

# Equine Lung Worm: A Systematic Review

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## Abstract

Lungworms are parasitic nematode worms of the order Strongylidae that infest the lungs of vertebrates. *Dictyocaulus arnfieldi* is the true lungworm affecting donkeys, horses, mules and zebras and is found throughout the world. *Dictyocaulus arnfeildi* can cause severe coughing in horses and because patency is unusual in horse (but not in donkeys) differential diagnosis in disease due to other respiratory disease can be difficult. Adult *Dictyocaulus* worms are slender, medium sized roundworms, up to 8 centimeter long. Females are about one third longer than males. They have a whitish to grayish color. *Dictyocaulus* worms have a direct lifecycle, i.e. there are no intermediate hosts involved. The pathogenic effects of lungworm depends on their location within the respiratory tract, the number of infective larvae ingested, the animal immune status, on the nutritional status and age of the host. Despite the prevalence of patent *D. arnifieldi* infection in donkeys, overt clinical signs are rarely seen; however, on close examination slight hyperpnoea and harsh lung sounds may be detected. Diagnosis is based on clinical signs, epidemiology, presence of first-stage larvae in feces, and necropsy of animals in the same herd or flock. Bronchoscopy and radiography may be helpful. Larvae are not found in the faeces of animals in the prepatent or postpatent phases and usually not in the reinfection phenomenon. ELISA tests are available in some laboratories. Bronchial lavage can reveal *Dictyocaulus arnifieldi* infections in horses. The concern of lungworm in Ethiopia is increasing and is now to be a major problem of equines. Routine deworming of horses and donkeys may help prevent cross infection when kept together. Reducing pasture contamination with infective larvae is a key preventative measure that can be achieved to a large extent with adequate management measures. Rotational grazing with a change interval of 4 days and keeping the paddocks empty for at least 40 days significantly reduces pasture contamination.

**Index terms**— coughing, *dictyocaulus arnfeildi*, lifecycle, lung, pathogenic effect.

**Equine Lung Worm: A Systematic Review** Nuraddis Ibrahim Summary-Lungworms are parasitic nematode worms of the order Strongylidae that infest the lungs of vertebrates. *Dictyocaulus arnfieldi* is the true lungworm affecting donkeys, horses, mules and zebras and is found throughout the world.

*Dictyocaulus arnfeildi* can cause severe coughing in horses and because patency is unusual in horse (but not in donkeys) differential diagnosis in disease due to other respiratory disease can be difficult. Adult *Dictyocaulus* worms are slender, medium sized roundworms, up to 8 centimeter long. Females are about one third longer than males. They have a whitish to grayish color. *Dictyocaulus* worms have a direct lifecycle, i.e. there are no intermediate hosts involved. The pathogenic effects of lungworm depends on their location within the respiratory tract, the number of infective larvae ingested, the animal immune status, on the nutritional status and age of the host. Despite the prevalence of patent *D. arnifieldi* infection in donkeys, overt clinical signs are rarely seen; however, on close examination slight hyperpnoea and harsh lung sounds may be detected. Diagnosis is based on clinical signs, epidemiology, presence of first-stage larvae in feces, and necropsy of animals in the same herd or flock. Bronchoscopy and radiography may be helpful. Larvae are not found in the faeces of animals in the

### 3 III. MORPHOLOGY OF DICTYOCaulUS ARNFIELDI

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50 pasture contamination.

## 51 1 I. Introduction

52 equines are one of the most important and mostly intimately associated with man. They have enormous  
53 contribution through their involvement in different social and economic sectors. Equines play an important  
54 role as working animals in many parts of the world, for packing, riding, carting and ploughing. Equine power is  
55 very crucial in both rural and urban transport system. This is because of its cheapness and availability and so  
56 provides the best alternative transport means in places where the road network is insufficiently developed and the  
57 landscape is rugged and mountainous and in the cities where narrow streets prevent easy delivery of merchandise  
58 (Feseha et al., 1991).

59 In Ethiopia equines have been as animals of burden for long period of time and still render valuable services  
60 mostly as pack animals throughout the country particularly in areas where modern means of transportation are  
61 absent, unaffordable or inaccessible (Abayneh et al., 2002).

62 In some areas of North West Kenya and Southern Ethiopia, donkey meat is a delicacy and the milk believed  
63 to treat whooping cough (Fred and Pascal, 2006).

