

Study of *Monarda Fistulosa* Essential Oil as a Prospective Antiseborrheic Agent

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Monarda fistulosa essential oil characterized by pronounced therapeutic effects is proposed for the treatment of seborrhea. Studies of its antibacterial, antimycotic, and antiinflammatory activities showed that it inhibits microorganism growth and is superior to hydrocortisone in combination with vitamin B₆ by its antiinflammatory activity.

Key Words: *seborrhea; burdock oil; Monarda essential oil; antimycotic and antibacterial effects; generalized infection*

Seborrhea is a skin disease involving dysfunction of the sebaceous glands in various areas of the skin. It is most incident in young people aged 17-24 years.

The known spectrum of antiseborrheic means does not fully solve the problem of drug therapy for this condition. Many widely used agents contain highly toxic antimycotic synthetic compounds, which can lead to the appearance of various side effects.

Therapeutic and cosmetic preparations based on burdock oil (BO) are widely used for the therapy and prevention of seborrhea. Oil extract of burdock root is characterized by tonic, bactericidal, and antiallergic effects on the skin and hair.

We think that the antimycotic and antibacterial effects of BO should be enhanced by adding essential oil to the preparation for the treatment of seborrhea.

We proposed *Monarda fistulosa* essential oil (MEO) as an essential oil component with pronounced therapeutic effects. The output of *Monarda* essential oils is high (up to 2.4% dry weight). This essential oil is characterized by high antibacterial activity, suppresses the growth of mycoplasma and *Candida* fungi,

and stimulates antibiotic sensitivity of many gram-negative bacteria [1,3].

In contrast to eucalyptus oil, MEO is characterized by pronounced antiinflammatory activity and hyposensitizing effect.

We studied the effects of MEO and lavender essential oil (LEO) as antibacterial (antimycotic) and antiinflammatory agents on the model of a generalized infection in laboratory animals.

MATERIALS AND METHODS

The antibacterial (antimycotic) effect was studied on test cultures of reference strains of microorganisms and fungi recommended by the WHO for testing the sensitivity to antibacterial agents: *Staphylococcus aureus* strain ATCC 25923; *Pseudomonas aeruginosa* strain 27853; *Escherichia coli* strain ATCC 25922; *Proteus vulgaris* strain "H" 4636; *Penicillium* strain 187.

The test microorganisms were cultured in solid nutrient media for 24 h at 37°C, fungi at 22°C. Only cultures with homogenous colonies, typical growth, and specific of the test microorganism reaction to Gram staining were selected for the study. Test bacteria and fungi were cultured in the basic media used for culturing of Clostridia, *Bacillus subtilis*, *Escherichia*

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coli, and *Proteus*; Sabourand's solid nutrient medium for culturing of fungi; "starvation" nutrient media for the lower layer.

Antibacterial activities of MEO and LEO were studied by the agar diffusion test. The bacterial and fungal test cultures were added into nutrient media in accordance with the opacity optical standard (Tarasevich Institute for Standardization and Control). Bacterial concentrations (per ml medium) were specific for each microorganism: 40×10^6 for *Staphylococcus*, 50×10^7 for *P. aeruginosa*, 50×10^7 for *E. coli*, 50×10^7 for *Proteus*, and 50×10^7 for *Penicillium*.

RESULTS

Both MEO and LEO exhibited inhibitory effects of different intensity towards gram-positive and gram-negative microorganisms (Fig. 1).

The inhibitory effect of MEO on microorganism growth was more pronounced than that of LEO. Lavender essential oil virtually did not change the multiplication of *P. aeruginosa*, while MEO sharply inhibited its growth.

Antiinflammatory activity of MEO was studied on 20 mice. A focus of inflammation was created by intracutaneous injection of turpentine solution in mineral oil (0.05 ml); after 24 h, 1% strychnine nitrate solution (0.03 ml) was injected into the resultant necrotic focus with a microsyringe. This dose is undoubtedly lethal for mice, but just few animals die after strychnine injection by this mode, because the inflammation roll prevents toxin penetration into the blood. If the anti-inflammatory drug is effective, this barrier function is violated and the animals die.

All animals were divided into 4 groups: 2 control and 2 experimental ones, 5 per group. Animals of groups 1 and 2 were intramuscularly injected (every 48 h) with 0.1 ml 1% LEO and MEO solutions, respectively. All animals received 3 injections, the last one 24 h before initiation of the inflammatory focus.

Group 3 animals were injected with a mixture of hydrocortisone and vitamin B₆ characterized by high antiinflammatory activity. The hydrocortisone-vitamin B₆ mixture was injected twice: 30 min before

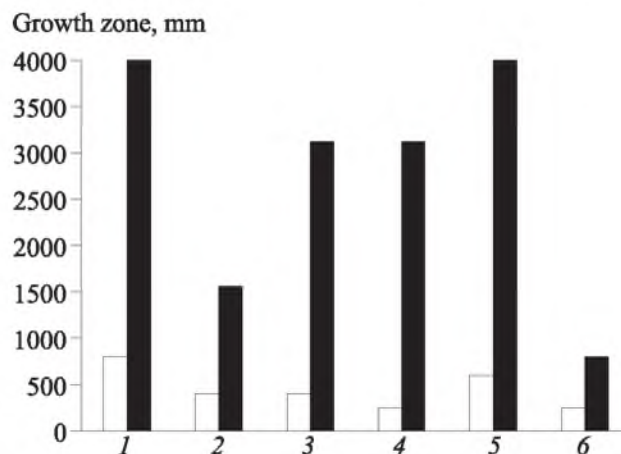


Fig. 1. Antibacterial and antimycotic activities of MEO (light bars) and LEO (dark bars). 1) *P. aeruginosa*; 2) *E. coli*; 3) *Proteus vulgaris*; 4) *Staphylococcus*; 5) *B. subtilis*; 6) *Penicillium*.

