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Identification of Helminths Parasites, Species Richness and their Effects on Hematological Components in Chicken Kept Under Scavenging Chicken Production System in and Around Bishoftu, Ethiopia

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Abstract

The current study was undertaken around Bishoftu town using 75 chickens to identify helminths species and to elucidate the effects of helminths species on hematological components in chickens kept under scavenging production system. Researchers hypothesized that the hematological parameters would be correlated to the species richness per chicken. Hematological analysis was employed to estimate the effects of helminths on blood components and postmortem examination also used for the purpose of detecting the presence or absences of helminths infections. In hematological analysis the mean values of hematological indices in infected chicken were 30.1 ± 2.7%, 10.2 ± 1.4 gm/dL, 3.12 ± 0.3 × 10^6/μL and 3.53 ± 0.3 × 10^3/μL for Packed Cell Volume (PCV), Hemoglobin concentration (Hbc), Red Blood Cells count (RBCc) and White Blood Cells count (WBCc), respectively and in non-infected chicken were 34.56 ± 2.4%, 12.3 ± 0.9 gm/dL, 3.6 ± 0.2 × 10^6/μL and 3.35 ± 0.2 × 10^3/μL for PCV, Hb, RBCc and WBCc respectively. The effect of helminths assessed by comparing the two groups of chickens infected with non-infected. There was significant association ($p<0.05$) between infected and non-infected chicken and mean hematological indices. There was a negative significant correlation between infected and mean hematological of PCV ($r=-0.57$, $p=0.00$), Hb ($r=-0.54$, $p=0.00$) and RBCc ($r=-0.53$, $p=0.00$) but positive correlation between infected and mean values of WBCc ($r=0.262$, $p=0.023$). The postmortem finding identified six nematode and six cestode species. *Ascaridia galli* (24%) and *Heterakis gallinarum* (21.3%) were more prevalent nematode species and *Raillietina echinobothrida* (22.7%) was prevalent cestode species encountered. In conclusion, conducting a large scale research for further understanding whether other risk factors that were not considered in this study affect the epidemiology of helminthic disease and other complimentary physiological parameters indices of health research works would be recommended for further elucidation of the interaction between helminths and the aforementioned health indices. It is also advisable to create awareness to farmer on the importance of deworming in order to reduce economic losses induced by helminths parasites.

Keywords: Bishoftu; Chicken; Ethiopia; Helminth; Haematological components; Postmortem; Species-richness

Introduction

Poultry production plays a vital role for food security and contributes to the country economy [1]. It is a promising farming activity, particularly in the regions where there is a consistent decrease of grazing areas [2]. Low technology poultry production demands small investment compared to other livestock species [3]. As a result, chicken production is very well practiced by Ethiopian smallholder farmers [4].

The total chicken population in Ethiopia is estimated to be 56.5 million. From this 96.9% are indigenous and the rest 2.56% and 0.54% are exotic and hybrid chicken with native chicken representing 96.9%, the rest 2.56% and 0.54% are exotic and hybrid chicken, respectively [5].

Currently, chicken production systems of Ethiopia can be classified as scavenging, large scale commercial and small-scale commercial production. This classification is based on the level of inputs and scale of production. They co-exist and contribute to solve the socio-economic problems of different target societies of the country [6].

The scavenging chicken production account for more than 95% of production in the Ethiopia [7,8]. This production system in Ethiopia contributes 90% egg production and 92% chicken meat production to the nation [7]. Besides its advantage as a source of food and income, scavenging chicken production ensures employment opportunities for rural smallholder farmers and offers socio-cultural advantages [9].

However, the scavenging chicken production system is challenged by diseases, predators, feed shortage, and traditional husbandry practices. Among the different infectious diseases Newcastle disease (NCD) and Infectious Bursal Disease (IBD) are the most devastating diseases of scavenging chicken [10-13].

Studies conducted on Helminthiasis have indicated that chicken raised under the backyard scavenging system in Ethiopia are invariably infected by diverse species of cestodes and nematodes [14-18]. Previous reported study has also indicated that chickens kept under the scavenging chicken production system exposed to different helminths parasites infections that ranges from an infection rate of 5% to 75% [19].

Helminths parasites infections in chicken has a negative effect on the host as the host responds to try and counteract these negative effects. For example, low hematological values related to helminths infections has been documented in chickens [20].

In the present study area, the status of haemoparasitic diseases and

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viral diseases in scavenging chicken production system studied and reported by Emebet et al. [21,22]. However, there is no any study done that indicates the status of helminths parasites infection rates. Thus, the objectives of this study were to identify the major helminths parasites species, their species richness and to elucidate the effect of varying helminths species on hematological values of chickens' blood which were naturally infected with helminths.

Materials and Methods

Study area

The study took place at Bishoftu town as presented in Figure 1. The town located 45 km in east of Addis Ababa at 9°N latitude and 4°E longitudes, at altitude of 1850 m above sea level in the central Oromia region. The area has an annual rainfall of 86.6-mile meter (mm) of which 84% is in the long rainy season (June to September). The dry season extends from October to February. The mean annual maximum and minimum temperatures of the town are 26 and 14°C, respectively, with mean relative humidity level of 61.3%. Mixed crop-livestock production system is the common production system around Bishoftu town National Metrological Service Agency [23].

