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Morphology and Seasonal variation of fowl tape worm, *Raillietina tetragona* (Molin, 1858) in Purba Bardhaman, West Bengal, India

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ABSTRACT

The tape worm, *Raillietina tetragona* (Molin 1858) is a common parasite of domestic fowl, *Gallus domesticus* in West Bengal. This cestode parasite plays a significant role in growth and reproduction of fowl. In the current study, Light microscopic (LM) examination showed that the present cestode has a minute pin like scolex or head (18.98µm – 19.76 µm) and a long flat body divided into immature, mature and gravid proglottids. Head bears a rostellum (2.94 -3.11µm), four acetabula (6.79µm - 7.4µm) and followed by a neck (15.1µm – 16.27µm). Seasonal variation of *R. tetragona* from *Gallus domesticus* in Purba Bardhaman, West Bengal, India has been studied through two years span (January, 2016 to December, 2017). Monthly variations of infection of *Raillietina tetragona* showed comparatively higher prevalence in hot summer months (58.33 - 70 %) and humid rainy season (80-95.24%) and lower prevalence during winter season (0 - 10%). Mean intensity of *Raillietina tetragona* was also higher in summer (1-2.5) and rainy season (3.36-10.2). The present study on the morphology and seasonal prevalence of *Raillietina tetragona* in Purba Bardhaman region of West Bengal showed that more awareness should be focused towards upgrading and maintenance of the local free ranging chicken breeds.

KEY WORDS: *RAILLIETINA TETRAGONA, GALLUS DOMESTICUS*, LIGHT MICROSCOPIC OBSERVATIONS, PREVALENCE, PURBA BARDHAMAN, INDIA

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INTRODUCTION

Domestic fowl, *Gallus domesticus* (Linnaeus 1758) (Galiformes: Phasianidae), is supposed to have derived from the South East Asian and wild Indian red forest chicken (Permin and Ranvig, 2001). These fowls are with high nutritional value. Sometimes these are domesticated traditionally under free-range management systems in villages where little or no supplementary foodstuff is provided and the poultry farmers are unaware of any veterinary care, which finally leads to the parasitic infections to the chicken (Gary and Richard 2012). According to Rohde (1994), there are some other factors like temperature, humidity, rainfall and parasite maturation which influence the parasitic infection in domestic fowl. Thus environment plays a significant function in the seasonal variability of these cestode parasites. During the present study *G. domesticus* were collected from Purba Bardhaman and surrounding rural areas while some other gastrointestinal cestode parasites were also recovered from the domestic fowl gut and *R. tetragona* was found to be the most prevalent species among all. This is also supported by the findings of Khan et al. (2016).

In the present survey morphological observations were made using light microscope (LM) and measurements of its cephalic regions were taken. Other morphological characters like shape of the scolex; rostellum and suckers, number of eggs in the egg capsules and shape of the eggs were also made.However, reports on seasonal prevalence of *Raillietina tetragona* in domestic fowl of Purba Bardhaman region of West Bengal could not be noticed in the accessible reports. The two year survey was carried out to determine the prevalence of this cestode parasite in *G. domesticus* occurring in and around Purba Bardhaman, West Bengal, India.

MATERIAL AND METHODS

Freshly dissected out guts of the domestic fowl, *Gallus domesticus* were purchased from the local markets of Bardhaman, West Bengal, brought to the laboratory, as soon as possible, and examined for the presence of *Raillietina tetragona* in each week of every month for a period of consecutive two year study period from January 2016 to December 2017. Live worms were washed in normal saline (0.85% NaCl) and freed from the adhering host materials, fixed and preserved in 70% alcohol. For identification and morphological observations, the adult cestodes were washed in normal saline, dried and flattened on filter paper, fixed in 70% alcohol and observed with the help of compound light microscope.

The prevalence of infection and mean intensity were calculated from the recorded data with the help of the following formulas

$$\text{Prevalence of infection (In percentage)} = \frac{\text{no. of infected } \textit{Gallus domesticus}}{\text{total number of } \textit{Gallus domesticus} \text{ examined(Infected + uninfected)}} \text{X } 100$$

$$\text{Mean intensity} = \frac{\textit{Total no. of Raillietina} \text{ sp. collected from infected intestine}}{\text{No. of infected } \textit{Gallus domesticus} \text{ in the sample}}$$

RESULTS

General morphology of the cestode

Light microscopic (LM) study showed that the body of *R. tetragona* was typically divided into scolex, followed by a short unsegmented region, the neck, succeeded by a chain of proglottids consisting of immature, mature and gravid segments. Scolex is small pin like and provided with four well-formed hemispherical acetabula, armed with hooks and an armed disc shaped rostellum (**Plate 1**). In the mature proglottids the genital pores are unilateral (**Plate 3**) and in the gravid proglottids (**Plate 4**) eggs are found in egg capsules, each containing six to twelve eggs.

