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Study on Prevalence of Ectoparasites of Poultry in and Around Jimma Town

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Abstract: In Ethiopia, poultry production plays an important role in the socioeconomic develop of the country. Majority of Ethiopian chicken are maintained under traditional management systems contributing to 98.5% of national egg and 99.2% of chicken meat production. However, chicken production in Ethiopia is adversely affected by a variety of constraints. Among the constraints, external parasitism ranks top in village chicken production. To get data concerning this, a cross sectional study was conducted in and around Jimma town with the objectives of indentifying the species composition of ectoparasites circulating in the area and assessing their prevalence and associated risk factors. To achieve these objectives; 384 chicken were selected using systematic random sampling technique. Samples of ectoparasites were collected from different parts of the body including skin scraping from shanks and identified to species level under stereomicroscope. Concomitantly ages, sexes as well as other risk factors were recorded. The result of this study showed that three chicken ectoparasites (lice, flea and mite) were found to be prevailing in both the intensive and back yard production systems. Four species of lice; *Lipeurus caponis*, *Menopon gallinae, Menacanthus stramineus* and *Cuclotogaster heterographus* and two species of *mite: Knemidocoptes mutans*, *Dermanyssus gallinae* and one species of flea *Echidnophaga gallinacean* were identified. In current study, an overall prevalence of lice (42.71%), flea (16.15%) and mite (8.85%) irrespective of management differences was recorded. However, the prevalence in extensive (backyard) production system was found to be: 26.03% of lice, 8.85% of flea and 2.34% of mite while in intensive production system was: 16.67% of lice, 7.29% of flea and 6.51% of mite. The difference in prevalence rate of ectoparasites in adult chicken (49.48%) was higher than young grower (17.97%); higher in female (41.4%) than that of the male (28.08%); higher in local (41.4%) breed than exotic (28.64%) breed and higher in extensive management system (42.44%) than intensive (26.04%) managements. The finding in age group showed that there was a statistically significant differences in prevalence of ectoparasites between young grower and adult chicken ($P<0.05$). However, there was no statistical significant difference between male and female chicken ($P>0.05$). Generally, the study indicated that ectoparasites are highly prevalent in both backyard and intensive poultry production systems and in both local and exotic breed. This might be associated with lack of due attention with respect to hygienic system, treatment and control practices. Therefore, integrating ectoparasite control strategies and awareness creation to the community concerning the effect of ectoparasites on poultry production are recommended.

Key words: Prevalence · Ectoparasites · Backyard · Intensive and Chicken

INTRODUCTION

Animal production in general and chicken production in particular plays an important socioeconomic roles in developing countries. Poultry production is one area of livestock production with significant contribution to human food production. In most parts of Ethiopia, consumers have high preferences for poultry products. This may be due to poultry products provides proteins of high biological value [1].

Ethiopia has about 38.1 million chicken [2]. The majority are rural chicken which contribute to 98.5% and 99.2% of the national egg and chicken meat production, respectively [3]. Therefore, majority of Ethiopian chicken (99%) is maintained under traditional management systems with little or no inputs for housing, feeding or

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health care [4]. In developing countries, animal production is being subjected to great pressure to satisfy the demand for animal protein required by the continued increase in human population and also to have surplus for international trade. The proportional contribution of poultry to the total animal protein production of the world by the year 2020 is believed to increase to 40%, the major increase being in the developing world [5].

Among the animal production activities, poultry sector is the fastest growing. Nevertheless, it has been adversely affected by a variety of constraints. Among the constraints viral diseases especially Newcastle disease and parasitic infections are the major one. Out of these diseases, external parasitism ranks top in village chicken production. External parasites of poultry are common in the tropics because of the favorable climatic conditions for their development and the poor standards of poultry husbandry. In most rural areas, chicken infestation with external parasites poses a challenge to free-range chicken productivity and associated benefits since there is inappropriate housing and lack of appreciable pest control efforts [6].

