^6	27.2×10^7	70×10^6
0.25	32.5×10^6	35.5×10^7	90×10^6
0.50	X	17.5×10^6	45×10^6
0.80	X	X	65×10^6
1.00	X	5×10^6	30×10^6
Eucalyptus oil			
0.10	45×10^6	15.7×10^7	29×10^7
0.25	15×10^6	29.2×10^7	18×10^7
0.50	X	29.7×10^7	14×10^7
0.80	10×10^6	45×10^6	65×10^6
1.00	20×10^6	34.5×10^6	65×10^6

X – no spores.

doses (0.8 and 1.0 mm/cm^3 PDA). A phenomenon of diversified effect of peppermint and Tasmanian blue gum oil on plant pathogenic microorganisms is connected with the specific character of chemical compounds in the composition of these oils, their complex effect and sensitivity of the phytopathogen itself, as reported by Daferera [8] and Lo Cantore et al [14].

Conclusion

The fungistatic activity of essential oils *in vitro* depends on the kind of plant oil, its dose and fungus species. Among the tested pathogenic microorganisms, *Sclerotinia sclerotiorum* fungus proved more sensitive to the presence of mint and eucalyptus oil. On the other hand, higher doses of the oils (0.8 and 1.0 mm/cm^3 PDA) reveal fungistatic properties towards *Fusarium* fungi.

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Abstrakt: Badania laboratoryjne dotyczyły porównania wpływu olejku mięty pieprzowej (*Mentha* x *piperita* L. var. *Officinalis)* i olejku eukaliptusa gałkowego (*Eucalyptus globulus* Labill.) oraz ich dawek na wzrost liniowy, biomasę i zarodnikowanie *Fusarium culmorum* (W.G.Sm.) Sacc., *F. solani var. coeruleum* (Sacc.) Booth*, Sclerotinia sclerotiorum* (Lib.) de Bary. Z badań wynika, że aktywność fungistatyczna olejków eterycznych w warunkach *in vitro* zależy od rodzaju olejku roślinnego, jego dawki i gatunku grzyba. Z testowanych mikroorganizmów chorobotwórczych roślin, grzyb *Sclerotinia sclerotiorum* jest bardziej wrażliwy na obecność olejku miętowego i eukaliptusowego. Natomiast właściwości fungistatyczne w odniesieniu do grzybów z rodzaju *Fusarium* wykazują większe dawki olejków (0,8 i 1,0 mm/cm^3).

Słowa kluczowe: olejki roślinne, grzyby fitopatogenne, testy laboratoryjne