The current LM observation showed that the scolex of *Raillietina tetragona* was about **18.98µm – 19.76µm** in width, neck was about 15.1**µm- 16.27µm** and rostellum was 2.94**µm** – 3.11**µm** in width and armed with one row of hooks. Four acetabula were measured about 7.08µm, 6.95**µm**, 6.79µm and 7.4**µm** in length and 4.12**µm**, 4.03**µm**, 3.17**µm** and 3.71**µm** in width respectively. Mature proglottids (**Plate 2**) were rectangular in shape (65.68**µm - 68.96µm**) and gravid proglottids (60.85**µm**-61.44**µm**) were more or less square containing numerous egg capsules (**Plate 5**) which were more or less round or oval in shape and measured about 0.85**µm**- 1.09**µm**.

During the two year study period from January 2016 to December 2017, out of 382 fowl guts examined, 230 were found infested with *R. tetragona* and totally 907 parasites were collected. As *R. tetragona* was isolated all through the year from *Gallus domesticus*, characterization and seasonal prevalence were done for this species only. Monthly variations in respect to percentage of prevalence andthe mean intensityof *R. tetragona* infection have been presented in **Table 1** and total number of parasite present in *Gallus domesticus* in each season for the two year study period has been shown in **Figure 1** .The result showed that average prevalence percentage was 51.91%. The study revealed that the higher percentage of prevalence of *R. tetragona* occurred in summer season showing higher peak in May (61.58% -70%) and it showed its highest values during rainy season and the maximum value of percentage of prevalence was recorded in the month of July (93.33% - 95.24%). From September to November it tends to lower down and the lowest prevalence occurred in winter (0 -10%). The mean

Table 1. Monthly variation in % of prevalence and Mean intensity of infection of *Raillietina tetragona* infecting *Gallus domesticus*

Month of collection	Number of gut examined		Infected host		Parasite present		Prevalence %		Mean Intensity	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
January -16	8	10	0	0	0	0	0	0	0	0
February -16	8	14	1	2	1	3	12.5	14.28	1	1.5
March -16	12	16	2	2	2	4	16.67	12.5	1	2
April -16	12	10	7	6	12	10	58.33	60	1.71	1.66
May-16	20	13	14	8	25	20	70	61.58	1.79	2.5
June-16	20	17	16	15	54	67	80	88.24	3.36	4.46
July-16	15	21	14	20	120	204	93.33	95.24	8.57	10.2
August -16	19	23	16	21	95	119	84.21	91.3	5.93	5.66
September -16	25	15	18	11	50	52	72	73.33	2.78	4.72
October-16	24	28	20	23	22	26	83.33	82.14	1.1	1.13
November -16	15	16	7	5	9	10	46.67	31.25	1.28	2
December -16	10	11	1	1	1	1	10	9.09	1	1
Total duration: 2 years	total no. of sample: 382		Total number of infected host: 230		Total number of parasite present: 907		Mean percentage of prevalence: 51.91%			
Period of study: January 2016 to December 2017										

intensity of infection also declined in the winter season (0-1) during the two year study period.

DISCUSSION

Raillietina tetragona has a cosmopolitan distribution occurring in pigeon, chicken and guinea fowl. This tapeworm completes its development in two hosts. Birds are the definitive hosts and ants, mostly of the species *Tetramorium*, and housefly of the species *Pheidole* and *Musca* act as the intermediate hosts (Horsfall 1938; Soulsby 1982; Su 1986). Light Microscopic observations revealed that *Raillietina tetragona* was different from the other *Raillietina spp*. in respect to the shape of scolex, rostellum and acetabula. The hooks of the rostellum were placed in one row (Butboonchoo et al., 2016). This type of study was also carried by some scientists earlier (Hofstad et al. 1984; Sawada 1964 and 1965) but scanty literature is available. Lalchhandama (2009) observed the morphological structures of *R. echinobothrida from* fowl gut and Mu et al. (2009) worked on R. echinobothrida and *R. tetragonal* from the gut of domestic

