HELMINTH PARASITES OF *GALLUS DOMESTICUS L.* IN PENANG ISLAND

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INTRODUCTION

IN ADDITION to fishes, chickens are an important source of proteins to all Malaysians, which are taken in the form of poultry meat or eggs. Most people in the villages rear chickens in their backyards. Townfolks, however, because of the unavailability of space to do such a practice usually buy chickens from the nearest markets. The chickens available in the markets are obtained from broiler farms where chickens reared may usually be caged or free-ranged. Helminthiasis are common among chickens and if this condition is allowed to continue will affect the economy of poultry rearing as well as depriving people of one of the main sources of proteins.

Incidence of helminthiasis among chickens is affected by climatic and local factors. The tropical climate of high temperature and heavy rainfall is suitable for development of the parasites. Faeces are important sources of infection especially among free-ranged and housed chickens. Moreover, chicken houses are usually poorly ventilated so that damp areas provide adequate environment for the hatching of nematode eggs. The presence of snails, earthworms and arthropods such as ants, cockroaches, house flies, grasshoppers and beetles increase the chance of helminthiasis among the chickens.

Lancaster (1958) gives an account of helminth parasites of fowls in Malaya. This report gives some of the species of helminths that have been identified by various investigators over the years. Several recent published surveys of helminthiasis among fowls had been carried out in this region (Omar and Lim, 1968; Shanta, *et al*, 1971; Lim, 1971). These surveys revealed the occurrence of helminths which had not been previously recorded by Lancaster. Many of these were cestodes and these included *Choanotaenia infundibulum* (Bloch, 1779), *Cotugnia digonopora* (Pasquale, 1890), *Davained proglottina* (Davaine, 1860), *Hymenolepis cantianiana* (Polonio, 1860), *Hymenolepis carioca* (de Magalhaes, 1898), *Hymenolepis exiqua* and *Raillietina cesticillus* (Molin, 1858). The nematodes identified were few, namely: *Cepillaria anatis* (Schrank, 1790), *Capillaria obsignota* (Holder Madsen, 1945) *Dispharynx nasuta*, *Gorgylorema* sp., and *Strongyloides avium* (Cram, 1929).

However, none of these surveys made any comparison of helminth burdens between male and female fowls. It is now well known that differences occur in parasitic burdens of male and female hosts. Various studies on vertebrates such as rats (Dobson, 1961 a,b; 1961, 1962), mice (Behnke, 1975) and frogs (Lees, 1962) showed that incidence of helminth infection was generally higher in male than female hosts. However, Berry (1962) demonstrated that more females than males of invertebrates (e.g. snails) are parasitized by trematoda larvae.

This project is undertaken to determine the types of helminths affecting fowls in Penang. It also aims at providing information as to the infection rates, severity of these infections and as to whether there is any difference in helminth burdens and hence susceptibilities between sexes. Information obtained will be useful in the management of poultry farms all over Penang in order to obtain maximum profit through the sale of poultry meat and eggs. It will also benefit members of the public who want to venture into small scale chicken rearing. Attempt is also made to do comparative studies of the nematodes and some of the cestodes identified.

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MATERIALS AND METHODS

Materials for Investigations:

All intestines were obtained from the Jelutong Market in Penang. They were collected from a stall selling dressed poultry of broiler stocks obtained from Ayer Itam, Balik Pulau and Batu Ferringhi Areas. The broiler farms of Ayer Itam and Balik Pulau Areas supplied free-ranged chickens while caged chickens were acquired from Batu Ferringhi area. The ages of these chickens were estimated to be about three months. Occasionally, however, members of the public from the surrounding areas brought their chickens to the stall to be slaughtered. The authors received five intestines from such a source and the ages of these chickens were variable. All intestines were made up of alimentary tract beginning from the duodenum up to the rectum. A total of 100 intestines were obtained and these were sexed prior to examination.

RESULTS

The total number of worms recovered for the various species of nematodes and cestodes is as shown in Fig. 1. Of all the nematodes recovered, *Ascaridia galli* (184 in number) showed the greatest number followed by *Heterakis gallinae* and *Strongyloides avium* (both 35 in number). The greatest number of cestodes recovered were those of *Railliatina tetragona* (280 in number) whose number exceeded that of *A. galli*. Other cestodes recovered arranged in order of decreasing number were *Raillietina cesticillus* (114 in number), *Amoebotaenia sphenoides* (93 in number), *Raillietina echinobothrida* (41 in number) and *Hymenolepis* sp. (11 in number).

