

Effects of Different Plant Products against Pig Mange Mites

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Abstract

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The objective of this study was to determine the antiparasitic efficiency of herbal-based products. Four medicinal plant species extracts in 10% ethanol solutions (hogweed *Heracleum sosnowskyi* Manden, mugwort *Artemisia vulgaris* L., tansy *Tanacetum vulgare* L., wormwood *Artemisia absinthium* L.), and seven essential medicinal ethereal oils used in 1% emulsions (garlic *Allium sativum* L., black pepper *Piper nigrum* L., juniper *Juniperus communis* L., citronella grass *Cymbopogon nardus* Rendle, pennyroyal *Mentha pulegium* L., eucalyptus *Eucalyptus globulus* Labill., tea tree *Melaleuca alternifolia* Gheel) were tested on a pig farm in Estonia to control swine sarcoptic mange mites (*Sarcoptes scabiei* var. *suis* (L. 1758) Latreille, 1802). Trial groups (6 pigs each) were treated over the whole body twice, with one week interval in between; one group was left as untreated control. All the preparations used inhibited the development of and were more or less lethal to mange mites. Tea tree and citronella volatile oil preparations proved to be the most effective (viability of mites < 5% in 4 weeks). The most active extract of tested ethanol solutions was obtained from hogweed seeds: after two treatments of pigs, 57 - 93% of parasites died in 2 - 4 weeks. The extracts of local plants tansy and wormwood diminished the number of mites up to 44% within the first week after treatments. The results indicate that plant extracts may be further tested in practice as alternatives to drugs of synthetic origin.

Swine sarcoptosis, farm trials, herbal preparations

Several arthropod reproductive inhibitors and repellents have been extracted from certain plants from ancient times. These extracts affect the feeding behaviour and life cycle of parasites (Tooning et al. 1988; Green et al. 1991; Wells et al. 1993; Perich et al. 1995). As pesticides of synthetic origin may have a negative impact on the environment, and pest resistance to toxic chemicals can develop after repeated applications, the use of natural products has become more popular. For example, pyrethrins are insecticides derived from the chrysanthemum plant. They are common ingredients of parasite control products and are neurotoxic at high levels (Hansen et al. 1994). The most commonly used derivatives of citrus fruits are D-limonene and orange essential oils. The main advantage of such products is a high margin of safety for warm-blooded organisms (Hooser et al. 1986). Garlic has been widely studied for its immunity boosting properties. Numerous studies indicate that the compound allicin, found in fresh garlic, has antibiotic, antiparasitic and antifungal properties (Ankri and Mirelman 1999; Rivlin 2001; Viegi et al. 2003; Anthony et al. 2005). Nowadays we know that about 2000 herbal species of the whole world might be used to control arthropod pests.

In order to work out a theoretical basis of veterinary herbal medicine in Estonia, the possibilities for the use of several plant products as natural pesticides will be investigated in local conditions. Herbal preparations were prepared in the laboratory for the purpose of using them for treating swine test groups. Databases and new technologies (Dr. Duke's Phytochemical and Ethnobotanical Databases 1992; Viegi et al. 2003) can help us, but plant efficacy must be studied with laboratory tests and on farm trials. On the basis of

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these investigations and our previous results of *in vitro* tests (Mägi and Kaarma 1999; Kaarma et al. 2000), several plant extracts were selected for pig treatments. Hogweed (*Heracleum sosnowskyi* Manden), wormwood (*Artemisia absinthum* L.), mugwort (*Artemisia vulgaris* L.) and tansy (*Tanacetum vulgare* L.), have shown the highest efficacy against swine ectoparasites in our laboratory tests with local Estonian herbs. As many of the active ingredients in manufactured drugs are originally derived from plant compounds and used against diseases, several products of the Australian essential oil company New Directions Ltd. have been used comparably in our farm tests: garlic (*Allium sativum* L.), black pepper (*Piper nigrum* L.), juniper (*Juniperus communis* L.), citronella grass (*Cymbopogon nardus* Rendle), pennyroyal (*Mentha pulegium* L.), eucalyptus (*Eucalyptus globulus* Labill.) and tea tree (*Melaleuca alternifolia* Gheel).

Recent studies abroad as well as in our laboratory have proved that the most effective preparations compared with traditionally used antibiotics are herbal-based products produced from high quality herbs from all over the world (Schmutter and Ascher 1980; Kaarma and Mägi 1994; Smith 1995; Kaarma et al. 1999; Mägi and Kaarma 1999; Viegı et al. 2003; Walton et al. 2004; Anthony et al. 2005).

Materials and Methods

From 1999 to 2004 several farm trials with natural antiparasitic products were carried out on experimental pig unit Heko Pöld in the Tartu district, Estonia. Investigations were carried out to determine the effect of 11 plant extracts and ethereal essential oils on swine mange mites. Seventy-two sows showing clinical signs of swine sarcoptosis were used in our trials. Trial groups of 6 pigs each were treated over the whole body twice, with a week intervals, one group was allocated as untreated control. Clinical evaluations were done weekly and observations continued up to 5 weeks after treatments. Scrapings of marked 10 cm² infested skin area from each pig were examined microscopically to determine the number of live mites. According to the results of our previous *in vitro* tests (Mägi and Kaarma 1999), several plant products were selected for pig treatments.