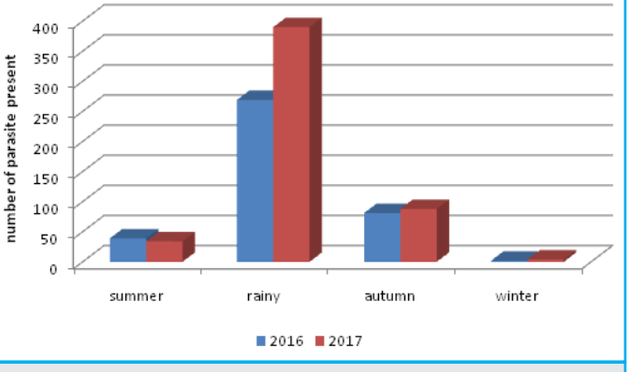

FIGURE 1. Seasonal prevalence (No. of parasite) of *Raillietina tetragona* present in *Gallus domesticus* during two year study period from January 2016 to December 2017

PLATE 1. Light Microscopic view of anterior portion of *Raillietina tetragona* showing Scolex (SC), Rostellum (RS), Acetabulum (AC) and Neck (NC)

chicken. In the recent year, Butboonchoo et al. (2016) distinctly differentiated four different species of *Raillietina spp*. including *Raillietina tetragona* on the basis of Light Microscopic and Scanning Electron Microscopic observations. The present study showed similar findings.

Seasonal variability of *R. tetragona* in domestic fowl, *Gallus domesticus*, was checked throughout the year and comparatively higher percentage of prevalence and mean intensity of this parasite were observed in the summer and rainy season. Seasonal variability of cestodes were showed that changes in prevalence and infection rates could depend upon host, parasite and also upon the geographical location (Biswal et al. 2013). Oniye et al. (2001) in Nigeria reported a high prevalence of

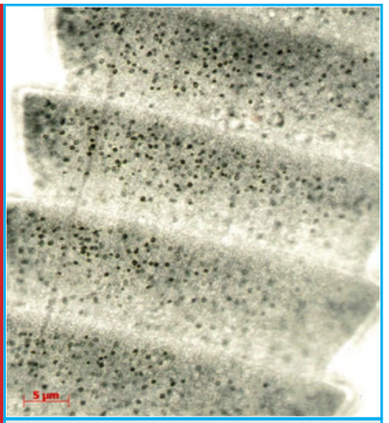

PLATE 2. Light Microscopic view of Mature proglottids of *Raillietina tetragona*

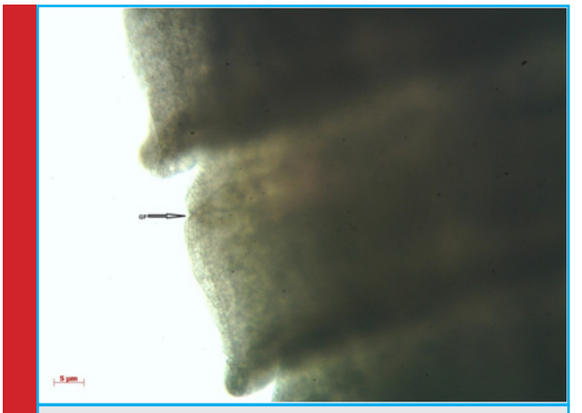

PLATE 3. Light Microscopic view of Mature proglottid of *Raillietina tetragona* showing genital pore (GP)

Raillietina tetragona in the month of June and August. Fakae et al. (1991) from Eastern Nigeria reported 72.5 % prevalence of *R. tetragona* in *Gallus gallus* during dry season (November to April). These finding were supported by the previous results as reported by Frontovo, (2000), Fakae et al. (1991) and Oniye et al. (2001).

Seasonal prevalence of *R. tetragona* also varied with geographical location and other climatic conditions. According to Adang et al. (2008) *R. tetragona* was found to be the most common cestode parasite in domestic pigeon, occurring in 11 months of the annual cycle, showing highest prevalence in rainy season in Zaria, Northern Nigeria. Salam et al. (2010) and Sheikh et al. (2016) reported that the prevalence of *R. cesticillus* from *Gallus gallus domesticus* in Kashmir is highest in summer followed by autumn, spring and winter months respectively. Butt et al. (2014) reported that the average percentage of prevalence of *Raillietina cesticillus* in *G. domesticus* was 83.5% during July to November, 2013 in Hyderabad, Sindh, Pakistan. Accord-

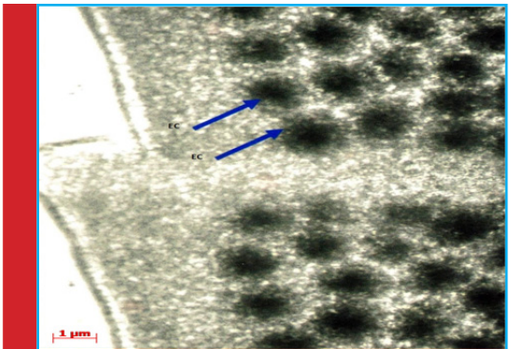

PLATE 4. Light Microscopic view of Gravid proglottids of *Raillietina tetragona* showing Egg Capsules (EC)

