**ANTINEMATODAL DRUGS**







**Benzimidazoles**

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| Ruminants | Equine | Canine |
| G.I nematodes* Haemonchus spp.
* Trichostrongylus spp.
* Bunostomum spp.
* Oesophagostomum spp.
* Strongyloides spp.
 | * Most large strongyles
* Cyathostomes
* Mature oxyuris equi
* Small pinworms (probstmayria vivipara)
* Trichostrongylus axei
* Strongyloides westerni
* Equine ascarids are susceptible

 **No activity against bots**  | Given at low doses for control of: * Hookworms
* Ascarids
* Whipworms

**Large, single doses are ineffective** |

* **Albendazole** and **Clorsulon** (Curatrem®) are "legal" drugs available for treatment of **liver flukes** in **cattle** in the United States.
* **Albendazole** is approved for **beef** and **non-lactating dairy cattle**; while **clorsulon** is approved for **beef** and **lactating** as well as **nonlactating** **dairy** **cattle**.
* Combination of **clorsulon** with **ivermectin** (Ivomec-F® or Ivomec Plus®) was designed for simultaneous treatment of **Fasciola** and **nematodes** in **cattle**.
* The combination is a **SC** injectable formulation.
* **Thiabendazole**: have good **antifungal** properties.
* It may be combined with **oral** **diethylcarbamazine** (DEC) (Filaribits Plus®). Used for control **of chronic infections** of **hookworm**, **roundworms**, **heartworms**/**pinworms** in **dogs**.  The use of this drug has been associated with hepatotoxicity, so client education is important.

**Probenzimidazoles**

* **Netobimin (Hapadex)**
* **Febantel (Rintal)**
	+ Are pro-drugs
	+ Have no direct anthelmintic activity in vivo
	+ **Netobimin** and **febantel** are converted in the GIT to **albendazole** and **fenbendazole** respectively, and their subsequent sulfone and sulfoxide metabolites.
	+ There is cross resistance between the probenzimidazoles and the other benzimidazoles.

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| **Netobimin** | **Febantel** |
| * Has **nematocidal** activity in **horses** and **ruminants**
* Also has **cestocidal** and **fasciolicidal** activity in **ruminants**.
* Anthelmintic activity is due to albendazole, (the active drug).
* Effective against **common GI nematodes** (including hypobiotic larvae of Osteragia ostertagi), **lungworms** and **Fasciola hepatica**.
* In **horses**, it is effective against **ascarids** including **large strongyles** and **cyathostomes**.
 | * A pro-drug
* Approved for use in **horses**, **dogs**, and **cats**.
* Has broad-spectrum efficacy against **nematodes** of **ruminants**, **swine**, and some **zoo animals**.
* Has a wide margin of safety similar to the benzimidazoles.
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**Imidazothiazoles (Cholinergic Agonists)**

**Levamisole** (Levasole®, Tramisol(R), Tolalon (R), Citarin-L Spot-on(R))

**Butamisole HCl** (Styquin®)

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| **Butamisole** | **Levamisole** |
| * An injectable used in **dogs** for **whipworm** and **hookworm** infections.
 | * Broad range of activity in numerous host species (**sheep**, **cattle**, **swine**, **horses**, **chickens** and **dogs**).
* Levamisole has the advantages of being effective against **nematodes** of the **lungs** and **GIT**.
* Its optional routes of administration are oral, parenteral, or topical.

**Cattle/Sheep:** * **GI parasites**, adult and larval stages.
* **Lungworms** of **ruminants**
* **Eyeworms** (**Thelazia) of cattle**

**Swine**: * Oral levamisole is effective in eliminating 99% of **ascarids**, **threadworms** and **lungworms**.
* Nodular worm is also expelled; kidney worms are removed from the urinary tract also.

**Dogs**:* Is not approved for use in the USA,
* It is not effective against canine whipworms.
* Has a bad taste

  **Horses**: * Questionable efficacy against most strongyles.
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**Tetrahydropyrimidines**

**Pyrantel** (pyrantel tartrate, pyrantel pamoate, morantel tartrate)

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| **Dogs** | **Cats** | **Cattle** | **Horses** |
| Single dose of **5mg/kg** of pyrantel pamoate is effective against **hookworm** and **ascarids**Efficacy is inconsistent in pups less than 1kg in weight, hence higher dose (15mg/kg) is recommended 30 minutes after a light meal. Clinically safe for pups and can be used from 2 weeks of age to control parasites acquired prenatally or lactogenically. Limited efficacy against whipworms  | Pyrantel pamoate (**20mg/kg**) is effective against the **hookworm** and **ascarids**  Pyrantel pamoate (20mg/kg) is combined with praziquantel (5mg/kg) in tablet form (Drontal®) to control hookworm, ascarid and tapeworm infections in cats and dogs  | All major **GI parasites** except **Oesophagostomum** spp. and **Chabertia** spp. | Good for treatment of **ascarid** and **Strongylus vulgaris** infections Effective for many Cyathostomes including those resistant to benzimidazole Effective at 2X the therapeutic dose (i.e. 13.2 mg/kg) effective for Anoplocephala perfoliata (tapeworm)  But of very limited use against bot-fly larvae (Gasterophilus spp.).  |

Hookworms- (Ancylostoma tubaeforme)

Ascarids- (T. cati).