64 Even though mules and donkeys have often been described as sturdy animals; they succumb to a variety of  
65 diseases and a number of other unhealthy circumstances. Among these, parasitic infection is a major cause  
66 of illness (Sapakota, 2009). Lungworms are widely distributed throughout the world providing nearly perfect  
67 conditions for their survival and development but are particularly common in countries with temperate climates,  
68 and in the highlands of tropical and subtropical countries. *Dictyocaulidae* are known to exist in East Africa and  
69 South Africa (Hansen and Perry, 1996).

70 *Dictyocaulus arnfieldi* is the true lungworm affecting donkeys, horses, ponies and zebras and is found  
71 throughout the world (Smith, 2009). Donkeys and their crosses (Mules) are the natural hosts for lungworm  
72 and the condition in horses is usually found in those that have been in the company of donkeys and mules (Rose  
73 and Hodgson, 2000). This review article supports researchers to more understand the equine lung worm disease  
74 and factors influencing the disease occurrence under Ethiopian condition. It also helps policy makers to draw  
75 sound decisions in order to improve the control policy. The review paper gives information to farmers and cattle  
76 rearing people regarding equine lung worm disease.

77 And therefore, the objectives of this paper are to give background information on the disease and recommend  
78 modern control measures.

## 79 2 II. Definition and Etiology of Lungworm

80 Lungworms are parasitic nematode worms of the order *Strongylidae* that infest the lungs of vertebrates. The  
81 taxonomy of this parasite is belonging to kingdom Animalia, phylum Nematoda, class Secernentea, family  
82 *Dictyocaulidae*, genus *Dictyocaulus* E and species of *Dictyocaulus arnfieldi* (Johnson et al., 2003). An infection of  
83 lower respiratory tract, usually resulting in bronchitis or pneumonia can be caused by several parasitic nematodes,  
84 including *D. viviparous* in cattle and deer; *D. arnfieldi* in horses and donkeys; *D. filaria*, *Protostrongylus rufescens*,  
85 and *Mullarius capillaries* in sheep and goats; *Metastrongylus apri* in pigs; *Filaroides (Oslerus) osleri* in dogs; and  
86 *Aelurostrongylus absrtusus* and *Capillaria aerophila* in cats, other lungworm infection occur but less common  
87 (Fraser, 2000).

88 *Dictyocaulus arnfieldi* is the true lungworm affecting donkeys, horses, mules and zebras and is found throughout  
89 the world (Smith, 2009). It is a relatively well adopted parasite of donkeys but tend to be quite pathogenic in  
90 horses, where this parasite is endemic (Bowman, 2003).

91 The first three lungworm listed above belong to

## 92 3 III. Morphology of *Dictyocaulus Arnfieldi*

93 Adult *Dictyocaulus* worms are slender, medium sized roundworms, up to 8 centimeter long. Females are about  
94 one third longer than males. They have a whitish to grayish color. As in other roundworms, the body of these  
95 worms is covered with a cuticle, which is flexible but rather tough. The worms have a tubular digestive system  
96 with two openings, the mouth and the anus. They also have a nervous system but no excretory organs and no  
97 circulatory system, i.e. neither a heart nor blood vessels. The female ovaries are large and the uteri end in an  
98 opening called the vulva. Males have a copulatory bursa with two short and thick spicules for attaching to the  
99 female during copulation. The eggs of *Dictyocaulus arnfieldi* are approximately 60x90 micrometers. They have  
100 an ovoid shape and contain a fully developed L1 larva (Junquera, 2014). The epidemiology of lungworm disease  
101 is largely concerned with factors determining the number of intensive larvae on the pasture and the rate at which  
102 they accumulate. The third stage larvae are long living in damp and cool surroundings. Warm and wet summers

103 give rise to heavier burdens in the follow autumn and spring. Horses are not the favorite host of this parasite and  
104 do not usually transmit the disease to other horses. In most instances, horses acquire this disease when pastured  
105 with donkeys (Blood et al., 1999).

106 Under optimal condition the larvae may survive in the pasture for a year. They are quite resistant to cold  
107 although it generally delays their maturations. They can withstand temperature of 4-5 degree Celsius; Larvae  
108 can over winter in cold climates (Blood et al., 2000).

109 Most outbreak of verminous pneumonia occur during cool season specially autumn and early winter because  
110 the larvae stages of the causative worms tolerate and prefer low temperatures (Hansen and Perry, 1996).

