

Tapeworms of Poultry in Ethiopia: A Review

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Abstract: Several species of cestodes have been described in poultry throughout the world. In Ethiopia, species under the genera *Davainea*, *Raillietina*, *Choanotaenia*, *Amoebotaenia* and *Hymenolepis* are the commonest tapeworms. They are mostly found in chickens reared in free-range systems and losses are higher in low land areas of the country. All of them require arthropods and other invertebrate intermediate hosts to complete their life cycle. Tapeworms parasitize the intestinal tract and they debilitate the birds. Some of the clinical manifestations of chicken tapeworm infections include decline in production, retarded growth, emaciation, weight loss, ruffled and dry plumage, slow movement (weakness), rapid breathing, paralysis and diarrhea. Catarrhal enteritis, hemorrhage, intestinal blockage (large worms) and nodular growths can also be seen in heavy infestations. Other poultry diseases may have similar symptoms and effects like tapeworm infections. Hence, definitive diagnosis should be done in the laboratory and at post-mortem examination. The use of drugs for removal of tapeworms is usually not effective if the intermediate hosts are still present as sources of infection. Therefore, treatment should be associated with control measures directed against intermediate hosts. Prevention of birds from contact with the intermediate hosts is the most important step that should be taken in the control of tapeworm infection.

Key words: Cestode • Tapeworm • Poultry • Ethiopia

INTRODUCTION

Poultry applies to a wide variety of several species and it refers to them whether they are alive or dressed (slaughtered and prepared for market). This term is used for chickens, turkeys, ducks, geese, swans, guinea fowl, pigeons, pea fowl, ostriches, pheasants, quails and other birds [1]. They are reared in most parts of the world either in the backyard or commercial production system and serve as important sources of protein (meat and eggs), income and organic manure of high fertility [2,3]. However, endoparasites present a main threat to the poultry production especially in free range or backyard rearing systems and cause heavy economic losses. Tapeworms are among those endoparasites and incidences of different species of cestodes have been reported in chickens [4].

The most important cestodes of poultry include *Raillietina echinobothrida*, *Raillietina tetragona*, *Raillietina cesticillus*, *Davainea proglotina*, *Choanotaenia infundibulum*, *Amoebotaenia cuneata*, *Hymenolepis cantaniana* and *Hymenolepis carioca*.

They are common in tropics, where the poor standard husbandry practices and climatic conditions are favorable for the development of the parasites [5]. Their life cycle is indirect which involves earthworms, snails, slugs, beetles, ants and house flies as intermediate hosts depending on the species of the tapeworm [6].

Tapeworms affect chickens by taking the required nutrients from the intestine and also disturb the absorptive organs at sites where they grow and result in low feed conversion efficiency. The amount of feed needed to produce one kilogram of live weight in broilers and a dozen of eggs in layers increases as these worms compete for feed [7]. Birds require longer time to attain market size and to reach at their laying age. The market value and turnover rate of worm infected chickens also decrease and medication and production costs increase. Heavy parasitic infections cause stress that lowers the chickens' resistance to other infections [8,6].

Domestic fowls infected with cestodes show retarded growth, decreased egg production, reduced weight gain and significant reduction in haemoglobin. Cestode infected chickens also show villous atrophy, catarrhal

enteritis, granuloma formation in duodenum, desquamation of villi, congestion of submucosal glands, inflammatory reaction and vacuolation of epithelial cells [9,10].

Chickens play an important role in the provision of animal protein for the rural population in Ethiopia [11]. The total poultry population of Ethiopia is estimated to be 49.5 million, of which about 99% are raised under the traditional backyard system of management, while the rest 1% are exotic breeds maintained under intensive management system [12].

Most of the studies conducted in different parts of Ethiopia have indicated that the majority of chickens are infected by different species of helminthes and tapeworms are considered to be an important cause of ill health, reduced production and losses due to mortality in birds of the country [13].

Therefore, the objectives of this review paper are:

- To discuss the major tapeworms of poultry in Ethiopia
- To summarize the effects of tapeworms in poultry
- To recommend some prevention and control measures

Poultry Cestodiasis

Etiology: More than 1400 species of tapeworms have been recognized as the causes for cestodiasis in domestic and wild birds throughout the world. In Ethiopia, the major cestode species recovered from the small intestine of chickens were *Raillietina echinobothrida*, *Raillietina tetragona*, *Raillietina cesticillus*, *Davainea proglottina*, *Choanotaenia infundibulum*, *Amoebotaenia cuneata* *Hymenolepis cantianiana* and *Hymenolepis carioca* [14].

