

Chapter 7

**Host-parasite relationship, Harms done
by different types of parasites to hosts**

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A. Host parasite relationship:

The term host-parasite relationship refers to the relationship between the host and the parasite and the competition for supremacy that takes place between them. If the host has upper hand, due to increased host resistance it remains healthy and the parasite is either driven away or assumes a benign relationship with the host. On the contrary, if the host loses the competition (may be due to increased pathogenicity), disease develops. Thus disease is the outcome of competition between host and the parasite. Disease is generally considered as any change from the general state of good health. But this does not present true scientific nature of disease, since general state of good health may also be changed by a factor, other than parasite.

(Note : For further details on host parasite relationship and different phenomena, readers are requested to refer to Chapter 2 of the Course VPA-211 entitled Symbiosis, Phoresy, Commensalism, Mutualism, Parasitism, Predatorism)

B. Harms done by different types of parasites to hosts:

(following text is from: Gaffar, S. M., Howard, W.E., Marsh, R.E. 1985. (ed) Parasites, Pests and Predators. World Animal Science. B2. Disciplinary Approach. Elsevier. Oxford. Readers are requested to refer to this document for further details)

Parasites are considered to produce harmful effects on their hosts by two different ways:-

1. **Direct effects** in the host tissues as a result of those parasitic activities associated with establishment, feeding and multiplication.
2. **Indirect effects** which accompany the infections; these often influence productivity and the well being of the host more than the direct effects.

1. Direct effects:

a. Tissue feeding

Because of their size, many parasites destroy or **consume host tissues**. The

important ruminant parasites are of this sort. *Haemonchus contortus*, the abomasum dwelling nematode is a voracious blood sucker. When these parasites are present in any sizeable numbers, they can virtually exsanguinate the host, often resulting into heavy mortality, particularly in lambs, also in older sheep. Nematodes like *Bunostomum* or *Chabertia* are tissue grazers. They ingest plugs of mucosal tissues as they feed. This naturally results in loss of tissue, but also gives rise to denuded gut areas which bleed and can serve as avenues for entry of other types of infectious organisms.

b. Blood loss and functional deficiencies

Many of the trematodes are also tissue ingestors. *Fasciola gigantica* or *F. hepatica* consumes large quantities of blood resulting into severe **anaemia**. These parasites possess spines on their tegument. Because of their spines, they produce irritation to the delicate mucosal or serosal surfaces with which they may come into contact. Consequent to the feeding and irritation, there occur structural changes in the affected areas. This in turn leads to parasitism by causing **functional deficiencies**.

c. Calcification of bile duct and gut wall

Dicrocoelium dendriticum, a trematode parasite which lives in the bile ducts of sheep and cattle, can produce **calcification in the bile duct walls**. Fourth stage larvae (L₄) of *Oesophagostomum columbianum* (nodular worm) of sheep and goat because of their irritative effects in the mucosa of the ileum, caecum and colon lead to **formation of calcified nodules** which can interfere with digestion .

d. Anaemia, skin irritation and loss of hide quality by arthropods

Parasitic arthropods are also tissue and blood consumers. Heavy infestation with cattle louse *Haematopinus eurysternus* can lead to severe **anaemia** in young cattle with weight loss. Biting lice can cause severe **irritation**, inflammation and leakage of serum from the damaged skin. *Sarcoptes scabiei* mite causes severe **damage to the skin** due to their piercing and browsing habits. These adversely influence the health of the host and also interfere with the quality of the hides produced.

e. Myiasis

Larvae of some Dipteran flies infest the body of some hosts. They produce a condition known as **Myiasis**. The nasal bot fly of sheep *Oestrus ovis* causes irritation and influences

the well being of these animals. The warble flies (*Hypoderma* species) cause injury and weight loss when the animal runs to escape, cause lower weight gains and severely damage hides from perforations caused by the larvae. Screw worms (*Cochliomyia bezziana*) seriously affect livestock production in the Far East and India.

