BioGecko Vol 12 Issue 02 2023

ISSN NO: 2230-5807

Prevalence of Gastrointestinal Parasite Infection in Native Chickens (*Gallus gallus domesticus*) Under Type I Climate

Christian C. Taba

Instructor, Iloilo Science and Technology University, F. Cabarles, St. Leon, Iloilo, Philippines
christian.taba@isatu.edu.ph

ABSTRACT
The study aims to determine the factors influencing the prevalence of gastrointestinal parasite infection in native chickens raised by farmers in the selected Municipalities in Iloilo. The survey covers the management practices of one hundred eighty farmers on feeding, supplementation, disease prevention, and control. The study used quantitative and qualitative research approaches, and respondents were selected using a multi-stage sampling technique. Faecal and blood samples were collected from one hundred fifty birds of varying weights, ages, and types. Survey data were analyzed using the SPSS, and the STAR packages used parasite eggs and white blood cell count. The most common gastrointestinal parasite species were *Eimeria spp., Capillaria spp., Ascaridia galli, Strongyloides, Heterakis gallinarum* and *Raillietina spp.* A regular deworming program, especially in those barangays with a high rate of parasite infection, must be implemented by the raisers to control the incidence of parasite infection.

Keywords: *prevalence, parasite infection, native chickens, Type 1 climate*

Introduction

The native chicken industry provides animal protein and generally contributes to the national economy (Obiora, 1992). Native chicken is the most intensively reared poultry species and developed as a profitable animal production enterprise. Its contribution to the economy provides income to many small farmers. In general, the production of chickens in the country is divided into the commercial and semi-subsistence sectors. The most commonly reared chickens are the indigenous domestic fowls *Gallus gallus* domesticus or local or native species. Due to its meat flavour is regarded as the primary protein source of the household. The Philippine Statistics Authority (2016) recorded that Western Visayas accounted for only 9.48% of the total production of 80.85 million birds. The record shows a low production rate; flock sizes of individual households vary from 5-50 heads utilized only for consumption and other social obligations. Nnadi (2010) claims that several external problems, including parasitism, malnutrition, poor management, and low genetic potential, limit the productivity of native chickens. In conjunction with the previous study by Slimane (2010), helminthiasis is a disease affecting the poultry industry, especially the traditionally reared free-ranging chickens. Ranging chickens exposes them to many types of parasites. It is threatened by parasitism, as parasitic infections result in stunted growth, decreased egg output, emaciation, anaemia, and mortality.

Studies in the country have shown that the prevalence of parasitic infestations in village chicken flocks is close to 100%. In most cases, individual birds harbour more than one parasite type. The Bureau of Animal Industry (2012) reported that Leyte Province has the highest helminth infection of 5.2%, while 52% was recorded in Quezon Province. Also, in Northern Mindanao, a study showed that the prevalence rate of helminth infection is about 70%. Cecal worm *Heterakis gallinarum* is associated with transmitting Histomonas in turkeys and chicks. It was reported that parasitic or concurrent infections result in immune suppression, especially in response to vaccines against some poultry diseases. One of the identified gaps in the farmers' knowledge is the need for more information on factors that influence the prevalence of gastrointestinal parasite infection. Assessment of the production constraints is essential to understand its dynamics and interactions on how parasitism affects the overall productivity of the flock. In addition, knowledge of their prevalence in understanding the epidemiology of such diseases and the design of their appropriate control measures. The study investigated the factors influencing the prevalence of gastrointestinal infection in native chickens in the selected municipalities in Iloilo. It determined the relationship between helminth infection and the identified factors. The study provided baseline data for determining the causes and possible interventions to control parasite infection in chickens.

Literature

Native Chicken Production in the Country

The top-producing region for native chicken production was Western Visayas, followed by Central Visayas (PSA, 2011). The contribution of Region VI in the total 76 million heads was only 18%, with a decrease in the previous production of 19.27%. Northern Mindanao and Central Visayas contributed 10%. The most dominant strain of native chicken in the region is Darag and Jolo, found to evolve from the red jungle fowl *Gallus gallus domesticus.* One of the characteristics of these strains is their ability to adapt to a changing environment, stress and low nutrient demand. Hence, meat from these strains is healthy, free from chemicals addressing the safety and issues of the consumers. Most Filipinos favour these qualities because of their distinct flavour and taste.

Dusaran (2005) mentioned that native chickens are upgraded and crossed to Jolo strains with high lean and dressing percentages. Their study showed that breeding mongrel birds to upgrade produce leaner growers with a heavy body and increases income from PhP 100 to PhP 500 in marketing. The demand for chickens is higher from September to December, and July to August is the least due to the high rainfall. However, sudden changes in climate and disease occurrence cause lower productivity in chickens. Hence, the use of antibiotics and herbals were the practices used to cure the disease. In correlation to the previous studies of Costales (2003), to attain successful chicken production, care and management are essential. The production of chickens depends on the availability of antibiotics, veterinary treatments, and drugs for illness prevention and control. Other cultural practices of farmers include supplementing indigenous materials such as vinegar, oreganos, warm rice, wormwood, pepper and others. These are given to chickens to prevent or control respiratory diseases, coryza, fowl pos, and new castle disease. Hence, the research would want to investigate the factors affecting the prevalence of parasite infection and their measures to prevent and control the incidence and recurrence of diseases affecting the production of native chickens.