External parasites compete for feed or cause distress to the birds and hence cause anemia, reduce growth, egg production and may lead to death [7]. Some of the ectoparasites with devastating effect in chicken are mites, lice and fleas [8]. Despite their devastating effects, ectoparasites received little attention in almost all the production systems. Even there is scanty information regarding comparative study, distribution, burden and economic impact of ectoparasites in different husbandry practice in Ethiopia. Furthermore, there is limited information in the species composition of poultry ectoparasites in the country in general and in particular in the study area. Therefore, the objectives of this study were:

- To indentify species composition of ectoparasite of poultry circulating in the area.
- To assess the prevalence and associated risk factors of poultry ectoparasite in and around Jimma.

MATERIALS AND METHODS

Study Area: The study was conducted from November 2014 to May 2015 to determine the prevalence and associated risk factors of poultry ectoparasite in and around Jimma town, south western Ethiopia. Jimma town is located in Oromia region, south west of Ethiopia, at a distance of about 352 km from Addis Ababa. Geographically, Jimma is located at 7°13' and 8°56' N latitude and 35°52' and 37°37E longitude. The climatic condition of the area is 'midland with altitude ranging between 1720 to 2110 m above sea level and receives annual rainfall which ranges between 1200 to 2000 mm. There are two rain seasons, short rainy season (November to April) and long rainy season (July to October). The annual mean temperature ranges from about 12.1°C to 28°C [9]. Jimma zone has a poultry population of about 1,139,735 [2].

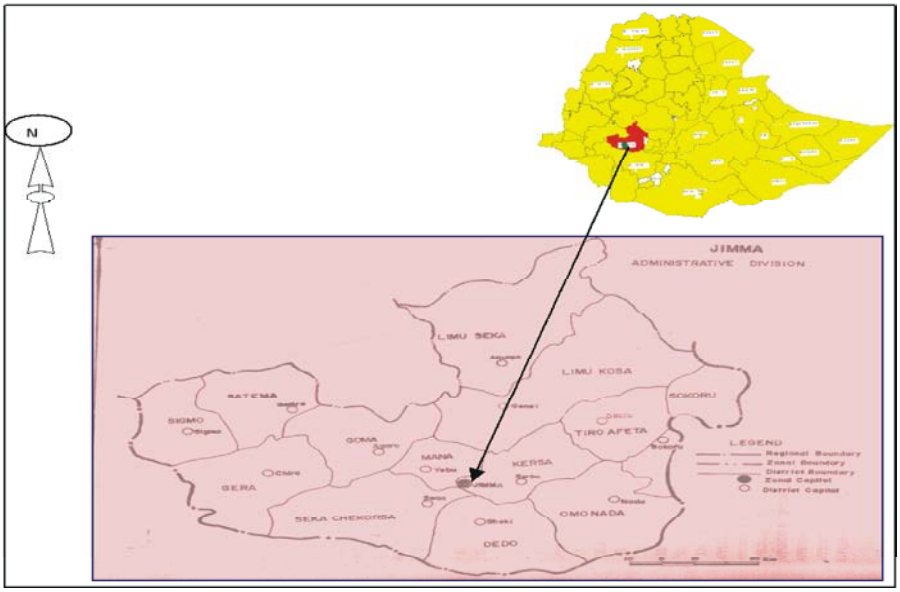

Fig. 1: Map of the study area

Source: Tolosa *et al.* [10]

Study Population: In the present study, 384 chicken were randomly selected from different production system (Intensive and extensive farming system) and all age, sex and breed were considered. Jimma town and Kersa and Manna from the surrounding Woredas were purposely selected for their large poultry population and their proximity to Jimma town. In Jimma town, five kebeles namely: Bossa Kito, Hirmata, Qoci Mandara, Mantina and Sexoo Semero were randomly selected. Information concerning breed and management system was obtained from the owners and observation. Ages of chicken were determined subjectively based on the size of crown, length of spur and flexibility of the xiphoid cartilage together with observing color of the shank and growth of the spur and categorized as young grower (Less than 12 weeks of age) and adult (Greater than 12 weeks of age) [11].

