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NATURAL ANTIPARASITICS IN ORGANIC LIVESTOCK

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No [774340 - Organic-PLUS]

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SUMMARY

The control of parasites in livestock is still reliant on the application of synthetic compounds. The emergence of parasites (helminths and arthropods) resistant to virtually all the available compounds together with the fact that organic farming should be free from these substances, make finding alternative treatments an urgent matter. The literature is rich in studies of the use of plant and plant-derived substances as antiparasitics. Their use is often documented in traditional medicine (ethnomedicine). Despite the increasing amount of published studies, standardised procedures are lacking, as well as an agreement in the scientific community that could lead to a recognised status of antiparasitic products for at least some of the plant studied. Here we present examples of plants and plant-derived substances (essential oils and extracts) and their activity against a broad group of parasites, mainly helminths and arthropods.

INTRODUCTION

Parasitic infection in livestock impairs growth performances, fertility and productivity (milk, wool, meat) with a wide range of impacts on either calves/heifers, dairy cattle, sheep and swine. These parasites can be generally classified as endoparasites (protozoa and metazoa) and ectoparasites (arthropods). There is an urgent need to explore alternatives to conventional treatments since anthelmintic and antiparasitic drug resistance is emerging worldwide and the routine use of antiparasitic drugs in organic farming is unclear.

Plants naturally produce over 60,000 chemical compounds to deter herbivores, to destroy microbial pathogens and to communicate with other organisms. Based on both empirical and scientific evidence, the exploitation of the diversity and bioactivity of plant secondary metabolites may be a viable alternative to synthetic antiparasitic products. The consumption of medicinal plants either in the form of plant parts or as extracts has been related to anti-nutritional and immune-modulatory effects. Toxic effects on hosts can occur after plant or plant products administration and, as a result, the possibility of using plant products to control parasitism in livestock is still under investigation. Over the last 7 years there has been a substantial increase in the number of publications on this topic, showing that this is a very active research field.

What does the European legislation say?

Organic livestock production is regulated by Regulation (EU) 2018/848 of May 30th 2018, which indicates that chemically synthesised allopathic veterinary medicinal products are prohibited for preventive treatment. However, the regulation does not specify what is allowed or forbidden regarding antiparasitic products, thus making even more urgent the need to define alternatives to conventional antiparasitic drugs.

Table 1. Phytochemical compounds with antiparasitic activity.

Phytochemical compound
Saponins
Benzyl isothiocyanate
Cysteine proteinases
Isoflavones
Artemisin
Phenolic compounds
Tannins
Alkaloids

Reliability of results on the antiparasitic properties of plant products

The great variety of models and methods available to test the anthelmintic properties of plants and the lack of measures to minimise experimental variability lead to a general inconsistency between studies on the anthelmintic activity of plant products. When testing plant products, it should also be considered that the *in vitro* results are sometimes not confirmed *in vivo*.

ANTIPARASITIC EFFECTS OF PLANTS

Recent reviews highlight that products derived from plant extracts will probably become a viable alternative for the control of parasites of veterinary interest in the near future. Their mode of action depends on their content of different phytochemicals (**Table 1**).

Plants with anthelmintic compounds

Plants with anthelmintic efficiency in livestock and humans are[1]: extracts from **lichens** and **ferns** (e.g. *Dryopteris filix-mas*) against **tapeworm** infections; **trees** and **shrubs** (e.g. *Salix* spp.) against parasites; oil from herbaceous plants like **wormseed** or **goosefoot** (*Chenopodium ambroisoides*) against ***Ascaris*** infections; **Caraway** (*Carum carvi*), **thyme** (*Thymus* spp.), **mint** (*Mentha* spp.) against ***Trichostrongylus larvae*** *in vitro* and *in vivo* (sheep); plants from ***Artemisia*** genus (active compound: santonin) and ***Tanacetum vulgare*** (active component: thujon) against several **nematode** (*Ascaris*, *Enterobius*, *Trichostrongylus*, *Ostertagia*) and **tapeworms**; ***Daucus carota***, ***Brassica*** spp., ***Allium*** spp. and all kinds of **berries** against parasites; the ***Cucurbitaceae*** family, particularly pumpkin and cucumber seeds (active compound: cucurbitine) against **tapeworm** infections; ***Nicotiana rustica***, particularly leaves, (active compound: nicotine) against **nematode** in ruminant until mid-1950s; **pasture plants** (active compound: proanthocyanidins) such as *Hedysarum coronarium* (sulla) and *Lotus pedunculatus* (lotus major) against **nematodes** both *in vivo* and *in vitro*; and **tanniferous plants**, the activity of which against internal parasites could be explained by the increased availability of digestible protein to the animal or by a direct anthelmintic effect on resident worm populations or on free-living stages in animals.