Bishoftu is the town is of Ada'a District, which is one of the districts in East Shoa Zone of Oromia Region. The District covers an area of 92, 751.33 ha. Debre Zeit is the town of the study district, located at 47 km South East of Addis Ababa with a human population of about 95,000. The average altitude is about 1880 meter above sea level. It is an important small town where many governmental institutions, national and international research centers are found. The average annual rainfall is about 839 mm and the average temperature is 24°C. The District has a village poultry population of 24,045 Oromia National Regional State [24]. The soil and climate are similar to many highlands in Ethiopia.

Study design

The research was carried between January and May 2017 using convince sampling approach. Selection of chicken from the market was based on the ease of availability and access. So, it was not possible to obtain a representative sample. However, sampling calculation was used. A total of 75 adult healthy-looking scavenging chickens that were sold at local market were purchased based on simple random sampling technique and transported alive to the Department of Veterinary pathology and Parasitology, College of Veterinary Medicine and Agriculture, Addis Ababa University.

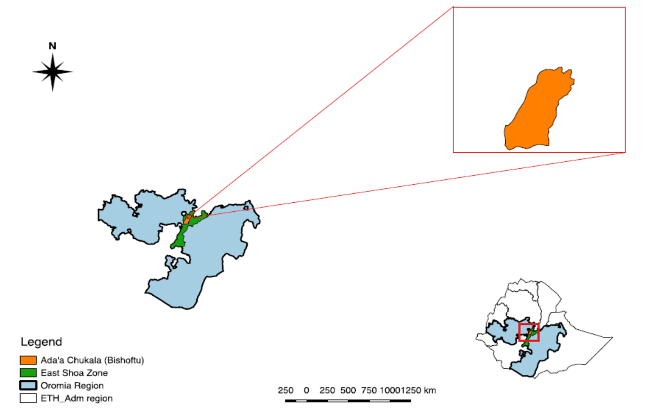

Figure 1: Map of Bishoftu town in East Shoa Zone of Oromia Regional State, Ethiopia.

Study animals

The study was conducted on 75 scavenging chickens that were brought by farmers from neighboring areas/kebeles (Godino, Akako, Dukam, Denkeka and Tullu Dimtu) to Bishoftu town to be sold at a market found in kebele-013 of Bishoftu town. All of the selected chickens for the study were adults, because the farmers and owners provide adult chickens to the market and according to Magwisha [25].

Sample size determination

In Ethiopia, different researchers from different parts of the country reported different rates of gastrointestinal parasites infections which ranges from 5% to 75% in chickens' which were kept under the scavenging production system. Therefore, authors use the lowest range infection rate (i.e., 5%) which was previously [19]. Since one of the pivotal aspects of planning a clinical study is the calculation of the sample size. It is naturally neither practical nor feasible to study the whole population in any study. Hence, 75 adult chickens were selected and purchased from the total chicken population available at that local market, which seems less sample size but they can adequately represents the population from which it is drawn because authors employed simple random probability sampling technique so that inferences about the population can be made from the results obtained. So, by using 5% expected prevalence of helminths infection rate in chicken which was previously reported in the country [19], 95% confidence interval, 5% absolute precision error and by using the formula given by Thrusfield [26] and indicated below authors calculated their sample size as follows:

$n=1.96^2\ P\ exp\ (1\text{-}P\ exp)/d^2$

Where, n=sample size required,

P_{exp}=expected prevalence=5%=0.05,

d=desired absolute precision=5%,

hence d=0.05 and p=0.5,

z=1.96, value for 95% confidence level.

Accordingly, a total of 75 chickens were included in the study.

Study methodologies

Blood collection and hematological analysis: For hematology studies, around 3 mL of blood sample was collected from the wing veins of each chicken using tube containing ethylene diamine tetra acetic acid (EDTA) anticoagulant. Hemoglobin concentration (Hb) was measured by Sahli's hemoglobin meter. Packed cell volume (PCV) was determined by Sahli's microhaemoglobin meter method using blood sample filled with blood samples in a hematocrit centrifuged at 12,00 g and at 2000 revolution per minute (rpm) for 5 minutes and they were measured according to the methods outlined [27]. Sahli's hemoglobin meter manufactured by Radical Scientific Private Limited Company found in Ambala city. The total erythrocytic counts and total leukocytic counts were determined with the aid of Neubauer counting chamber (Hemocytometer) after the blood was diluted 1:200 Heyem's solution and 1:20 WBC diluent (1 mL Glacial acetic acid, and 1 mL methylene blue, both diluted to 100 mL with distilled water) respectively.

Postmortem examination: After blood collection the corresponding chickens from which the blood had been collected were euthanized through dislocation of the atlanto-occipital joint, followed by opening of the gut using a scalpel blade. Then the viscera detached from the tract were separated as esophagus with crop, gizzard with proventriculus, and caeca with rest of the intestine and were kept in separate containers.

Each piece was identified and incised longitudinally to collect worms from the different intestinal pieces by washing with physiological saline in separate trays and placed in different beakers containing physiological saline and then the parasites were examined in a stereomicroscope [28]. The helminths were identified by using the helminthological keys earlier [29].

Ethical issues: After purchasing the 75 adult healthy-looking chickens sold at local market, procedures in the study were in accordance with the ethical standards of the Department of Veterinary pathology and Parasitology, College of Veterinary Medicine and Agriculture, Addis Ababa University.

***Data management and analysis*:** The collected data was stored in Microsoft Excel® (Microsoft Ltd) while Minitab® version 14 (Minitab Inc., Pennsylvania, USA) and analyzed by using statistical package for social science [30] Version 20. Descriptive statistics, One-way-ANOVA and Pearson's correlation coefficient analysis were performed to know the effect of species-richness on hematological components of chicken blood. Differences were considered significant when $p<0.05$ at 95% confidence interval.