f. Damage due to tissue migration

Many parasites in their course of development undergo migration in the tissues of their hosts. This results in damage to the tissues, which in some cases produces profound effects if the migration involved a primary organ like the brain. In cattle, lungworm larvae, *Dictyocaulus viviparus* extensively **damage the lung tissues** as they migrate out of the blood vessels and into the alveoli, small bronchioli and bronchi. *Acsaris suum* larvae can severely **damage the liver and lungs of pigs** as they migrate from the gut to the lungs. *Trichinella spiralis* larvae cause a **severe myositis** as they migrate through the muscles of their hosts. Strongyle worm *Strogylus vulgaris* in horse migrate in the walls of arteries like the anterior mesenteric artery where they often lead to **aneurysm** and resultant attack of **colic** in affected horses. As a result of these migrating activities, some parasites also serve to introduce other types of organisms.

g. Introduction of bacterial or viral organisms

Some parasites may introduce bacterial or viral organisms into its host. For example, *Metastrongylus apri*, the lung worm of pig and its association with **swine influenza virus** and *Fasciola hepatica* and its association with **bacteria** *Clostridium novyi* can produce Black disease in sheep.

h. Anaemia , haemorrhage, diarrhea, abortion by protozoan parasites

Protozoan organisms like *Babesia* species that inhabit erythrocytes often lead to rupture of these cells and the development of hemolytic **anaemia**. Coccidian parasites e.g., *Eimeria tenella* in poultry cause **disruption of mucosal cells** leading to **hemorrhage, desquamation of large areas of mucosa** and consequent **diarrhea, loss of condition** and often **death**. Some protozoan organisms also have migratory activity in their hosts. The cyst forms of *Toxoplasma gondii* are found in a variety of tissues in the body of their hosts, including the brain which in some animals can have serious consequences. *Sarcocystis fusiformis* can cause **abortion** in cattle.

i. Mechanical obstruction, exerting pressure, atelectasis, emphysema

Due to large size of the parasites, many of them can produce **mechanical obstruction** in various organs. Trematode parasites in bile duct can **obstruct the flow of bile**. Large number of *Ascaris* parasites can cause **mechanical obstruction of the gastrointestinal tract**. Pressure from tapeworm cysts for example, Hydatid cyst can interfere with the normal functioning of the organs. Lung worms, *Dictyocaulus viviparus* can produce blockage of bronchi leading to **atelectasis** and **emphysema** in the affected lung tissue. Some adult cestodes e.g., *Moniezia expansa* in heavy infection can block the gastrointestinal passage.

j. Alterations in important enzymes and change of pH

Damage to the gastrointestinal mucosa of ruminants by nematode parasite can lead to a variety of pathological disturbances. The pH of the abomasum may shift from highly acidic to neutral or alkaline. Serum pepsinogen levels may be elevated and there may be leakage of albumen leading to a hypoproteinemia. There may be reduction in the quantities of important intestinal enzymes like maltase and alkaline phosphates. Often there is hypoglycemia and hypophosphataemia.

k. Deficiency in nutrient absorption

The harmful effects on the mucosa of the gastrointestinal tract usually lead to problems with nutrient absorption which can lead to nutrient imbalances in the host. Metabolic processes may also be disrupted, and loss of nutrients by leakage may occur. Energy balances may be significantly depressed in clinical and subclinical infections by *Trichostrongylus* spp. Derangement of nitrogen economy is principally responsible for the decrease in productive efficiency. This was due to leakage of plasma proteins into the gut and led to secondary endocrine responses which in turn results in reduced muscle protein synthesis and wool.

l. Host's immune resistance to parasites /Immunopathology

Host immune reactions to parasites involve not only those referable to protection of the host but importantly, from a pathological standpoint, include hypersensitivity or allergic type of responses. In some instances of parasitism these latter responses may be very important in the pathogenesis of these conditions. Associated with the migratory phase of many parasitic worms is stimulation of a cell-mediated response that leads to granuloma formation in the affected organs. The formation of immune complexes with their consequent effects on such organs as the kidneys and the liver may be highly significant in such diseases as trypanosomiasis.