Taxonomy: Most tapeworms have no common names. Hence, they are best recognized by their genus and species names [15].

Morphological Features: Tapeworms are long, segmented, flattened, almost ribbon-like white parasites. On the extreme anterior end of a true tapeworm is the holdfast organ, the scolex or the head. The scolex of the adult tapeworm has four suckers, with which the tapeworm holds on to the lining of the small intestine, the predilection site of most adult tapeworms. The suckers of true tapeworms are not associated with intake of food but rather serve as organs of attachment [6,16]. Tapeworms do not have mouth and alimentary canal but instead, they absorb nutrients from the hosts' intestine through their body wall called cuticle [9].

An anchor like organ called the rostellum may also be present. The rostellum usually has backwardly directed hooks and with these hooks, the tapeworm further anchors itself in the mucosa of the small intestine. Just posterior to the scolex is a germinal or growth region called the neck. It is from the neck that the rest of the tapeworm's body, the strobila arises. The strobila consists of a number of segments or proglottids which are separated by transverse constrictions and vary in shape and size [17].

Immature, mature and gravid segments are present in the strobila. Proglottids closest to the head and the neck are immature (youngest proglottids); those that are intermediate in distance from the scolex and the neck are the mature (adolescent) proglottids and those farthest from the scolex and the neck are gravid (aged or oldest) proglottids. Gravid proglottids contain male and female reproductive organs that have grown old and degenerated so that only the uterus filled with eggs remains. The eggs of tapeworms comprise onchosphere (hexacanth embryo), a striated shell (embryophore) and a delicate membrane [18].

Tapeworms are hermaphrodite parasites; each proglottid contains complete sets of both male and female reproductive organs. The sex organs of these tapeworms are usually located along the lateral aspects of the proglottids. Both cross-fertilization and self-fertilization can take place between and among individual proglottids [6].

Species Identification and Life Cycle: Different species of tapeworms vary considerably in their pathogenesis. Prevention and control strategies may also vary with each species of the tapeworm. So species identification is worthwhile [19].

Davainea Proglottina: This is the smallest and the most pathogenic tapeworm of poultry. It is about 0.5 up to 3mm long and has 4 up to 9 segments. The predilection site for this worm is the duodenal loop of the small intestine [20].

This microscopic tapeworm may be recognized in the duodenal mucosa by protrusion of the gravid proglottids above the villi if the open intestine is floated in water. Both the rostellum and the suckers are armed with hooks. Genital pores alternate regularly and they are located near the anterior margin [21].

The eggs are 28 up to 40µm in diameter and occur singly in the egg capsule of the gravid proglottid. Only one gravid proglottid is shed per day by this parasite. Chickens become infected with *Davainea proglottina* after ingestion of infective slugs from the ground [4].

