Research Journal of Poultry Sciences 6 (3): 53-58, 2013
ISSN: 1993-5285

Skin Lesions Associated with Ectoparasitic Infestation in Indigenous Chickens in Eastern Province of Kenya

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Abstract: Indigenous chickens constitute over 81% of poultry in Kenya and produce 71% of eggs and poultry meat. Ectoparasites limit production of these birds in the rural areas, since they cause significant pathology. This study was conducted to determine the prevalence of and the level of skin damage (in apparently healthy birds) by ectoparasites among different chicken ages, sexes and obtained from two agro-ecological zones: Lower Highland 1 (LH1) and Lower Midland 5 (LM5) in Eastern Province, Kenya. Parasites found on chicken were: lice, fleas, ticks and mites. Of the 144 indigenous chicken examined, gross and microscopic lesions in the skin were observed in 94 and 129 birds, respectively. Gross lesions were observed on 24.3% chicken heads, 31.9% body and 43.8% leg skins. Microscopic lesions were observed in 36.1% of head skin, 89.6% of body skin and 55.6% of leg skin. Head lesions differed among the bird's age groups, between sexes and agro ecological zones ($p<0.05$). Body lesions varied among chickens of different age groups and birds with lesions in zones ($p<0.05$). Gross leg lesion varied among age groups and between infected birds in different agro-ecological zones ($p<0.05$). This study documented severe effects of ectoparasitic infestations on the skin of chicken and hence recommends for control measures in order to improve productivity among these birds.

Key words: Indigenous chicken, ectoparasites, skin pathology, ages, sexes

INTRODUCTION

The poultry industry in Kenya is characterized by a rapid expansion witnessed in commercial and backyard or free-range indigenous chicken production. In 1993, poultry population in the country was 21 million which had increased to 29 million birds by 2001 and 34 million birds in 2006. Of these, 81% are indigenous chicken (Maina, 2005). Indigenous birds are however faced with all kinds of hardships such as poor management, lack of external inputs of production and poor disease control among others. This has contributed to discouragingly very low levels of productivity and high mortality rates (Ndegwa *et al*., 2000; Njue *et al*., 2001).

Rural indigenous poultry production is precarious and permanently threatened by disease outbreaks which cause heavy mortalities. These include infectious and parasitic diseases. Parasitic diseases appear to be a daily concern, causing little mortality but lower production. The ectoparasites do lower the reproductive success of the birds and during periods of heavy infestation, may weaken them, lower their resistance. They suck blood, interfere with the feed consumption by giving continuous irritation and thus they are associated with emaciation, anaemia and eventually loss of production (Shanta *et al*., 2006).

For most ectoparasites, the damage they do and hence, their clinical significance is a direct result of their abundance. Most of the species that are important ectoparasites have short generation times, produce large numbers of offspring and have very high potential rates of population growth; they are well adapted to exploit situations in which there is a temporary superabundance of food (Wall, 2007).

In Kenya, prevalence of ectoparasites in indigenous poultry has been studied, although the effects of these parasites on the health of rural chicken have not been evaluated. Therefore, the present research work was taken to study the pathological effect of ectoparasites in rural indigenous poultry.

MATERIALS AND METHODS

Study areas: Two agro-ecological zones in two neighboring districts were chosen for this study. The selection was based on the availability of an indigenous

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village rural poultry population with a free-range system practiced in the areas and the contrasting agro-ecological zones.

These were: Lower Highland 1 (LH1) in Embu district, a high agricultural potential area growing tea, maize, beans and various fruits and also practice free range poultry and dairy cattle farming. The area has a bimodal rainfall pattern of long rains between March and June and short rains in October to December. It has an annual average rainfall of 1080 mm. Altitude ranges from 1500-4500 m above sea level. The temperatures range from 12-27°C (Onduru *et al*., 2002) (Fig. 1). The other study area was the Lower Midland 5 (LM5) in Mbeere District. This is a semi-arid area with livestock (beef cattle, sheep and goats), poultry, millet and green gram as the main agricultural activities. It has a bimodal and erratic rainfall pattern with average annual rainfall of 180 mm per year. Altitude is 1200 m above sea level and temperatures range from 20-30°C (Onduru *et al*., 2002) (Fig. 2).

