

**Phylum: Apicomplexa
(Sporozoa)
(Enteric coccidia)**

Dr. Dalia Ahmed

DVM, M.Sc., PhD.

Baghdad University/Veterinary Medicine College/Parasitology Department

Phylum:	Apicomplexa
Class:	Conoidasida
Order:	Eucoccidiorida
Family:	Eimeriidae
Genus:	<i>Eimeria</i>

Enteric Coccidia

G. *Eimeria*

G. *Isospora*

G. *Cryptosporidium*

G. *Cyclospora* (*Cystisosopora*)



Definition

Genus: *Eimeria*

- ▶ Intracytoplasmic
- ▶ Mainly enteric except:
 - *E.stiedae* (liver of rabbit)
 - *E.truncata* (kidney of goose)
- ▶ Affect all animals except dog and cat
- ▶ Causes a sever disease called: **Coccidiosis**



Hepatic coccidiosis

General Characters

- ▶ Monoxenous parasite
- ▶ Host specific
- ▶ Cell specific
- ▶ Multiplication of the parasitic stages occurs in:-epithelial cells of mucosa or may reach sub mucosa of the intestine
Except: *E.stiedae* & *E.truncata*.
- ▶ Multiplication is mostly intracytoplasmic except some species (*E.alabamensis*) which multiplies inside the nucleus.

Distribution

- ▶ Cosmopolitan
- ▶ Spreading of the disease increases in winter and spring(humidity)
- ▶ Intensive breeding farms are highly susceptible
- ▶ Infective stage: Sporulated oocyst



Mode of infection: Ingestion of sporulated oocysts.

Requirments of sporulation:

- *Oxygen
- *Adequate moisture (high humidity)
- *Temperature around 27°C
- Time required for sporulation:1-7 days(except: *Eimeria* of camel,17 days).
- Sporulated oocysts are more resistant to environmental conditions than unsporulated oocysts.



Eimeria oocysts, A- Unsporulated, B- Sporulated

Phases of Life Cycle

**Schizogony
(Merogony)**

Asexual Reproduction

Merozoites

**Gametogony
(Gamogony)**

Sexual Reproduction

Microgametocytes

Macrogametocytes

**Sporulation
(sporogony)**

Sporulation

Sporulated Oocyst

Sporulation

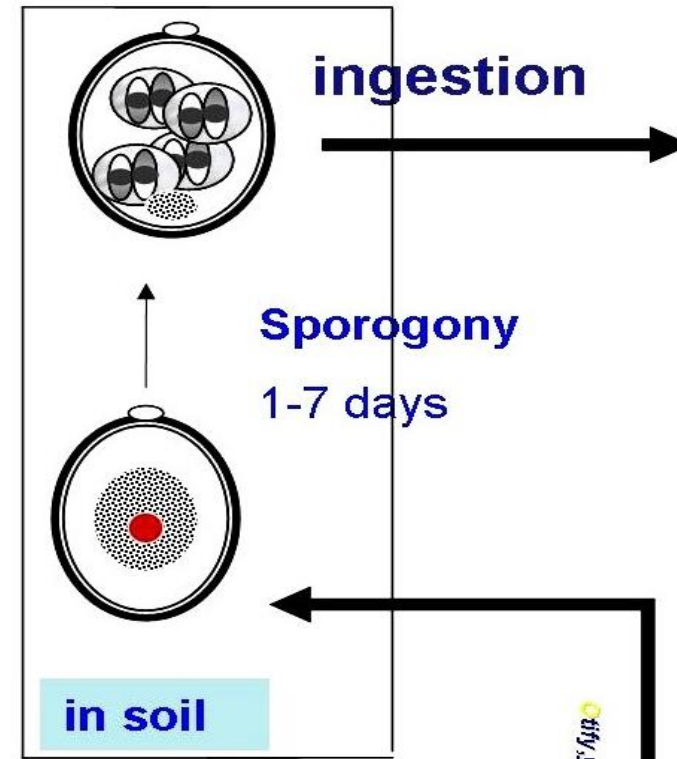
Unsporulated oocysts, consisting of a nucleus of protoplasm enclosed by a resistant wall, are passed to the exterior in the faeces.

Under suitable conditions of oxygenation, high humidity and temperatures of 27°C.

The nucleus divides twice and the protoplasmic mass forms four conical bodies radiating from a central mass. Each of these nucleated becomes rounded to form a sporoblast.

Each sporoblast secretes a wall of refractile material and becomes known as a sporocyst, while the protoplasm within divides into two banana-shaped sporozoites.

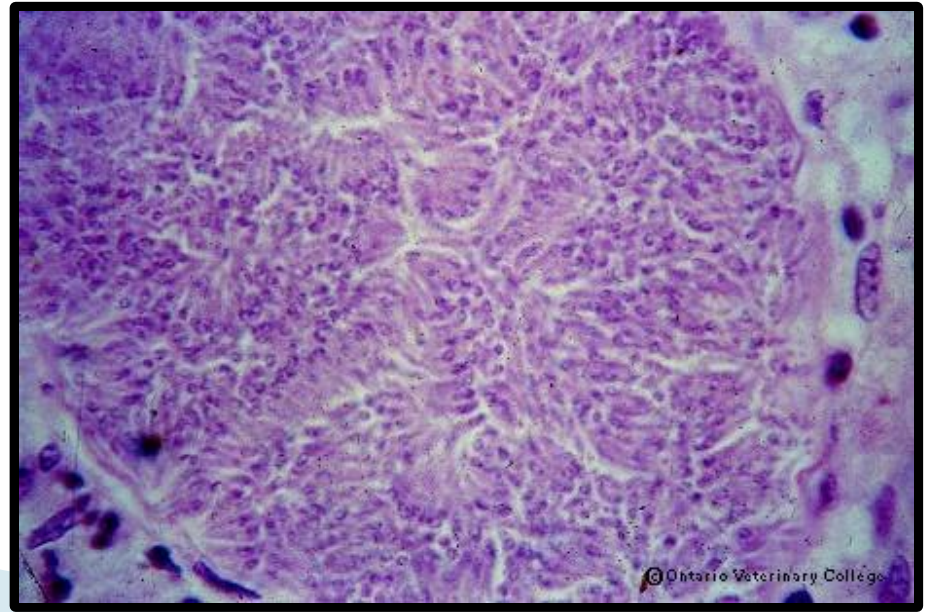
The time varies according to temperature, but under optimal conditions usually requires 2–4 days. The oocyst, now consisting of an outer wall enclosing sporocysts each containing sporozoites, is referred to as a sporulated oocyst and is the infective stage.