Study Design: A cross sectional study was carried out from November 2014 to May 2015 to identify species composition and determine prevalence of ectoparasites and other risk factor in the study area.

Sample Size Determination: Sample size was determined based on the formula provided by Thrusfeild [12]. Sample size was determined using 95% level of confidence, 50% expected prevalence since there was no previous work in this study area and 0.05% desired absolute precision. Accordingly, a total of 384 chicken were sampled.

Study Methodology: After a detailed physical and clinical examination of each chicken, samples were taken randomly from vent, head, neck, leg, back, wattle, comb and wing by naked eyes and using hand lenses. A systematic approach was followed to detect and count ectoparasites. The head was examined first and followed by the neck, body sides, back, ventral part of the abdomen; wings, vent area and legs. Ectoparasites were collected from the birds by displaying the feathers horizontally against their anatomical direction of alignment so as to expose them. Lice and fleas were collected from hosts by parting the hairs or feathers, gently brushing the base of the feathers with a fine soft brush so as to prevent the chicken from injuries and some of them were collected by hand picking and non-toothed thumb forceps. Mites were collected by scraping the skin surface with scalpel blade.

Generally, during examination, bird's legs were tied with the help of assistant. Individual feathers were manually deflected to observe the presence of parasite. Thoroughly examination of cracks and crevices in chicken houses were checked early in the morning and during the night time to ensure the presence of parasites with nocturnal activities. Shank scraps were collected on clean petri-dish. Each chicken examined was assigned with serial number and labeled with the necessary information on the sampling bottle for easy identification. The bio data of each chicken like sex, breed, age and predilection sites and managements systems were recorded in separate sheet. Representative of ectoparasites found in body of the chicken were collected in universal bottle (Film holders, vial) containing 70% alcohol. Numbers of parasites collected were counted and their predilection sites on the body of the chicken and hypothesized risk factor were simultaneously recorded. For samples suspected of mites, wet film was prepared from the scrap and 10% potassium hydroxide was added to digest debris and examined under light or stereomicroscope. The rest parasite were mounted under stereomicroscope and identified according to their morphological characteristics using entomological keys with the consultation of standard books such as Saulsby [13], Urquhart et *al*. [14], Wall and Shearer [15] and Williams [16].

Data Managements and Statistical Analysis: Data were coded and entered in to Microsoft Excel spread sheet and analyzed using Statistical software for Social Sciences (SPSS) version 16.0. The data were thoroughly screened for errors and properly coded before subjecting to statistical analysis and analyzed using the Pearson chi-square (x^2) test to determine the association present among the different variables. Infestation of ectoparasites in sex, breed and age with their relative prevalence were tabulated. Frequency was used to calculate the prevalence of different species of parasites. In all cases, 95% of confidence intervals and $P< 0.05$ were set for significance. Finally, descriptive statistics were used to summarize part of the data.

RESULTS

Overall Prevalence of Ectoparasites: Total of 384 chicken kept under different management systems were considered for the present study. Out of these, 260 heads of chicken (67.71%) were infested by at least one or more species of ectoparasites. According the present study, the prevalence of the different species of ectoparasites was found to be: *Dermanyssus gallinae* (7.03%), *Knemidocoptes mutans* (1.82%), *Lipeurus caponis* (18.75%), *Menopon gallinae* (13.28%), *Menacanthus stramineus* (4.95%), *Cuclotogaster heterographus* (5.73%) and *Cuclotogaster heterographus* (16.15%).