Results

Post mortem result

In this study of the 75 scavenging chickens examined, 42 (56%) of them were female and 33 of them were male. Of the chickens examined, 59 (78.7%) were infected with helminths parasites. The result of helminths infections of the chickens according to their sexes are presented in Table 1. Our results in Table 1 showed that, of the 42 (57%) female chickens examined, 34 (80.9%) were infected with helminths. And out of the 33 male chickens examined, 25 (75.8%) of them were infected.

The prevalence of the twelve species of helminths parasites (six nematodes and six cestodes) in chickens reared in the current study area is presented in Table 2. Of the identified six species of nematodes *Ascaridia galli* is the most prevalent and *Heterakis isolanche* is the least prevalent (Table 2). From the six cestode species identified *Raillietina echinobothrida* and *Railloetina tetragona* are the most prevalent and least prevalent, respectively (Table 2).

Of the chickens examined, 25 (33.3%) of them were infected by single helminthes species, while 34 (45.3%) of them were infected by mixed helminthic parasites (Table 3).

Hematological analysis results

The mean values of hematological indices in infected chickens were 31.1% for PCV, 10.2 gm/dL for Hb, $3.12 \times 10^6/\mu L$ for RBCs and $3.53 \times 10^3/\mu L$ for WBCs. On the other hand, the mean hematological values in uninfected chicken were 34.56%, 12.3 gm/dL, $3.6 \times 10^6/\mu L$ and $3.35 \times 10^3/\mu L$ for PCV, Hb, RBCs and WBCs, respectively. The Effects of helminths assessed by comparing the two groups of chickens infected (parasitized) with non-infected (non-parasitized). There was significant association ($P<0.05$) between parasitized and non-parasitized chicken and mean hematological indices. There was a negative significant correlation between parasitism and mean hematological of PCV ($r=-0.57$, $P=0.00$), Hemoglobin (Hb) ($r=-0.54$, $p=0.00$) and RBCs ($r=-0.53$, $p=0.00$) but positive correlation between parasitism and mean values of WBCs ($r=0.262$, $p=0.023$) (Table 4).

There was mild negative correlation between the types of infection (species richness) with overall mean of hematological indices and a positive association with mean of WBCs (Figures 2-5 and Table 5).

Sex	Total no of chickens examined	Number of helminths infected chickens	Prevalence (%)	Chi-square (χ^2)	P- value
Female	42	34	80.9	0.297	0.586
Male	33	25	75.8		
Total	**75**	**59**	**78.7**		

Table 1: Overall prevalence rate of helminths parasitized local scavenging chickens based on sexes.

Helminths species	Number of infected chickens	Prevalence (%)
Nematodes		
Cheilospirura hamulosa	2	2.7
Ascaridia galli	18	24
Heterakis gallinarum	16	21.3
Heterakis isolanche	1	1.3
Heterakis dispar	3	4
Subulura brumpti	5	6.7
Total	**45**	**60**
Cestodes		
Raillietina echinobothrida	17	22.7
Railloetina tetragona	4	5.3
Raillietina cesticillus	11	14.7
Choanotaenia infundibulum	9	12.0
Hymenolepis carioca	7	9.3
Hymenolepis cantainana	12	16
Total	**60**	**80**

Table 2: Frequencies of different helminths parasites species in infected chickens.

Types of infections	Number of chickens infected	Prevalence (%)	Chi-square (χ^2)	P-value
Single nematode infection	14	18.7	7.5	0
Mixed nematode infection	3	4		
Single cestode infection	11	14.7		
mixed cestode infection	10	13.3		
Mixed nematode and cestode infection	21	28		
Total	**59**	**78.7**		

Table 3: Prevalence rates of different mixed types of infections in infected chickens.

Hematological values	Type of infection	Number of chickens examined	Mean	Std. Deviation	P-value	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
PCV (%)	uninfected	16	34.56	2.449	0.00	33.26	35.87	30	40
	infected	59	30.10	2.734		29.39	30.81	25	36
	Total	**75**	**31.05**	**3.234**		**30.31**	**31.80**	**25**	**40**
Hb (gm/dL)	uninfected	16	12.25	0.931	0.00	11.75	12.75	10	14
	infected	59	10.20	1.399		9.84	10.57	8	13
	Total	**75**	**10.64**	**1.557**		**10.28**	**11.00**	**8**	**14**
RBCcX (10/micr.L)	uninfected	16	3.6013	0.20979	0.00	3.4895	3.7130	3.27	3.97
	infected	59	3.1222	0.33885		3.0339	3.2105	2.30	3.75
	Total	**75**	**3.2244**	**0.37141**		**3.1389**	**3.3099**	**2.30**	**3.97**
WBCcCX (10/ micr.L)	uninfected	16	3.3531	0.23994	0.023	3.2253	3.4810	2.90	3.74
	infected	59	3.5310	0.27920		3.4583	3.6038	2.90	4.20
	Total	**75**	**3.4931**	**0.27956**		**3.4287**	**3.5574**	**2.90**	**4.20**

Table 4: Mean Values hematological components of parasitized (infected) and non-parasitized (non-infected) chickens.