Hypersensitivity reactions at the level of the mucosa exemplified by the “self

cure” phenomena in sheep and cattle to the infective larvae of some trichostrongyles trigger the release of the vaso active amine, histamine, which is an important mediator substance of inflammatory reaction.

In Trypanosomes the hemolytic anaemia that accompanies these infections is due to the uptake by the erythrocytes of fragments of the glycoprotein antigenic coat of the organisms that is shed as they evade the host immune system. These attract the host antibodies that have been produced in response to the parasite invasion resulting in a cytotoxic hemolytic reaction on the erythrocytes. These parasite glycoproteins may also activate complement and other mediators of the inflammatory process thus adding to the pathologic effects of this infection.

m. Host's immunosuppression

Some parasites also suppress the host's immunity. Protozoan parasites like **Trypanosomes have been shown to depress both the cell mediated and humoral immune responses in their hosts**. This benefits the parasitic organism but often renders the host more susceptible to infection by other types of infectious organisms.

n. Parasitic toxins

Various species of **ticks produce toxins** which cause paralysis in their hosts. Tick paralysis cause mortality occasionally in sheep and cattle and can be produced by relatively few ticks.

Some protozoa like **trypanosomes**, the excretion of the contents of lysosomal vacuoles may release a host of important enzymes like proteases, aminopeptidases, phosphatases, lipases and deoxyribonucleases and these in turn can adversely affect various systems in the host.

2. Indirect effects:

a. Parasites as vectors of bacterial or viral pathogens

Many arthropod parasites act as vectors of various disease producing organisms. These include a wide range of viral agents like the encephalitides and the arboviruses transmitted by such arthropods as mosquitoes. It also involves in the transmission of bacterial organisms like *Moraxella* and *Theileria* by ticks, the trypanosomes by tsetse flies and the filarial nematodes by mosquitoes and black flies (*Simulium*).

b. Facilitating other pathogenic agents

Many parasites create avenues of entrance for secondary invading organisms,

because of their traumatic effects on many of the natural barriers to infection like skin and mucosa. Outbreaks of swine influenza due to virus infection have been associated with the migratory activities of the lungworm *Meatastrongylus apri* and clostridial infections (a bacterial infection) of the liver in sheep have been associated with the migration of *Fasciola hepatica*.

c. Competing with host for essential elements/vitamins

Some parasites may compete with their hosts for nutrients. It has been demonstrated that *Diphyllbothrium latum* shows a selective uptake of Vit B₁₂ and this can on occasion lead to condition similar to pernicious anaemia in the affected host. It has also been suggested that competition for nutrients might be responsible for some of the poor rates of gain in lambs infected with cestode *Moniezia expansa*.

d. Nutritional drainage

Due to their feeding habits, parasites impose a nutrient drain on their host. This not only results in adversely affecting productivity but through weakening the host's protective capacity, renders them more susceptible to a variety of additional pathological insults both infectious and non-infectious. Heavily parasitized animals thus succumb more readily to relatively low challenges from viral and bacterial agents. Such animals are also unable to adapt well physiologically to environmental stresses like extreme cold. This is particularly important in border line situations where animals may be under nutritional or environmental stress. The superimposition of parasitic stresses in such situations may well result in severe production losses in meat, milk and fiber. Death of many of these animals is often a consequence.

e. Effect of irritation by external parasite

The irritative effect of many parasites, particularly the ectoparasites like lice, mites or even the biting flies can also have important indirect effects. There is the constant rubbing and other attempts by the animals to relieve the irritation. This leads to loss of hair or fleece and expose the animals to greater stress from environmental conditions, such as cold. It also renders them more susceptible to stress related diseases like pneumonia. Also there is loss of condition and productivity because of the need for additional nutrients to maintain homeostasis. Because of the irritation, these animals often spend less time feeding than necessary, further compounding the situation. Cattle warble flies (*Hypoderma lineatum*) can cause the run or 'gad' in the animals producing physical harm or losing condition because of the disruption of normal feeding.

References :

Gaffar, S.M., Howard, W.E., Marsh, R.E. 1985. (ed) Parasites, Pests and Predators. World Animal Science. B2. Disciplinary Approach. Elsevier. Oxford.