Table 1: Prevalence and distribution of different species of ectoparasites circulating in the study area

Species identified	Number of infested chicken	Prevalence (%)
D. gallinae	27	7.03
K. mutans	7	1.82
L. caponis	72	18.75
M. gallinae	51	13.28
M. stramineus	19	4.95
C. heterographus	22	5.73
E. gallinacea	62	16.15
Total	260	67.71

Table 2: The overall prevalence of ectoparasites

Ectoparasite	No positive	Prevalence (%)
Lice	164	42.71
Flea	62	16.15
Mite	34	8.85

Table 3: Summary of data and distribution of lice with associated risk factor

Categories		No. positive	Prevalence	Chi square (X^2)	P-value
Breed	Local	100	26.0	2.16	0.714
	Exotic	65	16.92		
Age	Young	32	8.33	1.43	<0.001
	Adult	132	34.37		
Sex	Female	112	29.17	1.390	<0.001
	Male	53	13.8		
Management	Extensive	101	26.03	1.368	<0.001
	Intensive	64	16.67		

Table 4: Summary of data and distribution of mite with associated risk factor

Category	No positive	Prevalence (%)	X^2	P value
Breed Local	23	5.98	2.244	0.360
Exotic	11	2.86		
Sex Female	20	5.2	8.82	<0.001
Male	14	3.64		
Age Young	18	4.68	8.614	0.0012
Adult	16	4.17		
Management Extensive	9	2.34	8.797	<0.001
Intensive	25	6.51		

Three major groups of ectoparasites were identified and their prevalence was lice (42.71%), mites (8.85%) and stick tight fleas 16.15% as follows.

Lice Infestation in Chicken: In the present study, 42.71% of chicken were infested by lice on one or more of their body surface. In current study, four species of poultry lice were identified, namely: *Lipeurus caponis* (18.75*%), Menopon gallinae* (13.28*%), Cuclotogaster heterographus (*5.73*%)* and *Menacanthus sramineus* (4.95*%*). Overall prevalence of lice was higher among adult chicken (34.37%) than in young grower (8.33%). In the current study, female birds (29.0%) were slightly prone to lice infestation than males (13.80%). The infestation of lice was higher in local breed (26.0%) than exotic breed (16.67%), higher in extensively managed chicken (26.03%) than intensively managed chicken (16.67%) (Table 3).

Mite Infestation: In this study, (8.85%) chicken were found to have mites on their body surface, subcutaneous tissue or the legs. Two species of mites (*K. mutans, D. gallinae)* were found to be the post prevalent parasites in Jimma and surrounding areas. The occurrence of mites was less in adult chicken (4.17%) compared to young grower chicken, (4.68%). These parasites had a higher frequency of occurrence in females (5.2%) than males (3.64%). It was higher in local chicken (5.98.0%) than exotic chicken (2.86%) as well as higher in intensively managed chicken (6.51%) than extensively managed chicken (2.34%) (Table 4).

Flea Infestation: The common chicken fleas in the study area were the stick tight flea (*E. gallinacea*). The overall prevalence of fleas was 16.15% (Table 2). The prevalence was higher in adult chicken (10.09%) in compared to young growers (5.2%). The parasite was relatively higher in males (7.03%) than in females (3.64) and also higher in local chicken (8.85%) than exotic chicken (2.86%) as well as higher in extensively managed chicken (8.85) than intensively managed chicken (2.86%) (Table 5).

Table 5: Summary of data and distribution of flea with associated risk factor

Category		No positive	Prevalence	X^2	P-value
Breed	Local	34	8.85	2.976	0.085
	Exotic	28	7.29		
Sex	Female	27	7.03	7.831	<0.001
	Male	32	8.33		
Age	Young	20	5.2	7.93	<0.001
	Adult	42	10.9		
Management	Extensive	34	8.85	7.8412	<0.001
	Intensive	28	7.29		

Table 6: Prevalence and risk estimate of chicken ectoparasite with hypothesized risk factors

Risk factors		No examined	No positive	Prevalence (%)	Odd ratio	CI (95%)	P value
Sex	Male	159	104	28.08	0.79	0.508-1.21	0.275
	Female	225	159	41.40	*	1.808-3.209	
Age	Young	115	69	17.79	0.58	0.3666-.971	0.020
	Adult	269	190	49.47	*	1.971-3.376	
Breed	Local	220	159	41.4	*	0.577-1.377	
	Exotic	164	110	28.64	0.89	1.713-3.04	0.606
Mgt	Extensive	238	163	42.44	0.9997	0.642-156	0.999
	Intensive	146	100	26.04	*	1.533-3.802	

*=the rest are calculated in reference to this

Mgt= management

The relative prevalence (ODD ratio) of chicken ectoparasites to the relative risk factors is summarized as follow in Table 6.