The percentage of intestines infected was 50%. The most prevalent group of helminth infection was nematodes (27%), followed by cestodes (10%). The infection rate of cestodes and nematodes was 13%. Infection with one species of helminth per intestine was greatest (29%), with the percentage infection rate decreasing, 16% for two species and 5% for three species, with increase in the number of species per intestine. This negative linear correlation between number of species per intestine and percent of intestine infected was further proved when it was found, the coefficient of correlation = -0.98 (using product-moment formula).

The percentage incidence of infection according to species of nematodes and cestodes is as shown in Fig. 2. The most common nematode infection was with *A. galli* (35%) followed by *H. gallinde* (8%) and *S. avium* (5%). *Raillietina* (23%) was the most common cestode infection with *R. tetragona* being the most common species. Infection rates with *A. sphenoides* and *Hymenolepis* sp., were very low (1% each).

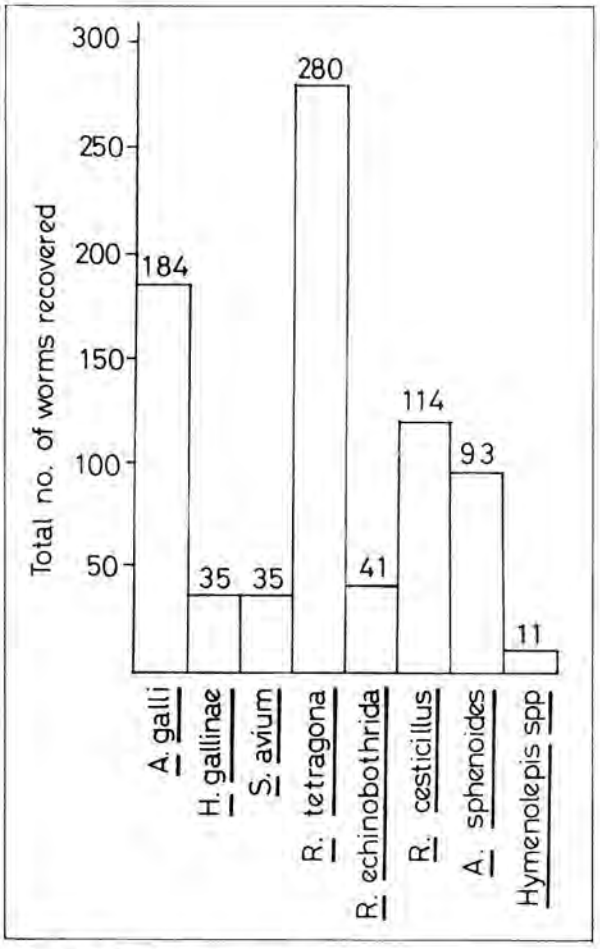

Fig. 1 Bar-chart showing total number of worms recovered according to species of nematodes and cestodes.

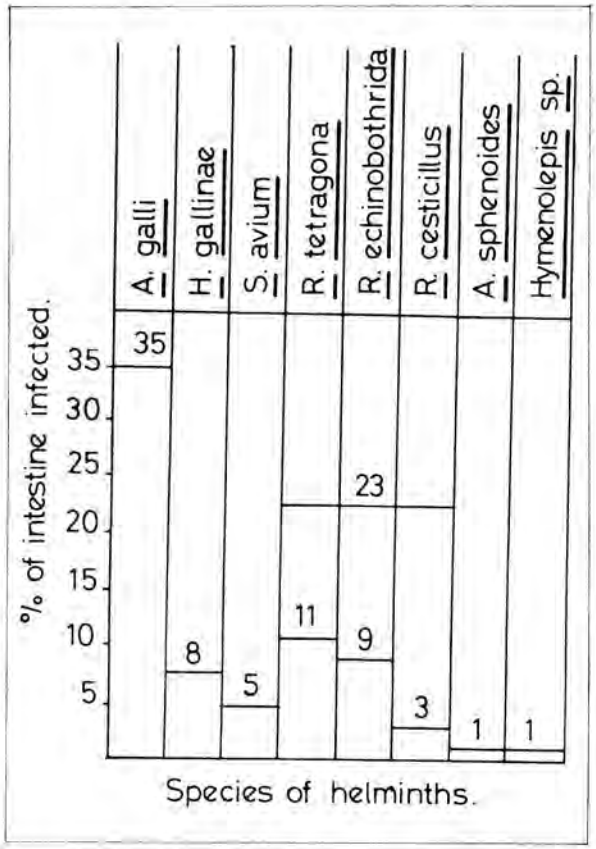

Fig. 2 Bar-chart showing % incidence of infection according to spp. of nematodes and cestodes.