Infection and merogony (asexual reproduction)

The host becomes infected by ingesting the sporulated oocyst. The sporocysts are then liberated either mechanically or by carbon dioxide, and the sporozoites, activated by trypsin and bile, leave the sporocyst. Each sporozoite penetrates an epithelial cell, rounds up, and is then known as a trophozoite. After a few days each trophozoite has divided by multiple fission to form a meront (schizont), a structure consisting of a large number of elongated nucleated organisms known as merozoites. When division is complete and the meront is mature, the host cell and the meront rupture and the merozoites escape to invade neighbouring cells. Merogony may be repeated, the number of meront generations depending on the species.

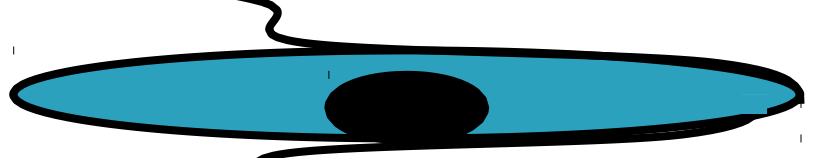
**First generation schizont
(meront), *E.bovis***



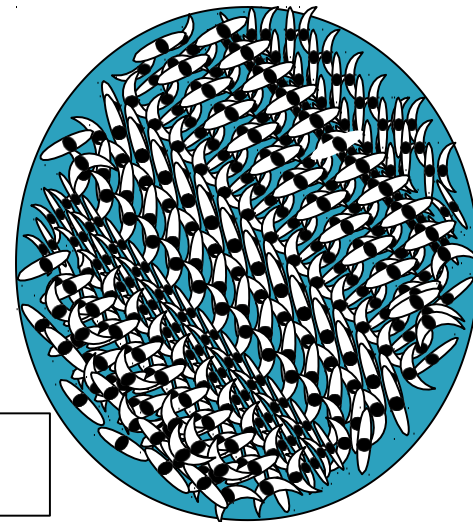
Gametogony and oocyst formation (sexual reproduction)

Merogony terminates when the merozoites give rise to male and female gametocytes.

The macrogametocytes are female and remain unicellular, but increase in size to fill the parasitised cell. They may be distinguished from trophozoites or developing meronts by the fact that they have a single large nucleus. The male microgametocytes each undergo repeated division to form a large number of flagellated uninucleate organisms, the microgametes. It is only during this brief phase that coccidia have organs of locomotion. The microgametes are freed by rupture of the host cell, one penetrates a macrogamete, and fusion takes place to form a zygote. A cyst wall forms around the resulting zygote, now known as an oocyst, then unsporulated oocyst is liberated from the body in the faeces.