DISCUSSION

The current overall prevalence of chicken ectoparasites (67.71%) was comparable to 70.73% report from Meerut [17] and 67.95% in and around ambo town [11]. However, it was relatively lower than the reports higher prevalence rate of 91.5% [18] 86.67% [19] and 100% [20] were recorded in East Shoa zone Ethiopia, Bangladesh and Nigeria, respectively. The difference between the current and previous findings may be due to breed, seasonal, management, agro ecological and implemented methods of the disease control and prevention practiced in the study area, which exposes the chicken to poor hygiene on the farm and chicken houses thus, enabling them to contract a wide range of harmful ectoparasites.

According to the present study, the highest prevalent external parasites were lice (42.71%); followed by stick tight fleas (16.15%) and mites (8.85%) respectively. Lice infestation (42.71%) was the most prevalent followed by flea infestation (16.15%) while mite (8.85%) was the least prevalent. The lice prevalence disagreed with the findings of authors in Kenya by Sabuni *et al.* [21] and Sadiq *et al*. [22] from Nigeria and Belihu *et al.* [18] and Mekuria and Gezahegn [23] who reported 90%, 72.72%, 84.3% and 88%, respectively from Ethiopia. The relative low prevalence of lice in current study may be due to management system, season of study and other agro ecology influencing the distribution of lice. Four species of lice were recovered during the present study. These were *L. caponis*, *M. gallinae*, *M. stramineus* and *C. heterographus*. Among the identified ectoparasite species*, L. caponis* (18.75*%)* was most frequently identified species while *M. stramineus* (4.95%) was the least one. The prevalence of *L. caponis* (18.75%) is higher than reported by Bala *et al.* [20], Sadiq *et al.* [22] and Biu *et al.* [24] who reported 5%, 3.7% and 6.27%, respectively. These differences in prevalence may be attributed to differences in geographical areas, sample size and period of study. Different geographical areas and period of study have different climatic conditions (Temperature and humidity) which may alter the population dynamics of the parasites [25].

The prevalence of 70%, 41.7%, 6.9% and 65.33% *M. stramineus* was reported from Bangladesh [19] from Ethiopia [18, 20, 26] which is higher than present study. This may be due to different host factors, management system and other factors related with size of sample taken. The prevalence of *M. gallinae* was 13.28% higher than the finding of Bala *et al.* [20] who reported 8.1% and lower than finding of Sabuni *et al.* [21] and Sadiq *et al.* [22] who report 97.7% and 40.12%, respectively. This may be related to favorable climatic condition in tropics for their development. Infestation by *C. heterographus* which is 5.73% is lower than finding of Belihu *et al.* [27] who report 25%. Generally differences in type and prevalence of the most commonly encountered lice may be due to a variation in agro-climatic and topographic conditions and species adaptability. Besides climatic conditions, these investigators did their work in different ecological locations where differences in breed and general husbandry practices would account for the difference in finding. In addition, a longer period of study might show the seasonal prevalence pattern of the parasites compared to the shorter one. Larger sample sizes depict the true reflection of what is on the ground compared to smaller sample sizes, hence the variation encountered. Collecting ectoparasites within a relatively short period minimizes errors since parasites have their own biology and populations that can vary rapidly in both space and time [28]. Lice tend to be more of a problem in household flocks than commercial flocks, as

commercial breeders do not permit parent-offspring contact. In backyard flocks the hen incubates the egg and cares for the chick.