Plants used in ethanol extracts:

1. Hogweed (*Heracleum sosnowskyi* Manden) - contains natural insect growth regulators, which break the arthropod lifecycle and prevent larvae from maturing Lipnitskij 1996; Mägi and Kaarma 1999).
2. Mugwort (*Artemisia vulgaris* L.) - contains repellents and toxic alkaloids (Viegı et al. 2003).
3. Tansy (*Tanacetum vulgare* L.) - contains ethereal oils and toxic alkaloids (Viegı et al. 2003).
4. Wormwood (*Artemisia absinthum* L.) - contains repellents and ethereal oils (Viegı et al. 2003).

All local plant herbs were collected from natural growing places and dried in room temperature. Dried herbs (hogweed seeds, tansy flowers, mugwort and wormwood leaves) were infused in 70% ethanol solutions in volume relation of 1/4 for 24 hours. These home-produced extracts were stored in small glass bottles at +4 °C. Before swine external treatments, 10% water solutions were made from ethanol extracts (Kaarma and Mägi 1994).

All 7 manufactured essential medicinal ethereal oils used in farm tests were 100% pure Australian products (New Directions Ltd., Australia):

1. Garlic (*Allium sativum* L.) - contains sulphur compounds, particularly diallyl sulphide. Garlic oils are the oldest kind of manufactured preparations and were made long before research identified the active ingredients (Ankri and Mirelman 1999; Rivlin 2001; Anthony et al. 2005).
2. Black pepper (*Piper nigrum* L.) - ethereal oil is produced from black pepper berries. As an antiseptic, antitoxic and antibacterial agent (Lydon and Duke 1989; Anthony et al. 2005) was used to determine its possible repellent or lethal effects on swine mange mites.
3. Juniper (*Juniperus communis* L.) - has been used historically to disinfect the air. Diffusing or evaporating juniper oil can also be used for the same purpose. Juniper promotes metabolism, is antiseptic, detoxifying, toning and antibacterial (Viegı et al. 2003).
4. Citronella grass (*Cymbopogon nardus* Rendle) - volatile oil obtained from the leaves and stems of the citronella plant contains citronellal, geraniol, camphor-like camphene, borneol and methyleugenol (Dr. Duke's Phytochemical and Ethnobotanical Databases 1992). Because of its association with insect repellent qualities, citronella is an excellent alternative to chemical methods against fleas and biting insects.
5. Pennyroyal (*Mentha pulegium* L.) - oil is distilled from the herb of this mint. The chief constituent (ketone pulegone) is known to be repellent to insects, especially fleas (Viegı et al. 2003).
6. Eucalyptus (*Eucalyptus globulus* Labill.) - oil is distilled from fresh leaves and branch tips. The primary active constituent is cineol, also known as eucalyptol (Dr. Duke's Phytochemical and Ethnobotanical Databases 1992; Bennet-Jenkins and Bryant 1996). Its camphoraceous aroma has antiseptic qualities and is known as insect repellent.
7. Tea tree (*Melaleuca alternifolia* Gheel) - oils act both as a bactericide/antiseptic and as an antifungal agent,

kill certain viruses and provide a boost to the immune system (Walton et al. 2004; Anthony et al. 2005). Melaleucas grow only in the South Wales region of Australia.

To test the viability of swine mange mites, medicinal plant essential oils were used in 1% emulsions. The one-way analysis of variance (One-way Anova) was used to test the hypotheses. Comparisons of means were used to compare different groups.

Results

All the tested plant products occurred to be lethal against swine mange mites. Insect reproductive inhibitors and repellents, extracted from medicinal plants, affected the reproduction of parasites. The results of our tests are presented in Table 1. The effectiveness of 6 plant products - mugwort, wormwood, garlic, tansy, hogweed, and tea tree - is illustrated in Fig. 1. Already in the first post-treatment examination the number of mites was significantly lower in scrapings from the treated pigs, and a great improvement of pigs was noticed two weeks after the treatments.

Table 1. Pig mange mite treatment with various plant products: pair-wise comparisons of means (4 weeks after treatments)

Variants	Parasitic stage	Number of live parasites (% of initial level)	Homogenous groups			
Control	Adult	101.31	I			
Mugwort	"	18.22		I		
Juniper	"	14.62		I		
Black pepper	"	11.75		I	I	
Wormwood	"	10.98		I	I	
Eucalyptus	"	10.69		I	I	
Garlic	"	10.64		I	I	
Tansy	"	8.82			I	I
Pennyroyal	"	6.75			I	I
Hogweed	"	6.66			I	I
Citronella	"	4.82				I
Tea tree	"	1.45				I

Control = non-treated group

Critical t-value = 3.69

Critical value for comparison = 9.33

Rejection level = 0.05

The most active extract of tested local plant extracts was obtained from hogweed. After treatments with 10% extract of hogweed seeds 57 - 93% of parasites died in 2 - 4 weeks. The extracts of tansy and wormwood diminished the number of parasites by up to 44-90% in 1- 4 weeks (Fig. 1). The solutions of mugwort proved to be less effective against mites: 4 weeks after treatments the number of parasites observed in scabs appeared to be 18% of the initial level. Regardless of the final number of live mites, it may be concluded that mugwort extract solutions significantly reduced the number of mites in the first 1-2 weeks (42 - 72%).