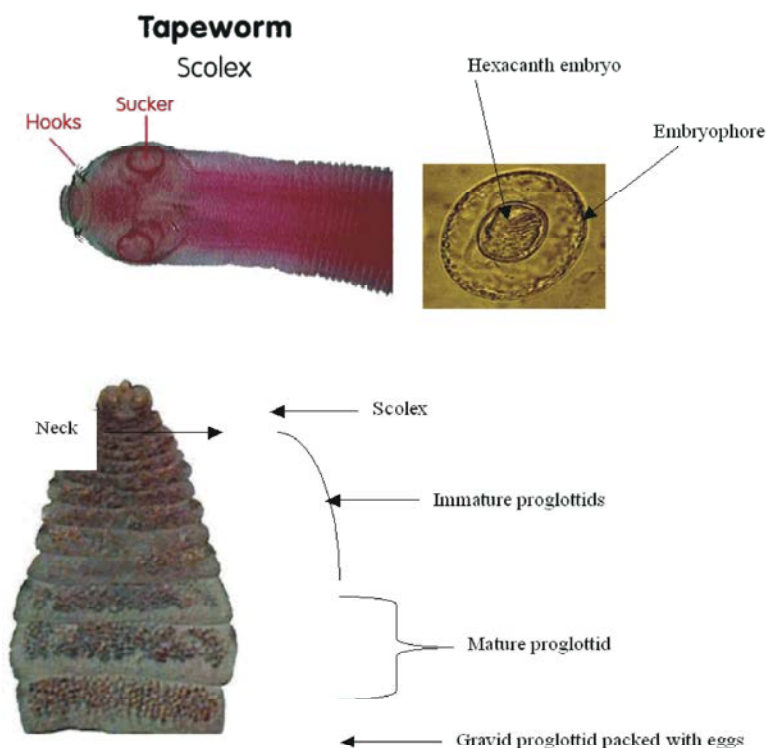


Fig. 2: Adult tapeworm and its egg (Source: [18])



Fig. 3: Snail. Source: [4].

Life Cycle: Several species of slugs and snailshost the larval stages of *Davainea proglottina*. Gravid proglottids are found in the feces primarily in the afternoon or night.

The gravid segments of adult tapeworms are shed with the birds' feces (usually one gravid segment per tapeworm per day). The gravid segments are motile and capable of climbing upwards on the vegetation. The slugs and snails ingest the gravid segments, which release the eggs after digestion. The eggs then develop to bladder worms called cysticercoids in the body cavity of the intermediate hosts. More than 1500 cysticercoids have developed along the digestive tract of susceptible slugs; where they have remained infective for more than 11

months. These tapeworms may live as long as 3 years and about 300 worms have been recovered from a single bird [15].

The birds ingest such infected snails or slugs. After digestion, the cysticercoids release the young tapeworms that attach to the gut wall and develop to adults there. The time between infection and shedding of the first eggs (pre-patent period) is 2 to 3 weeks [17].

Raillietina Tetragona: It is one of the largest and commonest tapeworms of poultry. Adults measure up to 25cm in length [21]. *Raillietina tetragona* occurs in the posterior half of the small intestine of chickens and other birds throughout the world. The scolex is smaller than *Raillietina echinobothrida*. The rostellum is armed with one or two rows of hooks and the suckers are oval in shape and also armed with 8-12 rows of minute hooks. The genital pores are usually unilateral and the uterus breaks in to capsules containing 6-12 eggs. The cirrus sac is small (75 up to 100mm) and more anterior in proglottid margin. The eggs are 25 up to 50µm in diameter [18].

Life Cycle: Cysticercoids develop in ants of the genera *Pheidole* and *Tetramorium*. The minimum pre-patent period after feeding cysticercoids to chickens is 13 days to 3 weeks [17].



Fig. 4: Ant. Source: [9].



Fig. 5: Beetle. Source:[18].

Raillietina Echinobothrida: *Raillietina echinobothrida* is the most pathogenic tapeworm among the *Raillietina* group. It occurs in the intestine of chicken and turkey. The length of this worm is about 25 centimeters. Both rostellum and suckers are armed with hooks. The eggs are found in the egg capsules in the gravid segments [22]. This species resembles *Raillietina tetragona* but differ in the following characteristics. The strobila is larger (34cm long by 4cm wide); the scolex has rounded suckers containing 200-250 hooks; genital pores are in the posterior half of the proglottid and gravid proglottids frequently loosen from each other in the center, making a window-like arrangement not found in *Raillietina tetragona*[15].

Life Cycle: As *Raillietina tetragona*, numerous species of ants have been found naturally infected with cysticercoids. Concurrent infection with both *Raillietina echinobothrida* and *Raillietina tetragona* cysticercoids have been found in ants. The pre-patent period after feeding cysticercoids in chicken is 20 days [23].

Raillietina Cesticillus: This is the most common tapeworm of the genus *Raillietina* and can be recognized easily from others by the absence of neck and a large scolex bearing wide rostellum [21].

The scolex of this large robust tapeworm (up to 15cm long) embeds deeply in the mucosa of the duodenum or jejunum. The distinctive, wide, flat rostellum bears a double row of 300-500 hammer-shaped hooks that act as a retractable piston drawing in to an outer sleeve of the scolex and provide a firm grip to the mucosa. It has four unarmed weak suckers. The genital pores of this worm

alternate irregularly. There are 20-30 testes posteriorly in proglottid. Mature eggs (75 up to 88µm in diameter) have two distinctive funnel-shaped filaments between the inner and middle membranes and occur singly in egg capsules [15].