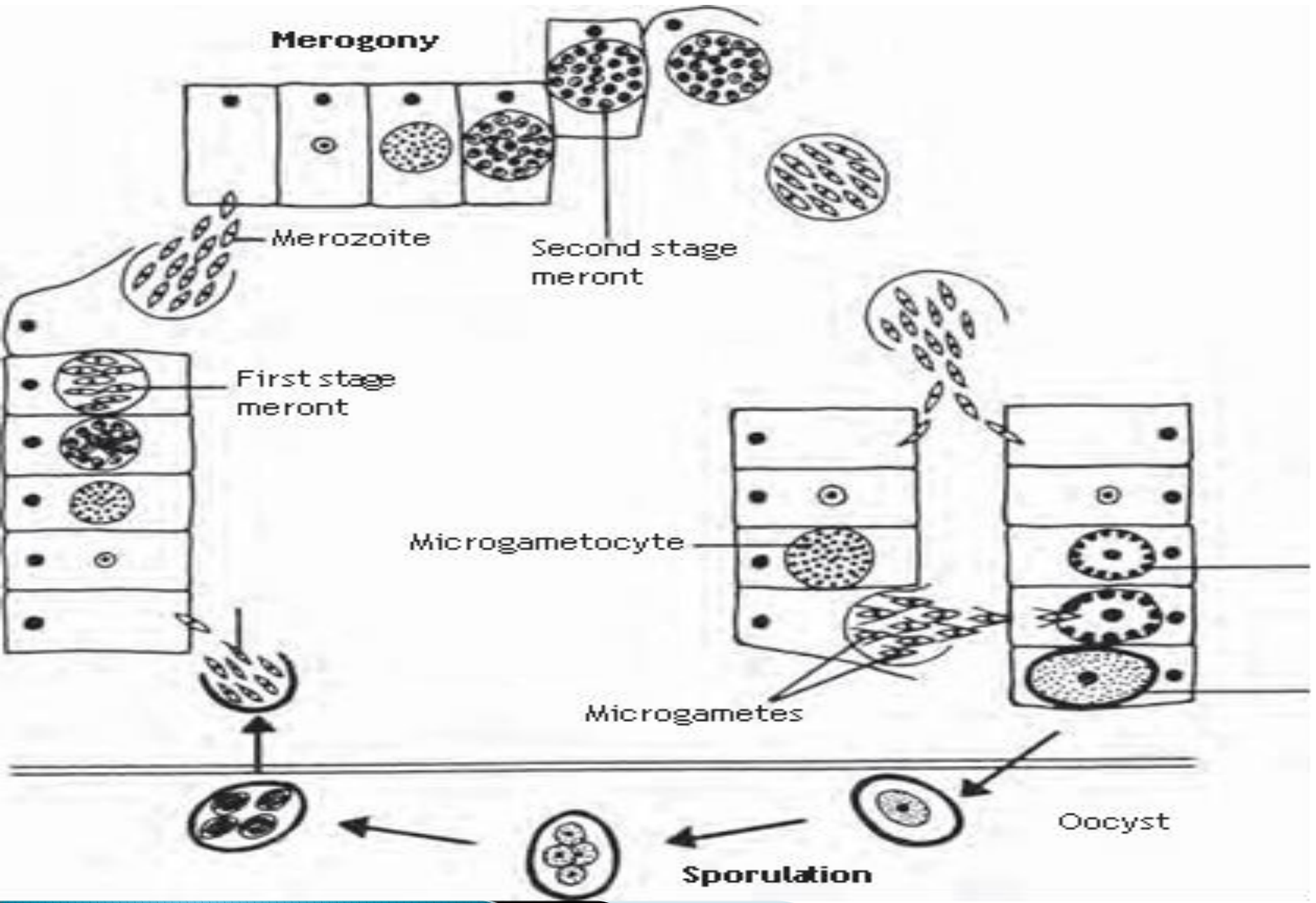


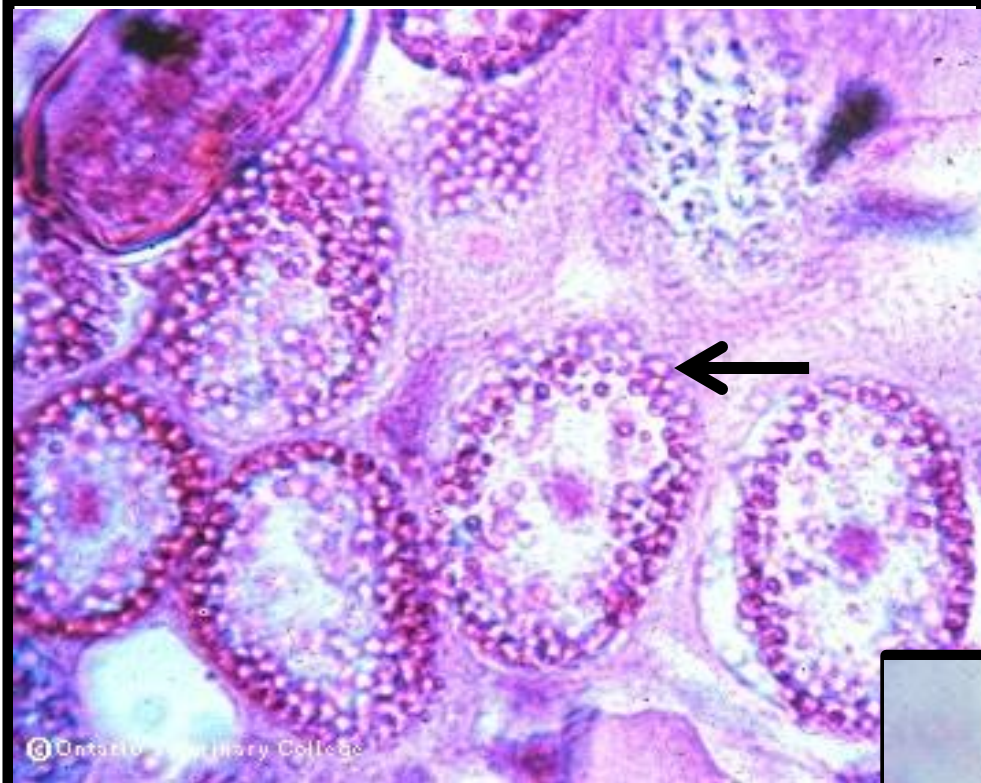
Biflagellate microgamete



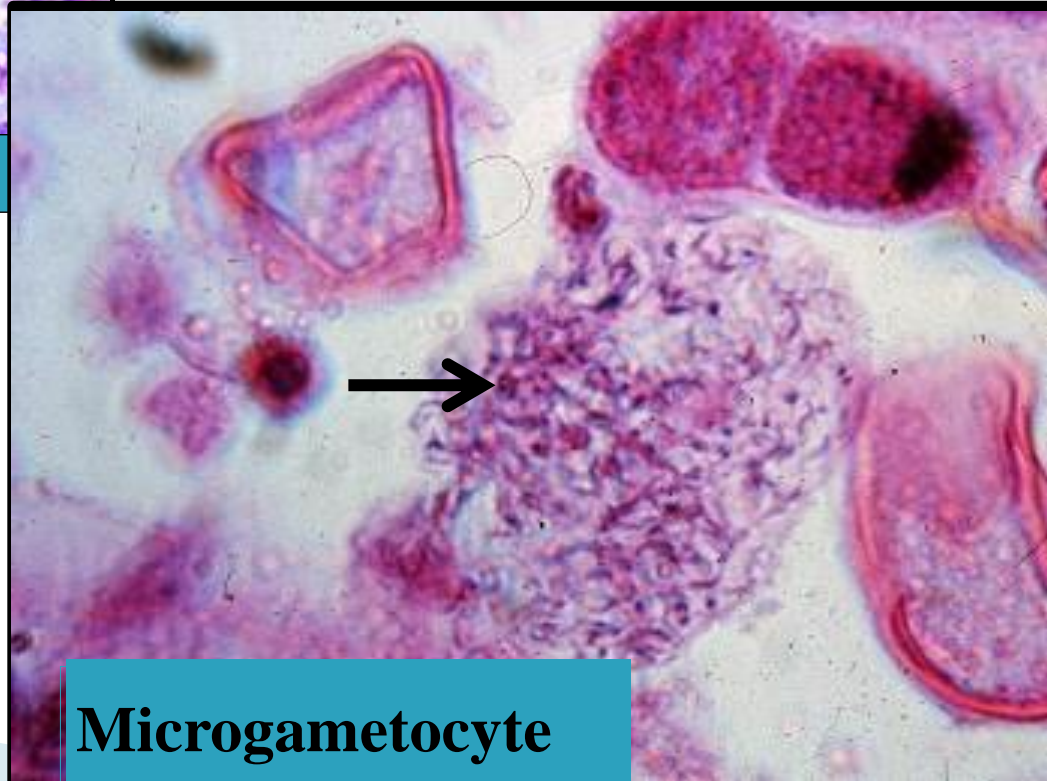
Microgametocyte

Life cycle of *Eimeria*





Macrogametocytes



Microgametocyte

Epidemiology

- Coccidial infections are **self-limiting**
i.e. (in the absence of re-infection, one cycle of development can take place).
- Under natural infections, **repeated infection** usually occurs in **closed farms**.
- **Repeated infections** with small number of oocysts, induce the development of immunity.
- Old ages are immune hosts (carriers).

