



## Importance of Anti-Parasitic drugs in Animal Health and Production

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### Content



- Introduction
- Spectrum of parasites
- Economic relevance of parasites
- Parasite control and economic impact



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## Introduction



**Parasitism:** A two-species association in which one species, the parasite, lives on or in a second species, the host, for a significant period of its life and obtains nourishment from it.

- Important features of the host-parasite relationship:
  - Parasitism always involves two species, **parasite** and **host**.
  - Many parasitic associations produce pathological changes in hosts that may result in disease.
  - Successful treatment and control of parasitic diseases requires not only comprehensive information about the parasite itself but also a good understanding of the nature of parasites' interactions with their hosts.
  - The **parasite** is **always** the **beneficiary** and the **host** is **always** the **provider** in any host-parasite relationship.



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Parasites and Parasitic Diseases of Domestic Animals  
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## Introduction



Traditionally regarded as parasites:

- protozoa, arthropods, helminths

Broader definition of parasites:

- all infectious agents of animals, i.e. viruses, bacteria and fungi as well as the arthropods, helminths and protozoa; can be further divided into microparasites and macroparasites



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## Spectrum of Parasites



A female **mosquito** blood feeding. Mosquitoes serve as intermediate hosts of other parasites such as **Dirofilaria immitis** the dog and cat heartworm and **Plasmodium** species causing malaria in humans and birds. They are also vectors of viruses causing yellow fever and encephalitis.



A cluster of **nematodes**, the roundworm of dogs, **Toxocara canis**. This parasite is common in puppies and may be transmitted transplacentally as well as to nursing pups in their mother's milk. This parasite has public health importance as a cause of visceral larva migrans in man.



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## Spectrum of Parasites



**Fleas** are common parasites of dogs and cats. They bite their hosts and feed on blood. Fleas are intermediate hosts of the tapeworm *Dipylidium caninum* and the filarid nematode *Dipetalonema reconditum*. The cat flea is a vector of feline parvovirus.



**Fasciola hepatica**, the liver fluke of ruminants. The parasite has a complex life cycle involving snail intermediate hosts. Migration of developing flukes in the host liver provokes an intense inflammatory reaction with severe liver damage.

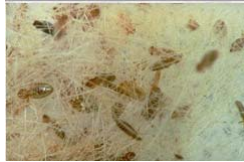


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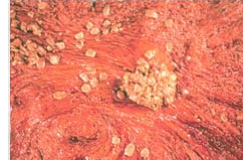
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## Spectrum of Parasites



**Hematopinus suis**, the blood-sucking louse of swine is common in pigs raised indoors with transmission readily occurring from pig to pig. Infested pigs are restless and rub their skin frequently to relieve the itching.



**Anoplocephala perfoliata**, a tapeworm of horses, is often found in clusters at the ileo-cecal junction. It is widespread in distribution and usually benign. However, cecal abscesses, and intussusceptions have been reported.

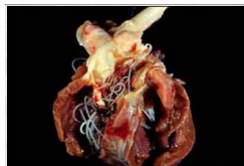


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## Spectrum of Parasites



The nematode **Dirofilaria immitis**, the heartworm has a complex life cycle involving mosquitoes as intermediate hosts. These worms are found in the cardio-pulmonary circulation and may cause severe heart disease in dogs and cats.



The protozoan **Giardia** is important as a cause of diarrhea in dogs and cattle but is also found in other domestic animals as well as man. The trophozoite stage, shown here, attaches to the mucous epithelium cells of the small intestine.



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## Spectrum of parasites



Parasites in fish include external parasites (shown above: isopod *Anilocra gigantea*), leeches, nematodes, cestodes, flukes, carp lice and salmon (sea) lice. *Tetracapsuloides bryosalmonae*, a myxozoan parasite causes Proliferative kidney disease (PKD) in salmonids.

Sea lice are marine ectoparasites (external parasites) that feed on the mucus, epidermal tissue, and blood of host marine fish. *Lepeophtheirus salmonis* and various *Caligus* species are adapted to saltwater and are major ectoparasites of farmed and wild Atlantic salmon. Several antiparasitic drugs have been developed for control purposes.



