USE OF HERBS AND SPICES AS ALTERNATIVE COMPOUNDS TO MANAGE HELMINTHOSIS IN SHEEP AND GOATS

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INTRODUCTION

Helminthosis (worm burdens) in small ruminants is a problem within itself in all agro-climatic zones of the world. In addition, anthelmintic resistance (AR) is a global problem that threatens the welfare of sheep and goats and represents a challenge in eroding the productivity of small ruminants, thus affecting the survival of the sheep/goat farms (Jabbar et al. (2006)). AR is identified when a previously used commercially available anthelminticceases to kill an exposed worm population at the recommended therapeutic dosage. In the United States (USA), all major groups of the commercially available anthelmintics have been reported to have experienced variable degrees of resistance when used to protect small ruminants, and in some cases multi-class resistance to these drugs hasbeen reported.Efforts to reduce production losses caused by gastrointestinal nematode parasitism in small ruminants (sheep and goats) have led to the investigation, development and implementation of a number of alternative control methods to complement or replace commercially available anthelmintics. This presentation will attempt to focus on the use of herbs and spices considered *"natural alternative compounds"* to reduce gastrointestinal parasitism in sheep and goats. Herbs and spices have been an essential factor in health preservation all over the world and in many cultures (Peter, 2004). Depending on the use, for external or internal applications, the extraction of the active ingredients varies. Herbs and spices are rich in volatile oils, alkaloids, glycosides, and many other compounds (Table 1). The definitions of *¨herbs¨* are abundant. Generally, herbs are plants valued for their medicinal, aromatic, coloring and flavor enhancing properties. Hence, herbs are grown and harvested for such unique properties. The link between humans and herbs is documented from 4,000 years ago in Egypt.In addition in this presentation, results from several experiments using, garlic, pumpkin seeds, papaya seeds, etc., to control worms will be appraised. Bearing in mind that the list of reports on the use of the so called *"alternative natural"* dewormers is overwhelming, suggestions will be proposed in order to evaluate the informative value and more importantly, use of the natural materials to enhance survival of parasitized sheep and goats. One of the documented alternative in USA are condensed tannins in sericea lespedeza (*Lespedeza cuneata)* and other plants have shown an effective alternative against worms in sheep and goats. Finally, recommendations will be proposed to develop a dialogue with other disciplines in order to help animal scientists in identifying natural dewormers that work.

PRACTICAL REVIEW AND CURRENT PRACTICES

Among many systems of herbal medicine, the most important is the Ayurvedic system which originated in China and India (Peter, 2004). Ayurveda is one of the oldest documented health care systems consisting of theoretical and practical clinical applications (Jain, 2006). One of the earlier reports in the USA on the use of plants with anthelmintic properties was published in 1781. The author (Kissam, 1771) expressedthat the plant known as cow-itch (*Phaseoluszuratensissiliquahirsuta)* could be used as a vermifuge to treat children with worms instead of preparations of mercury, aloes, rhubarb, jalap (a dried tuberous root from *Ipomoea purga*syn. *Exogoniumpurga*, a plant in the morning-glory family*)*, steel, tin, Sulphur [*sic*] (sulfur)…"and others too tedious to mention". The author indicated that the hairy substance growing outside the pods was mixed with molasses or syrup and given to children and adults for 3 consecutive days at the rate of one teaspoon for children and double for adults.

Condensed tannins as an alternative anthelmintic for sheep and goats

Tannins are natural polyphenols. Biosynthetically the Condensed Tannins (CT) are formed by the successive condensation of the single building blocks, with a degree of polymerization between two and greater than fifty blocks being reached. The coupling pattern of the catechin units in condensed tannins can vary considerably

(Khanbabaee and van Ree, 2001). In some herbs, spices and forages (mostly leguminous plants), tannins are considered secondary compounds and in general herbivores avoid plants with excess tannin content. However, it has been reported by many investigators that CTs have beneficial effects relative to parasitized sheep or goats eating plants with CTs because CTs aid in the management of Gastro Intestinal Nematodes (GIN) infestations (Min and Hart, 2003; Coffey, 2007; Lisbonbee et al., 2009; Novobilský et al., 2001; Juhnke et al., 2012; . In the USA, several plants containing CTs are of interest to sheep and goat producers: Sericea lespedeza (*Sericeacuneata*), birdsfoot trefoil (*Lotus corniculatus*), chicory (*Cichoriumintybus*) and sainfoin (*Onobrychisviciifolia*). In other regions in the world plants of the genera *Acacia, Schinopsis, Leucaena, Salix*have shown to have anthelmintic activities (Minho et al., 2008; Beserra de Oliveira et al., 2011; Mupeyo et al., 2011). Chicory (*Cichoriumintybus L.*), a perennial herb of the Asteraceae family, has a long history and utilization in many parts of the world. It is relatively new as a forage crop. Recently, forage chicory is being studied for its bioactive compounds, such as tannins or sesquiterpene lactones, which can reduce nematode infection in animals. However, the effects of feeding high tannin containing feeds have not always reduced parasite burdens. For example, Whitley et al. (2009) reported that high tannin sorghum rations did not affect Fecal Egg Count (FEC) or Pack Cell Volume (PCV) of goats eating the high sorghum diets. Also, Max et al., (2007) reported a slight FEC reduction (only 19%) in sheep and goats fed up to 170 g/animal/day of acacia leaf meal (*Acacia polycantha*) compared to control groups. Use of plans containing CTs as alternative anthelmintic has multiple research trials backing up claims of efficacy and has encouraged producers to the use of lespedeza as a component of integrated parasite management plans.