Pathogenesis

Depends on:

1. Location of the parasite in the host tissue.
 2. Size of the infecting dose.
 3. Acquired immunity.
 4. Age of the host.
 5. Species of the parasite.(Virulence)
- ▶ parasite can destroy epithelial cells causing villus atrophy & hemorrhage is seen in severe disease
 - ▶ majority of pathology caused by asexually replicating stages vs. sexual stages, therefore see clinical signs of disease prior to presence of oocysts

Clinical signs

- ▶ Diarrhea
- ▶ blood may or may not be observed in feces (depends on species & severity of infection)
- ▶ poor weight gain, emaciation & death
- ▶ Death or acquired immunity and self cure

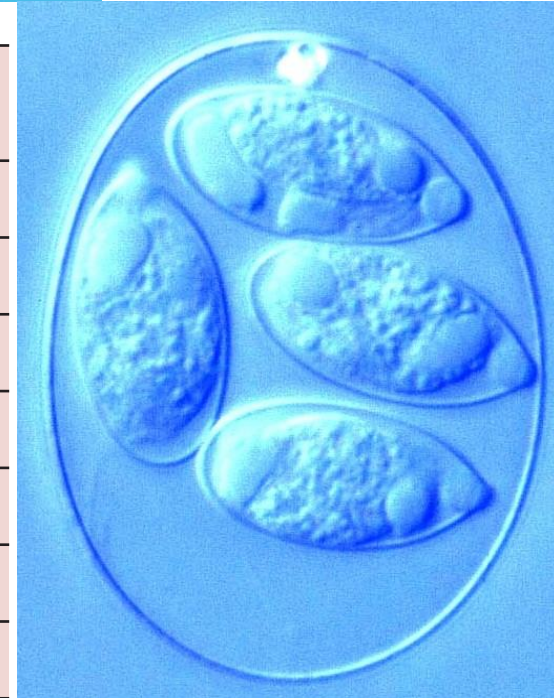
Clinical Signs — Haemorrhagic Diarrhoea



Poultry Avian coccidiosis

Eimeria species (chicken).

Species	Oocyst description	Mean size (µm)
<i>Eimeria acervulina</i>	Ovoid, smooth without a micropyle or residuum but with a polar granule	18 × 14
<i>Eimeria brunetti</i>	Ovoid, smooth without a micropyle or residuum but with a polar granule	26 × 22
<i>Eimeria maxima</i>	Ovoid, yellowish and smooth without a micropyle or residuum but with a polar granule	30 × 20
<i>Eimeria mitis</i>	Subspherical, smooth without a micropyle or residuum but with a polar granule	16 × 15
<i>Eimeria necatrix</i>	Ovoid, smooth, colourless without a micropyle or residuum but with a polar granule	20 × 17
<i>Eimeria praecox</i>	Ovoid, smooth, colourless without a micropyle or residuum but with a polar granule	21 × 17
<i>Eimeria tenella</i>	Ovoid, smooth, colourless without a micropyle or residuum but with a polar granule	25 × 19



Eimeria maxima



Eimeria tenella

Poultry

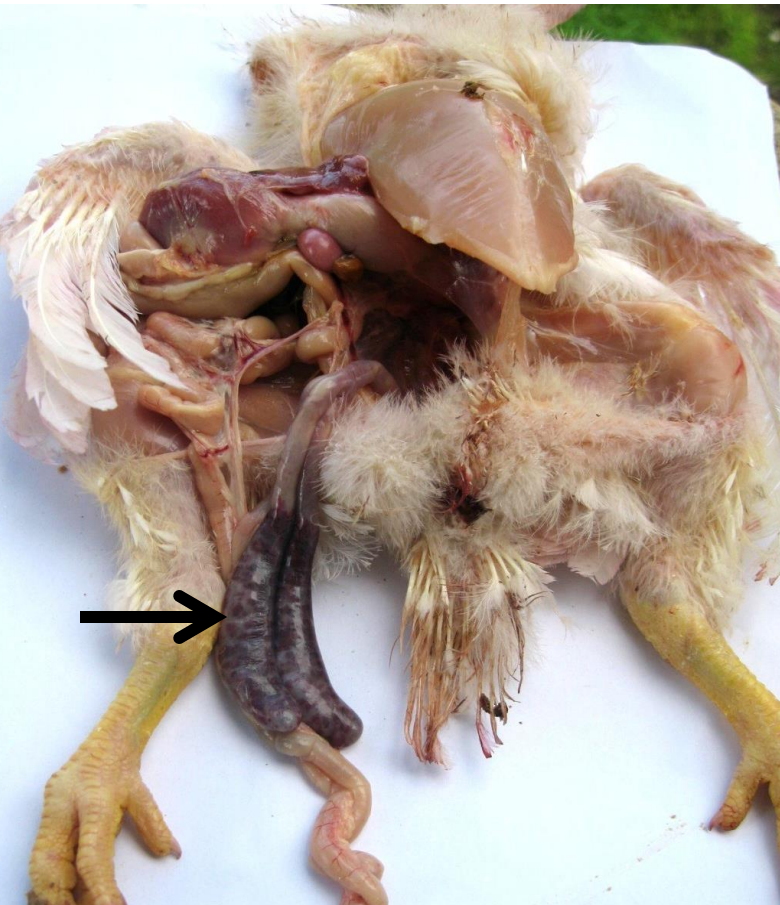
Avian coccidiosis

Species	<i>E.tenella</i>	<i>E.necatrix</i>	<i>E.acervulina</i>
Pathogenicity	Pathogenic	Pathogenic	Less pathogenic
Lcalization	Caecum	Mid S.I(Schizont) &caecum(Ga mont)s	Anterior S.I