TABLE I

Frequency of species of parasites in relation to number of species for intestine.

Species of Helminths	% of intestines infected with specific parasite among the indicated number of species	
	1	2
A. galli	14	4
H. gallinae	5	3
S. avium	4	1
R. tetragona	5	2
R. echinobothrida	3	2
R. cesticillus	1	0
A. sphenoides	0	0
Hymenolepis sp.	0	0

A finer analysis of the intestinal infection involving the number of species per intestine is given in Table I. Infection rate involving 2 species of parasites per intestine was significantly higher that that involving 3 species of parasites per intestine ($P \leqslant 0.25$ by chi-square test).

Comparative studies of both nematodes and some of the cestodes show that the female worms of *A. galli* and *H. gallinae* were longer and larger than the corresponding males. The males of *S. avium* were not encountered during this project. The size of the eggs varied in accordance to the species of nematodes. Table III gives the variation in lengths of some of the cestodes with *R. tetragona* (mean 80.5 mm long) being the longest, followed by *R. echinobothrida* (mean 75.6 mm long), *R. cesticillus* (mean 71.9 mm long) and *A. sphenoides* (mean 2.55 mm long). Of the four species of cestodes *R. cesticillus* had the greatest mean diameter of scolex (0.42a mm long). The means of width-length ratio of the various of the cestodes showed that the gravid segments have the largest values. Since lengths of segments of the particular species of cestodes were more or less the same, it is therefore showed that width of segments of the various cestodes increased from scolex backward.

DISCUSSION

General

This project has brought to light the presence of helminthiasis in free-ranged and caged chickens from the broiler farms and probably some of the housed chickens reared by some members of the public. Shanta *et al.* (1971), states that tropical conditions of heat and moisture combined with the intensive or semi-intensive type of management provides ground which favours growth and propagation of the parasites. *S. avium* has a direct life-cycle, infection of bird is mainly by skin penetration, although oral infection may also occur (Soulsby, 1968). Direct as well as indirect life-cycles involving earthworms and arthropods as intermediate hosts occur in *A. galli* (Oslen, 1974). Earthworms are intermediate hosts of *A. splenoides* (Soulsby, 1968), while indirect life-cycle molluscs and arthropod intermediates exist in *Raillietina* (Bhalerao, 1955; Soulsby, 1968; Lim, 1971, Oslen, 1974). Caged birds are usually infected with helminth parasites that undergo

TABLE II

Showing comparison of various nematode species.

Species of Nematodes		LENGTH		Standard Deviation	WIDTH		Standard Deviation
		Range	Mean		Range	Mean	
A. galli	Male	38 — 48 mm	41.3 mm	2.9 mm	0. 5 — 1 mm	0.87 mm	0.22 mm
	Female	68 — 74 mm	71 mm	2.2 mm	1. 3 — 2 mm	1.49 mm	0.24 mm
	Egg	59 — 63 μ	61.1 μ	1.4 μ	30 — 35 μ	32.6 μ	1.7 μ
H. gallinae	Male	12 — 16 mm	13.2 mm	1.6 mm	0.22 — 0.24 mm	0.232 mm	0.01 mm
	Female	17 — 22 mm	19.2 mm	1.7 mm	0.32 — 0.034 mm	0.332 mm	0.05 mm
	Egg	56 — 60 μ	58.2 μ	1.4 μ	27 — 30 μ	28.2 μ	1.2 μ
S. avium	Female	2 — 2.2 mm	2.11 mm	0.14 mm	0.003 — 0.034 mm	0.0333 mm	0.12 mm
	Egg	48 — 50 μ	49.1 μ	1 μ	27 — 30 μ	28.9 μ	3.3 μ

TABLE III

Showing comparison of various cestode species

Species of Cestodes	Length		Mean width — Length Ratio			Diameter of Scolex	
	Range	Mean	Immature	Mature	Gravid	Range	Mean
R. tetragona	78 — 86 mm	80.5 mm	2.65	4.67	7.74	0.28 — 0.35 mm	0.317 mm
R. echinobothrida	69 — 80 mm	75.6 mm	2.63	6.46	10.3	0.33 — 0.35 mm	0.336 mm
R. cesticillus	68 — 75 mm	71.9 mm	6.31	9.51	12.6	0.38 — 0.45 mm	0.429 mm
A. sphenoides	2.2 — 3 mm	2.55 mm	4	4.67	5.33	0.16 — 0.3 mm	0.187 mm

indirect life-cycle while helminths with direct and indirect life cycles parasites both free-ranged and housed chickens (Lim, 1971).

