Assessment of Coccidia in Poultry in Guyana

Renáe L. Turney[1] and Johaine E. McAllister[2]
Departments of Parasitology[1] and Pathology[2], Veterinary Services Laboratory, Guyana Livestock Development Authority, Agriculture Road Mon Repos, East Coast Demerara, Guyana, South America

Abstract

Coccidiosis is known to cause great economic losses to poultry producers affecting the performance of poultry globally. A study was carried out reviewing the prevalence of coccidia in commercial broilers and layers from faecal samples and whole animal from 37 farms dispersed mainly throughout the low-lying coastal plain of Guyana. The faecal oocysts count for samples subjected to the Modified McMaster Technique, along with the pathological lesions seen at necropsy were reviewed. A total of 71.2% of poultry examined through necropsy showed mild to moderate thickened, wrinkled and edematous intestinal walls with multifocal ecchymotic haemorrhages and congestion with mucoid content. An overall prevalence of 42.2% was observed in 48.6% of the farms. 67.9% prevalence was observed in broilers and 25.6% in layers. Broilers, ≤3 weeks old showed a prevalence of 72%, while layers ≤ 6 months a prevalence of 33.3%. A total of 96.4% of the birds which showed positive signs for coccidia also appeared to have other infections.

Keywords*: broilers, layers, oocysts per gram*

1. Introduction

1.1 Poultry production in Guyana

Local poultry production is undertaken entirely by the private sector, Guyana's estimated 5,000 poultry farmers produce between 37 million and 42 million birds annually and since 2000, Guyana has moved from being a net importer of chicken to becoming self-sufficient in poultry meat. The poultry industry remains one of the single most important industries in the livestock sub-sector in terms of employment, contribution to GDP, and production. The industry remains an essential element in the effort to ensure food and nutritional security domestically, eliminate poverty, expand the agro-industrial base nationally, and earn/save foreign exchange for Guyana. The industry guarantees Guyanese a constant supply of fresh, healthy meat and is a primary source of animal protein in the local diet. For example, it was found that chicken was the main meat consumed in Guyana at approximately 40 kg/person per year. The per capita annual consumption of broiler meat in Guyana averaged 22.33 kg in 1999 and represented approximately 70% of all meats consumed in Guyana.

The growth of local poultry production and the increase in capacity building in the agriculture sector, has led to subsequent increases in the monitoring of poultry farms. This has increased the number of poultry samples submitted to the veterinary laboratory. It was noticed that a large number of the birds necropsied showed lesions suggestive of coccidiosis. This prompted us to review the prevalence of coccidia in the poultry samples submitted to the laboratory.

1.2 Causative agent of Coccidiosis

Coccidia is a protozoan parasite of the phylum Apicomplexa. This parasite affects all species of animals including poultry. High-density flocks and confinement have increased the exposure of poultry to this parasite (Saif et al 2008). There are various coccidian species that affect humans and animals, however, coccidiosis in poultry is produced by the *Eimeria*spp. There are about 1800 *Eimeria* species that affect birds and other animals (Nematollahi et al 2009). These species are highly host specific and affect different areas of the intestinal tract of its host (Aiello 2016). There are nine species that affect chickens and approximately 13 that affect ducks. The specificity of these parasites allows that the species that affect chickens, for example, do not affect turkeys and vice versa (Chapman et al 2010). Of the species that affect domesticated chickens *Eimeria brunette*, *Eimeria maxima*, *Eimerianecatrix*, *Eimeriatenella* are considered the most pathogenic; while *Eimeriaacervulina*, *Eimeriamitis*, *Eimeriamivati*, *Eimeriapraecox*, and *Eimeriahagani* are less pathogenic (Lawal et al 2016).

Each specie produces a separate and distinct reaction, independently of the other species (Saif et al 2008). Clinical disease is determined by the species of coccidian infection, less pathogenic species produce few or no lesions.