Other tested "herbal dewormers" and anthelmintic compounds

- At least two commercial herbal dewormers have been tested in research trials. Burke at al. (2009a) did not find any indication, after a 112 day trial, that a commercially available herbal dewormer controlled GIN in goats.
- Yoder (2011) tested plumbagin in sheep and reported that treated sheep and control sheep did not show a difference on parasite burden as expressed by PCV and FEC. Plumbagin is a compound found in several herbal mixtures, but mostly in venus flytrap, *Dionaeamuscipula* (carnivora, plumbagin).
- Garlic, papaya seeds and pumpkin seeds have been used in trials with sheep and goats and have not been found to enhance PCV or reduce FEC in the treated sheep and/or goats (Burke et al. 2009b; Gooden 2012, Escobar et.al. unpublished data). However, Strickland et al. (2009) reported 64.4% reduction in FEC in sheep using garlic and 65.5% reduction in FEC when pumpkin seeds were fed.
- Diehl (2004) published an extensive report of 60 plants in the Ivory Coast that have shown larvicidal activity against *H. contortus.* Several parts of plants were extracted with 90% ethanol and 25.6% of the extracts showed a high activity. Only 12 species showed proven activity against *H. contortus*(caused 95 to 100% larvae mortality).
- Oil and seed paste of *Chenopodium* spp. (epazote, wormseed, erva de Santa Maria) has been used to treat worm infections in animals and humans for centuries, however the margin of safety is very narrow (Jabbar et al., (2007). *Chenopodium* may cause adverse reaction and even death to the treated animals (Cornell University, 2013).
- Jain (2006) mentioned that the powder of *Embeliaribes*Burm. (FamiltyMyrsinaceae) is the drug of choice for worms, *i.e.*,tapeworms, in the Ayurvedic system. Chaudhary (2012) reported up to 96% anthelmintic activity of an *E. ribes* seeds extract (10 to 200 µg/mL) by microwell plat assay using levamisole and ivermectin as reference. The *Embelia* seeds were extracted with 95% ethanol by using soxhlet extractor. Phytochemical screening of the extract indicated the presence of tannins and glycoside. Other names for *Embeliaribes*Burm., are:Vidanga, false black pepper, and Devnagari.
- From the Mediterranean,*Thymus capitatus* (family Lamiaceae) is usedtraditionally as a spiceand grown in most part of the world. Also known as Spanish oregano. Aqueous and ethanolic extracts of *Thymus* leaves and stems were compared to albendazole on effects on in-vitro hatching *Hoemonchuscontortus* eggs (Boubaker-Elandalousi et al., 2013). Both *Thymus*extracts inhibited eggs hatching in concentrations of 2mg/ml. The ethanolicextract containedthymol (71.22%) and camphor (17.18%)and showed higher ($P<0.05$) in-vitro activity against adult worms than the aqueous extract. The anthelmintic activity was defined asparalysis or death of the worms after several hours post-treatment. Other plants containing similar compounds are *Lysiloma* spp., and*Acacia* spp.
- Other relevant alternative plants are included in Table 2.

DISCUSSION

The list of reports on the use of alternative anthelmintics for use in sheep and goats is overwhelming; however, the methods for analysis are ingenious but not standardized. Diehl (2004), Jain (2006), Bachayaetal. (2009), Boubaker-Elandalousi et al., (2013) and Tariq et al., (2009) have listed extraction procedures and in-vitro procedures to measure worm egg hatching rate and worm larval mortality when the eggs and larvae are exposed to the plant extracts.It seems that the compounds tested may reduce larval activity in-vitro but when tested in-vivo the results from treated animals are not different than results from the control ones. One difficulty which is very common is the proper identification of the plants and the geographical origin. The scientific name, the variety plus the exact place were the herbs or spices were collected should be included in the reports. For example, pumpkin's scientific name is *Cucurbitapepo*; however there are at least 5 varieties commercially cultivated in the USA. Another example: *Thymus capitatus* grows in many parts of the world; however, Boubaker-Elandalousi et al. (2013) properly identified the part of the world where the tested material came from "…*Tunisian arid zone*…".Another underlying situation exist when researchers need to decide between running an in-vitro trial or an in-vivo trial. Both complement each other providing information to better understand the results in the field and to make recommendations. Once more there is the need of collaborative studies and the contribution of chemists, botanists and animal scientists in order to identify alternative compounds to control worms in sheep and goats.

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