Worms Identified:

All the worms identified, namely: *A. galli, H. gallinae, S. avium, R. tetragona, R. echinobothrida, R. cesticillus* and *A. splenoides* are known to occur in Malaya (Lancaster, 1958; Omar & Lim, 1968; Shanta *et al.*, 1971; Lim, 1971). In all these instances, the project carried out showed the presence of *A. galli, H. gallinae, R. echinobothrida* and *R. tetragona* which indicated that they aware relatively more common than the other helminth parasites; *S. avium* was first recorded in Malaysia by Shanta *et al.* (1971). Surveys in Singapore also has recorded the presence of *S. avium* (Lim, 1971).

Infection Rates:

No previous attempts have been made to count individual tapeworms by local investigators. Shanta *et al.*, made actual enumeration of roundworms but not those of tapeworms. Many local investigators enumerated infection rates based on the number of chickens affected by the helminth parasites. Enumeration of infectionrates in this manner showed that majority of the chickens affected was of infection with *A. galli* (35%). Omar and Lim (1968) observed that of the 16 helminthiasis cases of poultry diseases majority of the infection was due to *A. galli* and or *H. gallinae.* In Singapore, the most common helminth species in sick birds or fowls was *A. galli* (Lim, 1971). A survey by Shanta, *et al* (1971) also showed that percentage incidence of infection was highest in *A. galli.* In fact, percentage incidence of infection

caused by other species of helminth parasites in this project resembled closely to that given by Shanta *et al.* (1971).

However, such enumeration of infection rates did not bring to light about the severity of helminth infection. Thus, as can be seen in this project, although the percentage incidence of infection by nematodes (48%) was higher than that produced by cestodes (25%), the severity of infections in chickens or intestines affected by cestodes was higher than that affected by the nematodes (Figs. 1 and 2). Except for *R. echinobothride* which occurred in low numbers (approximately 5 worms per intestine) high numbers of the other representatives of cestodes were found in each of the intestines (approximately 31 worms per intestine). The severity of infection caused by nematodes, namely *A. galli, H. gallinae* and *S. avium* was lower, there being approximately 5 worms per intestine.

The percentage infection rate decreased with increase in the number of species per intestine. This negative linear correlation was further supported when it was found that $r = -0.98$, using product-moment formula. This relationship had earlier been recognised by Shanta *et al.*, (1971), however, no explanations were given as to why such a situation arose. A comparative study of intestinal infection involving of two and three species of parasites per intestine showed that infection rate of the former was significantly higher than the latter ($P \leqslant 0.25$). The explanation that may be advanced to explain as to why few intestines were parasitized by large number of parasites is probably because of intraspecific competition between the parasites, due to overcrowding. Hesselberg and Andreassen (1975) showed that there was a decrease in the number of *Hymenolepis diminata* in rats during 8 weeks after infection with high number of cysticercoids. Holmes (1961) suggested that competition was possibly for carbohydrate and occurred more intensely in interspecific competition.

Significantly more nematodes and cestodes were recovered from the duodenum than from other parts of the intestine ($P \leqslant 0.95$). A possible explanation for the above occurrence is the secretion of bile by bile ducts into the distal end of the ascending part of the duodenum (Sturkie, 1965 and Mc Lellard, 1975). According to Dobson (1962a) bile is a carrier of oestrogen tenue and other parts of the intestine. Besides, it is also known that bile acts directly upon the parasites, inhibiting their metabolism of sugars (Dobson, 1962a).

Helminth burdens of male and female chickens:

Although infection rate among female chickens were significantly higher than males ($P \leqslant 0.25$), the number of worm burdens in male chickens were significantly higher than those in females ($P \leqslant 0.995$). This showed that there was a tendency for males to be more heavily infected with the parasites than the females. The difference was more likely to be attributed to higher physiological resistence of females although difference in behavioral resistence of the two sexes might play a part. This is because analysis of food eaten by the two sexes was not carried out which would otherwise eliminate factor due to behavioral resistence. Gray (1972) studied the effect of host age on the course of infection of *R. cesticillus* in fowls and found that in female hosts, age resistence developed more rapidly than in males until the birds were 84 days old.