PLATE 5. Light Microscopic view of Egg Capsules of *Raillietina tetragona* isolated from gravid proglottids

ing to the observations of Sheikh et al. (2016) the high prevalence of *Raillietina sp*. infection was seen during warm summer followed by autumn, spring and winter months. Except winter, the high prevalence of cestode infection throughout the year is a strong evidence of unscientific management and control in domestic fowls. As a result an infection creating environment originates continuously. However, Shukla et al. (2012) reported that the maximum prevalence of *Raillietina sp*. in *G. domesticus* from Ahmednagar district, Maharashtra, India was found in winter followed by rainy season and minimum prevalence was noted in summer. According to Patil and Bhamare (2018), a high prevalence of *Raillietina sp*. in *G. domesticus* from Nashik district of Maharashtra, India occurred in winter season followed by summer season and low in rainy season. A possible explanation of this report is the availability of the intermediate host and oncosphere stages of *Raillietina sp*. increases during cold climatic condition. The oncosphere stages are taken by the intermediate hosts and grow into cysticercoids which become adult in the definitive host during summer season.

In our survey greater number of mature cestodes were obtained during summer and rainy seasons whereas in autumn mostly immature stages were obtained. High rate in the percentage of prevalence and mean intensity of *R. tetragona* in the summer and rainy season may be a result of the abundance of infective stage and the stage bearing intermediate hosts in the survey zone during these seasons. It seems that moisture and temperature favour the development of intermediate hosts, the development of eggs in soil as well as proliferate the reproductive rate of parasites (Møller, 2010). Low prevalence of *R. tetragona* in winter season may be the result of elimination of multiple infections. This condition may occur due to intraspecific antagonistic reaction.

In fact, reports from other researchers around the world in different times showed that *Raillietina spp*. has a very high prevalence of infection in birds especially in indigenous chickens. (Ahmed and Sinha, 1993; Puttalakshmamma et al. 2008; Nnadi et al. 2010; Sreedevi et al. 2016; da Silva et al. 2016). According to a recent report of Jajere et al. (2018) who found the guinea fowls have been heavily infected with *Raillietina spp*. and among the various species, *Raillietina tetragona* was most abundant having 72.8% prevalence of infection. When the infective stages of intestinal parasites pass out to the surroundings, they have to get over the environmental hazards before they reach their suitable hosts for further development (Gillett, 1974). So, favourable environmental conditions are also necessary for the effective transmission of the parasites (Smith, 1990) and seasonal variations in the social conduct of the host and their accumulation can also describe for seasonal dynamics of parasitic infections (Hosseini et al. 2004). The time period for obtaining table size, in case of indigenous breed, is longer than exotic breeds which are usually feed on artificial supplementary diets. So another reason of higher infection is may be due to improper management, the inadequacy of food grains for the local breeds and they have to feed on insects, mites and worms which may be the intermediate hosts for the cestode parasite and has been shown to improve susceptibility to parasitism in the system (Shukla and Mishra, 2013).

Moreover, earlier studies have shown that the immune systems of humans, rodents and birds got weaker by rough climatic conditions, under-nutrition or investment in reproduction (Lloyd 1995; Nelson et al. 2002) and due to low immunity level, hosts become more vulnerable to infections (Hillgarth and Wingfield, 1997). A longer breeding period of the host bird provides a selective advantage to the parasites (Dunn and Winkler 2010; Møller et al. 2010). Reports have shown that during the breeding season of host birds, antibody production and cell mediated immunity rate is getting weaker which is the reason for higher rates of parasitic infection (Hillgarth and Wingfield, 1997; Moreno et al. 2001). According to Sheikh et al. (2016) the host birds have shown a moderate resistance against the cestode parasites with the advancement of age because of the improved immune status in grown-ups than in young ones. Chicks hatch out during late spring. During summer and autumn they are in their young age when they get exposed to parasite infection. The young and the juvenile forms are susceptible to the parasite because they are immunologically weak. This may also affect the seasonal variability of *Raillietina tetragona*. Till now

there are many surveys on *Raillietina spp*. reported from different parts of the world but it is still needs to execute more studies to follow the changing dynamics of helminth infection in domestic poultry management.

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Compliance with ethical standards: Though our Institution does not have such ethics committee, domestic fowl has been slaughtered for the present work following the guiding principle of CPCSEA (The Committee for the Purpose of Control and Supervision of Experiments on Animals) established by the Act of the Indian Parliament.

Conflict of interest: All the authors have declared that in the present work there is no conflict of interest.

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