Study chicken: Indigenous chickens were obtained from individual homesteads and purposive sampling used. The

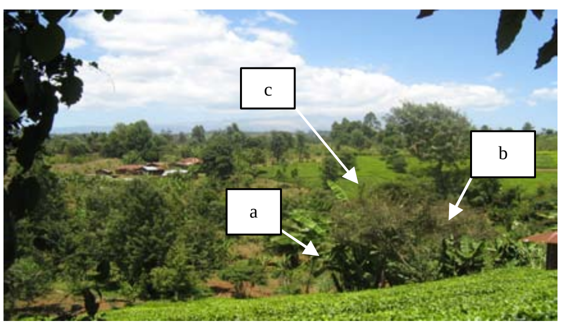

Fig. 1: Lower highland zone 1, a high agricultural potential area showing tea (a), banana (b), plantations and fruit trees (c)

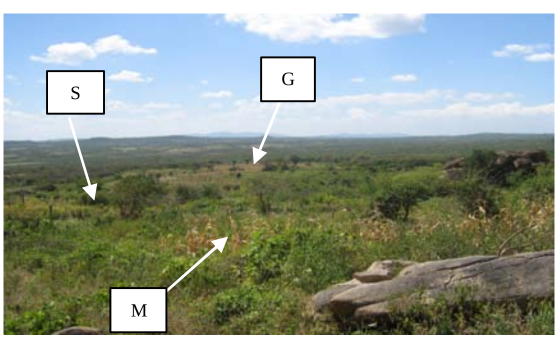

Fig. 2: Lower midland zone 5 (semi arid area) shows open grasslands (G), shrubs (S) and scanty "katumani" maize crops (M)

calculated sample size was 144 birds which were purchased. The expected prevalence used in the sample size calculation was 50% and the maximum limits of error at 8.3% as per the following equation (Martin *et al*., 1987):

$$n = 1.96^2 pq/L^2$$

Where:

n = The sample size
p = The prevalence
q = 1-p
L = The limits of error on the prevalence

The birds were categorized into three age groups as follows: chicks (aged<2 months), growers (2-8 months) and adult (aged >8 months) according to Magwisha *et al*. (2002) with modification. The ages were determined subjectively based on the size of crown, length of spur and flexibility of the xiphoid cartilage together with information from the farmers. The birds were classified as adults (cock or hen), growers (pullet or cockerel) and chicks (male and female) according to Magwisha *et al*. (2002) and Maina (2005). Birds were purchased from January to February 2007. They were transported alive in cages to the Department of Veterinary Pathology, Microbiology and Parasitology Laboratories, Kabete for examination.

Clinical examination and gross pathology: Before slaughter, birds were examined using magnifying glass for the presence of ectoparasites and any detectable lesions by parting of feathers by digital palpation and close inspection. Ectoparasites were collected by hand picking and preserved in 70% alcohol in separate vials for each host. They were latter dehydrated first in 80% then 90% and finally 100% alcohol before being cleared in xylene and mounted on a slide for final identification with a light microscope. Identification was done using entomological keys of MAFF (1986), Wall and Shearer (1997) and Arends (2003). The birds were then humanely killed followed by sectioning and collection of skin samples for histopathology.

Histopathology: Five skin samples were taken per bird together with sections showing obvious gross lesions and examined for skin histopathology. They were taken from the head, leg and body skin (neck, back and cloacal area) then preserved in 10% buffer neutral formalin and processed for histopathology. Histopathological changes were studied by preparing permanent slide according to the description given by Luna (1968).

Examination of tissue sections: Examination of the tissue sections was done under (x4, 10 and 40) magnification using a light microscope. The lesions on the skin were scored as none, mild, moderate or severe.

Microscopic lesion scoring: Microscopic skin lesions induced by the ectoparasites were scored as none, mild, moderate or severe according to Mbuthia (2004) and Maina (2005) with modifications.

Head, body and leg skin lesions were scored on the basis of no lesion (-) = intact epidermis, no cellular infiltrations or skin tissue reaction or hyperkeratinization. Mild lesion (+) = hyperkeratinization combined with either; compression of epidermis and or dermis by parasites (present or absent), thickening of epidermis and or dermis, congestion of dermal blood vessels or parasite sections within the skin tissue. Moderate lesion (++) = hyperkeratinization and skin necrotic changes, combined with either parakeratosis, compression of epidermis and or dermis by parasites (present or absent), thickening of epidermis and or dermis, hemorrhage or congestion or parasite cross-sections within skin tissue and severe lesions (+++): hyperkeratinization, parakeratosis and epidermal rupture combined with either of the following: necrosis, changes in blood vessels, pressure atrophy due to parasites (present or absent), hemorrhage, inflammatory changes involving deeper layers of the skin and parasite cross-sections within the skin tissue.

Scoring of leg lesions: Infestation with *Cnemidocoptes mutans* was classified on a clinical evaluation based on the presence of hypertrophic dermatitis on the legs as follows: + = no macroscopic changes, no visible sign of the mite infestation though mites were present on laboratory examination; ++ = minor scale formation only the distal parts of the legs and +++ = massive hypertrophic dermatitis with involvement of the whole leg. Scrapings cleared with potassium hydroxide (KOH) were used to identify the developmental stages and adult parasites (Permin *et al*., 2002).