111 The natural host of the parasite is donkey, and comparably, large numbers of parasites can accumulate in  
112 the lungs of this host without clinical signs. Donkeys and mules can act as a reservoir for horses (Beelitz et al.,  
113 1996). Pilobolus fungi may play a role in the dissemination of *D. arnfieldi* larvae from faeces, as *D. viviparus*.  
114 *D. arnfieldi* is found worldwide, particularly in areas with heavy rainfall (Urquhart et al., 1999).

## 115 4 b) Life Cycle

116 The detailed life cycle is not fully known, but is considered to be similar to that of bovine lungworm, *Dictyocaulus*  
117 *viviparus* except in the following respect.

118 The adult worms are most often found in the small bronchi and their eggs, containing the first stage larvae,  
119 hatch soon after being passed in the faeces (Urquhart et al., 1999).

120 *Dictyocaulus* worms have a direct lifecycle, i.e. The pathogenic effects of lungworm depends on their location  
121 within the respiratory tract, the number of infective larvae ingested, the animal immune status, on the nutritional  
122 status and age of the host (Blood et al., 1989; Fraser, 2000). Larvae migrating through the alveoli and bronchioles  
123 produce an inflammatory response, which may block small bronchi and bronchioles with inflammatory exudates.  
124 The bronchi contain fluid and immature, latter adult worms and the exudates they produce also block the bronchi.  
125 Secondary bacterial pneumonia and concurrent viral infections are of the complication of *Dictyocaulosis* (Howard,  
126 1993). The major pathologic changes which results from primary infection may be divided into three stages. These  
127 are the prepatent stages, where blockage of small bronchi and bronchioles by eosinophilic exudates produced  
128 in response to the developing and migrating larvae. The patent stage, when adult worms cause bronchitis and  
129 primary pneumonia development occurs. The post patent phase is when adult worms are expelled and majority of  
130 animals gradually recover. The pathological changes seen in the lungs during necropsy are atelectasis, emphysema,  
131 petechial hemorrhage and lung consolidation (Aiello and Mays, 1998).

## 132 5 d) Clinical Signs

133 Despite the prevalence of patent *D. arnfieldi* infection in donkeys, overt clinical signs are rarely seen; however, on  
134 close examination slight hyperpnoea and harsh lung sounds may be detected. This absence of significant clinical  
135 abnormality may be partly a reflection of the fact that donkeys are rarely required to perform sustained exercise.  
136 Infection is much less prevalent in horses. However, patent infections may develop in foals and these are not  
137 usually associated with clinical signs.

138 In older horses infections rarely become patent but are often associated with persistent coughing and an  
139 increased respiratory rate (Urquhart et al., 1999).

140 Donkeys usually show no disease signs and can be silent carriers and shedders of this parasite, which causes  
141 clinical signs in horses (Johnson et al., 2003).

## 142 6 e) Diagnosis

143 Diagnosis is based on clinical signs, epidemiology, presence of first-stage larvae in feces, and necropsy of animals  
144 in the same herd or flock. Bronchoscopy and radiography may be helpful. Larvae are not found in the faeces of  
145 animals in the prepatent or postpatent phases and usually not in the reinfection phenomenon. ELISA tests are  
146 available in some laboratories. Bronchial lavage can reveal *Dictyocaulus arnfieldi* infections in horses (Stuart,  
147 2012).

148 Verminous pneumonia is easily confused clinically with bacterial bronchopneumonia, with acute and chronic  
149 interstitial pneumonia, and with viral pneumonia. The disease usually occurs in outbreak form in summer and  
150 autumn (Blood et al., 1999). The diagnostic methods of lungworms are described as the following ways in details.

## 151 7 f) Clinical Diagnosis

152 Typical signs and symptoms are heavy coughing (often paroxysmal), accelerated and/or difficult breathing and  
153 nasal discharge. Affected animals lose appetite and weight. Severe infections can also cause pneumonia (lung  
154 inflammation), emphysema (over inflation of the alveoli), and pulmonary edema (liquid accumulation in the  
155 airways). Adult livestock usually develops resistance and if re-infected may not show clinical signs but continue  
156 shedding larvae that contaminate their environment (Junquera, 2014).

## 11 D) PREVALENCE OF LUNGWORM INFECTION IN DIFFERENT PARTS OF ETHIOPIA

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### 157 8 g) Faecal Examination

158 A convenient method for recovering larvae is a modification of the Baermann technique in which large faecal  
159 samples (5-10 grams) are wrapped in tissue paper or cheese cloth and suspended or placed in water contained in  
160 a beaker. The water at the bottom of the beaker is examined for larvae after 4 hours; in heavy infections, larvae  
161 may be present within 30 minutes.