Life Cycle: The intermediate hosts are beetles of the genera *Calathus*, *Amara*, *Pterostichus*, *Bradycellus*, *Harpalus*, *Poecilus*, *Zabrus*, *Anisotarsus*, *Choeridium*, *Caratacanthus*, *Stenolaphus*, *Stenocellus* and *Stenophorus*. A minute histerid beetle (*Carcinops pumilo*) is the natural intermediate host in broiler houses. More than 930 cysticercoids have been found in a single ground beetle. The pre-patent period after feeding cysticercoids in chickens is 20 days [17,18].

Amoebotaenia Cuneata (Amoebotaenia Sphenoides): *Amoebotaenia cuneata* is a small, slender, thread like worm found in the duodenum of domestic fowl. It is about 4mm long, has up to 20 proglottids and is roughly triangular in shape [22].

It can be recognized as whitish projections in the villi of the duodenum. Its triangular anterior end with a pointed scolex gives the entire worm a wedge-shaped appearance. The suckers are unarmed but the rostellum is armed with a single row of 12 to 14 hooks. The genital pores usually alternate irregularly at the extreme anterior end of the proglottid margin; 12 to 15 testes are located transversely in a single row across the posterior end of the proglottid. Hexacanth embryos are surrounded by distinctive granular layers. The uterus is sac-like and slightly lobed [17].

Life Cycle: Several species of earthworms belonging to the genera *Allotophora*, *Pheritima*, *Ocnerodrilus* and *Lumbericuss* serve as intermediate hosts for this tapeworm. Fowls usually acquire the infection after rains when the earth worms come to the surface. The pre patent period is 4 weeks [15].

Choanotaenia Infundibulum: This large robust tapeworm of fowl is extremely white and is readily seen attached to the upper half of the small intestine [21].

Mature worms are about 23cm long. The suckers are unarmed but the rostellum is large with a single row of 16-22 hooks. Genital pores alternate irregularly; 25-60 testes are grouped in posterior portion of the proglottid. The segments of this worm are markedly wider posteriorly than anteriorly, giving the worm a characteristic saw-edged appearance. The eggs are with distinctive elongated filaments [22].



Fig. 6: Earth worm. Source: [9].

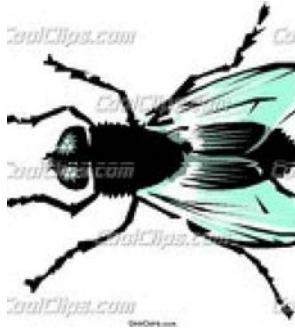


Fig. 7: House fly. Source: [21].

Life Cycle: *Choanotaenia infundibulum* has an indirect life cycle with house flies (*Musca domestica*) and beetles of the genera *Geotrupes*, *Aphodius*, *Calathus* and *Tribolium* acting as intermediate hosts. The time between infection and shedding of the first egg (prepatent period) is about 2 to 4 weeks [17, 18].

Hymenolepis Carioca: Several numbers of this extremely slender worm have been found in the duodenum of a chicken. The worm is so slender (about 1mm in diameter) that hundreds of inconspicuous proglottids look more like a thread than a worm. The suckers are unarmed and the rostellum is rudimentary. Genital pores are unilateral, located anterior to the middle of proglottid margin. There are three testes, usually in a straight row. An inner membrane enveloping the onchosphere is elongated in to a foot ball shape with granular deposits at poles [15].

Life Cycle: Stable flies and dung beetles are the intermediate hosts for this tapeworm. The cysticercoids are liberated after digestion of beetles or flies and develop to adult tapeworms in the chicken [18].

Hymenolepis Cantaniana: This short hymenolepid tapeworm has a maximum length of about 2cm and it superficially resembles the longer *Hymenolepis carioca*. It is usually listed as unarmed but rostellar hooks have been described. Genital pores are unilateral, anterior to the middle of the proglottid [15].

