SAND2013-7572P

Veterinary Pharmacology

ANTIPARASITIC DRUGS

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.**SAND**

BEP

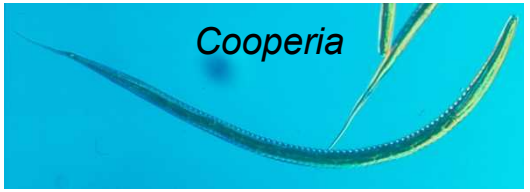
International
BIOLOGICAL THREAT REDUCTION

Parasites

- **Internal parasite infections and external parasite infestations can cause significant production losses in food producing animals such as cattle, sheep, and goats**
  - Parasite induce a number of clinical symptoms
    - **Anemia**
    - **Diarrhea**
    - **External erosions**
    - **Pruritus**
    - **Weight loss**
    - **Infertility**
- **Parasites are generally host specific**
  - Cattle, sheep, goats, and horses serve as hosts to a number of different parasites

Cattle Parasites

- **Internal parasites pose a major threat to cattle health and production**
  - Stomach and intestinal worms can often be the most significant of the parasite infestations
    - **Most are found in the abomasum and small intestines**
    - **Abomasum**
      - *Ostratagia ostertagi* (Brown Stomach Worm)
      - *Haemonchus contortus* and *Haemonchus placei* (Barberpole Worm)
      - *Trichostrongylus axei* (Small Stomach Worms)
    - **Small intestines**
      - *Nematodirus spathiger* (Threadneck Intestinal Worm)
      - *Cooperia punctata* and *Cooperia oncophora* (Small Intestinal Worms)
      - *Bunostomum phlebotomum* (Hookworms)



Anti-Parasitic Drugs
Cattle

- **Several antiparasitic drugs are available for the treatment of parasites in cattle**
  - Avermectins
    - **Ivermecin**
    - **Moxidectin**
    - **Doramectin**
  - Benzimidazoles
    - **Albendazole**
    - **Fenbendazole**
    - **Oxfendazole**
  - Imidothiazoles
    - **Levamisol**
  - Morantel tartrate

General Sensitivity of Common Parasites to Antiparasitic Drugs

Generic Name	Avermectins	Levamisol	Moxidectin	Albendazole	Fenbenda-zole	Morantel Tartrate	Oxfendazole
Ostertagia Type 2	All mature and immature	Not effective	Not effective	All mature and immature	All at 10 mg level	Some	All mature and immature
Cooperia	Variable response		All mature and immature	All mature and immature	All mature and immature		All mature and immature
Lungworms	All mature and immature	All mature and immature	Not effective	All mature and immature	All mature and immature	Not effective	All mature and immature
Tapeworms	Not effective	Not effective	Not effective	All mature and immature	All mature and immature	Not effective	All mature and immature
Flukes	Not effective	Not effective	Not effective	All mature and immature	Not effective	Not effective	Not effective

Common Antiparasitic Drugs Approved for Use in Cattle

Generic Name	Avermectins	Levamisol	Moxidectin	Albendazole	Fenbenda-zole	Morantel tartrate	Oxfendazole
Trade or Drug Names	Ivermectin, Ivermectin and praziquantel, doramectin Pirvermectin	Levasole Tramisol Ripercol Totalon	Cydectin	Valbazen	Panacur Safe-Guard	Rumatel Nematal	Synanthic
Manufacturer	Merial Pfizer Generic products	Merck	Boehringer Ingelheim	Pfizer	Merck	Pfizer	Boehringer Ingelheim
Dosage Forms	Injectable Pour on, paste, bolus	Drench Bolus Paste Injectable Pour on Feed	Pour on Injectable	Drench paste	Liquid drench, paste, feed block, bolus	Bolus, feed	Drench
Slaughter Withdrawal	35 – 48 days	2 – 9 days	21 days for the injectable	27 days	13 days	14 days	7 days