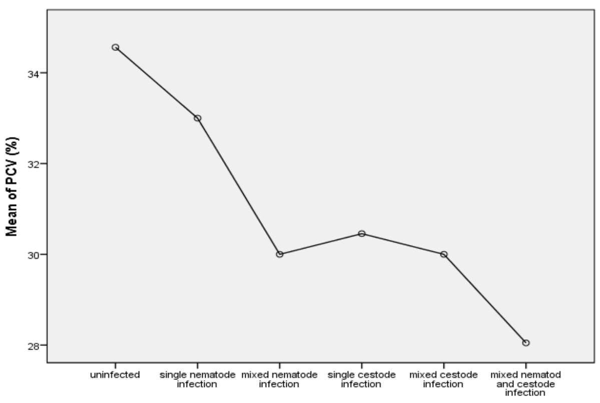

Figure 2: Mean plot PCV versus type of infection/species richness.

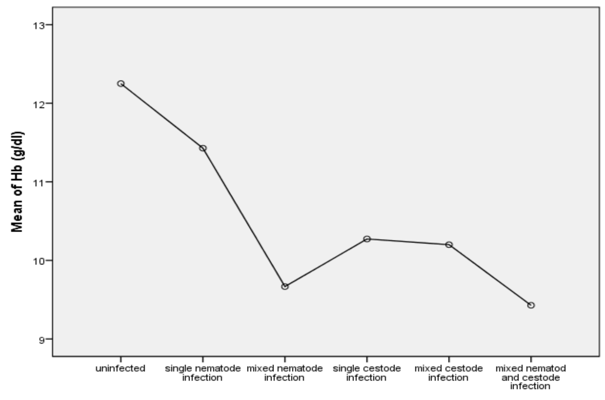

Figure 3: Mean plot Hb versus type of infection/species richness.

Discussion

In this study the overall prevalence of helminths parasites in chickens was 78.7%. This result is lower than the a prevalence of 87% in free ranging chickens in Nigeria [31], a prevalence of 84.6% in Bahirdar town, Ethiopia [32], a prevalence of 81.5% in central Ethiopia [14]. Beruktayet [33] who reported a prevalence of 80% in Ethiopia [33], Berhanu et al. who reported a prevalence of 88.5% in Hawassa, Ethiopia, a prevalence of 81.5% in Giwa, Kaduna State [27]. a prevalence of 89.5% [34], a prevalence of 72% in India [35], a prevalence of 97% in Uganda [36], a prevalence of 100% in Tanzania [25]. The reason for these prevalence rates variation could be the number of chickens and the study design and study methodologies used by the researchers in their studies.

On the other hand, the overall prevalence of the present study is higher than previous prevalence rates 28.9%, 46.9%, 35.5% and 53% [37-40] respectively. This discrepancy could be related to the differences in the management system and number of chickens included in the studies.

Although helminths infection was more prevalent in females (80.9%) than males (75.8%), however there was no significance difference (P>0.05) in the prevalence of helminths parasites among sexes groups of the chicken. This finding agrees with previous study

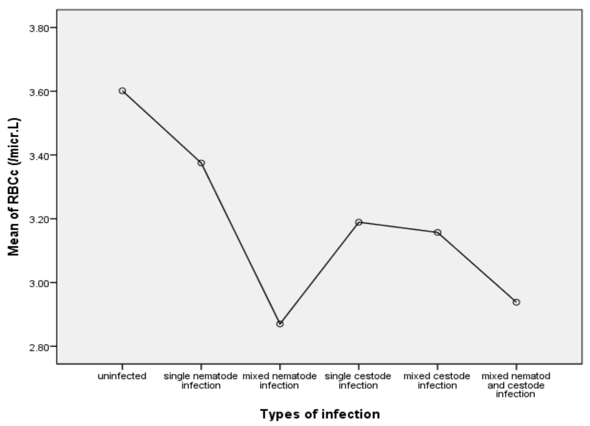

Figure 4: Mean plot RBCs versus type of infection/species richness.

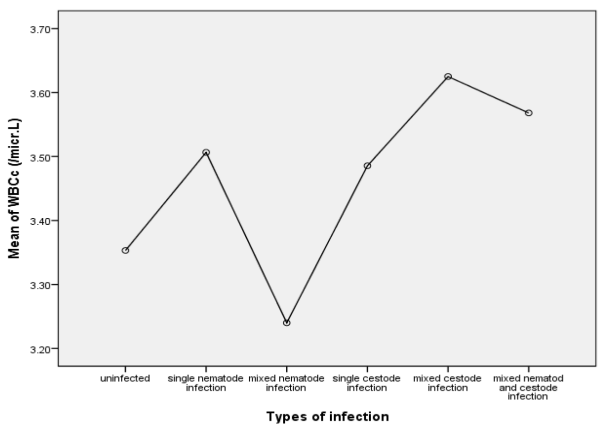

Figure 5: Mean plot WBCs versus type of infection/species richness.

[41]. This might be due to an equal chance of access to infection for the disease [33] but another study in the local and exotic chickens in Nigeria [42] explained that female chickens were more infected by helminths parasites than males. The reason for discrepancy could be due to the breed types of poultry for the studies.

Out of 75 chickens subjected to postmortem examination 25 (33.3%) were found to be infected by single helminths and 34 (45.3%) of them infected by mixed infections. From 25 chickens infected by single parasite 14 (56%) and 11 (44%) of them infected by nematode and cestode parasites respectively (Table 3). An effort was made to identify twelve (six nematodes and six cestodes) species of helminthes in chickens in the study area. In this study the six identified species of nematodes were *Ascaridia galli*, *Hetrakis gallinarum Cheilospirura hamulosa, Hetrakis Isolanche, Hetrakis dispar and Subulura brumpti*. Consequently, from the identified species of nematodes recorded during the postmortem examination *Ascaridia galli* was the first prevalent which was identified from the 18 (24%) of chickens examined. Previous studies conducted in Ethiopia [13,32,43] have indicated the presence of infections in chickens kept under the scavenging production system by *Ascaridia galli*, *Hetrakis gallinarum, Subulura brumpti* and *Cheilospirura hamulosa* species.