1.3 Signs of Coccidiosis

Coccidiosis is considered to be one of the major causes of poor performance and productivity loss in poultry and other farm animals (Bachaya et al 2012 & Mujahid et al 2007). Coccidia is known to inhabit the epithelial walls of the small intestines and caecum of birds and causes tremendous damage such as interruption of feeding, digestive processes or nutrient absorption, dehydration and blood loss (Saif et al 2008). Some of the signs include mucoid and/or bloody diarrhoea, fever, inappetence, weight loss, emaciation, and in extreme cases death, even though many infections are subclinical (Constable 2015). Poultry growth rate is oftentimes negatively affected as a result of the aforementioned signs; additionally, in layers, coccidiosis can be manifested in a decrease in the production of eggs. Coccidiosis is also known to produce malabsorption and thus reduces the animal's ability to receive adequate nutrition producing subsequent immune suppression, paving the way for secondary disease conditions (Kabell et al 2006). This suppression of the immune system results in the animals becoming susceptible to other disease agents (Saif et al 2008). Lankriert et al (2010) suggest that chicken anaemia virus infectious, Marek disease, and Infectious Bursal Disease exacerbate coccidiosis and vice versa.

1.4 Coccidian life cycle

The life cycle of coccidian parasites in birds was first described by parasitologist H. B Fantham at the Cambridge University in the United Kingdom (Chapman 2003 & McAllister 2018). Research was also carried out at the veterinary laboratory in Weybridge on coccidia and since then many countries around the world have recorded the presence of coccidia (OIE Handistatus 2005 & Gharekhani et al 2014).

Animals become infected with coccidia when they come into contact with the parasite and ingest sporulated oocysts. Coccidiosis, however, is largely dependent on the number of infective oocysts ingested, the genetical reproductive disposition of the species, the stage of infection, the age, prior exposure and the immune status of the bird (Saif et al 2008). Oftentimes, multiple faecal examinations may be required for the identification of oocysts. An animal being infected with coccidia oocysts, however, is not always indicative of disease and even though this might be true consideration must be made that where a coccidian infection is, there is some amount of invasion and destruction of host intestinal epithelial cells (Gussem 2007).

The oocysts enter the environment in the faeces of an infected host, nevertheless, they are unsporulated and therefore not infective when passed in faeces. With the correct environmental conditions, the oocysts passed in the faeces will sporulate and once ingested by an animal the sporozoites escape from the sporulated oocysts. It then invades the intestinal epithelial cells and develops intracellularly into multinucleated schizonts. Each of the nuclei develops into a merozoite, which enters new cells and repeats the process. After multiple asexual generations, merozoites develop into macrogametocytes or microgametocytes, which will produce a single macrogamete or several microgametes in a host cell. When fertilization is complete the macrogamete develops into an oocyst. The oocysts are then passed in faeces and the cycle continues (Constable 2015).

There has been a lack of surveillance and research on the prevalence of coccidia in poultry in the Caribbean except for some islands like Trinidad & Tobago and Grenada. In Trinidad and Tobago, research was carried out on the molecular identification of *Eimeria* spp in broilers (Brown-Jordan et al 2018). In this study, real-time Polymerase chain reaction (qPCR) was used to identify the different *Eimeria* spp affecting broilers. The study done in Grenada captures the gastrointestinal parasites of small ruminants (Chikweto et al 2018).

This current study sets out as a forerunner for future studies on coccidia in poultry in Guyana. The information will hopefully guide future studies and stimulate discussions and implementation of improved management and control strategies for coccidian infections.

2. Materials and Methods

In Guyana, coccidiosis is a direct threat to poultry production, faecal samples and poultry samples are regularly sent to the VSL for analysis. This is done especially when there are signs of infections and when coccidiosis is considered a suspected cause of death of poultry on farms. Additionally, in conjunction with necropsy examinations of poultry a faecal analysis is done.

Having archived the results of the analysis of the presence of coccidia in commercial poultry (broilers and layers) from January 2018 to July 2019, a retroactive case study was done analyzing the prevalence of coccidia on the low coastal plain of Guyana using the GLDA VSL database. Permission was given by the authority for the use of the information. A comprehensive literature review using internet searches was also used to facilitate the compilation and analysis of data.

2.1 Study area

Guyana is situated in central north of South America with coastlines at the North Atlantic Ocean. Venezuela, Suriname and Brazil are countries with international borders to Guyana. It is divided into four natural geographical regions: the low-lying coastal plain (Coastal plain) situated along the Atlantic coast, the hilly sand and clay area, the highland region, and the interior savannahs situated in the south-west of the country, covered predominantly by grassland interspersed with rivers and streams. The samples analyzed were submitted from farms situated predominantly on the low coastal plain, since approximately 90% of the population inhabits this region and a greater percentage of poultry rearing is done here.