Data analysis: Data was entered into MS Excel® 2007 (Microsoft Corporation, USA) and analysis was conducted using MS Statview® (SAS Institute Inc. 1995 to 1998, Cary, NC, USA). Descriptive statistics were calculated and presented as tables and graphs. For the epidemiological studies, the prevalence (p) of skin lesions was calculated as:

$$p = \frac{d}{n}$$

Where:

d = The number birds found as having a given skin lesion at that point in time

n = Number of birds at risk (examined) at that point in time

The association between presence of ectoparasites and the occurrences of the various skin lesions were evaluated using Chi-square statistic (χ^2). Mean difference in skin lesions for host age and sex and between the two agro-ecological zones was tested by ANOVA. In all the analysis, confidence level was held at 95% and $p<0.05$ was set for significance.

RESULTS AND DISCUSSION

Of 144 indigenous village chickens examined, 138 had one or more species of ectoparasites, giving an overall prevalence rate of 95.8%. Four groups of ectoparasites, namely; lice, fleas, soft ticks and mites were found in this study. In all, 65.3 and 89.3% of chickens examined for pathology of the skin had gross and microscopic lesions, respectively. Lesions varied from mild to severe. These skin lesions accompanied ectoparasitic infestation, although in some cases, the presence of these parasites did not associate well with the occurrence of skin lesions in chicken. More lesions were seen microscopically than macroscopically.

Lesions on the head: The 35 (24.3%) of the 144 heads examined had gross lesions (Table 1). These were

Table 1: Number of chicken with gross lesions on the head, body and leg skins and their percentage prevalence rates among chicken age groups, sexes and agro ecological zones

Varibles	Number of chicken with gross head lesions	Percentage prevalence rates	Number of chicken with gross body lesions	Percentage prevalence rates	Number of chicken with gross leg lesions	Percentage prevalence rates
Age groups						
Chicks	8	22.9	8	22.9	13	20.6
Growers	12	34.3	15	32.6	20	31.7
Adults	15	42.8	23	50.0	30	47.6
Sexes						
Females	21	60.0	20	43.5	35	55.6
Males	14	40.0	26	56.5	28	44.4
Agro ecological zones						
LH1	11	31.4	18	39.1	23	36.5
LM5	24	68.6	28	63.5	40	63.5
Total positive chicken	35	24.3	46	31.9	63	43.8

LH1 = Lower Highland zone; LM5 = Lower Midland zone 5

Table 2: Number of chicken with microscopic lesions on the head, body and leg skins and their percentage prevalence rates among chicken age groups, sexes and agro ecological zones

Varibles	Number of chicken with gross head lesions	Percentage prevalence rates (%)	Number of chicken with gross body lesions	Percentage prevalence rates (%)	Number of chicken with gross leg lesions	Percentage prevalence rates
Age groups						
Chicks	9	17.3	37	28.7	15	18.8
Growers	18	34.6	45	34.9	32	40.0
Adults	25	48.1	47	36.4	33	41.3
Sexes						
Females	29	55.8	61	47.3	43	53.8
Males	23	44.2	68	52.7	37	46.2
Agro ecological zones						
LH1	20	38.5	58	45.0	29	36.3
LM5	32	61.5	71	55.0	51	63.7
Total positive chicken	52	36.1	129	89.6	80	55.6

LH1: Lower Highland zone; LM5: Lower Midland zone 5

characterized by edema and hyperemia around the eye (on the eye lids); pox-like lesions and necrotic wounds especially on the comb which were most likely due to trauma. Microscopically, 52 (36.1%) birds had lesions (Table 2) that ranged from mild (51.9%) to moderate (48.1%) ones. The 60% of the heads examined had no lesions and no parasites, 25% had both lesion and parasite, 11% had lesion alone and 4% had parasite alone. Of those that had lesions, 36 (69.2%) of these were attributed to *Echidnophaga gallinacea* while 16 (30.8%) were not. Lesions due to parasite were necrosis, pressure atrophy due to parasites (present or absent); hemorrhage, hyperkeratinization, parakeratosis, epidermal breakages resulting to parasitic tracks in the epidermal and dermal tissues (Fig. 1); inflammatory changes involving deeper layers of the skin characterized by plasma cells and heterophilic granulocytic infiltrations and parasite cross-sections within the epidermal skin tissue. The 92 (63.3%) head skin sections had no lesion, 27 (18.7%) had mild lesions, 25 (17.4%) had moderate lesions and there were no severe lesions. There was an association ($p<0.001$) between the gross head lesions and the presence of *Echidnophaga gallinacea* among the study chickens and a strong association between presence of microscopic lesion and occurrence of *E. gallinacean*. There was statistical significant ($p<0.05$) difference in occurrence of head lesions among the birds' age groups between sexes and agro ecological zones. Males exhibited a higher prevalence of head lesions than female which may be as a result of fighting. Statistically, there was a significant difference in occurrence of microscopic lesions among chicken age groups between the birds from LH1 and LM5 but not between chicken sexes.