**Hookworm** (Ancylostoma caninum, Uncinaria stenocephala)

**Ascarids** (Toxocara canis, Toxascaris leonina)

* Eliminated rapidly &toxicity is low due to poor absorption and rapid elimination.

**Macrocyclic Lactones (Macrolide Endectocides)**

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* **Avermectins**
	+ Ivermectin
	+ Abamectin
	+ Doramectin
	+ Eprinomectin
	+ Selamectin
* **Milbemycins**
	+ Milbemycin
	+ Moxidectin
* These drugs have activity against both internal and external parasites, specifically **nematodes** and **arthropods**.
* They have **no activity against cestodes, trematodes, or protozoa.**
* Dogs of the **Collie breed** and certain lines of **Australian Shepherds** appear to be unusually SENSITIVE to certain macrocyclic lactones antehlemintics.

**Avermectins**

* + Main drug in this group is **IVERMECTIN**
	+ **(Cardomomec®, Double impact®, Equimectrin®, Eqvalan®, Heartgard-30®, Ivomec®, Mectizan®, Oramec®, Rotectin 1®, Topline®, Ultramectrin®, Zimecterin®).**

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* + Ivermectin is a semi-synthetic derivative of avermectin.

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* + It has broad spectrum of activity against a wide variety of arthropods and  nematodes of domestic animals and humans.
* normal dose = 200 μg/kg (oral)
* toxic dose = 2000 μg/kg  Signs of toxicity include:

 ataxia, depression, visual impairment.

* Ivermectin IS EFFECTIVE IN ELIMINATING the following
	+ All **major GI and lung nematodes**, and certain **ectoparasites** of cattle, sheep, horses and swine;
	+ **Intestinal nematodes**, **ear mites**, and **sarcoptic mange of dogs**;
	+ Infective-stage **heartworm** and **microfilariae** of dogs; and
	+ Certain **GI nematodes and ectoparasites of chickens**.

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| **Species** | **Dose** | **Indications** | **Other** |  |
| **Cattle & Sheep** | 0.2mg/kg  (Orally) | Adult & 4th-stage larvae : Haemonchus, Ostertagia,(Cooperia, Trichostrongylus, Strongtloides, Bunostomum, Nemtodirus, Trichuris, Oesophagostomum, Dictyocaulus, and Chabertia ovina. Arthropods affected include oestrid larvae, mites, and sucking lice. Ticks | Eliminated in the faeces |  |
| **Horses** | 0.2mg/kg  (Orally) | Adult & 4th –stage larvae of cyathostomes, large strongyles, ascarids, pinworms, stomach worms, threadworm, lungworm, migrating or stomach-attached stages of bots, and Onchoceca microfilariae. |  |  |
| **Swine** | 0.3mg/kg  (SC) | Immature and adult stages of most intestinal worms (but not muscular stages of Trichinella spiralios), lice and mange mites. | Treatment of pregnant sow is effective in preventing transmission of S. ransomi to piglets via colostrums. |  |
| **Dogs** | These drugs are all **chewable formulations** designed to be given **once monthly** at a dosage of ≥0.006 mg/kg. |  | NOTE although ivermectin is an effective microfilaricide, it is not approved for this purpose. It is ONLY approved as a preventative.  It is also used in preventing transmission of ascarids and hookworms to pups via colostrums.  | **Heartgard-30, Heartgard** and **Heartgard-30 Plus** are approved as a heartworm preventative Heartgard-30 Plus in addition to ivermectin, also contains pyrantel pamoate which is effective **against hookworm and ascarids.**  |
| **Cats** | ≥0.024 mg /kg.  | Approved as a heartworm preventative.  |  |  |

**Heterocyclic Compunds**

**Phenothiazine**

* Has wide range of efficacy against **G.I. nematodes**
* Use in ruminants (sheep, goats and cattle), horses and chicken but
* **NOT** in swine, dogs, cats and human because of toxicity.

**Piperazine**

* Good efficacy against **ascarid** and **nodular worm** infections of **all** species of **domestic** **animals**.
* Has a wide margin of safety in all animals.
* **Horses**: Use against **cyathostomes** . Has bad taste and must be given via stomach tube.
* **Dogs & Cats**: Effective only for **ascarids**
* Effective in removing more than 90% of T. canis infections in pups aged 2 to 8 weeks.
	+ - Combining piperazine with thenium closylate (Thenatol®) increases the efficacy against ascarids.

* **Cattle & Sheep: Oesophagostomum**(nodular worm of sheep)

**Organophosphate Compounds (Ach Inhibitors)**

* **Dichlorvos**
* **Haloxon**
* **Coumaphos**
* **Trichlorfon**

**Signs of mammalian toxicity include:**

 -  increased urination/defecation

 -  vomiting

 -  increased lacrimation

 -  salivation and

 -  muscular twitching

**Contraindications to OP use in  animals**

* + - treatment with the same and different OP within a few days of the previous treatment.
		- concurrent use of muscle relaxants e.g. succinylcholine.

**Treatment of Toxicity**

 -  with atropine or 2-PAM (pyradine-2-aldoxime)