The low-lying coastal plain occupies about 5 percent of Guyana's area, it ranges from five to six kilometres wide and extends from the Corentyne River in the east to the Venezuelan border in the northwest.

2.2. Management systems

In Guyana, both commercial layers and broilers are reared intensively. In this system, birds spend their entire life up until slaughter in their pens. Farmers would generally practice a system where birds of a particular pen (on large farms) and the entire batch of birds (on small farms) will enter the pen at the same age and will be slaughtered at the same time. Birds are kept in pens constructed with wood and/or mesh, a large number of these pens are built directly on dirt/sand floors which are covered with rice paddy husk or wood shaving which farmers would collect from local rice mills and lumberyards. Additionally, some pens are built with concreted or wooden floors. The environment of the pens is sometimes controlled by the addition of sheets of plastic around the pens to prevent the entrance of water during heavy rains and winds. Heat is also added to the pens through different mechanisms. Farmers would administer mineral and vitamin supplements to their flocks as they see fit.

2.3 Sample submission

This investigation was carried out on 205 birds (broilers and layers) and 135 faecal samples submitted from 37 farms throughout Guyana, predominantly from the low coastal plain.

205 (dead and live) broilers and layers were submitted for necropsy. Live birds were submitted in boxes or bags and dead birds were submitted in bags or in cooler on ice. All birds accepted by the laboratory for analysis were accompanied by sample submission forms with information on the samples. Some of the sample submission forms were submitted incomplete, thus an unknown category was established for this group.

19 faecal samples were collected on-farm and 116 at necropsy (in lab). Samples that were collected on-farm were labelled and then transported in a cooler with ice packs to the laboratory, accompanied by a sample submission form. Upon arrival to the lab,these samples were either processed immediately or stored at 4-8°C, which is recommended by Cork and Halliwell (2019). Samples that were collected at necropsy, were also submitted with a sample submission form. All samples were processed within 7 days of collection.

2.4 Sample processing

2.4.1 Necropsy

A detailed necropsy examination was carried out on euthanized birds and dead birds submitted to the VSL. The necropsy procedures were adapted from various sources, including Brown et al (2012), Brown et al (2019) and Morishita (2019). The presence of gross lesions was carefully recorded and representative sections of intestines (from random birds) were collected and stored in 10% buffered neutral formalin. Faecal samples were taken from random birds with intestinal lesions and/or diarrhoea, placed in clean faecal containers, labelled and submitted to parasitology for analysis along with a sample submission form.

2.4.2 Faecal processing

Faecal samples were subjected to either the Modified McMaster Technique (MMT) or the Direct Faecal Smear (DFS) based upon the request of the customer. A greater percentage of our customers requested the MMT. The MMT used in the experiment required a total of 2 g of faeces mixed with 28 mL of Sheather's flotation solution. This is a saturated sugar solution used to separate parasite eggs and/or oocysts from faecal debris since it has a higher specific gravity in comparison to some parasite eggs and/or oocysts. Each oocyst observed represented 50 oocysts per gram (opg), thus this procedure did not detect fewer than 50 opg, which is equivalent to seeing one oocyst on the McMaster slide. The DFS was done using a drop of faeces and a drop of water/saline on a microscope slide (Zajac & Conboy 2012).

2.5 Data analysis

Data was collected from the VSL database. Microsoft Excel spreadsheet was used to analyze the data and calculate percentages.

3. Results

3.1 Pathological analysis

A total of 205 poultry (broilers and layers) necropsies were performed. Of these, 71.2% of birds showed intestinal and caecal lesions including thickened, wrinkled and edematous intestinal and caecal walls with multiple focal ecchymotic haemorrhages and congestion with mucoid content. Less than 30% of samples showed marked enlargement and distended caecal pouches with clotted blood, fibrinous exudate with caseous appearance and diffuse haemorrhagic enteritis

The examination of intestines revealed that gross lesions were highest in the small and large intestines (67.8%), while 45.9% of birds showed lesions in the caecal tonsils with the majority being marked lesions, inclusive of enlargement and distention of the caecal tonsils, presence of thick caseous exudate with liquid and or clotted blood and diffuse haemorrhagic enteritis (Table 1).