Ostertagia

- ***Ostertagia* is a common parasite found in cattle in the US**
  - Infection causes significant production losses
- ***Ostertagia* life cycle dictates when animals should be treated**
  - Direct life cycle
    - **Infected cattle pass eggs in the manure and with good weather conditions, the eggs hatch and develop into infective (third stage) larvae in 14 days**
    - **Larvae move from the manure up grass blades and are eaten as cattle graze**
      - Usual migration is less than one meter
    - **Larvae penetrate the lining of the abomasum and mature into egg-laying adults, two to four weeks after ingestion**
  - Fourth stage may vary and sometimes the larvae can stay in the stomach glands for up to six months, this is called arrested or inhibited larvae
    - **Environmental, nutritional, or health factors can trigger the inhibited larvae to leave the glands**

Ostertagia

- **The complex life cycle is divided into three parts**
  - Type 1
    - **Large numbers of infective larvae are eaten over a short time and quickly complete their life cycle to become adults**
  - Pre-Type 2
    - **The development of the fourth stage larvae is interrupted and maturation is inhibited**
    - **When conditions are favorable, the larvae will leave the abomasal glands and become adults**
    - **This is the fifth state of development**
  - Type 2
    - **Occurs when the larvae leave the lining of the abomasum**
    - **If large numbers leave, infection is high and the animal will develop severe clinical signs**
    - **If small numbers leave, infection is minimal and only mild clinical symptoms may be observed**

Ostertagia Control

- Control is not based only on administration of the proper antiparasitic drug: pasture management and properly timed administration of antiparasitic drugs
  - Control requires treatment to be administered at the proper time
    - **When the weather permits hatching and migration of the larvae, usually early spring (April)**
      - As the weather gets warmer the larvae are less likely to complete their life cycle
    - **When inhibited larvae may be released, during pregnancy, after calving, or during winter when animals are stressed from the cold and poor nutrition**
    - **Mid-summer administration reduces the egg count for the winter pasture**
  - Pasture rotation
    - **Pastures with high infestation may become safe for grazing during the hot months of summer**
  - Scatter and break up manure piles allow the larvae to be exposed to hot conditions during the summer months

Anti-Parasitic Drugs for Ostertagia

- **Several anti-parasitic drugs are efficacious against Ostertagia**
  - Avermectins
    - **Ivermectin**
    - **Ivermectin and praziquantel**
    - **Doramectin**
  - Albendazole
    - **Has efficacy against almost all other common cattle parasites including lung worms and liver flukes**
  - Fenbendazole
    - **Requires 10 mg/kg dose for efficacy against Ostertagia type 2**
    - **Effective against lung worms**
  - Oxfendazole
    - **May lack some efficacy against immature stomach and intestinal worms**

Parasites of Sheep and Goats

- **Internal parasites pose a major threat to sheep and goats health and production**
  - Stomach and intestinal worms can often be the most significant of the parasite infestations
    - **Most are found in the abomasum and small intestines**
    - **Abomasum**
      - *Haemonchus contortus* and *Haemonchus placei* (Barberpole Worm)
        - **Primary importance**
      - *Ostratagia ostertagi* (Brown Stomach Worm)
      - *Trichostrongylus axei* (Small Stomach Worms)
    - **Small intestines**
      - *Nematodirus spathiger* (Threadneck Intestinal Worm)
      - *Cooperia punctata* and *Cooperia oncophora* (Small Intestinal Worms)