The dominance of *Ascardia galli* over *Hetrakis gallinarum* has also been observed by several studies. Prevalence of 35.58% and 17.28% in Central Ethiopia [15], 25.7% and 8.25% from Pakistan [44], 25.63% and 1.43% in indigenous chicken from Kenya [45]. 48.39% and 35.48% from Nigeria [39], 75.6% and 68.9% in Palestine [46]. However, the prevalence of *Ascaridia galli* in this study lower than other previous studies in Ethiopia [17].

The second most prevalent nematode species identified in the present study was *Hetrakis gallinarium* (21.7%) which is comparable to the finding of Ashenafi [14] who reported a prevalence rate of 22.8%, but the finding in the present study is higher than a prevalence of 17.28% [47], 4% prevalence which has been reported in guinea fowls by Junker [48], 1.43% prevalence which has been reported in indigenous chicken from Kenya [45], but the finding on this parasite was lower than 42.24% and 32.61% prevalence in central Ethiopia reported [15]. The lower prevalence in the present study could be due to the fact that the number of chickens used for the present study is small and the management system might be different.

From the six cestode species *Raillietina echinobothrida* species was detected in 22.4% of chickens and it was the second most prevalent parasite from the total twelve helminths species identified in the present study (Table 2).

The prevalence of cestodes in this study (80%) was higher than other studies [46] in free range chickens in Palestine and in indigenous and exotic layers at Faisalabad area of Pakistan [49]. The relatively higher prevalence of *Raillietina echinobothrida* can be attributed to the wide spread and eases accessibility of intermediate hosts (dung beetles) to the local scavenging chickens because dung beetles were very common in the study area. The existence of these six species of cestodes in the present study were observed in other studies reported [50]. In addition, the studies of Shiferaw et al. [13,32,43] conducted in Ethiopia have reported the presence *Raillietina echinobothrida, Railloetina tetragona, Raillietina cesticillus, Choanotaenia infundibulum* and *Haymenolepis carioca* species infections in chickens kept under the scavenging production system.

In the present study mixed infection of two or more species of parasites per chicken was seen in 34 (45.3%) of them. Similar, mixed infections in rural free- ranging chickens have also been reported by previous authors [14,27,31,33,34,50,51]. This could be due to food preference of the parasites at a particular time which determines the establishment of mixed or single infection in the chickens.

This study was also designed to elucidate the effects of helminths infections on hematological profiles in chickens kept under scavenging production system that was expected as this production may expose chickens to natural helminths infection.

Haematological disorders can be studied by identifying the primary hematopoietic components affected (i.e., Total red blood cells count (RBCs), packed cell volume (PCV), hemoglobin concentration (Hb) and white blood cells count (WBCs) [52].

In the present study, Table 4 showed the effects of helminths in infected groups significantly decreased than non-infected groups. The packed cell volume and the hemoglobin concentration were showed a significant decrease in infected groups than non-infected groups which is in line with the report of Deka et al. [53,54]. The lowered Hb value might be due to metabolic disturbance caused by worms rather than direct blood loss [55]. Moreover, both hematocrit and haemoglobin indirectly measure the status of erythrocytes integrity. Hence the intestinal leakage of iron that follows damage caused by migrating larvae is linked to the observed low values of hematocrit and haemoglobin

Hematological values	Type of infection	Number of chickens examined	Mean	Std. Deviation	P-value	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
PCV (%)	uninfected	16	34.56	2.449	0	33.26	35.87	30	40
	single nematode infection	14	33	2.219		31.72	34.28	29	36
	mixed nematode infection	3	30	1.732		25.7	34.3	28	31
	single cestode infection	11	30.45	1.753		29.28	31.63	27	34
	mixed cestode infection	10	30	1.826		28.69	31.31	28	34
	mixed nematode and cestode infection	21	28.05	2.179		27.06	29.04	25	32
	Total	**75**	**31.05**	**3.234**		**30.31**	**31.8**	**25**	**40**
Hb (gm/dl)	uninfected	16	12.25	0.931	0	11.75	12.75	10	14
	single nematode infection	14	11.43	1.222		10.72	12.13	9	13
	mixed nematode infection	3	9.67	0.577		8.23	11.1	9	10
	single cestode infection	11	10.27	1.104		9.53	11.01	9	13
	mixed cestode infection	10	10.2	1.398		9.2	11.2	9	13
	mixed nematode and cestode infection	21	9.43	1.207	.	8.88	9.98	8	13
	Total	**75**	**10.64**	**1.557**		**10.28**	**11**	**8**	**14**