The flea was the second most prevalent indentified in the study area and one species of chicken flea (*E. gallinacean,* stick tight flea) was found in the present study, at a rate of 16.15%. These findings were lower in contrast to the previous studies done in Kenya, 56.0% prevalence [8] and 76.7% [29] and in Zimbabwe, 76.7% [30]. The variation in prevalence is likely to be due to agro climatic differences between the study areas, age of study birds and season of study and control measure (Local) instigated against *E. gallinacean* in these chicken. *E. gallinacean* has been reported in a number of hosts including chicken, turkeys, wild birds, humans, mice, cats and dogs [29]. The range of stick tight flea is widespread in tropical and subtropical regions [30]. The difference in geographical and climatic factors could probably be the reason for the differences observed between the present study and the previous studies. The stick tight flea is a unique among poultry fleas in that the adults become sessile parasites and usually remain attached to the skin of head for days or weeks. It causes irritation and blood loss leading to anemia and death particularly in young chicken [31].

The flea infestation is higher in female group than male. This finding is in contrast with the finding of Fraol *et al.* [11] who reported male group has more infested with flea than female and parallel with finding of Sabuni *et al.* [21] who reported female group has more infested by flea than male. Social behavior increases opportunities for vertical (Within species) transmission of ectoparasites from one individual to the other as most of the time female's huddle together. The male chicken may introduce more parasites on to the female during mating, since the male is forced upon the female for every mating.

Mites were the least indentified ectoparasite in this study area and two mite species mites (*C. mutans*, *D. gallinae*) were found during the present study. *D. gallinae* (7.03%) was the most prevalent followed by *C. mutans* (1.82*%)*. This prevalence was low compared to findings by Permin *et al.* [30] who reported low prevalence rates of 32% chicken [8] (24%) and Mungube *et al.* [29] (13.3%). The finding that the mite, *C. mutans* had the least prevalence concurs with the findings of Shanta *et al.* [19]. The variation in prevalence of *C. mutans* is likely to be due to agro climatic differences between the study areas, season of study, geographic (Altitudinal) difference and control (Management) measure against *C. mutans* in these chicken**.** The prevalence rate found mites is presumably lower than the actual prevalence due to its nocturnal behavior and a possible limiting collection strategy used. *D. gallinae* hides in densely feathered skin areas, away from possible light (nocturnal behavior. The difference in rate of occurrence between the current and previous studies is likely to be due to a difference in geographical and climatic factors between the study areas. *D. gallinae* is most prevalent in summer and the conditions will be favorable for its growth and multiplication [29]. In this current study the mite, *C. mutans* had the least prevalence and this concurs with the findings of Shanta *et al.* [19] who also recorded *C. mutans* being the least indentified parasite. The variation may attribute to different management system in different area which allows the parasite to inter into poultry site.

The adult chicken had a 49.47% overall prevalence of ectoparasite, which was slightly higher than that of growers (17.96%). These findings are in agreement with those from studies in Zimbabwe by Permin *et al.* [30] and Nigeria by Biu *et al.* [24] in which adult chicken were compared to young chicken. Older chicken may be exposed longer to the infested environment than the young grower, hence a higher prevalence and intensity rates. This result disagrees with the finding of Sabuni *et al.* [21] who report adult chicken had a 100% overall prevalence of ectoparasite, which was slightly higher than that of growers (97.7%) and Nnadi and George [32] where 100% and 92% of adult and young chicken were infested, respectively with statistical significance difference $P<0.05$. Management difference in different study areas may attribute to such differences.