### 162 9 Bronchial lavage can reveal *Dictyocaulus arnfieldi* infections 163 in horses (Stuart, 2012). h) Serological Diagnosis

164 Enzyme Linked Immuno Sorbent Assay (ELISA) test can demonstrate antibodies from five weeks after the  
165 animals have been exposed and it may be useful in identifying infected animals when heavy burdens of worms  
166 do not generate and larvae in the feces. This time need to perform an ELISA depends on the availability of  
167 antigen-coated microstate-plates. If such plates can be provided; the result can be obtained within four hours  
168 after the serum has been prepared. If not, plates have to be coated with antigen for up to 16 hours (Boon et al.,  
169 1984).

### 170 10 IV. Necropsy Findings

171 The morphological change in the lungs include wide spread areas of collapsed tissue of dark pink color,  
172 hemorrhagic bronchitis with much fluid filling all the air passed and enlargement of the regional lymph nodes.  
173 Histologically, the characteristic lesions are edema, eosinophilic infiltration, debris and larvae in the bronchioles  
174 and alveoli. The most obvious lesions at necropsy are discrete patches of over inflation. The bronchial epithelium  
175 is hyperplastic and heavily infiltrated by inflammatory cells, particularly eosinophils (Reinecke, 1989). Reducing  
176 pasture contamination with infective larvae is a key preventative measure that can be achieved to a large extent  
177 with adequate management measures. Rotational grazing with a change interval of 4 days and keeping the  
178 paddocks empty for at least 40 days significantly reduces pasture contamination. This is due to the fact that  
179 larvae are susceptible to dryness and won't survive more than 4 or 5 weeks on pasture if they do not find an  
180 adequate host. Obviously, by very moist weather or where pastures are almost permanently moist survival may  
181 be longer. Alternate grazing with sheep and/or horses may be considered, since *Dictyocaulus* species are quite  
182 host-specific (for cattle, sheep & goats, horses). The longer the absence of the specific host, the higher will be the  
183 reduction of its specific lungworm. However, this may not be advisable in places infected with gastrointestinal  
184 roundworms that are simultaneously parasitic of cattle and sheep or horses. For their first grazing season it is  
185 highly advisable that young stock does not share the pastures with older stock that has been exposed earlier to  
186 infected grounds and can therefore shed larvae. It must also be avoided that young stock uses pastures already  
187 used by older stock during the same season. It must also be considered that heavy rains and flooding can  
188 disseminate infective larvae inside a property or from one property to neighboring ones. Keeping the pastures as  
189 dry as possible and keeping livestock away from places excessively humid are additional key measures to reduce  
190 the exposure of livestock to infective larvae. In endemic regions preventative strategic treatment of young stock  
191 is often recommended just prior to their first grazing season, followed by additional treatments depending on the  
192 infestation level of the pastures and the residual effect of the administered anthelmintic (Junquera, 2014). c)  
193 Economic Impact of the Disease

194 The vitality and wellbeing of horses of all age are thread by a variety of internal parasites and the use of control  
195 ensures and the best performance (Power, 1992). Internal parasites are one of the greatest limiting factors to  
196 successful horse rising throughout the world. All horses at pasture become infected and suffer a wide range of  
197 harmful effects ranging from impaired development and performance to death despite the availability of large  
198 array of modern anthelmintic, parasite controls often fail to safeguard horse health.

199 The main reason for these break downs are errors the choice of anthelmintic and in the time of treatment  
200 (Herd, 1987).

### 201 11 d) Prevalence of lungworm infection in different parts of 202 Ethiopia

203 The concern of lungworm in Ethiopia is increasing and is now to be a major problem of equine in the central  
204 highlands of Ethiopia. However there were little preliminary findings of lungworm infection which were done by  
205 few researchers of the country (Table 2). <sup>1 2 3</sup>