Parasitism in Native Chickens

The Philippine climate is characterized by high rainfall of 406.4 centimetres and 50-90% humidity. This condition predisposes chickens to many external and internal parasites. In the study, Manuel (2013) stated that chickens raised in open pastures favour direct infection to chickens, especially when the soil is wet. Production of chickens is constrained by many factors, including poor management and malnutrition outstands the losses. The previous statement is in coherence with the study of Barnes (1997) that low genetic potential due to inefficient selection of breeders poses a threat to productivity. Also, he mentioned that agroecology directly influences the perpetuation of helminth parasites. Slimane (2014) highlighted that parasitism is the primary threat among mortality factors higher than Cory, new castle disease, avian influenza, and others. It also correlates with Gibe (2013) that parasitism is a vital disease problem in domestic animals, contributing 10% of the total annual losses. The direct manifestation of parasitism includes competition between hosts and parasites in food/nutrients, deficiency, reduced appetite, emaciation and thin skeletal muscles (Soulsby, 2014). These effects are attributed to body weight loss, low reproduction and poor feed efficiency, predisposing the animals to different diseases. Nnadi's (2010) study on parasitism in other fowls found that infection is close to 100%. A lack of biosecurity preventive control measures directly affects village chickens in open pastures. The same results are found in Yoriya's (2008) study that backyard raising has a higher chance of infection from mites, lice, ticks, fleas, helminths, etc. The scavenging behaviour of chickens in the contaminated environment makes them more susceptible to harbour parasites than confined production systems. Therefore improved management, suitable housing and feeding schemes, and efficient disease prevention and control are essential to counter these problems in poultry production. Puttalakshmamma (2008) stated that parasitism threatens domestic fowls more. He observed that chickens infected with cestodes are found to have delayed growth, low weight gains, poor egg production, and haemoglobin suppression leading to mortality. The gastrointestinal cestodes and other internal parasite species arrest the function of the gastrointestinal tract where significant mortality and decline in egg production are noticeable (Katoch, 2012). High infections are found in nematodes that damage the gastrointestinal tract and respiratory linings. In the study of Matur in 2010, roundworms are the most common helminth that infects birds. The principal genera consist *of Ascaridia galli*, *Heterakis gallinarum* and *Capillaria* species. These species are widely distributed in different areas of the region, and higher infection rates are found in lowland elevations. Aside from parasitic infections, coccidiosis adversely affects the poultry industry, where decreased growth rate, weak feed conversions, and sudden death causes economic losses to poultry raisers. Landes (2007), in their study on parasitic species, mentioned that chickens are susceptible to at least nine species of coccidia. The most common species are *Eimeria tenella*, causing cecal coccidiosis, while *E. acervulina* and *E. maxima* causes severe intestinal coccidiosis. In small birds, higher death incidence is caused by *Ascaridia galli*, of which delayed growth, reduced egg production, and death of young birds are the expected effects. In the country, *Ascaridia galli*, *Heterakis gallinarum and Subulura brumpti* were recorded to infect several poultry species (Mohammed, 2007). Therefore, it is essential to establish the identity and prevalence of gastrointestinal helminth species and the degree of endoparasite infection in native chickens. Data and information from this study will serve as the basis for formulating health program development in the Province and consequently improving poultry production.

Parasite Infection Interactions

As previously mentioned, parasite infections contribute significantly to economic losses and the quality of products. Adang (2008) states that the direct deleterious effects of parasite infections are found predominantly in young birds at 2-5 months. Older birds are prone to secondary diseases due to their low resistance to parasite infection. The same results were revealed in the study of Ashenafi (2004) that the birds' age and the infection rate have a significant relationship where the adult where young birds develop immunity and older birds have lowered pathogenesis. Radfar (2012) in their study on sex and rate of parasite infection, revealed that 59 free-range chickens 27 males and 32 females, 26 of 27 and 29 of 32 are infected with parasites of different species. It can be concluded that infections are more prevalent in males compared to females since males as kept in free pastures and females in cages. Hence males can harbour more parasite eggs.

Regarding classification, adults were more infected than young birds, but the results were insignificant. The results in the previous study coincide with the study of Gicik (2011) the prevalence of infection was found higher in adults due to the cohort effect. Oladele (2010) studied the effect of season, elevation and sex of birds on the packed cell volume, haemoglobins and total proteins in different countries in Asia. Higher values of PCV and Hb as 37.50 ± 1. 23% and 129 ± 03.0 g/L, respectively, during the rainy season, while the lowest PCV and Hb values of 29.12 ± 0.88% and 97.2 ± 2.9 g/L obtained during the hot season in lowland areas. High moisture level favours the proliferation of parasite eggs. The intensity of worm infection might also be due to frequent ingestion of infected droppings where farmers kept their chickens in cages against rain and cold weather conditions. Abamo (2019) highlighted that birds at early stages have a high intensity of parasite infection which means that the infection starts to develop at early stages and hampered 17% of the weight gain and 12.5% of the total egg production. Mwalusanya (2018) claimed that helminth infection is due to insufficient and poor provision of nutrients given to the birds, making them scavenge more on infected soils. In general, parasitism is claimed to be a problem affecting the optimum production of poultry, as reported by many researchers.