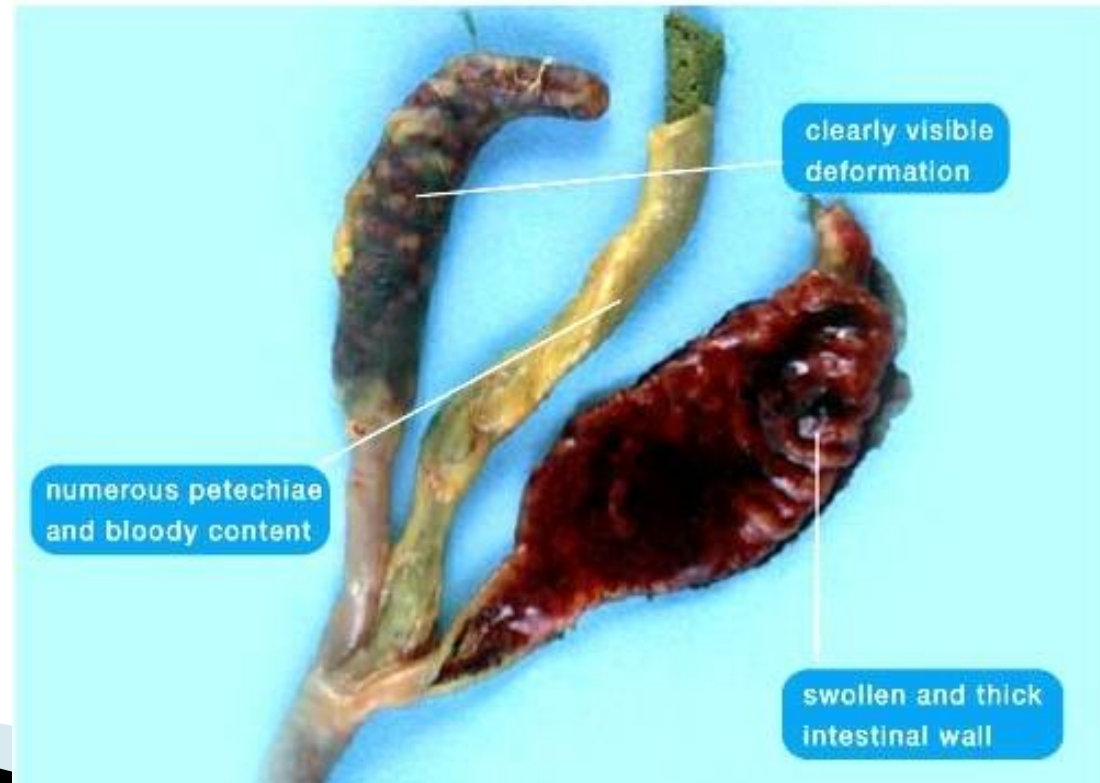
Clinical signs *of E. tenella*

The most pathogenic and important species in domestic poultry

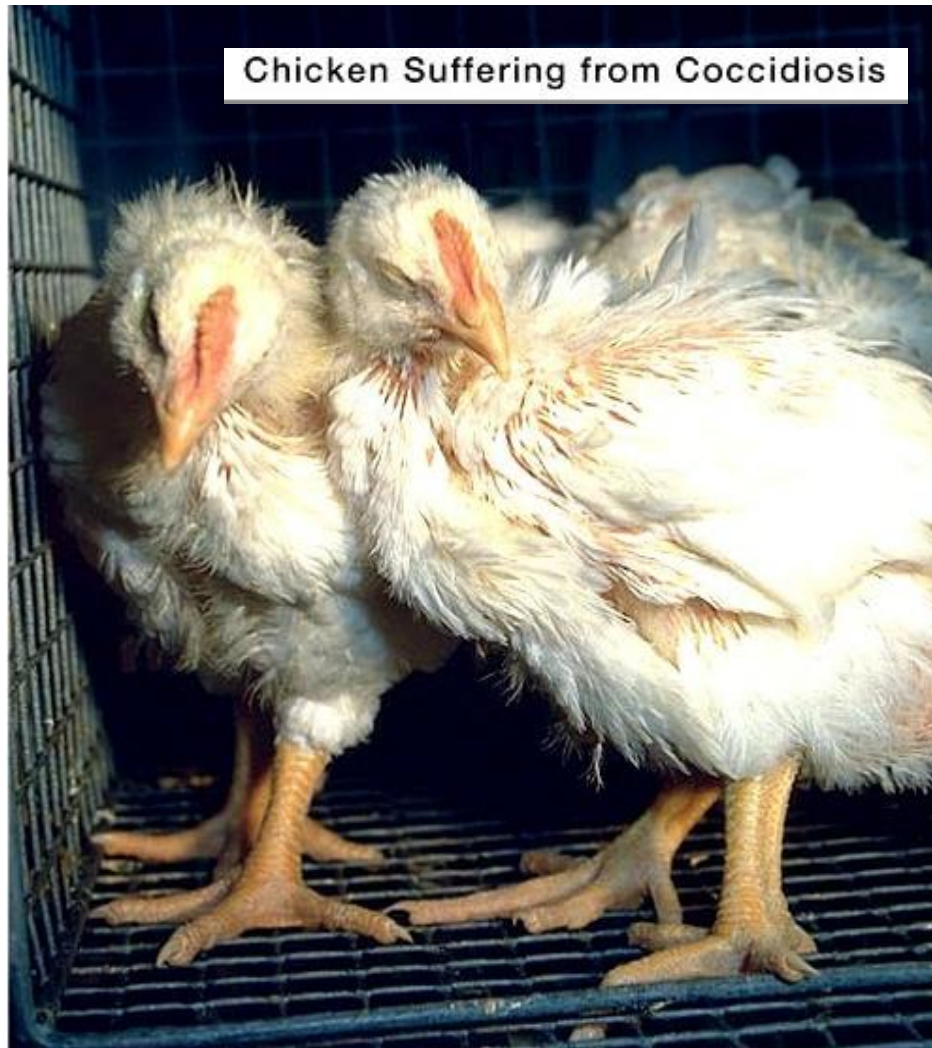
- Chicken huddle together & stop feeding
- Haemorrhagic enteritis.
- Mortality is highest between 4th & 6th day due to excessive loss of blood.



Eimeria tenella - Lesion Score 4



Chicken Suffering from Coccidiosis



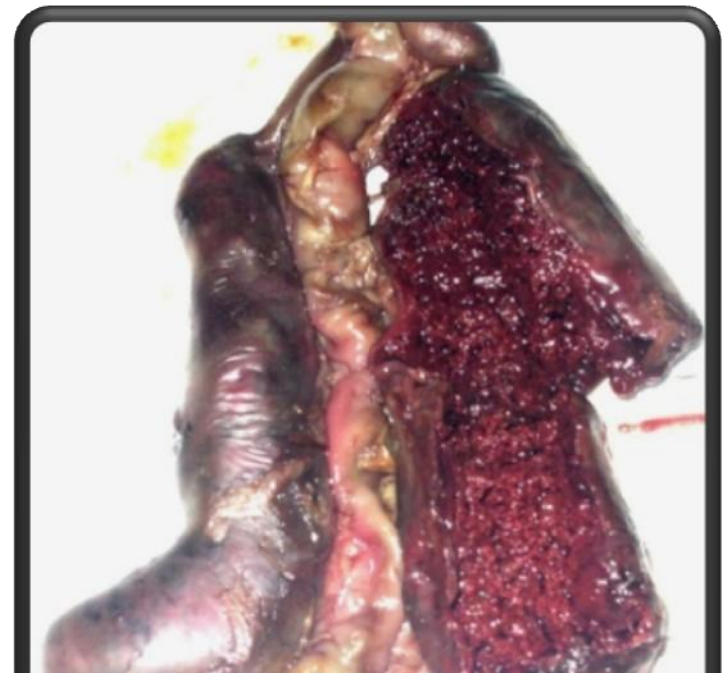
- **Chicken huddle together & stop feeding**