Life Cycle: Dung beetles (*Scarabeidae*) are the intermediate hosts for this tapeworm. Each beetle may carry 100 or more cysticercoids. A unique larval development involves budding, which produces many cysticercoids from a single onchosphere. Birds get the

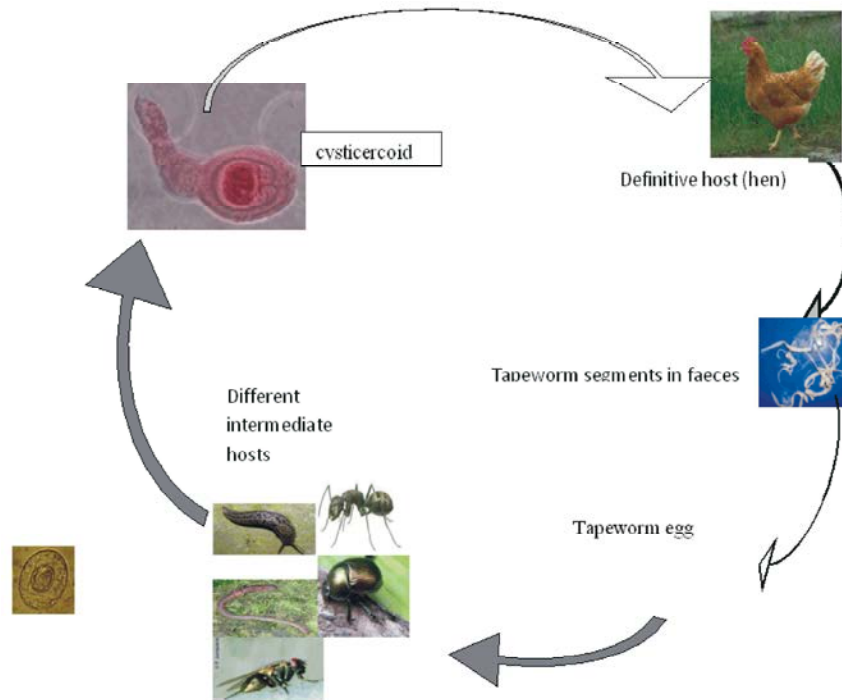


Fig. 8: General life cycle of poultry tapeworms. Source: [9].

Table 1: Pathogenesis of some important poultry tapeworms

Tapeworms	Definitive host	Degree of pathogenesis	Length of mature worm(mm)
<i>Davainea proglottina</i>	Chicken	Severe	4
<i>Amoebotaenia cuneata</i>	Chicken	Mild	3
<i>Choanotaenia infundibulum</i>	Chicken	Moderate	50-200
<i>Raillietina echinobothrida</i>	Chicken	Moderate to severe	200-340
<i>Raillietina tetragona</i>	Chicken	Moderate to severe	100-250
<i>Raillietina cesticillus</i>	Chicken	Mild or harmless	5-150
<i>Hymenolepis cantianiana</i>	Chicken	Mild or harmless	20
<i>Hymenolepis carioca</i>	Chicken	Unknown	40

Source: ([29]).

infection by ingestion of beetles containing cysticercoids. The cysticercoids are liberated after digestion of beetles and develop to adult tapeworms in the chicken [23].

Epidemiology

Host Range: A large number of cestode species have been reported from domestic and wild birds. They produce diseases in chickens, turkeys, ducks, geese, swans, guinea fowl, pigeons, pea fowl, ostriches, pheasants, quails and other birds [1, 9, 19].

Distribution: Tapeworms have cosmopolitan distribution, but they are most common in developing countries where chickens are reared in free-range systems. In many parts of Africa, Asia and Latin America, chicken are reared on an extensive system and sanitation is poorly developed. In such circumstances, the incidence of infection with tapeworms is high [22]. In Ethiopia, cestodes of poultry are more frequent in the low land areas and in the warmer seasons of the year when intermediate hosts are abundant [13].

At higher altitudes, the infection level is low. This may be because the extreme low temperatures of the highland areas inhibit the development and survival of the intermediate hosts. Hence, the intermediate host has difficulty in surviving the colder environmental conditions of the highland areas whereas the warmer temperatures of the lowland areas create conducive conditions for their survival and transmission of the parasites [24].

In developed countries, the intensive production system reduces tapeworm infection of birds. However, under intensive management, cestodes, particularly *Choanotaenia infundibulum* for which flies are the intermediate hosts, may occur in poultry raised in open houses. *Raillietina cesticillus* may also survive owing to beetles which breed in litter. Tapeworms are found more frequently in warmer seasons when intermediate hosts are abundant [25].