Objectives of the Study

This study aimed to determine the prevalence of gastrointestinal parasite infection in native chickens in the selected municipalities in Iloilo. Specifically, the study aimed to answer the following questions:

1). Determine the prevalence and severity of gastrointestinal parasite infection in native chickens in selected Municipalities in Iloilo.

2). Assess how management systems affect the prevalence of internal parasitic infection intensity.

3). Determine the relationship between the degree of parasite infection with the topographical location, body weight, and age group classification of native chickens.

4). Quantify the severity of parasite infection with the level of leukocyte counts of native chickens.

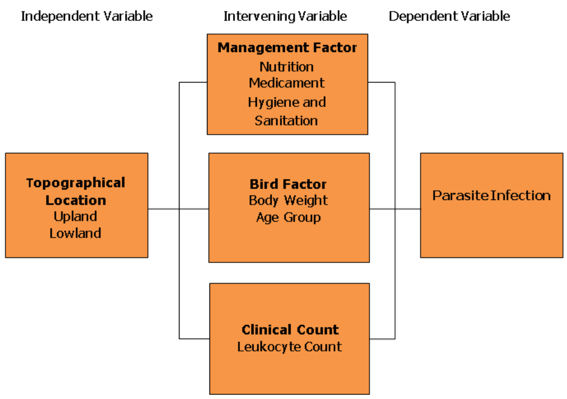


Figure 1: The conceptual framework of the study.

Figure 1 shows theframework of the study. Location was made as bases of comparison to identify which of the two areas, upland and lowland, parasite infestation are more prevalent since the altitude and topography affect rainfall pattern, per cent humidity and moisture. These are the most common factors that trigger the reproductive cycle of parasites. Aside from the topographical location, age, nutrition, change in climate, medicament, hygiene, and type of housing also influence the growth of parasites. The prevalence of the parasite infestation was measured by identifying the presence of parasitic ova found in the faeces, whether the animal is infected or not infected and was scaled to very high prevalence, prevalent, and not prevalent. The white blood cell count was correlated to the degree of parasite infection. The relationship between the identified factors and parasite infection was correlated to the samples' age classification and body weight.

Methodology

Formulation of the Survey Questionnaires

The survey questionnaire was designed based on the principles described by (El Ghany, 2014). This method was formulated to elicit essential information to be tested on eighty respondents in the selected Municipalities in Iloilo. The questions were grouped into the socio-economic characteristics of the native chicken raisers, the overall viewpoint of the poultry farmer on parasite infection, the dimension and attributes for poultry parasite infection management index measurement, and the management practices of the poultry farmers.

Collection of the Data

A multi-stage sampling technique was used in selecting the farmers engaging in native chicken production. The first stage was the selection of three municipalities which was based on climate type. Municipalities of San Joaquin, Miagao, and Guimbal belong to Type I Climate with two pronounced seasons, dry from November to April and wet throughout the rest of the year. The second stage is the selection of two barangays, one barangay from the upland and the other in the lowland area. The selection process was based on the highest and lowest elevation. The data on elevation were obtained from National Mapping and Resource Information Authority (NAMRIA). The third stage was the selection of thirty farmer respondents in every barangay. Data was gathered using face-to-face interviews. After each interview, faecal and blood samples from 10 chickens per individual respondents with different age groups were collected, smeared, stained and directly subjected to differential and total white blood cell counting and parasite egg identification.

Statistical Analysis of the Data

Descriptive data were analyzed using Statistical Package for Social Science (SPSS). The extent of prevalence of gastrointestinal infection was presented using frequency, percentages, and ranks. The data on parasite count and haematological values were analyzed using Chi-Square (χ^2) to test the homogeneity and association of various factors. A logistic regression model was used to obtain the Odds Ratio (OR) only for those factors that gave statistical significance. Chi-Square (χ^2) and Simple Linear Regression were used to assess the association between the topographical locations. Analysis of Variance (ANOVA) was used to test the association between the areas of study and the identified factors. Significant differences were set at 0.01 level.

Results and Discussion

Table 1. Demographic Characteristics of Farmers Raising Native Chickens in Six Areas of the Study

Parameters	Upland			Lowland			Overall
	Lumboyan (N=30)	Dalije (N=30)	Iyasan (N=30)	Lawigan (N=30)	Palaca (N=30)	Sipitan (N=30)	(%) (N=180)
Sex							
Male	22	18	23	25	16	19	123 **68.3 %**
Female	8	12	7	5	14	11	57 **31.7 %**
Age							
<30	2	4	1	0	3	0	10 **5.6 %**
31-39	5	8	4	4	1	2	24 **13.3 %**
40-49	3	2	8	11	10	4	38 **21.1 %**
>50	20	16	17	15	16	24	108 **60 %**
Marital Status							
Married	27	21	26	28	28	25	155 **86.1 %**
Single	0	8	2	1	0	2	13 **7.2 %**
Separated	0	0	0	0	0	0	0 0
Widowed	3	1	2	1	2	3	12 **6.7 %**
Level of Education							
No formal education	1	3	0	5	2	1	12 **6.7 %**
Elementary	12	16	9	10	9	7	63 **35 %**
Secondary	15	8	18	9	10	15	75 **41.7 %**