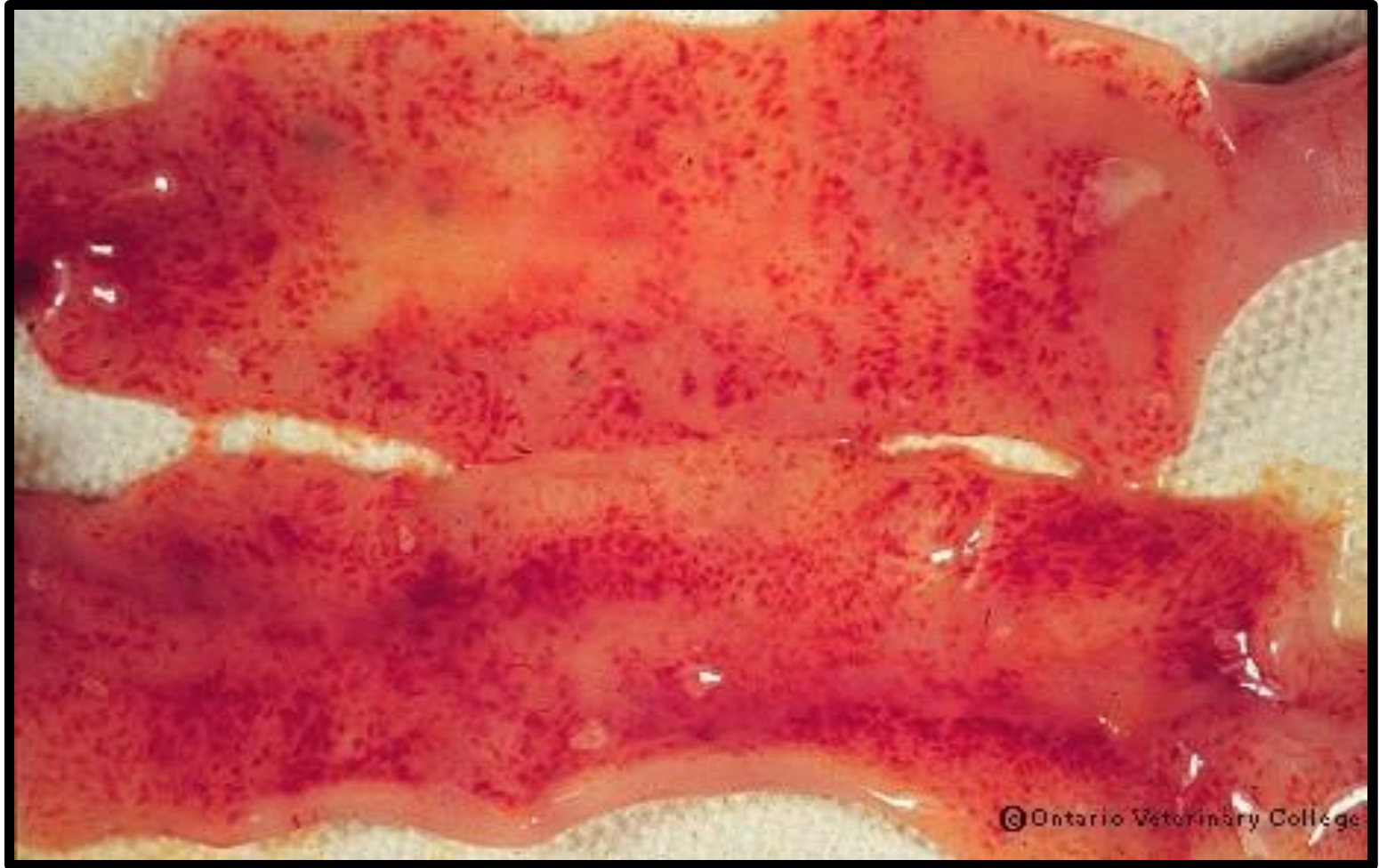
- **Bloody diarrhoea**

Clinical signs *E. tenella*

- **Cecal core**(clotted blood+ tissue debris)



Petechial haemorrhages



***E.acervulina*-chicken, hemorrhagic enteritis**

Source Ontario Veterinary college, Canada

Eimeria species (turkey).

Species	Oocyst description	Mean size (µm)
<i>Eimeria adenoides</i>	Ellipsoidal or ovoid, smooth, colourless with a micropyle, one to three polar granules but with no oocyst residuum	26 × 17
<i>Eimeria dispersa</i>	Ovoid, smooth with no micropyle, polar granule or oocyst residuum	26 × 21
<i>Eimeria meleagridis</i>	Ellipsoidal, smooth with no micropyle and no oocyst residuum but with one to two polar granules	23 × 16
<i>Eimeria meleagrimitis</i>	Subspherical, smooth, colourless with no micropyle or oocyst residuum, but with one to three polar granules	19 × 16
<i>Eimeria gallapovonis</i>	Ellipsoidal, smooth, colourless without a micropyle or oocyst residuum, but with one polar granule	27 × 17
<i>Eimeria innocua</i>	Subspherical, smooth, without a micropyle or polar granules	22 × 21
<i>Eimeria subrotunda</i>	Subspherical, smooth, without a micropyle or polar granules	22 × 21



Eimeria species in birds

Turkey	<i>E.meleagridis</i>	<i>E.adenoides</i>
Ducks&Geese	<i>E.anseris</i>	<i>E.truncata</i>
Quails	<i>E.bateri</i>	<i>E.uzuzra</i>

RABBIT

E. Stiedae
(Hepatic coccidiosis)

effect liver(epithelia of bile duct)

E.intestinalis ***E.media***

effect small intestine

Clinical signs of coccidiosis in Rabbit:

Diarrhae

Salivation

Enlarged liver&white necrotic foci

lethargy (lack of energy)

weakness

not eating/lack of appetite

weight loss

dehydration/not drinking

■ Enlarged liver & white necrotic foci

Hepatic coccidiosis



Normal liver



Hepatic coccidiosis

CATTLE

E. bovis

Pathogenic

Affect S.I +Caecum&colon

Giant 1st generation
schizont(120000
merozoites).