The fact that female fowls have greater resistence than males could be attributed to the effect of female hormone oestrogen. There are a number of evidence to show that the female hormone in vertebrate animals increases resistence to parasitism. Cases where mammals have shown lower infestation levels in females than in males are given by Dobson (1961a, b;) who demonstrated that male rates were more susceptible to *Nematospiroides dubus* Baylis than the females. Behnke (1975) also showed that the prevalence of infection of *Aspicularis tetraptera* was greater in male than female mice. Similar result has been noted for fish by Thomas (1964) who showed that male trouts were more heavily infected with helminth parasites than females except when later were spawning or recovering from it. The study by Lees (1962) revealed out that incidence of helminth parasites was generally higher in male than female frogs.

Experimental evidence showing that female hormone is involved in increasing resistance in mammals have been discussed by some workers, Dobson (1961b) implanted oestradion in sprayed

(without ovaries) female rats and found that hosts' resistance to *N. dubis* was increased. Work by Lees (1962) observed that levels of parasitization by helminth parasites was higher in male than female frogs, and that the greatest difference in level of sex hormone in the blood was high. These observations suggested that oestrogen depressed level of parasitization by helminths.

The possible mechanisms thereby that oestrogen may strengthen the resistence of the hosts have been viewed by Dobson (1961a, 1962) who suggested 2 resistence mechanisms of mice against *N. dubius* both of which were controlled by eostrogen. These were the indirect mechanism, involving the laying down of connective tissue and antibody reaction as well as the direct mechanism in which oestrogen carried in the bile and blood acted directly on the nematodes. He also reconstructed the general pattern of resistence of rates to infection of *N. dubius* from the time larvae penetrated the hosts' tissues until they were immobilized by the hosts antibody response, and were then encapsulated and phagocytosed. It was possible that the same mechanisms occurred in female chickens during helminthiasis.

Male hormones seem to favour growth and survival of the parasites as indicated by Dobson (1961a, b). In invertebrates, however, the relationship of parasites to the sex of the host often differs from that generally found in vertebrates. Thus papers cited by Berry (1962) indicated that females of *Littorina sexatilis* (Mollusca) were more heavily infected with trematode larvae than males.

Comparative studies of nematodes and cestodes

No comparative study on the nematodes and cestodes found in this country have been made by investigators. When obtained values were compared to those given by Soulsby (1968) it was found that some of the values did not fit into the ranges given. The values might fall short or exceed the given ranges. This shows that various factors like host animals and the nutritional state of the host probably influence the growth and development of these parasites. Besides the number of parasites examined were low and therefore the values obtained did not give true measurements of the various species. It is also found that values of the various measurements for nematodes given by Soulsby (1968) differ from that given by Bhalero (1935) and Ershow (1956).

Treatment and Control

Since more important helminth problem appears to be that caused by cestodes, any anthelminthics used should be those that have toxic effect on the cestodes. Other anthelminthics can be used but should be combined with cestoidal drugs. More male chickens should be treated with such drugs because they are the ones most susceptible to the parasites. It has been well accepted that judicious use of drugs give better livestock production and thus higher grass financial return (Campbell, 1977).

Faeces are main sources of infection especially in free-ranged and housed chickens and should be regularly removed. In free-ranged chickens, rotational type of raising chickens may be practiced. The used lands may be ploughed and exposed to the sun to be sterilized before raising the next batch of chickens. Alternatively, the ploughed lands may be used for cultivation and the batch of chickens raised on a new ground. Chicken houses should be well ventilated so that environment is kept dry thus depriving nematode eggs of moist environment which is essential for hatching of eggs.

An important factor in the control of nematodes and cestodes infections is the elimination of intermediate hosts. Chicken enclosures should be well drained to avoid breeding of molluscs and arthropods as well as preventing earthworms from coming to the surface of the ground. Molluscides can be used to destroy snails while arthropods such as ants, cockroaches, house flies, grasshoppers and beetles can be got rid off through the use of insecticides.

SUMMARY

A study of helminth parasites of *Gallus domesticus* L. was conducted based on examination of 100 intestines. The species which parasitized these chickens were *Ascaridia galli* (Schrank, 1978), *Heterakis gallinea* (Gmelin, 1790), *Strongyloides avium* (Cram, 1929), *Raillietina echinobothrida* (Megnin, 1880), *Raillietina cesticillus* (Molin, 1858), *Raillietina tetragona* (Molin, 1858), *Amoebotaenia sphenoidea* (Railliet, 1892) and *Hymendepis* spp. Although many

chickens or intestines were infected by nematodes, severe infections were mainly due to cestodes. The study revealed that male chickens were more heavily infected than females. More worms were recovered from the duodenum than other parts of the intestine. Explanations were offered for these two phenomena with particular reference to the female hormone estrogen. Comparative studies of the nematodes and some of the cestodes were carried out.

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