RBCc (10/micr.L)	uninfected	16	3.6013	0.20979	0	3.4895	3.713	3.27	3.97
	single nematode infection	14	3.375	0.31206		3.1948	3.5552	2.75	3.74
	mixed nematode infection	3	2.87	0.24269		2.2671	3.4729	2.67	3.14
	single cestode infection	11	3.1891	0.26021		3.0143	3.3639	2.74	3.67
	mixed cestode infection	10	3.157	0.26179		2.9697	3.3443	2.84	3.75
	mixed nematode and cestode infection	21	2.9381	0.32582		2.7898	3.0864	2.3	3.5
	Total	**75**	**3.2244**	**0.37141**		**3.1389**	**3.3099**	**2.3**	**3.97**
WBCc (10/micr.L)	uninfected	16	3.3531	0.23994	0.62	3.2253	3.481	2.9	3.74
	single nematode infection	14	3.5064	0.25948		3.3566	3.6563	2.9	3.9
	mixed nematode infection	3	3.24	0.06928		3.0679	3.4121	3.2	3.32
	single cestode infection	11	3.4855	0.27072		3.3036	3.6673	3	3.9
	mixed cestode infection	10	3.625	0.27484		3.4284	3.8216	3.36	4.2
	mixed nematode and cestode infection	21	3.5681	0.30176		3.4307	3.7055	2.9	4.2
	Total	**75**	**3.4931**	**0.27956**		**3.4287**	**3.5574**	**2.9**	**4.2**

Table 5: Values of hematological among different mixed types of infection (species richness).

through reduced erythropoiesis. It is also known that helminthiasis cause inappetence that ultimately affect dietary intake including iron-containing feeds and other nutrients essential for erythropoiesis [56]. The total red blood cells count decreased significantly in infected groups of chickens than that of non-infected chickens which is in agreement with Deka et al. [53,57].

On the other hand, as Table 4 of the present study showed there is a slightly increased of total white blood cells in infected group of chicken as compared with non-infected chickens. The elevation in the total white blood cells count might be for defense against body infection [58], but the net increases of total white blood cells count was insignificant between the two groups and the result disagrees with the study of Deka [53].

In this study, Table 4 and Figures 2-5 showed the separate mean values of PCV, Hb and RBCs comparison for each type of infections within infected group were appeared below the non-infected group and except mean values in mixed nematode infection WBCs slightly raised than non-infected group in all other types of infection. These were because of small frequency of infection with mixed nematode infection in this study. Similarly, the mean values of these different types of infection when compared with the over mean of infected group the mean PCV values except in group of chickens infected with single nematode infection they appeared below the overall for positive group. The Hb and RBCs mean values in infection type of mixed nematode and in mixed nematode and cestodes group appeared below the overall mean of infected groups and for WBCs except in nematode mixed types of infection they appeared above the overall mean positive group. In general, from Table 2 it may be understood that the values of hematological parameters in those five different types of infections influenced by frequency of infections and species differences. Species richness has been considered a more stable measure of parasitism than prevalence [59]. The finding of species richness parasitism with hematological values was significantly correlated which is partly in agreement with the finding of Millan [60].

In conclusion, this study demonstrates the presence of high prevalence of helminths parasites in chickens kept under scavenging system in the study area. A total of twelve species (six nematodes and six cestodes) parasites were identified, but from the six nematodes the most prevalent species are *Ascardia galli* and *Hetrakis gallinaru* and *Raillietina echinobothrida* from the cestodes. This high prevalence of helminths infection in chickens induces low levels of hematological values. In conclusion it is recommended conducting a large scale research for further understanding of whether risk factors that were not considered in this study affect the epidemiology of helminthic disease and other complimentary physiological parameters indices of health research works should be conducted for further elucidation of the interaction between helminths and the aforementioned health indices. It is also advisable to create awareness to farmer on the importance of deworming in order to reduce economic losses induced by helminths parasites.

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Conflict of Interests

The authors have not declared any conflict of interest.