Other plants showing antiparasitic activity are[2]: ***Zingiber officinale*** (containing zingiberene) against ***H. contortus***; ***Melia azedarach*** (rich in mliacaprin, scopoletin, meliartenin) has also larvicidal and ovicidal activity on ***H. contortus***; ***Nigella sativa*** L. (rich in thimoquinone) against **tapeworms** and several **nematodes**; ***Flemingia procumbens*** (containing genistein) against **intestinal parasites** of poultry and **trematode** species; ***Ocimum sanctum*** (containing eugenol, β-caryophyllene and urosilic acid) against several larvae of **mosquito** species; ***Azadirachta indica*** (containing azadirachtine) against *F. gigantica* and other **helminths** of livestock (*H. contortus*) and **ticks** (*B. microplus*); ***Calotropis procera*** (containing calotropin and calactin) against nematodes ***Oesophagostomum columbianum*** and ***Bunostomum trigonocephalum*** in sheep and ***Ostertagia***, ***Nematodirus***, ***Dictyocaulus***, ***Taenia***, ***Ascaris*** and ***Fasciola***; ***Artemisia annua*** (rich in artemisinin and quercetin) against ***F. hepatica*** and **gastrointestinal nematodes** in small ruminants and ***Plasmodium*** spp. and other important **protozoan parasites**.

A review from Serbia[3] mentioned the efficacy of **white mugwort** (*Artemisia absinthium*) and **black mugwort** (*Artemisia vulgaris*) as traditional anthelmintics treatments. Moreover, decoction of the rhizome of genuione brachens, **Male Fern** (*Dryopteris filixmas*), represents one of the strongest natural drugs to control **tapeworms** and **flukes** through the active compounds filicin and filmarone, which are toxic for the worms, and oleorescin that paralyses parasite musculature.

Plants for ectoparasitic control

At the moment, farmers rely mainly on chemical acaricides and repellents for the control of ectoparasites (e.g. ticks, mites, lice). However, as in other cases, ectoparasites resistant ticks are found with growing frequency in relation also to an increased application of acaricides. In places where small scale farms are the largest proportion of livestock enterprises – as in developing countries across the world – ethno-veterinary plant use for ectoparasites control is very important. Evidences of some activity against ectoparasites has been reported for the following plants:

Topical application of **natal laburnum** (*Calpurnia aurea*) juice of leaves and bark for **tick** control (to kill or compromise mobility) in Ethiopia; ***Otostegia integrifolia*** for **mosquito** repellence; ***Jetropha curcas*** in Latin America, Africa and Asia against **ticks** by decreasing their egg mass production and **acaricidal activity**, in particular against *Callosobruchus maculatus* and *R. annulatus*; ***Nicotiana tabacum*** in South-Western Nigeria for the prevention of **lice** and treatment of larvae and nymphs of ***R. appendiculatus*** on the ears of calves.

The use of **white mugwort** and **black mugwort** (ground fresh leaves, mixed with lard and rubbed over the cattle skin) as a repellent of **flies** has been reported from Serbia, and the use of **stinking hellebore** (*Helleborus* L., *Ranunculaceae* family) together with **hellebore** (*Veratrum album* L., *Liliaceae*) and **tobacco** (*Nicotiana tabacum* L.,

Solanaceae) to eradicate cattle **lice** infestation and **mange**.

Antiparasitic plants in fish farming

A further research area that should be considered when studying the use of plants as alternatives to synthetic antiparasitics is the use of plant products in fish farming. Information is available regarding the use of plant compounds for oral administration or immersion, active against the most economically important parasite species in fish farming, namely protozoans, myxozoans and helminths (monogeneans). Several studies have demonstrated the effects of both essential oils and different kinds of extracts in treating fish parasites[4].

PROJECT WEBSITE

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ACKNOWLEDGEMENTS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No [774340 - Organic-PLUS]
Proof reading by Judith Conroy and Sara Burbi, Coventry University.

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TAKE HOME MESSAGES

- A variety of plant products have traditionally been used for therapeutic purposes to control both endoparasites and ectoparasites.
- Scientific validation of the efficacy of these plant products is often lacking.
- Various evidences demonstrate that a scientific effort needs to be made to characterise and validate the use of various plant products.

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