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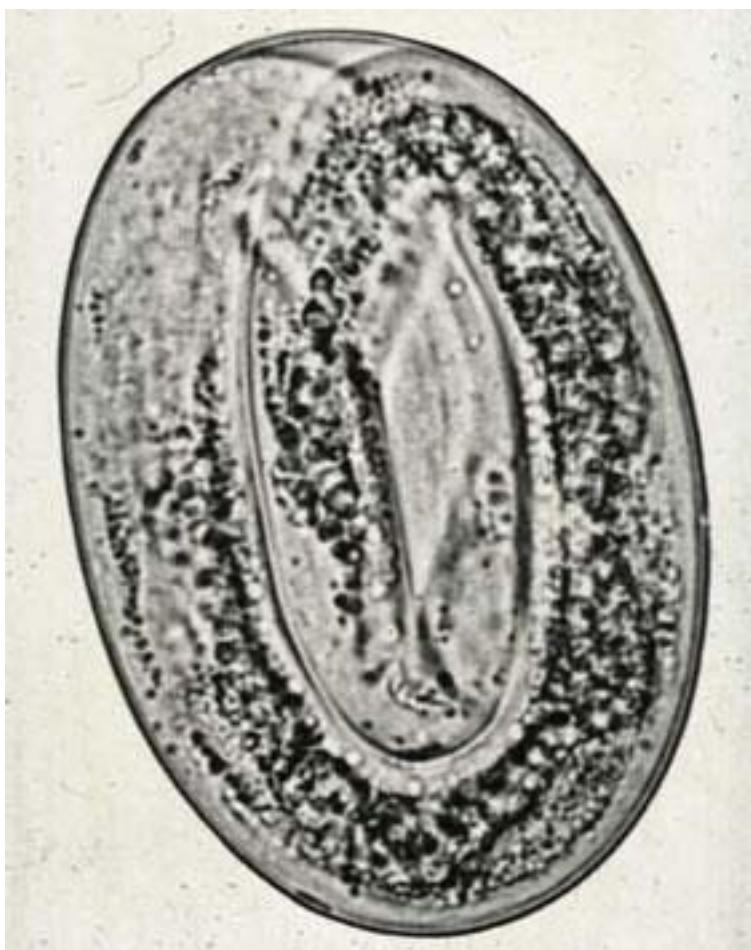


Figure 1: superfamily



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Figure 2: Figure 1 :Figure 2 :

## 11 D) PREVALENCE OF LUNGWORM INFECTION IN DIFFERENT PARTS OF ETHIOPIA

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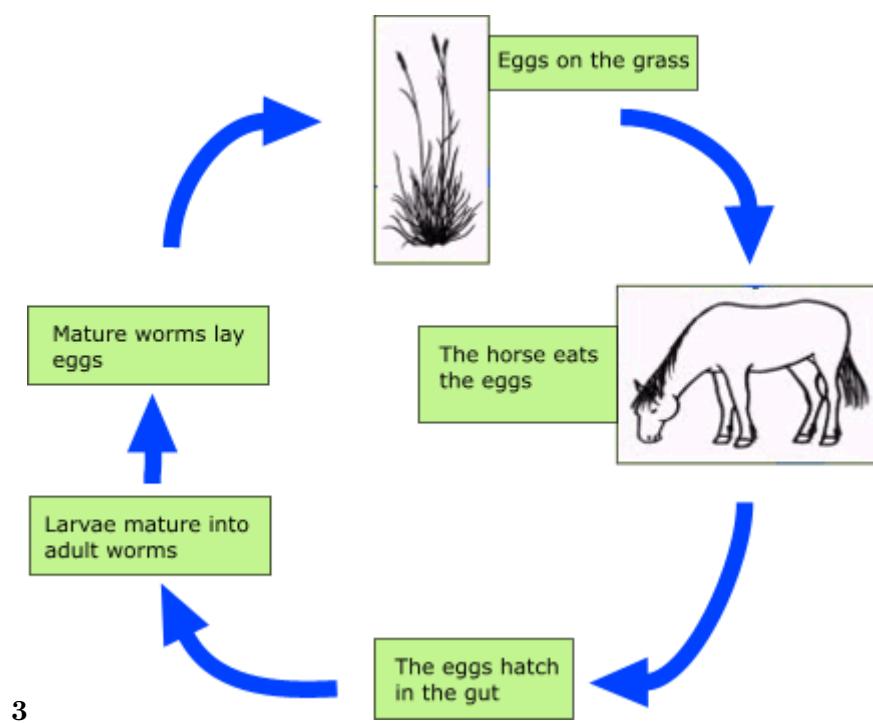


Figure 3: Figure 3 :