Table 1 shows the farmers' demographic characteristics composed of sex, marital status, level of education, poultry farming experience and their access to credit. Out of 180 respondents, the majority were males, 68.3% with women, and 31.7% were. Farmers who are 50 years and above were predominantly raising native chickens with 60%, followed by those ages 40-49 (21.1%), 31-39 years old (13.3%), while young ages (less than 30 years old) were engaging in native chicken production activities with 5.6%. Regarding marital status, 86.1% were married, 7.2% were single, and 6.7% were widowed. Few farmers (6.7%) had no formal education, and almost half of the total population had attained secondary level 41.7%, elementary 35%, tertiary 16.7%, and 0.6% with vocational courses. With regards to experience in raising native chickens, 58.9% of the respondents were raising native chickens for almost more than 16 years, 22.11% raised native chickens for almost 11-15 years, 15% under 5-10 years, and the lowest was 3.3% for below five years of experience. Regarding access to credit, only 11.7% of the respondents availed of credit services. The 11.7% comprised the farmers living near the town proper Brgy. Palaca, Iyasan and Sipitan while farmers in Brgy. Lawigan which is considerably far from the town proper of San Joaquin still availed these services because of the presence of many commercial establishments like sari-sari stores, buying and selling businesses and service rentals in this area.

ISSN NO: 2230-5807

Table 2. Viewpoints of the Respondents on Factors Affecting Prevalence of Parasite Infection in Native Chickens

Parameter	Upland			Lowland			Overall
	Lumboyan (N=30)	Dalije (N=30)	Iyasan (N=30)	Lawigan (N=30)	Palaca (N=30)	Sipitan (N=30)	(%) (N=180)
Primary cause of parasite infection							
Age of the bird	3	8	6	12	3	0	32 **17.8 %**
Change in climate	16	19	25	22	30	14	126 **70 %**
Season	23	4	16	19	12	6	80 **44.4 %**
Medicament	0	0	12	4	1	13	30 **16.7 %**
System of housing	3	11	14	0	3	2	33 **18.3 %**
Hygiene and Sanitation	21	18	25	23	21	26	134 **74.4 %**
Manner of feeding and Kind of feed	19	30	21	26	27	20	143 **79.4 %**
Age of the bird susceptible to parasitism							
1 year old and above	16	11	23	13	6	15	84 **46.7 %**
6 months to less than 1 year old	8	16	26	12	18	23	103 **57.2 %**
2 to 6 months	7	10	14	9	11	6	57 **31.7 %**
Season that favors the growth of parasites							
Wet	24	24	27	16	13	27	131 **72.8 %**
Dry	18	13	8	24	20	8	91 **50.6 %**
Fallowing rest period	0	0	0		0		
Yes	-	-	-	7	-	2	9 **5 %**
No	-	-	-	-	-	-	-
Practice of quarantine measure	0	0				0	
Yes	-	-	2	12	8	-	22 **12.2 %**
No	-	-	-	-	-	-	0
Common mode of parasite infection							
Ingestion of contaminated feeds	0	0	0	0	0	0	0
Direct contact with droppings of infected birds	6	18	4	10	21	19	78 43.3 %

Table 2 shows the respondents' viewpoints on factors affecting parasite infection prevalence in native chickens.It was noted that 79.4% of the respondents answered that the primary cause of parasite infection was the nutritional status of the chickens, followed by hygienic measures with 74.4%, change in climate with 70%, season with 44.4%, system of housing 18.3%, age of the bird with 17.8%, and choice of medicament with 16.3%. Most chickens depend on the available resources in the locality, and most of the infections occur during the scavenging period of chickens. As to the age of the birds, 57.2% of the respondents answered that chickens six months to less than one-year-old were more susceptible to parasite infection, followed by ages one-year-old and above with 47.6%, and 2 to 6 months of age 31.7%. Rivera (2016) stated that results on egg per gram revealed that growers had more positive cases mean and maximum egg per gram counts than adults and chicks. This result corroborates with Andy-Chimbo's (2014) study that the said factors may cause variations in some cases. However, generally, there was a significant difference in the infection rate to host age. Also, Vivas (2011) confirmed that the frequency of positives increased with age. This increase can be a factor since chickens at this stage are fed in a ranged manner, making them susceptible to infection. The results on the seasonal prevalence showed that farmers believe that infection is more abundant in the wet season at 72.8% compared to the dry season at

50.6%. The study's results are comparable to the study of Gordon (1982), which revealed that parasite infection at 79.17% was more prevalent in the wet season than in the dry season at 54.17%. This infection also concurs with Maina (2005), who reported that the parasite was more prevalent in the wet season, with 37.4% and 33.3% in the dry season. This result could be because chickens had greater chances of being infected, with 87.50% in the wet season and 58.33% in the dry season (Taylor, 2017).

Table 3. Percentage of Native Chickens with Single, Double and Multiple Infections

Number of Species of Parasite Isolated per Chicken	Number of Sampled Chicken Chickens (N=150)	Prevalence
1 (Single Infection)	62	41.33%
2 (Double Infection)	63	42%
3 (Multiple Infection)	19	12.67%