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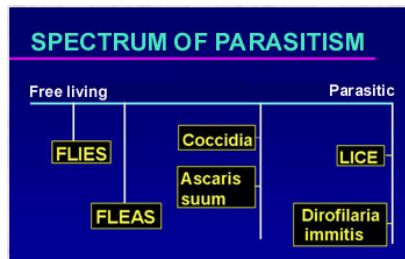
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## Spectrum of Parasites



Not all parasites are equally parasitic – parasitism can be seen as a spectrum

- Free living, seeking a host only to feed
- Cannot survive without a host at any stage of their life cycles



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## Why Do Parasites Matter?



Disease  
and Death



Production  
Loss



Zoonotic  
Potential



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## Consequence of parasite infections - animal health and productivity



- Reduced growth rates (including meat production)
- Reduced reproductive rates
- Reduced milk production
- Reduced fleece weight, fibre diameter and staple strength
- Behavioural changes, e.g. through flies, which annoy animals, causing reduced grazing behaviour and agitation
- Condemnation of carcass parts at slaughter
- Damaged hides and fleeces
- Increased maintenance feed consumption
- Increased susceptibility to infections
- Diseases transmitted by the parasite
- Pain



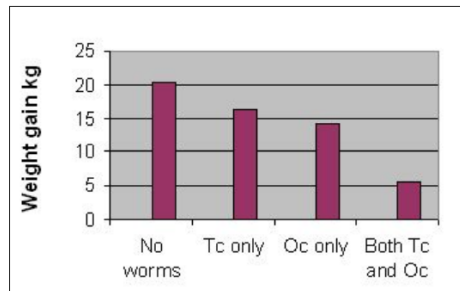
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## How big is the loss?



- Experimental infection in sheep with *Trichostrongylus* and *Ostertagia* – influence on weight gain over study period



(Tc = *T. colubriformis*; Oc = *O. circumcincta*. Data from Steel et al. 1982, Aust J Agric Res, 33, 131)



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## How big is the loss?



- Fasciolosis: Worldwide losses in animal productivity in 1999 estimated at over US \$ 3.2 billion per year
- Ticks: estimated productivity losses caused each tick

Tick species	Live-weight-gain loss (g)	Milk loss (g)
<i>Amblyomma hebraeum</i> (Norval et al., 1989)	10	7
<i>Amblyomma variegatum</i> (Pegram & Oosterwijk, 1990)	45-60*	-
<i>Amblyomma americanum</i> (Barnard, 1985)	16-29	-
<i>Amblyomma maculatum</i> (Williams, Hair & McNew, 1978)	33	-
<i>Boophilus microplus</i> (Sutherst et al., 1988)	0.6-1.5	-
<i>Rhipicephalus appendiculatus</i> (Norval et al., 1988)	4	7
<i>Rhipicephalus appendiculatus</i> (de Castro et al., 1985b)	NSD	-

- Cattle - worldwide: 80% of the population at risk from ticks and tick-borne diseases; losses: US \$7 billion (McCosker, 1979).



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## How big is the loss?



- Ticks, USA: eradication campaign for *B. microplus* and *B. annulatus* successfully completed in 1947, at a cost of US \$ 53.5 mio (at 1953 prices).  
Estimated benefit-cost ratio of the eradication: 140:1
- Ticks in cattle, Argentina(1992): cost of tick infestation: US \$ 154.6 mio for weight loss, death and hide damage,  
cost of tick control and tick fever vaccine: US \$ 34.9 mio
- Parasitic diseases in sheep and cattle: the annual cost in Australia estimated at US \$ 1 billion (2010)
- Africa and Middle East: estimated losses  
Endoparasites: > 3 billion US \$/Year direct and indirect losses  
Ectoparasites: > 2 billion US \$/Year direct and indirect losses (incl. tick borne diseases)



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## Controlling parasites



- Different strategies in livestock and companion animals
- Companion animals: most owners do not tolerate any parasites - chemotherapy
- Livestock: not economical or even possible to prevent all parasites. Aim is to minimise parasites to reduce economic loss



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## Controlling parasites



### Prevention of parasitic infections

- Management of pastures and animals, including monitoring of resistance
- Vaccines
- Routine chemotherapy treatment

### Treatment of manifest infections

- Curative treatment - chemotherapy



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## Antiparasitic drugs



- Ectoparasiticides
- Endectocides
- Ectoparasiticides
- Effectively kill or remove adult and immature parasites
- Safe
- Easy to administer
- Economic for the producer
- Practical withdrawal periods