42.4% of the birds showed mild to moderate lesions in the small intestines, while 31.7% showed marked changes. Within the large intestine, 45.4% of the birds showed mild to moderate changes and 22.4% showed marked changes. 20.5% of birds showed mild to moderate changes in the caecal tonsils while 25.4% showed marked enlargement and distended caecal pouches with clotted blood, fibrinous exudate with caseous appearance and diffuse haemorrhagic enteritis.

A total of 96.4% of the birds positive for coccidia showed signs of one or more other infections. Lesions suggestive of IBD and IBH were more frequently observed, with IBD suspected in 60.7% of birds positive for coccidia and IBH suspected in 37.5% of the cases. It was also noted that all birds positive for coccidia that presented with lesions and clinical signs of IBH also showed lesions and clinical signs of IBD. Other infections noted at necropsy were microbial infections (16.1%) (suspected *Escherichia coli, Salmonella* and *Clostridium perfringens*) Newcastle Disease (10.7%) and Avian Leucosis (3.6%).

3.2 Parasitological analysis

The total number of faecal samples examined from broilers and layers was 135. Of that, 42.2% of the samples were positive for coccidia. A 48.3% prevalence was observed in samples taken at the laboratory, while 5.3% prevalence was observed in samples submitted from the fields.

63.2% prevalence was observed in samples originating from region #3, 60% from region #6, 46.2% from region #5, 36.4% and 25% from regions #4 and region #10 respectively (table 4).

Broilers accounted for only 39.3% of the samples submitted while layers accounted for 60.7%. A greater prevalence of coccidia (67.9%) was seen in broilers in comparison to that of layers which showed a prevalence of 25.6%.

Based on the information on the sample submission forms, the category of animals (broilers and layers) were divided into various age groups. Some of the sample submission forms were incomplete and for that reason, there is an unknown age category.

It was observed that 72% of broilers 3 weeks and under tested positive for coccidia, while broilers 4 weeks and older had a prevalence of 68%. For layers, birds under 6 months had a prevalence of 33.3% while birds over 6 months 9.1%.

The overall median oocysts per gram (opg) observed was 2450, while the average opg was 8464, with broilers having a median of 6825 and an average of 11917 and layers having a median opg of 650 and an average opg of 3314.

The average and median opg in broilers surpassed that of layers. The percentage of broilers with higher levels of parasitism is greater than that observed in layers, while positive for coccidia, layers showed a lower level of infection. As the opg increased the prevalence of coccidia in broilers increased.

In the current study, four categories of opg were created for the samples that were subjected to the MMT. These categories were created using various resources (Peregrine et al 2010 and Abbott et al 2012). Table 8 shows that overall 41.1% of samples fell into the High category, 23.1% in the moderately high category, 21.4% in the Low category and 14.3% in the Moderate category. It also shows the level of infection for broilers and layers. 54.3 % of broilers showed an opg level of over 5050 while only 19% of layers fell into this category. 47.6% of layers fell into the lowest category (<200 opg) while only 5.7% of broilers fell into this category.

4. Discussion

Coccidiosis should be considered universal in poultry production as it is one of the most common and economically important poultry diseases (Ahad et al 2015 and Allen & Fetterer 2002). Its development and propagation are favoured by ecological and management conditions (Obasi et al 2006) and even under experimental work conditions, it is difficult to completely avoid infection for any period (Owai and Gloria 2010). Ola-Fadunsin and Ademola (2013) describe it as the most popular poultry disease of the intestinal tract. Its impact is seen largely as it produces great economic losses due to monies spent on prevention and control strategies and loss of livestock (Quiroz-Castañeda et al 2015 &Nematollahi et al 2009). The global cost of coccidiosis to the poultry industry has been estimated to surpass USD 2 billion per year (Fornace et al 2013, Yun et al 2000, Talebi and Mulcahy 1995).

In the current study, 48.6% of farms tested were positive for coccidia, with an overall prevalence of 42.2%. This is proven to be similar to that observed in Pakistan (43.89) (Awais et al 2011) and lower than that observed in other countries around the globe. The global prevalence of infected flocks has shown to be more than 50% with Nigeria having 52.9% (Mohammed et al 2015), Iran (55.96%) (Nemaollahi et al 2009) Turkey (56.2%) (Güvenet al 2013) and Korea (78.7%) (Lee et al 2010). The prevalence of coccidia in the Caribbean is scarcely reported. Obasi et al (2001) stated that chicken exposure to coccidia in tropical conditions is high since the environmental conditions are favourable throughout the year. However, there is reason to believe that the prevalence of coccidia in Guyana is greater than what is seen in the study. This assumption is made since follow up with farmers indicated that some animals were treated for coccidia before analysis.