Table 3 shows the percentage of native chickens with single and multiple infections. The data showed that 42% or 63 native chickens were identified with double infections, 41.33% or 62 with single infections and 12.67% with 19 multiple infections. The data showing the mean parasite count of six gastrointestinal species showed a higher parasite egg count from Brgy, Lumboyan, Dalije, and Iyasan, areas belonging to upland elevations. All native chickens taken with faecal samples were infected with different helminth species. The analysis of the incidence of six parasite species showed no significant difference between elevation. However, the mean parasite count revealed a highly significant correlation between the species of gastrointestinal parasites. This result means that all chickens are infected with parasite helminth, but the number of parasite egg count per chicken is significantly different. Slimane (2014) stated that the same analysis did not show a significant difference between the geographical distribution of various parasite species. However, the significant difference in the mean parasite egg count can be attributed to the climatic conditions of the study areas. The low temperature in the mountainous area promotes the development and survival of the parasites. This means that the difference between the climates influences the biological cycles of those helminths, which depend on a micro-environment favourable for their survival and the transmission of the infesting larvae and eggs of the parasites. Data showed that several chickens were infected by more than one parasite simultaneously. Studiesby Poulsen (2000) showed that multiple infections appeared as a common phenomenon in chickens. Studies carried out in Ethiopia revealed that 73.8% of chickens had an association from one to six species. In this study, most poultry (52%) had double to multiple infections. These findings mean that the environmental conditions and traditional management system are favourable for the simultaneous development of infection of various helminth species in native chickens.

Table 4. Overall Incidence of Six Gastrointestinal Parasites in Six Study Areas

Helminth Species	Barangay						Total	Mean
	Lum.	Dal.	Iya.	Law.	Pal.	Sip.		
Eimeria spp.	20	17	6	20	14	14	91	15.17^{a}
Heterakis	2	2	0	0	0	0	4	0.67^{cd}
Capillaria spp.	17	15	21	5	19	19	96	16^{a}
Ascaridia galli	10	5	5	6	8	8	42	7^{b}
Strongyloides	4	1	2	0	2	2	11	1.83^{bc}
Railleitina spp.	2	0	1	0	0	0	3	0.5^{cd}
Rep. Total	55	40	35	31	43	43		
Grand Total							247	
Grand Mean								6.86

[abcd]Means with different letter superscripts varied significantly from one another (P<0.01). Those with similar letter superscripts did not vary significantly from one another (P>0.05).

Table 4 shows the overall incidence of six gastrointestinal parasite species in six barangays of the study area. The results showed that the highest incidence of parasitism was recovered from *Capillaria* spp., with a mean of 16 incidences, where Brgy. Iyasan had the highest count in this kind of parasite species but in the overall Brgy. Lumboyan had the highest incidence of parasitism. This outcome was followed by Eimeria spp., with 15.7 incidences mean, but similar to *Capillaria spp.* with 16 mean incidences, then followed by *Ascaridia galli* with seven mean incidences, while *Heterakis gallinarum*, *Strongyloides*, and *Raillietina spp.* Species had the lowest incidence mean of 0.67, 1.83, and 0.5. The Analysis of Variance showed a highly significant relationship between the incidences of six gastrointestinal parasite species among six barangays, with a computed F value of 27.13 tested at P>0.01% significance level. The Duncan's Multiple Range Test (DMRT) further showed that the incidence of six gastrointestinal parasites was highest in *Capillaria* species with a mean incidence of 16, in contrast with other *Capillaria spp.Capillaria spp.* is similar to *Eimeria spp.*, with a mean incidence of 15.17 eggs per gram. *Capillaria spp.* Showed a highly significant difference from *Heterakis gallinarum* (0.67), *Ascaridia galli* (7), *Strongyloides* (1.83) and *Raillietina* (0.5) mean incidences.

Table 5. Overall Mean Parasite Count of Six Gastrointestinal Parasite Species in Six Prevailing Areas

Helminth Species	Barangay						Total	Mean
	Lum.	Dal.	Iya.	Law.	Pal.	Sip.		
Eimeria spp.	20	17	6	20	14	14	91	15.17^{a}
Heterakis	2	2	0	0	0	0	4	0.67^{cd}
Capillaria spp.	17	15	21	5	19	19	96	16^{a}
Ascaridia galli	10	5	5	6	8	8	42	7^{b}
Strongyloides	4	1	2	0	2	2	11	1.83^{bc}
Railleitina spp.	2	0	1	0	0	0	3	0.5^{cd}
Rep. Total	55	40	35	31	43	43		
Grand Total							247	
Grand Mean								6.86

[abcd]Means with different letter superscripts varied significantly from one another (P<0.01). Those with similar letter superscripts did not vary significantly from one another (P>0.05).