Sheep&Goat

E. ahsata

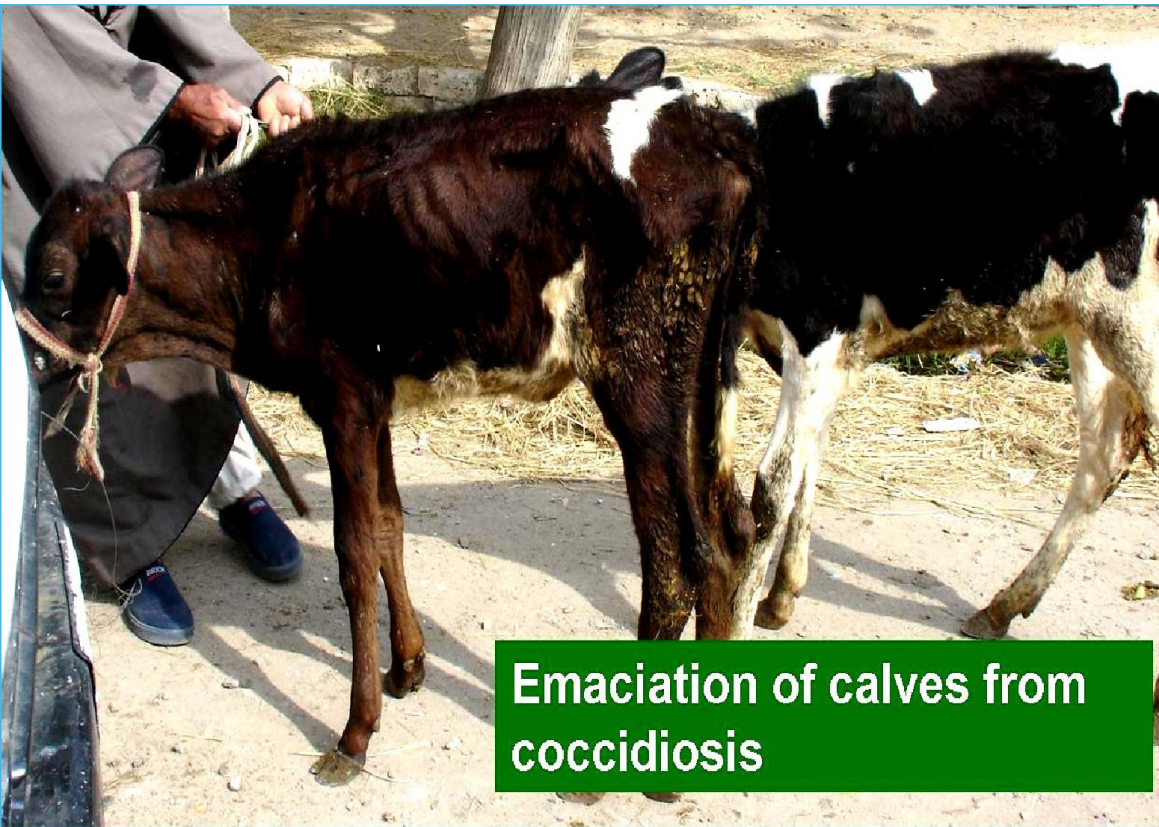
E. crandalis

Pathogenic

Less pathogenic

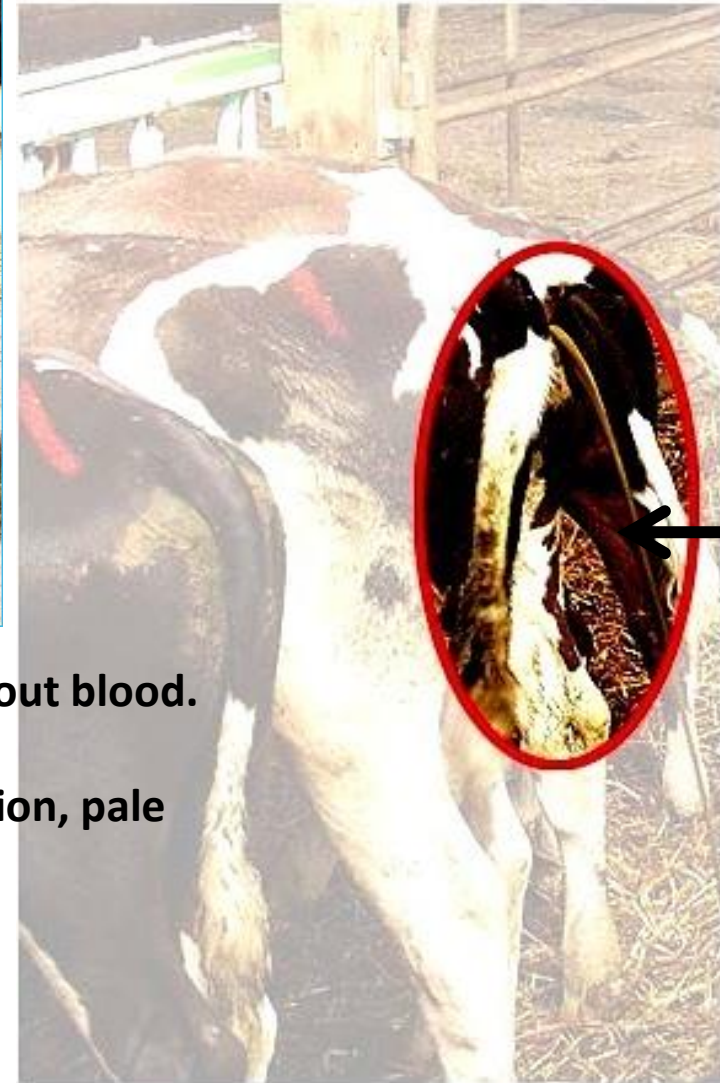
Affect ileum

Affect cecum&
colon



Emaciation of calves from coccidiosis

Clinical Signs — Watery Diarrhoea



- Sick animals usually have acute diarrhoea with or without blood.
- decreased appetite and mild depression.
- In more severe infections, severe depression, dehydration, pale mucous membranes, straining and severe weight loss.
- Some cattle with coccidiosis may present with neurologic symptoms.

CAMEL

E.cameli

effect S.I

Giant oocyst
(91X79um)

Giant schizonts

Sporulation time:10-15days

The camels had diarrhea of 2-5 days duration.
hemorrhagic enteritis in the large intestine of any animal.