Female birds had higher prevalence (41.4%) than male which has prevalence of (28.08%). The result is in contrast to finding of Belihu *et al.* [18] and Mungube *et al.* [29] reported that males (94.3%) had a slightly higher rate of occurrence of ectoparasites compared to females (88.3%) and in line with Bala *et al*. [20], Mekuria and Gezahegn [23] and Biu *et al*. [24] who found that female chicken had a higher prevalence of ectoparasites than male chicken. In Nigeria, Biu *et al*. [24] found that female chicken had a higher prevalence of ectoparasites (15.4%), than male birds (14.7%). In both studies, the differences were not statistically significant. There are conflicting reports on the impact of host sex on prevalence of avian ectoparasites. However, some have stated that a number of host factors may occasionally cause variation in louse prevalence in some cases [33] but generally there is no significant difference in prevalence with respect to host sex.

These findings suggest that sex is not an influential factor on the prevalence rates of ectoparasites in poultry. Social behavior also increases opportunities for vertical (Within species) transmission of ectoparasites from one individual to the other as most of the time female's huddle together. The male chicken may introduce more parasites on to the female during mating, since the male is forced upon the female for every mating.

Local breed chicken (41.4%) were more infested than exotic breed chicken (28.6%). The finding was lower than report of Fraol *et al.* [11] who reported that 87.55% local breed was more infested than exotic breed chicken 26.4% and higher than report of Biu *et al.* [24] who reported (28.2%) in local breed and (2.6%) in exotic breed. The result is also in contrast to finding of 2.35% was reported from Debrezeit semi-intensive farm Biu *et al.* [24] and 100% in free ranging chicken [20]. Local breeds are allowed to free-range, thus becoming more vulnerable to ectoparasite than exotic breed, which are almost kept in door. The management system is also varying from place to place and in different husbandry system.

The prevalence was low intensive management system (16.67%) while high extensive management system (26.03%).the result is in contrast with finding of Mekuria and Gezahegn [23] who report high prevalence in back yard system and none in intensive system. This variation is due better measures and practices related to good housing, feeding and husbandry system applied intensive farms where exotic breeds are kept. Such high prevalence in extensive management could be due to the free-range system practiced in the study areas, which exposes the chicken to poor hygiene on the farm and chicken houses thus, enabling them to contract a wide range of harmful ectoparasites. The free-range system provides a more sustainable environment for the parasites [29] reported that lack of control measures towards these parasites was a possible factor contributing to the high prevalence of the parasites, becoming vulnerable to ectoparasitism. In study area the backyard farming system, chicken were sharing the same house with their owner's as well as with other livestock. The cleaning litter of poultry is not frequent. The design of houses also matter the introduction of parasite to poultry house and subsequent infestation resulted.

In intensive farming system, chicken were managed under the intensive management system which covers the range of measures and practices relating to good housing, feeding and husbandry standards, including all-in- all-out systems to protect stock from disease predisposing factors.

CONCLUSION

Chicken are hosts of a number of ectoparasites. In the present study lice is the most prevalent followed by flea but mites were the least. Four species of lice, *Lipeurus caponis*, *Menopon gallinae, Menacanthus stramineus* and *Cuclotogaster heterographus* and two species of *mite: Knemidocoptes mutans*, *Dermanyssus gallinae* and one species of flea *Echidnophaga gallinacean* were identified. The occurrence and intensity of parasitic infestations may be influenced by a number of epidemiological factors including host, sex, age, breed and environment. The control of these parasites should be made considering the time of year and the availability of resources to use products recommended for the control of these parasites. Therefore, there is need for enlightenment campaign to the chicken breeders on the dangers resulting from ectoparasitic infestation on chicken. It is also concluded that, proper sanitation, good hygiene, use of specific chemicals in the approved manner may also help the poultry farmers in the control of ectoparasites. Based the above conclusion, the following recommendations are forwarded:

- Awareness should be created to the community on the overall effect of ectoparasites on poultry production.
- Poultry disease control strategy should be planned together with the establishment planning of the farm
- Further research to evaluate the impact of ectoparasites on health and production performance of chicken including cost effectiveness of control strategies should be conducted
- Modern poultry farms should have ectoparasite control and evaluation strategy
- The country should design poultry disease including ectoparasite control planning, monitoring and evaluation strategy.

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