References

1. Gerima GT, Meseret Y, Teddy AA (2016) Socio-economic characteristics of poultry production in lowland and midland agroecological zones of central Tigray, Ethiopia. Afr J Poultry Farming 4: 149-158.
2. Kyule NM, Mwangi JG, Nkurumwa OA (2014) Indigenous chicken marketing channels among small-scale farmers in Mau-Narok division of Nakuru County, Kenya. Int J Soc Sci Entrepreneurship 1: 55-65.
3. Lawal JR, Bello AM, Balami SY, Wakil Y, Yusuf ZB, et al. (2016) Prevalence and economic significance of ectoparasites infestation in village chickens (Gallus gallus domesticus) in Gombe, Northeastern Nigeria. Direct Res J Agric Food Sci 4: 94-103.
4. Fisseha M, Azage T, Tadelle D (2010) Indigenous chicken production and marketing systems in Ethiopia: Characteristics and opportunities for market-oriented development. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 24. ILRI, Nairobi, Kenya.
5. Central Statistics Authority (CSA) (2014) Agricultural sample survey. Report on livestock and livestock characteristics. Statistical Bulletin, Addis Ababa, Ethiopia.
6. Duguma R (2009) Understanding the role of indigenous chickens during the long walk to food security in Ethiopia. Livestock Research for Rural Development 21: 116.
7. Tadelle D (2003) Phenotypic and genetic characterization of local chicken ecotypes in Ethiopia. PhD Thesis, Humboldt University of Berlin, Germany.
8. Mekonnen H, Mulatu D, Kelay B, Berhan T (2010) Assessment of the nutritional status of indigenous scavenging chicken in Ada'a district, Ethiopia. Trop Anim Health Prod 42: 123-130.
9. Moges F, Abera M, Tadelle D (2010) Assessment of village chicken production system and evaluation of the productive and reproductive performance of local chicken ecotype in Bure district, North West Ethiopia. Afr J Agric Res 5: 1739-1748.
10. Chaka H, Goutard F, Gil P, Abolnik C, Almeida-de RS (2013) Serological and molecular investigation of Newcastle disease in household chicken flocks and associated markets in Eastern Shewa zone, Ethiopia. Trop Anim Health Prod 45: 705-714.
11. Serkalem T, Hagos A, Zeleke A (2005) Seroprevalence Study of Newcastle Disease in Local Chickens in Central Ethiopia. Intern J Appl Res Vet Med 3: 1.
12. Zeleke A, Sori T, Gelaye E, Ayelet G (2005) Newcastle Disease in Village Chickens in Southern and Rift Valley Districts in Ethiopia. International Journal of Poultry Science 4: 507-510.
13. Shiferaw J, Gelagay A, Esayas G, Fekadu K, Stacey EL (2012) Infectious bursal disease: seroprevalence and associated risk factors in major poultry rearing areas of Ethiopia. Trop Anim Health Prod 45: 75-79.
14. Ashenafi H, Eshetu Y (2004) Study on Gastrointestinal Helminths of Local Chickens in Central Ethiopia. Revue Med Vet 155: 504-507.
15. Eshetu Y, Mulualem E, Abera K, Ebrahim H (2004) Study of Gastro intestinal helminthes of scavenging chicken in four districts of Amhara Region, Ethiopia. Scientific and Technical Review, Office International Des Epizooties 20: 791-796.
16. Molla W, Haile H, Almaw G, Temesgen W (2012) Gastrointestinal Helminthes of Local Backyard Ethiopia. Revue Med Vet 163: 362-367.
17. Tesfaheywet Z, Yonas Y (2012) Ectoparasite infestation of free scavenging chickens reared under traditional backyard production system in Wolayita Zone, southern Ethiopia. Ethiopian Veterinary Journal 19: 55-66.
18. Tolossa YH, Shafi ZD, Basu AK (2009) Ectoparasites and gastrointestinal helminths of chicken of three agro-climatic zones in Oromia Region, Ethiopia. Animal Biology 59: 289-294.
19. Eshetu Y, Tilahun T (2000) Survey of gastro-intestinal helminths of poultry in three woredas of Arsi zone, Ethiopia. J Ethiopian Vet Assoc 4: 30-39.
20. Aade U, Wankhede H, Kaldate K (2011) Haematological parameters change in Gallus gallus domesticus infected with Cotugnia digonopora. Recent Res Sci Technol 3: 16.
21. Emebet E, Mersha C, Yacob T (2017) Prevalence of haemoparasites infections in indigenous scavenging chickens in and around Bishoftu. World Applied Sciences Journal 35: 302-309.
22. Selam M, Kelay B (2013) Causes of village chicken mortality and interventions by farmers in Ada'a District, Ethiopia. International Journal of Livestock Production 4: 88-94.
23. National Metrological Service Agency (2011).
24. Oromia National Regional State (2011) Ada'a Liben Woreda Profile. Available from: http://www.oromiyaa.com/english/index.php?option=com_content&view=article&id=249&Itemid=514
25. Magwisha H, Kassuku A, Kvysgaard N, Permin A (2002) A comparison of the prevalence and burdens of helminth infections in growers and adult free range chickens. Tropical Animal Health and Production 34: 205-214.
26. Thrusfield M (2005) Veterinary Epidemiology. 2nd edn. London: Blackwell Science Ltd., p: 479.
27. Junaidu HC, Luka SA, Mijinyawa A (2014) Prevalence of gastrointestinal helminth parasites of the domestic fowl (Gallus gallus domesticus) slaughtered in Giwa market, Giwa local Government Area, Kaduna state, Nigeria. Journal of National Science Research 4: 54-58.
28. Yacob HT, Hagos AT (2013) Occurrence of ectoparasites and gastro-intestinal helminthes infections in Fayoumi chickens (Gallus gallus Fayoumi) in Debre Zeit Agricultural Research Center Poultry Farm, Oromia region, Ethiopia. J Vet Med Anim Health 5: 107-112.
29. Permin A, Hansen J (1998) Diagnostic Methods: Epidemiology, Diagnosis and Control of Poultry Parasites. FAO Animal Health Manual, No 4. Food and Agriculture Organization of the United Nations, Rome, Italy, pp: 33-118.
30. SPSS (2011) Statistical Package for Social Sciences. Version 20, SPSS Inc., USA.