The analysis has shown that 71.2% of the birds necropsied presented with intestinal and caecal lesions including thickened, wrinkled and edematous intestinal and caecal walls with multiple focal ecchymotic haemorrhages and congestion with mucoid content. These lesions concur with Saif et al (2008) and Abdul-Aziz & Barnes (2018) for the presence of coccidia in poultry. In table 1 we can observe that gross lesions were most prevalent in the small and large intestines. This table also indicates that all the birds showing marked lesions in the caecal tonsils had lesions in all sections of the intestines. Marked gross lesions were mostly observed in the small intestines followed by the caeca. Some of the differentiating factors for *Eimeria* spp are the level of pathogenicity, morphology and cell tropism. The aforementioned criteria are sufficient in identifying the most pathogenic and prevailing species: *E. brunetti, E. maxima, E. necatrix and E. tenella*. Their level of pathogenicity tends to range from moderate to very severe (Peek 2010).

In addition to host specificity of *Eimeria* spp there is also intestinal site specificity. Site specificity is so precise that intravenous, intramuscular or intraperitoneal injection of mammalian or avian *Eimeria* spp. results in infection of the intestine as if the animal were infected with the parasite orally (Peek 2010). The small intestine is predominantly affected by *E. acervuline E. mivati*, *Epraecox*, and *Ehagani* which are considered less pathogenic, while there is high pathogenicity associated with *E.tenella* which infects the caecal tonsils (Saif et al 2008).

Of the 146 birds presented with intestinal lesions, a faecal analysis was performed on 116, the results of the analysis showed that 48.3% of those samples were positive for coccidia. In some cases, samples that showed moderate to marked lesions typical of coccidiosis and clinical signs suggestive of coccidian infection were negative after faecal analysis, while others were positive for other parasites such as *Ascardia* spp and *Capillaria* spp. In addition to the observance of other parasites, some of the lesions presented at necropsy were suggestive of Infectious Bursal Disease (IBD), Inclusion Body Hepatitis (IBH), Newcastle, Microbial infections and Avian leucosis.Follow up with farmers revealed that some birds were treated for coccidiosis before sample submission, but the information was not reflected on the submission forms. This, as well as the lack of clinical information, reflects a need for further training of farmers and field staff on sample collection and submission as well as correctly filling out submission forms, since the determination of the cause of disease is oftentimes difficult because many infectious and non-infectious factors may influence intestinal health (Pantin-Jackwood 2013).
IBH was confirmed by PCR testing at an external laboratory and Avian leucosis was confirmed by histopathology. These results demonstrate the importance of controlling coccidia and any other parasitic disease, as stated by Lankriert et al (2010) and Saif et al (2008) the aforementioned diseases exacerbate coccidiosis and vice versa since there is suppression of the immune system of the animals, causing them to become more susceptible to other disease agents. Intestinal diseases can have a major impact on the broiler industry resulting from their effects on both technical performance and the welfare of birds. Reduced efficacy of digestion, as well as absorption of nutrients exaggerated by an increased and changing need for energy and nutrients, will result in depression of growth and an increase in feed conversion ratio. This was noted in the high level of stunted growth reported on farms. These findings have practical relevance for guiding treatment decisions on poultry farms, as well as farmers' training activities.

From table 5 we can observe that the prevalence of coccidia in broilers amounted to 67.9%, which in comparison, is higher than that observed in China (30.7%) (Lan et al 2017) and Algeria (54.3%) (Debbou-Louknane et al 2018). In layers, a 25.6% prevalence was observed, in comparison to the 36.6% seen in Benin (Dakpogana et al 2013). Etuk et al (2004) reported that poultry reared on deep litter show higher incidences of coccidiosis, because of their direct contact with the litter, this is seen on many broiler farms in Guyana and could be one of the reasons that broilers presented a higher prevalence of coccidia than layers.