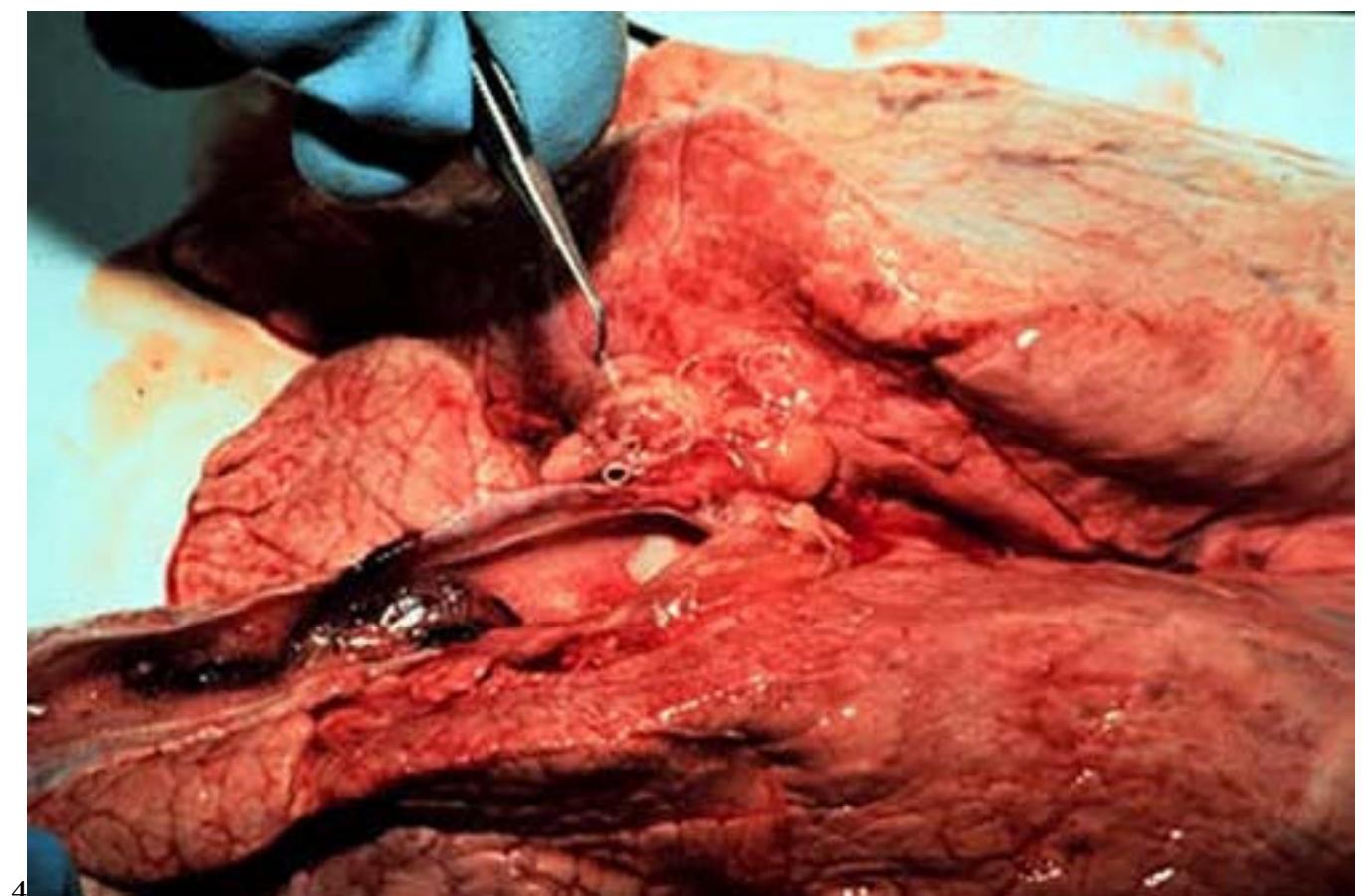


Figure 4: Figure 4 :

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Macrolides	Ivermectin	0.05	PO and SC
Benzimidazole	Oxfendazole	2.5	PO
	Fenbendazole	5.0	PO
	Albendazole	7.5	PO
	Febantel	10	PO
Imidathiazole	Levamisole	8.0	PO

Source: Blood et al.  
(2000)

Figure 5: Table 1 :

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S. No -2	Site of study	Prevalence in %	Researcher name
4 5	North Wollo	17.5	Belay, 2005 13.8 Ti-
	Jimma South		hitna et al., 2012 42.7 Kamil et
	eastern Ethiopia		al. (2017)

V. Conclusion

Figure 6: Table 2 :

**11 D) PREVALENCE OF LUNGWORM INFECTION IN DIFFERENT  
PARTS OF ETHIOPIA**

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