31. Yoriyo KP, Adang KL, Fabiyi JP, Adamu SU (2008) Helminth parasites of local chickens in Bauchi State, Nigeria. Science World Journal 3: 35-37.
32. Abebe B, Mekonnen A (2015) A Survey of Gastrointestinal Helminthes among Chickens in Bahir Dar Town, Ethiopia. European Journal of Applied Sciences 7: 64-71.
33. Beruktayet W, Mersha C (2016) Study on Gastrointestinal Helminthes of Scavenging Chickens in Hawassa and Shashemene Towns. British Journal of Poultry Sciences 5: 32-42.
34. Hussen H, Chaka H, Deneke Y, Bitew M (2012) Gastrointestinal Helminthes are Highly Prevalent in Scavenging Chickens of Selected Districts of Eastern Shewa Zone, Ethiopia. Pakistan Journal of Biological Sciences 15: 284-289.
35. Sonune MB (2012) Analysis of gastrointestinal parasites of poultry birds around Chikhli, Buldana, India. Science Research Reporter 2: 274-276.
36. Ssenyonga GSZ (1982) Prevalence of helminth parasites of domestic fowl (Gallus domesticus). Trop Anim Health Prod 14: 201-204.
37. Opara MN, Osowa DK, Maxwell JA (2014) Blood and Gastrointestinal Parasites of Chickens and Turkeys Reared in the Tropical Rainforest Zone of Southeastern Nigeria. Open Journal of Veterinary Medicine 4: 308-313.
38. Beyene K, Bogale B, Mersha C (2014) Study on Effects and Occurrence of Nematodes in Local and Exotic Chickens in and Around Bahir Dar, Northwest Ethiopia. American-Eurasian Journal of Scientific Research 9: 62-66.
39. Nnadi PA, George SO (2010) A Cross-Sectional Survey on Parasites of Chickens in Selected Villages in the Sub humid Zones of South-Eastern Nigeria. Journal of Parasitology Research 14: 18-24.
40. Matur BN, Dawam NN, Malann YD (2010) Gastrointestinal Helmith Parasites of Local and Exotic Chickens Slaughtered in Gwagwalada, Abuja, Nigeria. Journal New York Science 3: 96-99.
41. Hassouni T, Belghyti D (2006) Distribution of gastrointestinal helminthes in local chickens farms in the Gharb region-Morocco. Parasitol Res 99: 181-183.
42. Roy KD (2002) Helminthosis of Free-Range Chickens in Bangladesh with emphasis on prevalence and Effect on Productivity. MSc Thesis, The Royal Veterinary and Agricultural University, Department of Livestock Services, Farmgate, Dhaka, Bangladesh, pp: 297-330.
43. Berhanu MD, Haileyesus S (2014) Gastro intestinal Helminths of Scavenging chickens in districts of Hawassa, Southern Ethiopia. Global Veterinaria 12: 557-561.
44. Sayyed R, Phulan M, Bhatti W, Pardehi M, Ali S (2000) Incidence of nematode parasites in commercial layers in swat. Pakistan Veterinary Journal 20: 107-108.
45. Kaingu F, Kibor A, Shivairo R, Kutima H, Okeno T, et al. (2010) Prevalence of gastrointestinal helminthes and coccidia in indigenous chicken from different agro-climatic zones in Kenya. African Journal Agricultural Research 5: 458-462.
46. Rayyan A, Al-Hindi A (2010) Occurrence of Gastrointestinal Helminthes in Commercial and Free-Range chickens in Gaza Strip, Palestine. Egypt Poultry Science 30: 601-606.
47. Mungube EO, Bauni SM, Tenhagen AB, Wamae LW, Nzioka SM, et al. (2008) Prevalence of parasites of local scavenging chickens in a selected semi-arid zone of Eastern Kenya. Trop Anim Health Prod 40: 101-109.
48. Junker K, Boomker J (2007) Helminths of guinea fowls in Limpopo Province, South Africa. Journal of Veterinary Research 74: 265-280.
49. Shah A, Anwar A, Khan M, Iqbal Z, Qudoos A (1999) Comparative studies on the prevalence of cestode parasites in indigenous and exotic layers at Faisalabad. Department of Veterinary Parasitology, University of Agriculture, Faisalabad, Pakistan. International Journal of Agriculture and Biology 1: 277-279.
50. Abebe W, Asfaw T, Genete B, Kassa B, Dorchies P (1997) Comparative studies of external parasites and gastrointestinal helminthes of chickens kept under different management system in and around Addis Ababa, Ethiopia. Revue Med Vet 148: 497-500.
51. Ohaeri CC, Okwum C (2013) Helminthic Parasites of Domestic Fowls in Ikwuano, Abia State Nigeria. Journal of Natural Sciences Research 3: 1.
52. Haile H, Chanie M (2014) Comparative Aspects of the Clinical Hematology of Birds: A Review. British Journal of Poultry Sciences 3: 88-95.
53. Deka K, Borah J (2008) Haematological and Biochemical Changes in Japanese Quails Coturnix coturnix Japonica and Chickens Due to Ascaridia galli Infection. International Journal of Poultry Science 7: 704-710.
54. Muhammad AK, Syed AR, Muhammad Y, Muhammad SK, Iahtasham K, et al. (2006) Prevalence and Effect of Helminthiasis on Haematological Parameters in the Migratory Sparrows (Alauda arvensis) and Treatment with an Antihelmintic, Fenbendazole. Pakistan Journal Zoology 38: 105-108.
55. Kumar R, Sinha SR, Verma SB, Sinha S (2003) Haematological changes in the Japanese quails (Coturnix coturnix japonica) naturally infected with nematode Ascaridia galli. India Veteterinary Med J 27: 297-299.
56. Crompton DWT, Neisheim MC (2002) Nutritional impact of intestinal helminthiasis during the human life cycle. Annual Review Nutrition 22: 35-59.
57. Tanwar RK, Mishra S (2001) Clinico Haemato Biochemical studies on intestinal helminthiasis in poultry. Vet Practitioner 2: 137-140.
58. Matta SC, Ahluwalia SS (1982) Haematological indices as influenced by Ascaridia galli infection in fowl. Effect on the haemoglobin concentration, packed cell volume and erythrocytes sedimentation rate. India Journal of Poultry Science 17: 46-51.
59. Morand S, Poulin R (2000) Nematode Parasite Species richness and evolution of spleen size in birds. Can J Zool 78: 1356-1360.
60. Millan JC, Gortazar R (2004) Ecology of nematodes Parasitism in red-legged Partridges (Alectoris rufa) in Spain. Helminthologia 41: 33-37.