Broilers 3 weeks old and under showed a prevalence of 72%, while broilers 4 weeks and over showed a prevalence of 68%. On the contrary, Long et al (1975) state that oocysts numbers in broilers 2 weeks and under are relatively low, while at weeks 4-6 a higher number of oocysts is seen. He also specified that at weeks 8-9 there is a drop in the level of oocysts numbers in birds since the birds would have acquired some amount of immunity. Immunity to *Eimeria* spp is said to be slowly obtained and is generally not fully complete until the birds are 7 weeks of age. Eventhough immunity can be developed, it is species-specific, leaving birds susceptable to other *Eimeria* spp. In order to obtain immunity, sporulation and ingestion of the oocysts must occur to initiate the next cycle. Multiple life cycles must be completed to produce immunity against all species (Mitchell, 2016). 33.3% of layers less than 6 months were positive for coccidia, while layers 6 months and older had a prevalence of 9.1% (Table 6). Majero et al (2001) and Obasi et al (2001) proposed that coccidia is most prevalent in younger chicks between 1-5 weeks old. They also agreed that oocysts can be present in faecal samples of chicks as early as 7 days old, with clinical presentation of the disease by weeks 4. It should also be considered that the difference in age of the broilers and layers is remarkably wide. This is due to the layers being submitted at a later age and the health care given to layers in the form of deparazitation. In Guyana, the culture of deparasitizing broilers is close to non-existant, even though some farmers (very few) may administer an anticoccidial .

In the current study, the seasonal prevalence of coccidia during the rainy/wet season is 40.2%, while the dry season presented with 52.2% prevalence. Studies done in Nigeria (wet season 46% and dry season 33.3%) and Benin (wet season 39.3% and dry season 33.8%) showedhigher prevalences of coccidia in the wet season (Dakpogana &Salifoua 2013 and Ola-Fadunsin 2017) in comparison to the dry season. Eventhough there are established limits for the wet and dry seasons in Guyana, the analysis of the seasonal patterns for the time of the study would be necessary for confirmation of the results observed.

5. Conclusion

The study of coccidia in poultry is of utmost importance since it has great economic significance. The security of protein-rich foods is heavily dependent on the production of poultry. This study focuses on the prevalence of coccidia in poultry and the main pathological lesions observed at necropsy.

- The overall prevalence of coccidia in poultry is 42.2% with 67.9% in broilers and 25.6% in layers.
- The study also shows that the younger birds less than and equal to 3 weeks old (72%) are mostly affected.
- Some of the pathological signs observed at necropsy were intestinal and caecal lesions including thickened, wrinkled and edematous intestinal walls with multifocal ecchymotic haemorrhages and congestion with mucoid content. Marked enlargement and distended caecal pouches with clotted blood, fibrinous exudate with caseous appearance and diffuse haemorrhagic enteritis were also observed.
- 96.4% of the birds positive for coccidia showed signs of one or more other infections. Lesions suggestive of Infectious Bursal Disease (IBD) and Inclusion Body Hepatitis (IBH) were most frequently observed. It was also noted that all birds positive for coccidia that presented with lesions and clinical signs of IBH also showed lesions and clinical signs of IBD.

Considering poultry meat is one of the high-ranking sources of protein in the Caribbean and around the world, it is of great significance that there are continued studies on coccidia, its spread and adaptation to the environment and anticoccidial drugs. This study sets out as a forerunner for future studies on this parasite.

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8. Tables

Table 1: Number of birds with lesions in the gastrointestinal (GI) tract.

	Number of birds with lesions in the digestive tract	Prevalence (%)
Small intestine	139	67.8
Large intestine	139	67.8
Caeca	94	45.9
All sections of the GI tract	94	45.9

Table 2: Gross lesions observed in the GI tract of birds (broilers and layers) submitted for necropsy.

	Number of birds with mild-moderate lesions	Prevalence (%)	Number of birds with marked lesions	Prevalence (%)
Small intestine	87	42.4	65	31.7
Large intestine	93	45.4	46	22.4
Caeca	42	20.5	52	25.4

Table 3: Birds infected with coccidia that showed signs of other infections.

Other infections observed n=56	Number of birds	Prevalence (%)
Infectious Bursal Disease (IBD)	34	60.7
Inclusion Body Hepatitis (IBH)	21	37.5
Newcastle	6	10.7
Microbial infections	9	16.1
Avian leucosis	2	3.6
Both IBD and IBH	20	35.7

Table 4: Prevalence of coccidia in faecal samples submitted per region.