Table 5 shows the overall mean parasite count of native chickens from six barangays infected with gastrointestinal parasites. The data showed the highest mean parasite from six Barangays was 426.52 eggs per gram from *Capillaria* species. More parasite eggs were counted from Brgy. Iyasan, with 1, 250 eggs per gram. This development was followed by *Ascaridia galli* species with 266.23 mean eggs per gram, *Heterakis gallinarum* with 179.19 mean egg per gram, *Strongyloides* species with 63.55 mean eggs per gram, *Eimeria spp.* with 35.42 mean eggs per gram and *Raillietina* species had the lowest mean eggs per gram of 0.5. The Analysis of Variance showed a significant relationship between the mean egg count of native chickens in six areas of the study, with a computed F value of 3.27 at P>0.05% significance level (2.60). The Duncan's Multiple Range Test (DMRT) revealed that the mean parasite count was highest in *Capillaria spp.* (426.52 e.p.g.) from other species of the parasite but comparable to *Heterakis gallinarum* (179.17 e.p.g.) and *Ascaridia galli* (263.23 e.p.g.) and differ significantly from *Eimeria spp.* (25.42 e.p.g.), *Strongyloides* (63.55 e.p.g.) and *Raillietina spp.* (0.5 e.p.g.). However, *Ascaridia galli* having a mean of 263.23 e.p.g., is comparable to *Eimeria spp., Heterakis gallinarum, Capillaria spp, Strongyloides, and Raillietina spp.,* but *Strongyloides* with a mean e.p.g. of 63.55 significantly differ from *Capillaria spp.* The lowest mean parasite counted from *Raillietina spp.* (0.5) is similar to the mean parasite counts of *Strongyloides* (63.55), *Asacaridia galli* (263.23), *Heterakis gallinarum* (179.17), and *Eimeria spp.* (35.42) but differ significantly from *Capillaria spp*. The null hypothesis states that there is no significant difference in the mean gastrointestinal parasite counts of native chickens infected with six gastrointestinal parasite species under upland and lowland elevation is rejected—the parasite egg count of 1 250 eggs per gram in Brgy. Iyasan, which is under lowland classification, yield the same result as the study of Reta (2009), which found a higher helminth parasite burden in mid-altitude than in other agroecology, indicates the relative suitability of parasite-environment interaction to complete the cycle in the mid-altitude than in other ecologies.

Table 6. Mean White Blood Cell Count (x 109/L) of Chickens Within Between Different Parasite Count Range

Parasite Count in Range	Mean White Blood Cell Count							
	Lum.	Law.	Dal.	Pal.	Iya.	Sip.	Total	Mean
0-100	3.241	4.967	5.033	2.143	2.165	2.184	19.733	3.28^{cd}
101-200	2.687	4.768	1.435	6.876	6.6	5.329	27.695	4.61^{abcd}
201-300	5.153	7.2	5.0	6.346	8.175	3.95	35.824	5.97^{abcd}
301-400	6.167	7.371	4.285	8.125	7.893	2.0	35.988	5.99^{abc}
401-500	5.6	6.0	7.453	6.6	8.3	6.35	40.478	6.74^{ab}
>500	4.333	6.067	9.758	8.342	7.893	6.133	42.526	7.08^{a}
Grand Total							201.254	
Grand Mean								5.61

^{abcd}Means with different letter superscripts varied significantly from one another (P<0.01). Those with similar letter superscripts did not vary significantly from one another (P>0.05).

Table 6 shows the overall mean white blood cell (see Figure 3) count between the different parasite count ranges. The data showed that the highest mean *WBC* count was 7.08 x 109/L from chickens having a parasite load of more than 500 egg counts per gram of faeces. This event was followed by parasite egg counts of 401-500, 301-400, 201-300, 101-200, and 1-100 eggs per gram. The Analysis of Variance revealed a significant relationship between the mean *WBC* counts of chickens and the parasite count range, with an *F* computed value of 86.35 at P>0.01% significance level. The *Duncan's Multiple Range Test (DMRT)* revealed that the highest white blood cell count was from chickens having a parasite count range of >500 (7.08 x 109/L) is significantly higher in contrast with other parasite count ranges. It differs significantly from the 1-100 parasite range (3.28 x 109/L) but is similar to the parasite count range of 101-200, 201-300, 301-400 and 401-500 counts. Also, the parasite range of 401-500 (6.74 x 109/L) differs significantly from 0-100 (3.28 x 109/L) and is similar to 401-500, 301-400, 201-300, and 101-200 counts. Parasite count range 101-200, 201-300, and 301-400 is similar in terms of mean *WBC* count. The lowest mean white blood cell counted was 3.28 from 0-100 parasite count range is similar to 101-200 (4.61 x 109/L), 201-300 (5.97 x 109/L), and 301-400 (5.99 x 109/L) but differs significantly from >500 (7.08 x 109/L). The correlation between the mean WBC count of the birds was significantly different from the parasite count range. There was a highly significant difference between the mean WBC count (3.28, 4.61, 5,97, 5.99, 6.74, and 7.08 x 109/L) with the parasite count range of 0-100, 101-200, 201-300, 301-400, 401-500 and >500 eggs per gram, respectively. The result showed that when the parasite count increases, the total WBC also increases. The result is consistent with the report of Ramazan (2011) that the total *WBC* values increased with the increasing parasitic load. Nyaulingo (2013) reported that to assess the growth trend in chickens and other animals, white blood cell count values are generally used to determine the rate of infections, which will indicate the immune status of chickens. In this study, the mean white blood cells count increases in response to the parasite load of chickens. There was a significant increase in the mean white blood cell count difference from 0->500 eggs per gram. Significant developmental changes in the white blood cell count were observed. *WBC* values were not within the normal range (4.07-4.32 x 109/L) (Wikivet, 2012). White blood cell count values in chickens during the duration of the study indicated an increase at increasing parasite load. Tufan (2011) stated that leukocyte differentials were significant in different chickens' stages. In conclusion, significant differences were observed in the white blood cell values with different parasitic loads, indicating that most of the mean white blood cell count increased with parasite load. The result of the study is helpful as a diagnostic tool in clinical evaluation in determining the state of parasite infection in native chickens.