Source of Infection and Route of Transmission: Unlike round worms, infection of tapeworms can never be

attributed to consumption of worm eggs that have passed from the intestine in the manure. Tapeworm eggs must pass through an intermediate host before they can infect the primary host. Houseflies, snails, slugs, ants, beetles and earthworms are such intermediate hosts and many others are yet to be identified. Consumption of these hosts harboring the parasites in their larval stages results in infection of the birds [19].

Pathogenesis and Pathogenicity: Different species of tapeworms vary considerably in their degree of pathogenesis. *Raillietina echinobothrida* is usually listed as one of the most pathogenic tapeworms of poultry. Its presence has often been associated with the formation of nodules (nodular worm) in the intestinal wall of infected birds [26]. In this infection, the young forms of the parasite penetrate with their anterior end deeply into the mucosa and sub-mucosa of the duodenum, resulting in the formation of nodules and hyperplastic enteritis at the site of their attachment [21].

In *Raillietina tetragona* infection, the intestinal wall is thrown into ridges of purplish color and the intestinal mucosa sloughs off. *Raillietina cesticillus* is a common tapeworm found in the jejunum of chickens and causes degenerative and inflammatory changes in the intestinal villi. The level of sugar and hemoglobin falls below normal in the affected birds [27].

Davainea proglottina is the most pathogenic of poultry tapeworms. The parasite penetrates deeply within the villi and in heavy infection, it causes necrosis and hemorrhagic enteritis. Its acute form may be fatal while chronic infections are characterized by reduced growth rate, emaciation and weakness. Capillary congestion, lymphocytic and eosinophilic infiltrations, fibrosis and proliferation in the gut are also the important microscopic changes associated with tapeworm infection [28].

Tapeworm species under the genera *Choanotaenia* and *Amoebotaenia* are not normally pathogenic unless present in very large numbers. However, infection could cause decrease in production in intensively managed birds [22].

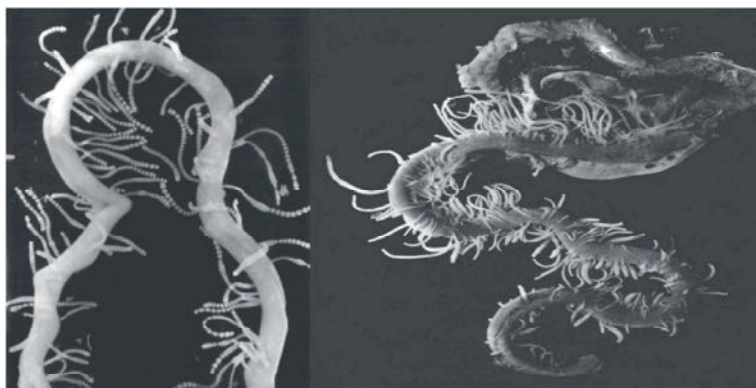


Fig. 9: Tapeworms of poultry at post mortem (Everted intestine)

Source: [26]

Clinical Manifestations: Intestinal worms affect birds by taking the required nutrients from the digestive system, resulting in depletion of nutrients[30]. Enteric worms also disturb the organ functions at sites where they grow and sometimes they produce toxic substances to damage the parts concerned. Due to decreased nutrient content, retarded growth and decline in production are the primary signs observed in birds. Furthermore, worms induce stress and predispose birds to other pathogenic organisms [10,31].

Often, the infection is moderate and not pathogenic. In other cases, symptoms of tapeworm infection include emaciation, weight loss, ruffled and dry plumage, slow movement, rapid breathing, paralysis, diarrhea and death [26,32]. Catarrhal enteritis, hemorrhage, intestinal obstruction and nodular growths can be seen in heavy infections [28].

Diagnosis: A large number of poultry diseases have similar symptoms and effects. Accurate diagnosis is best achieved in a laboratory. The flock should be checked daily for signs of diseases. A drop in production or an increase in the death rate may indicate the presence of disease [7].

Detection of tapeworms in the feces or at post-mortem examination establishes diagnosis. Cestodes are usually readily visible in the small intestine of affected birds. But, whenever possible, they should be removed intact so that their head, mature and gravid segments are all available for examination [33].

Eggs or individual segments (Proglottids) recently shed in the feces or collected from the intestine during post-mortem may be examined under the microscope. Microscopic examination does not only help in establishing diagnosis but also identifies different

species of chicken tapeworms. Some chicken cestodes are very small. Therefore, mucosal scrapings should be examined from representative members of the flock [26].