As our previous results with imported essential ethereal oils have shown, all the tested products were proved to be effective against sarcoptic mange mites: in their 0.5- 2% water emulsions the lethality *in vitro* was registered up to 95-100% in 24 hours (Mägi and Kaarma 1999). Thus, carrying out the farm trials, acaricidal effects of 1% ethereal emulsions in comparison with 10% local plant extract solutions were established and thoroughly studied. The most effective ethereal oil preparation against mange mites appeared to be tea tree oil - after two weeks the number of mites in scabs diminished by 85% (Fig. 1). After 4 weeks, comparisons of means were used to compare the results of different

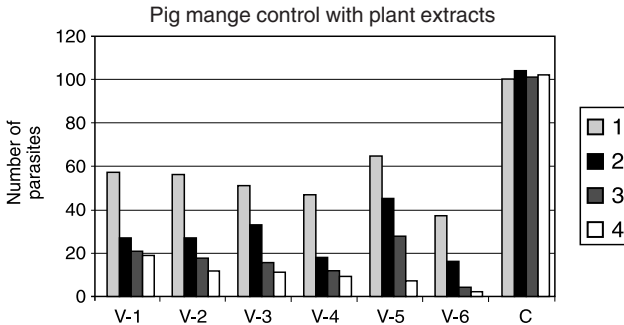


Fig. 1. Effects of different plant products on viability of swine mange mites

1 = one week after treatments
 2 = two weeks after treatments
 3 = three weeks after treatments
 4 = four weeks after treatments
 V-1 = mugwort
 V-2 = wormwood

V-3 = garlic
 V-4 = tansy
 V-5 = hogweed
 V-6 = tea tree
 C = control (non-treated group)

variants (Table 1). Our data indicate that no essential differences (< 9.33) exist between the variants of the same homogenous group. There are 4 columns according to our results because there are 4 groups of similar means. The first group contains the means of the control variant and it differs significantly from other groups. Tea tree, citronella, hogweed, pennyroyal and tansy which belong to the fourth group, diminished the number of parasites up to 1.45% - 8.82% from the initial level.

Conclusions

The tested dilutions of medicinal plants proved to be effective against pig mange mites and they reduced considerably the number of sarcoptic mange mites. Tea tree and citronella volatile oil dilutions proved to be the most active preparations.

The extracts of local plants containing insect reproductive suppressors and repellents, such as hogweed, tansy and wormwood, require more attention and further investigation.

It became evident that the plant extracts may be tested further in practice as alternatives to drugs of synthetic origin.

Vliv různých rostlinných produktů na zákožku svrabovou u prasat

Cílem studie bylo ověřit antiparazitární účinnost rostlinných produktů na zákožku svrabovou. Extrakt čtyř léčivých rostlin v 10% ethanolu (boľševník velký *Heracleum sosnowskyi* Manden, starček *Artemisia vulgaris* L., vratič obecný *Tanacetum vulgare* L., pelyněk *Artemisia absinthium* L.), a 7 léčivých éterických olejů použitých v 1% emulzích (česnek *Allium sativum* L., pepř černý *Piper nigrum* L., jalovec obecný *Juniperus communis* L., citronella *Cymbopogon nardus* Rendle, máta obecná *Mentha pulegium* L., eukalyptus *Eucalyptus globulus* Labill., čajovník australský *Melaleuca alternifolia* Gheel) bylo testováno v chovu prasat v Estonsku s cílem omezit výskyt svrabu (*Sarcoptes scabiei* var. *swis* (L. 1758) Latreille, 1802). Pokusné skupiny (každá o 6 prasatech) byly ošetřeny po celém povrchu těla dvakrát týdně; kontrolní skupina byla ponechána bez ošetření. Všechny preparáty inhibovaly vývoj zákožek a byly pro ně více nebo méně letální. Éterické oleje čajovníku australského *Melaleuca alternifolia* Gheel a citronelly byly neúčinnější (životnost zákožek byla $< 5\%$ v průběhu 4 týdnů). Neaktivnější extrakt testovaných roztoků

v etanolu byl získán ze semen bolševníku velkého: po dvou ošetřeních prasat uhynulo na nich 57 - 93% parazitů během 2 - 4 týdnů. Extrakty lokálních rostlin - vratiče obecného a pelyňku snížily počet zákožek o 44 % během prvního týdne po ošetření. Tyto výsledky naznačují, že testování a poté využívání rostlinných extraktů se jeví jako nadějná alternativa k látkám syntetického původu.

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