EQUINES

E.leukarti

effect S .I

**Large oocyst) (77X55um
(rough and brown(**

CONTROL

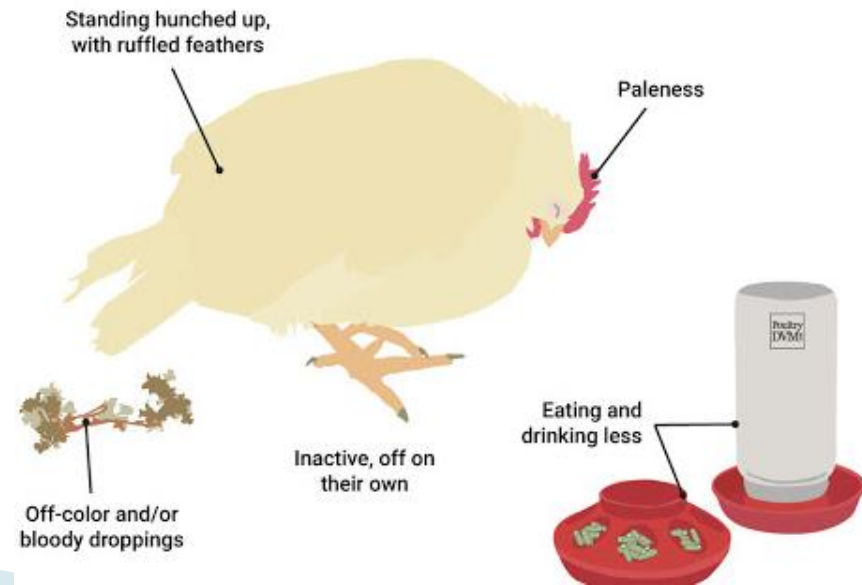
▶ **Good diagnosis:** clinical **coccidiosis**, and microscopically examination of faeces (oocysts, merozoites, or schizonts in are seen).

▶ **Treatment:** is based on chemotherapy drugs, sulphonamides, amprolium and toltrazuril

▶ **Prophylaxis:** using anticoccidial drugs

and/or vaccines along with hygienic measures

and improved farm management.



Diagnosis

- ▶ Clinical signs.
- ▶ Gross lesions(P.M Lesions)
- ▶ Microscopical examination

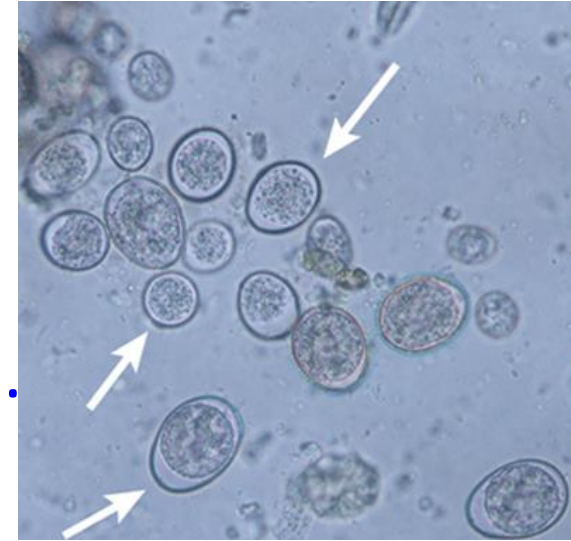


Haemorrhagic diarrhoea and fibrin strands from animals suffering from *E. bovis* infection

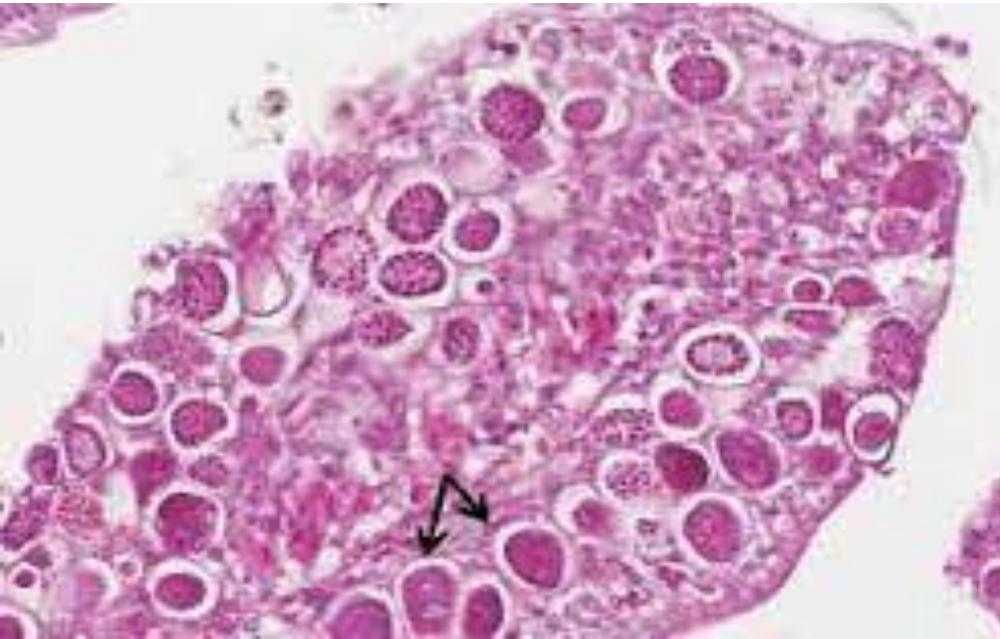


Microscopical Examination

- Direct smear.
- Flootation technique
- Fecal culture(2.5% Pot. dichromate sol.).
- Stained intestinal smear(Giemsa Stain).
- Histopathological examination(H&E stain)



Gamonts, unsporulated oocysts, sporulating oocysts, (contained 2 sporocysts and 4 sporozoites in each sporocyst).



TREATMENT (Anticoccidial drugs)

- ▶ Many different drugs have been used for therapy:
(coccidiostatics e.g. Amprolium, Sulfa drugs, Some drugs have a cidal effect (e.g. Panzuril, Diclazuril, Toltrazuril) mixed with food or water.
- ▶ Used for 3-5 days for treatment & repeated after 10-14 days + Good hygiene.

Prophylaxis

-Prophylactic programs: Rotation of anticoccidial drugs to prevent the drug resistance:

A-Shuttle program.

B-Switch program (slow rotation)

- Environment - reducing exposure to oocysts through good management can prevent or reduce severity of disease. e.g [Good sanitation](#).
- oocysts resistant to most disinfectants but steam cleaning, immersion in boiling water or 10% ammonia solutions (e.g. food & water bowls. (
- [Vaccination](#).

Vaccination

- **HIPRACOX®: vaccine** was launched in 2008 in Europe and U.S. the **vaccine** for broilers for the prevention of **coccidiosis**. A live attenuated of *E. acervulina*, *E. tenella*, and *E. maxima*.
- **Paracox 5:** a live attenuated oral vaccine which will protect chickens against the five species of coccidia that are significant in broilers: *E. acervulina*, *E. maxima* (two strains), *E. mitis*, and *E. tenella*.
- **COCCIVAC (TCV-4M5):** Live Oocysts of the following species of coccidia: *E. adenoeides*, *E. meleagridis*, *E. gallopavonis*, and *E. dispersa*, to aid in the prevention of coccidiosis in turkeys.