Differential Diagnosis: The eggs and proglottids of tapeworms should be identified for differentiating one species from the other [9]. In the case of *Raillietina echinobothrida* (nodular worm), a protuberance or nodule develops in the intestinal wall at the site of attachment of each worm. This sometimes confuses with tuberculosis. Hence, tuberculosis may be suspected in such fowls if no worm is found in the nodule [27].

Treatment: The use of drugs for removal of tapeworms from chickens is only a temporary means of solving the problem if the intermediate hosts are still present as sources of infection. Therefore, treatment should be associated with control measures directed against the intermediate hosts [26]. Some of the drugs include butynorate (75-150mg/kg), praziquantel (10mg/kg), niclosamide (100mg/kg) and hexachlorophene. Albendazole and febendazole may also be given at the respective rates of 20-30ml of suspension per 100 birds per day and 50mg per bird in the feed or in drinking water [10,17,23].

Prevention and Control: Prevention of birds from contact with the intermediate hosts is the most important step that should be taken in the control of tapeworm infection. These are best achieved by strict sanitation and management. Sanitation requires complete cleaning of poultry houses and good management indicates that the flock should be checked periodically for the presence of worms [7].

Close observation of the chickens is always important. It is wiser to remove suspected birds from the flock and to change the remainder to the new ground rather than to attempt dosing the flock which is hopeless if they remain on the same ground [32].

Droppings should be removed from the overnight housing and the free range compound and then properly disposed. New arrivals to the flock should be dewormed and quarantined in cages or baskets for at least 15 days before joining the flock. The litter in the poultry house should be turned frequently and changed if wet. The house should be disinfected for every two months and feeders and drinkers have to be cleaned properly. Overcrowding should be avoided and birds should be separated in to different age groups [34].

Controlling insects and keeping wild birds out of poultry houses are very important measures. Raising birds in confinement or on wire reduces infection by worms. Control measures are not possible in free range birds. Affected birds should be treated first by wormicide and wormistat drugs before taking up preventive measures. It is also necessary to have the right approach of eliminating intermediate hosts as removing worm only will lead to further outbreaks [10].

The feed used for poultry must be insect free feed. The use of Malathion or other insecticides should be carried out routinely to control flies, other insects and ants. Metaldehyde bait may be used for slugs. Beetles and earthworms are more difficult to control but rotation of ranges may be helpful [23].

CONCLUSION AND RECOMMENDATIONS

Infection by members of the genus *Davainea*, *Raillietina*, *Hymenolepis*, *Amoebotaenia* and *Choanotaenia* may be responsible for morbidity and mortality in most avian species, but they are of particular importance in poultry. The species of greater veterinary importance in Ethiopia are *Davainea proglottina*, *Raillietina echinobothridia*, *Raillietina cesticillus*, *Raillietina tetragona*, *Amoebotaenia cuneata*, *Choanotaenia infundibulum*, *Hymenolepis carioca* and *Hymenolepis cantaniana*. They are mostly found in the backyard poultry due to problems in sanitation and management. Chickens in the low land areas of the country are highly infected as climatic conditions are favorable for development of various intermediate hosts. All poultry tapeworms apparently spend part of their lives in intermediate hosts and birds become infected by eating the intermediate hosts. These hosts include snails, slugs,

beetles, ants, earthworms, houseflies and others. The intermediate host becomes infected by eating the eggs of tapeworms that are passed in the bird feces. Adult tapeworms are found in the small intestine of infected chickens while the larval stages (cysticercoids) are found in the body cavities of infected intermediate hosts. Cestode infections in poultry are usually characterized by retarded growth, decline in production, weight loss, weakness, rapid breathing, paralysis, diarrhea and death. Heavy infestations may also cause catarrhal enteritis, bleeding and intestinal blockage. The use of drugs for tapeworm removal is usually not effective means of solving the problem unless the intermediate hosts are controlled. Therefore, based on the above conclusive remarks the following points can be recommended.

- The chance of contact between infected and non-infected birds should be reduced.
- Appropriate sanitary and management measures should be taken.
- Appropriate stocking density has to be followed.
- Chickens should be dewormed strategically.
- Farmers and farm owners have to be educated about the impacts of tapeworms.
- Chicken should be protected from contact with the intermediate hosts.
- Poultry manure and litter materials should be disposed properly.

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