Region	Faecal samples examined	Positives	Prevalence (%)
3	19	12	63.2
4	77	28	36.4
5	26	12	46.2
6	5	3	60
10	8	2	25

Table 5: Prevalence of coccidia per Category of poultry.

Category	Faecal samples examined	Positives	Prevalence (%)
Broilers	53	36	67.9
Layers	82	21	25.6

Table 6: Prevalence of coccidia per category of poultry by age.

Category	Age	Faecal samples examined	Number of positives	Prevalence (%)
Broilers	≤3 weeks	25	18	72
	≥4 weeks	25	17	68
	Unknown	3	1	33.3
Layers	0-6 months	33	11	33.3
	over 6 months	33	3	9.1
	Unknown	16	7	43.8

Table 7: Median (midpoint vale) and Average (the sum/total divided by the count) coccidia opg.

	Overall	Broilers	Layers
Median (opg)	2450	6825	650
Average (opg)	8604	11917	3314

Table 8: Level of infection; Coccidia oocysts per gram (opg) per category of poultry**.**

Category	Level of infection opg	Percentage of total samples (%)	Percentage of broiler samples (%)	Percentage of layer samples (%)
Low	<200	21.4	5.7	47.6
Moderate	>250 - <1000	14.3	11.4	19
Moderately High	>1050 - <5000	23.2	28.6	14.3
High	>5050	41.1	54.3	19

Table 9: Prevalence of coccidia in the various months.

Months	Faecal samples examined	Number of positives	Prevalence (%)
January	17	14	82.4
February	4	2	50
March	1	0	0
April	10	4	40
May	23	8	34.8
June	31	5	16.1
July	23	10	43.5
August	4	2	50
September	-	-	-
October	18	11	61.1
November	-	-	-
December	4	1	25
Total	135	57	
Seasons			
Rainy	112	45	40.2
Dry	23	12	52.2

9. Figures

Figure 1: Commercial broiler and layer farms in Guyana.

Figure: 2 Caecal tonsils and small intestines of 3 week- old broilers.

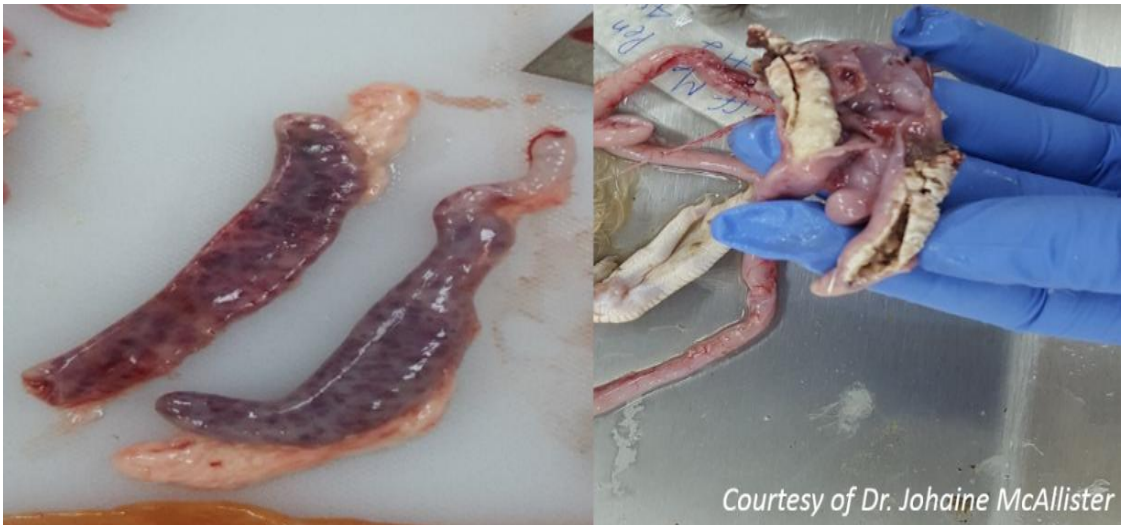

Figure: 3. Thickened caecal walls, petechial and ecchymotic haemorrhages, caecal tonsils filled with caseous material