Ostratagia ostertagi

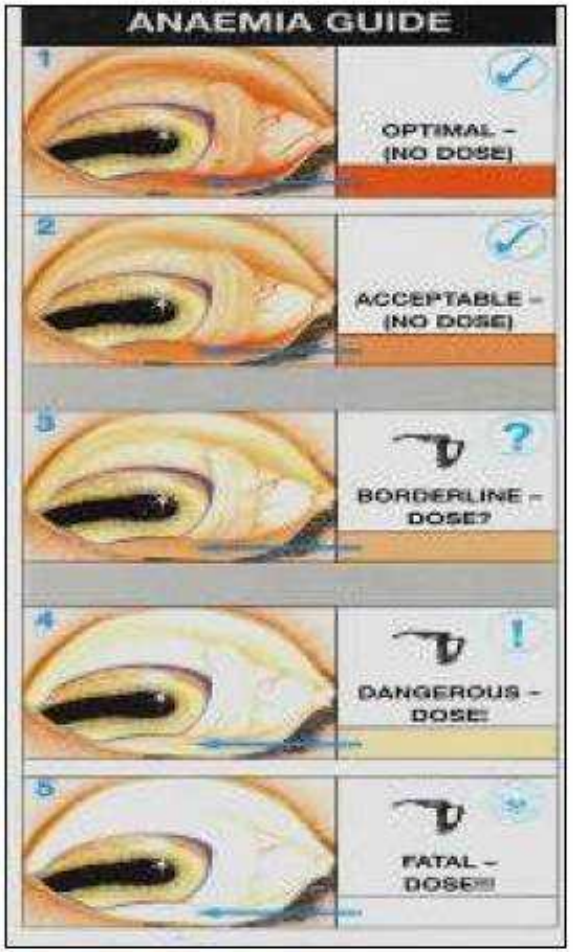

Haemonchus contortus

Parasites of Sheep and Goats

- **Other significant parasites**
  - Lung worms
    - ***Dictyocaulus filaria***
  - Liver flukes
    - ***Fasciola hepatica***
  - Coccidia
    - ***Eimeria spp.***

FAMACHA

- **FAMACHA is a system for classifying animals in categories based on level of anemia**
  - Uses a scale of 1 to 5 by examining the eyelids of sheep and goats
  - Treat only animals showing signs of anemia to reduce resistance to antiparasitic medications
  - FAMACHA is only effective for the treatment of Haemonchus



Common Antiparasitic Drugs for Use in Goats

Generic Name	Avermectins	Levamisol	Moxidectin	Albendazole	Fenbenda-zole	Morantel tartrate
Drug Names Use in Goats	Ivermectin, Extra-label use	Levasole Extra-label use	Cydectin Extra-label use	Valbazen Extra-label use	Panacur Safe-Guard Approved for goats	Rumatel Nematal Approved for goats
Dose	400 µg/kg	12 mg/kg	400 µg/kg	20 mg/kg	5 mg/kg	10 mg/kg
Dosage Forms	Injectable Pour on, paste, bolus	Drench Bolus Paste Injectable Pour on Feed	Pour on Injectable	Drench paste	Liquid drench, paste, feed block, bolus	Bolus, feed
Slaughter Withdrawal	35 – 48 days	10 days	23 days	7 days	6 days	30 days

Common Antiparasitic Drugs for Use in Sheep

Generic Name	Avermectins	Levamisol	Moxidectin	Albendazole
Drug Names Use in Goats	Ivermectin, Approved for sheep	Levasole Approved for sheep	Cydectin Extra-label	Valbazen Approved for Sheep
Dose	200 µg/kg	8 mg/kg ***Do not use in third trimester***	400 µg/kg	7.5 mg/kg ***Do not use in first trimester***
Dosage Forms	Injectable Pour on, paste, bolus	Drench Bolus Paste Injectable Pour on Feed	Pour on Injectable	Drench paste
Slaughter Withdrawal	11 days	3 days	23 days	7 days

General Sensitivity of Common Parasites to Antiparasitic Drugs for Sheep and Goats

Generic Name	Avermectins	Levamisol	Moxidectin	Albendazole	Fenbenda-zole	Morantel Tartrate
Ostertagia Type 2	All mature and immature	Not effective	Not effective	All mature and immature	All at 10 mg level	Some
Cooperia	Variable response		All mature and immature	All mature and immature	All mature and immature	
Lungworms	All mature and immature	All mature and immature	Not effective	All mature and immature	All mature and immature	Not effective
Tapeworms	Not effective	Not effective	Not effective	All mature and immature	All mature and immature	Not effective
Flukes	Not effective	Not effective	Not effective	All mature and immature	Not effective	Not effective
Haemonchus	Effective	Effective		Effective	Effective	

Integrated Parasite Management

- **Resistance develops more commonly in sheep in goats**
- **Must use additional techniques to reduce reliance on antiparasitic medications**
  - Good management – use feeders rather than feeding sheep on the ground
  - Use of clean pastures – pastures that have not been grazed by sheep or goats for 6 – 12 months
  - Pasture rotation
  - Grazing strategies – graze taller forages, larvae are typically found in the first two inches of grass
  - Healthy soil – earthworms will ingest larvae and clean the pastures
  - Nutritional support – sheep and goats on a higher plane of nutrition have stronger immunity against parasites