Table 7. Relationship Between Three Prevalent Parasite Species and Total White Blood Cell Count

Helminth Species	Total White Blood Cell Count *Pearson r*	Sig.
Eimeria spp.	.222**	.007
Capillaria spp.	.524**	.000
Ascaridia galli	.389**	.000
Total Parasite Count	.471**	.000

**Correlation is significant at 0.01 level (2-tailed)

Tables 7 and 8 show the relationship between three prevalent parasite species and total white blood cell count. The value of *r* is .222, whichshows that the total white blood cell count can explain 22.2% of the variation in the total parasite count. This counting means that the increase in the total parasite count (egg per gram) can be predicted by the increase in the white blood cell count (x109/L). The F - value in the ANOVA is 42.12, which is significant at $p < .001$. This result tells us that there is less than a 0.1% chance that an *F* – ratio would happen by chance alone. It showed that the overall mean total white blood cell count (6.78 x109/L) and its standard deviation differ between species, *Eimeria spp.* (6.80 x109/L), *Ascaridia galli* (6.70 x109/L) and *Capillaria spp.* (6.51 x109/L). The mean, the standard deviation of 2.08, also differs from the standard deviation by species where *Eimeria spp.* (2.091), *Ascaridia galli* (2.035) and *Capillaria spp.* (1.595) respectively (see Figure 2). This difference means that the total white blood cell count indicated variations regarding parasite infection of A*scaridia galli*, *Eimeria spp.* and *Capillaria spp.* There is greater variability between the overall mean (369.03 e.p.g) and its standard deviation (287.39 e.p.g). It showed that the overall mean egg count for *Capillaria spp.* was 224.13 e.p.g, *Ascaridia galli* was 199.53 e.p.g., and *Eimeria spp.* was 91.80 e.p.g. The standard deviation for parasite infection showed greater variability between these three species, with (265.702, 286.358 and 188.830) respectively. This result means that having a total white blood cell value of 6.70 x 109/L, 6.80 x 109/L, and 6.51 x 109/L is accounted to have greater variability in terms of parasite egg count of 199.53, 91.80 and 224. 13. Therefore, chickens having 369.03 eggs/ova of parasites per gram of faeces had 6.79 x109/L white blood cell counts which are higher than the normal white blood cell count of infected chickens. A mean correlation of r =.471 (P 000 < .0001) suggests a strong positive relationship between the total white blood cell count and the degree of parasite infection in native chickens. The normal probability plot of the standardized residuals shows the linearity of the regression model for *Ascaridia galli*, *Capillaria spp.* and *Eimeria spp*. The degree of parasite infection (egg per gram) ranges from 0-1,000, and the total white blood cell counts range from 0-20 x 109/L (Table 11). As the degree of parasite infection (egg per gram) increases, the total white blood cell count (x 109) also increases. The relationship is linear when the independent variable (parasite infection) increases by approximately the same rate as the dependent variable (total white blood cell count) changes.

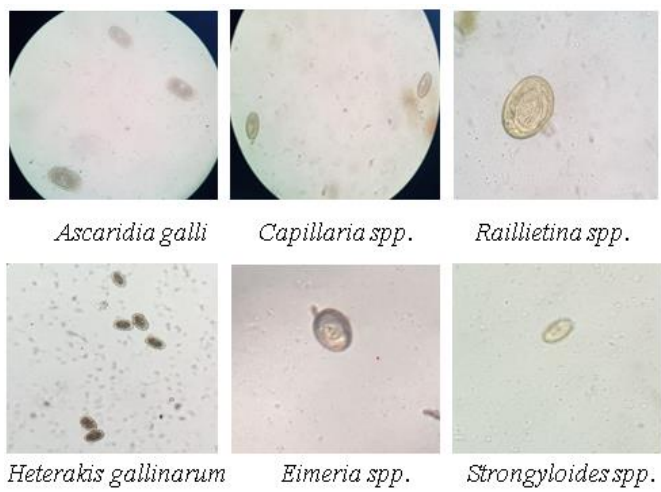


Figure 2 Parasite eggs collected from six study areas

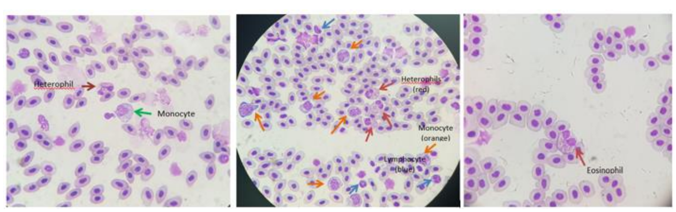
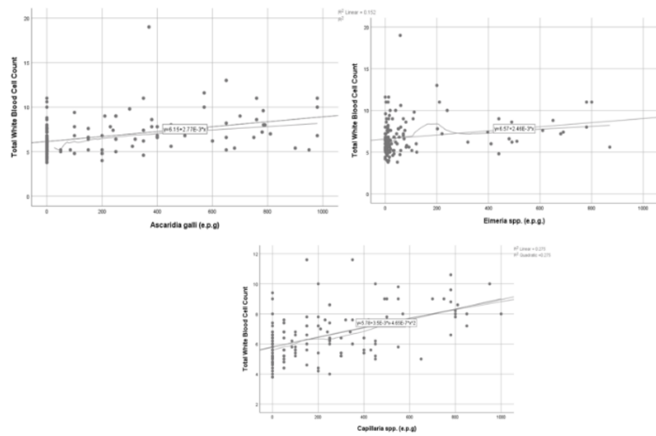


Figure 3 Cellular components of the blood samples

Table 8. Simple Linear Regression Model of the Total White Blood Cell Count (x10^9/L) and Total Parasite Count (egg per gram) According to Species of Parasites