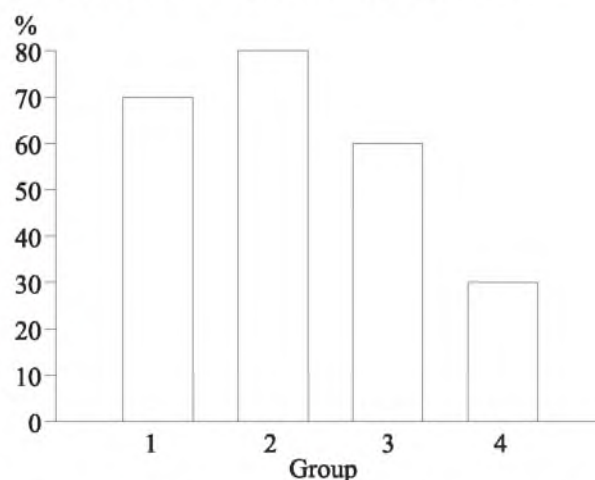


Fig. 2. Antiinflammatory effects of essential oils evaluated by the percentage of dead animals.

and 6 h after turpentine in doses of 0.025 and 0.5 μ g, respectively.

Group 4 animals received no antiinflammatory agents, only 50% turpentine and 1% strychnine nitrate solutions.

Monarda essential oil stimulated antiinflammatory activity of the hydrocortisone-vitamin B₆ combination (Fig. 2).

TABLE 1. Changes in the Volume (cm³) of Infected Paws of Mice under the Effect of Three Injections of 0.05% MEO Solution ($M \pm m$)

Group	Mean volume of intact paw	Mean volume of infected paw		
		day 1	day 3	day 6
Experiment	0.086 \pm 0.008	0.240 \pm 0.016	0.187 \pm 0.0311	0.012 \pm 0.0012
Control	0.080 \pm 0.005	0.190 \pm 0.015	0.197 \pm 0.0025	0.1800 \pm 0.0249

TABLE 2. Effect of MEO on Generalized Infection ($M\pm m$)

Group	Survivors, %	Incidence of gram-negative bacilli in the spleen, %	Growth of bacteria isolated from the blood, %
Control	32	54.0 \pm 3.1	58.0 \pm 6.3
1	70	13.0 \pm 2.3*	14.0 \pm 2.9*
2	55	23.0 \pm 3.1	32.0 \pm 4.1

Note. * $p<0.05$ compared to the control.

Antiinflammatory activity of MEO was studied on 10 mice intracutaneously injected with a 24-h culture of pyogenic staphylococcus 209 (10^9) into the hind paw aponeurosis. After injection of the bacterial suspension, the experimental animals ($n=5$) received 3 intramuscular injections (every 48 h) of 0.1 ml 0.5% MEO solution. Controls received no MEO.

The intensity of inflammation was evaluated by daily measurement of the inflamed and intact paws, using a special vessel (1 ml). The volumes were measured with an accuracy of up to 0.5 cm³.

Injection of MEO to experimental animals led to enlargement of the infected paw on day 1 in comparison with that in control mice (Table 1). However, on day 3 the volume of infected paws in experimental mice was less than in the controls. On day 6 after infection, the volume of injected paws in experimental animals was significantly less than in controls.

These results indicate an antiinflammatory effect of MEO, its effect on the exudative phase of inflammation being stronger than that of LEO.

Generalized infection was reproduced on 15 outbred albino mice. Animals of groups 1 and 2 were intraperitoneally injected with 1.5 ml suspension of *Klebsiella pneumoniae* (2×10^9 /ml) and 0.05 ml MEO (group 1; $n=5$) or LEO (group 2; $n=5$). Controls ($n=5$) received the bacteria but no essential oils. The survival

of mice 18 h postinfection was evaluated. All animals were autopsied under sterile conditions. Specimens of the heart were inoculated in meat-peptone agar and an impression smear of the spleen was made.

The study of the effects of essential oil on generalized infection showed that 70% experimental mice survived. Gram-negative bacilli were detected in the spleen in 13% cases and the growth of bacteria isolated from the blood was recorded in 14% cases (Table 2). Only 32% ($p<0.01$) mice survived in the control group (infection without treatment with essential oils).

The results of our experiments indicate good prospects of MEO as an antimycotic and antibacterial component of drugs. The antiinflammatory effects of this bioactive complex of plant origin, confirmed in our study, suggest its introduction into medical practice.

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