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## Ectoparasiticides



### Chemical control of Ectoparasites

- Organochlorines
- Organophosphates (e.g. Coumaphos, Trichlorfon)
- Carbamates ( e.g. Propoxur )
- Synthetic pyrethroids (e.g. Flumethrin, Cypermethrin, Deltamethrin)
- Amidines ( e.g. Amitraz, Cymiazole)
- Macrocyclic lactones ( e.g. Ivermectin, Doramectin, Moxidectin)
- Insect Growth Regulators (e.g. Fluazuron)
- Pyrazole group ( e.g. Fipronil)
- Spinosad



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## Ectoparasiticides



### Available formulations

- Dips (herd treatment)
- Spray (spray races - herd treatment, hand sprayer - fewer animals)
- Dust (few animals)
- Pour-on (herd treatment)
- Injectables (herd treatment)
- Ear tags (herd treatment)
- Pheromone or acaricide impregnated devices, e.g. tail band (few animals)



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## Endoparasites



### Chemical control of Endoparasites - Anthelmintics

#### Antinematodes

- Benzimidazoles and Pro-benzimidazoles (e.g. fenbendazole, albendazole, oxbendazole, febantel)
- Imidazothiazoles (e.g. levamisole)
- Tetrahydropyrimidine (e.g. pyrantel)
- Piperazines
- Organophosphates (e.g. trichlorphon)
- Octadepsipeptides (e.g. emodepside)
- Aminoacetonitrile derivatives (moxidectin)
- Spiroindoles (derquantel, only in combination with abamectin)



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## Endoparasites



### Chemical control of Endoparasites – Anthelmintics

#### Anticestodes

- Praziquantel
- Epsiprantel
- Benzimidazoles

#### Antitrematodes

- Clorsulon (benzenesulphonamide)
- Nitroxylnil (halogenated phenols)
- Salicylanilides ( e.g. closantel, rafoxanide)
- Triclabendazole



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## Endoparasites



### Chemical control of Endoparasites

#### Anticoccidials

- Ionophores (e.g. monensin, lasalocid)
- Amprolium
- Diclazuril
- Toltrazuril
- Quinolones (e.g. decoquinatate)

#### Antiprotozoals

- Imidocarb dipropinate
- Diminazene aceturate
- Isometamidium
- Quinapyramine
- Pantamidines\*
- Buparvaquones\*

\* human medicines



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## Endectocides



### Chemical control of endo and ectoparasites (chemical group available: Macrocyclic lactones)

- Ivermectin
- Doramectin
- Eprinomectin
- Moxidectin
- Abamectin
- Selamectin
- Milbemycin oxime

Large spectrum:  
intestinal worms, lung worms,  
ectoparasites: mange, lice,  
oestus ovis, parafilaria,  
Thelazia, Horn flies  
(Cochliomyia), Hypoderma  
bovis, Ticks (Boophilus spp)



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## Challenge



### Development of resistance

- Few new classes of antiparasitics have become available (emodepside – cats only, monepantel – sheep, derquantel – sheep)
- Monepantel-resistance is already emerging
- Integrated pest management and management of resistance is imperative to maintain efficacy of products.



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## Vaccines



- Anticoccidial vaccines for poultry
- Antileishmanial vaccine for dogs
- Antitick vaccines
  - Historically: Recombinant vaccine against *Boophilus* TickGARD, TickGARD Plus (Australia), Gavac, Gavac Plus (Cuba)
  - Current: None
  - Future: research ongoing

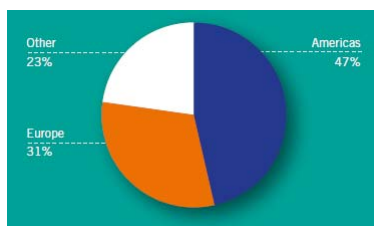
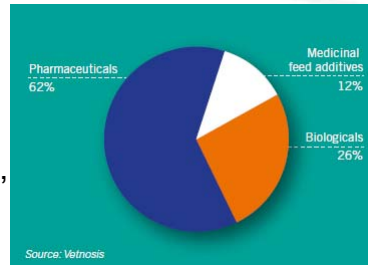


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## Global animal health market in 2013

- Total value in 2013: 23 billion US \$
- Antiparasitics part of Pharmaceuticals, traditionally about 28%, i.e. 6.4 billion US \$



- Americas region represents nearly half the global market
- Food animals account for 59% of the global market



Source:  
IFAH Annual Report 2013  
at [www.ifahsec.org](http://www.ifahsec.org)

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## Thank you for your attention!



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