Conclusion

1. A very high prevalence of parasite infection of 80% in upland and lowland elevations in Brgy. Lawigan and Lumboyan Municipality of San Joaquin, wherein 40 incidences of *Eimeria spp.* were identified. This finding was followed by *Capillaria spp.* and *Ascaridia galli*, representing 44% with 22 and 32% with 16 incidences. *Heterakis gallinarum*, *Strongyloides*, and *Raillietina spp.* Representing 16% of the total prevalence with eight incidences, only three helminth species were identified in one geographical location in Brgy. Lumboyan, San Joaquin, Iloilo;
2. A significant relationship exists between the overall incidence of six gastrointestinal parasites under upland and lowland elevation. The highest incidence of parasitism was recovered from *Capillaria spp.* with a mean of 16 incidences, where Brgy. Iyasan had the highest parasite count. This effect was followed by *Eimeria spp.*, with 15.7 incidences mean, *Capillaria spp.*, with 16 mean incidences, and *Ascaridia galli*, with seven mean incidences, while *Heterakis gallinarum* and *Railleitina spp.* Species had the lowest incidence mean of 0.67 and 0.5;
3. As to the species of gastrointestinal parasite and age group classification of chickens, there is a significant relationship between the said factors, where the highest mean parasite egg count was 523.80 mean eggs per gram from *Capillaria spp.*, followed by *Ascaridia galli* with 342.37 mean egg per gram and *Eimeria spp.* with 41.58 mean eggs per gram. In terms of age, group B (7-10 months) had the highest total parasite count of 1 045.91 eggs per gram, followed by age group A (2-6 months) with 959.59 eggs per gram and age group C (> ten months) with 717.8 eggs per gram; and
4. There is also a significant relationship between the WBC counts of chickens and parasite egg counts, where the highest mean WBC count was 7.08 x 10^9/L from chickens having a parasite load of more than 500 egg counts per gram of faeces, followed by parasite egg counts of 401-500 with 6.74 x 10^9/L, 301-400 egg counts with 5.99 x 10^9/L, 201-300 egg counts with 5.97 x 10^9/L, 101-200 egg counts with 4.61 x 10^9/L., and 1-100 egg counts with 3.28 x 10^9/L.

Recommendations

Based on the findings and conclusions of the study, the researcher recommends the following.

1. To farmers, a regular deworming program in barangays with high rates of parasite infection to control the incidence of parasite infection. Practice all in-all-out systems to mitigate the entry of pathogens;
2. Sanitation and biosecurity in and out of the poultry house will prevent the transmission of pathogens. Avoid sudden changes in the ration, especially from a low-nutrient density ration to a higher one that can upset bacteria in the gut to prevent other infections; and
3. Formulation and supplementing natural probiotics and dewormers to chickens help build immunity to other diseases. Wood ash and carbonized materials on the floor may prevent and control the reproduction of parasite eggs. Start raising chicks in confined areas with clean surfaces and bedding.

References

Abamo, Esch W, Holmes JC, Kuris AM, Schad GA (2019) The use of ecological terms in parasitology Parasitol 68: 131-133.

Ashenafi RG, Pym RAE, Rushton J (2004). Village poultry: still important to millions, eight thousand years after domestication. World Poult. Sci. J., 65: pp. 181–190.

Barrett, K.E. & Keely, S.J. (2000). Chloride secretion by the intestinal epithelium: Molecular basis and regulatory aspects. Annual Review of Physiology, 62,535_572.

Conroy et al. (2007). Studies on enteric helminth parasites in domestic birds. MVSc Thesis Fac Vet Med Banha Zagazig Universit

Davies OR, Junker K, Jansen R, Crowe TM, Boomker J (2008). Age and sex-based variation in helminth infection of helmeted guineafowl (*Numida meleagris*) River francolin (*Scleroptilalavaillantoides*). S. Afr. J. Wildl. Res., 38(2): 163-170.

FAO (1992) Distribution and impact of helminth diseases of livestock in developing countries. FAO animal production and health paper 96. Food and AgriculturalOrganization of the United Nations.

Landes, N.G., (2007). How to carry out a field Investigation In Poultry Diseases, FTW (2nd edn.), Bailliere Tindall, Londan pp: 370-400.

Maina, Y, Mulualem E, Ibrahim H, Berhanu A, Aberra K (2005) Study of Gastrointestinal helminths of scavenging c hickens in Amhara region Ethiopia. Rev Sci Tech off Int Epiz 20: 791-796.

Nnadi, Richard M, Andrews RH. Species of *Raillietina* Fuhrmann, 2010 (Cestoda: Davaineidae) from the emu, *Dromaius novaehollandiae*. Trans R Soc S Aust 2000; 124: 105-116

Obiora (1992) Comparative Studies of External ParasitesKept Under Different Management System.

Ramazan, C. Kayanja, F.I.B, Ziela M, Chota A, Masuku M, et al. (2011) Prevalence and distribution of gastrointestinal helminths and their effects on weight gain in free-range chickens in Central Zambia. Tropical Animal Health and Production 39: 309-315.

Taylor, BB, Umeorizu JM, Orajaka LJE (2017). Gastrointestinal helminth infections of the domestic fowl (Gallus gallus) during the dry season in Nigeria. J Afr Zool 105:503–508