Lesions on chicken body skin: Of the ectoparasites, lice, ticks and mites were found on the body. Gross examination of the body skins revealed that 46 (31.9%) chicken had macroscopic lesions (Table 1). The gross lesions on the body skin included: skin desquamation, superficial necrotic wounds commonly around the abdominal area, areas showing feather loss, hyperemia and obvious thickening of the skin around the neck area. Areas infested by ticks were characterized by pitting ulcer formation and/or nodular skin formation as a result of inflammatory reactions. Microscopic lesions were observed in 129 (89.6%) chicken skins (Table 2). These lesions included: acanthosis, parakeratosis, haemosiderosis, sections showing pressure atrophy and fibroplasias due to ectoparasites, mononuclear cells infiltration and parasite cross-sections within the epidermal skin tissue. Such pathological changes have been reported earlier by various researchers and could not be linked to specific parasites except the gross lesions caused by *A. persicus*, owing to the diversity of parasites isolated on the body skin. Arends (2003) noted that areas of the skin where soft ticks had just fed showed red spot (haemorrhages) while Prelezov *et al.* (2006) found shapeless areas with lack of feathers on the skin in the region of the cloaca, the abdomen and breast with haemorrhages, superficial wounds and brownish scabs with size of millet and corn seeds (1-5 mm) on chicken experimentally infested with poultry biting lice. These findings were to some extend comparable with the findings of the study.

The 15 (10.4%) chicken body skin sections had no lesions, 27 (18.7%) had mild lesions, 93 (64.6%) had moderate lesion while 9 (6.3%) had severe lesion. Association between presence of lice, body mites and ticks and occurrence of gross lesions was not statistically significant ($p>0.05$) while that of microscopic lesions was statistically significant ($p<0.05$). This suggested that ectoparasites caused microscopic lesions compared to gross lesions, since at low densities by definition, ectoparasites are responsible for some injury, in the vast majority of cases, the damage each does is difficult to measure and is judged to be sub-clinical.

There was a significant difference in occurrence of body lesion among age groups and between agro ecological zones ($p<0.05$) but not between sexes while the difference in rate of occurrence of microscopic lesions of the body among age groups and between agro ecological zones were significant statistically but not between the sexes of birds ($p>0.05$). In earlier studies, scanty information is available concerning comparison of skin pathology among chicken ages, between sexes and agro ecological zones.

Lesions on the chicken legs: Gross leg lesions were observed in 63 (43.8%) chicken examined (Table 1). These were characterized by small yellowish grey or reddish brown, wart like skin proliferations/ minor scale formation which seemed to begin on the soft parts of the planter side of the tarsus and the shanks and later spread along the digits to the hock in early cases. In severe cases, there was a massive hypertrophic dermatitis with the whole leg showing massive skin proliferations. There were hyperemia, heavy encrustations, increased desquamation and loss of epidermis. Feathered parts of the legs were not involved. These findings were comparable to those described by Jordan (1990), Rupley (1997), Permin and Hansen (1998) and Arends (2003). In this study, no lesions were found around the beak and the lesion was more advanced (moderate to severe) in older birds than chicks. Microscopic examination revealed that 80 (55.6%) chicken had leg lesions (Table 2). Microscopic lesions included hyperkeratinization (proliferated stratum corneum), parakeratosis (Fig. 2), inflammatory and cellular changes, congestion of the dermal blood vessels and pouches or burrows caused by mites. Some pouches had sections of mites (Fig. 2) while others were empty, probably due to loss of mites during the processing or because the mites had penetrated more deeply. Kirmse (1966) in his study on cnemidocoptic infestation in wild birds described the histopathology as pouches or burrows of mites to be in the cornified epithelium. He described a striking honeycomb pattern of the skin where proliferation of stratum corneum had taken place. These finding were not encountered during this study and is likely to be due to intensity of infestation which in this study was low compared to findings by Kirmse (1966). Arends (2003) described these parasites to cause tunnels into the epithelium, causing proliferation and formation of scales and crusts. Shanta *et al*. (2006) noted that in tissue sections, the mites were observed as transverse or cross section in the deeper parts of the stratum corneum or the superficial layers of the stratum malpighii of the skin and rarely went deeper. Characteristic lesions were observed as hyperkeratosis and acanthosis in some area of skin which was in agreement with the findings (Fig. 3). Shanta *et al*. (2006) further noted that in advanced cases, there were secondary pyogenic infection; characterized by severe pus cell infiltration in the dermis. This however

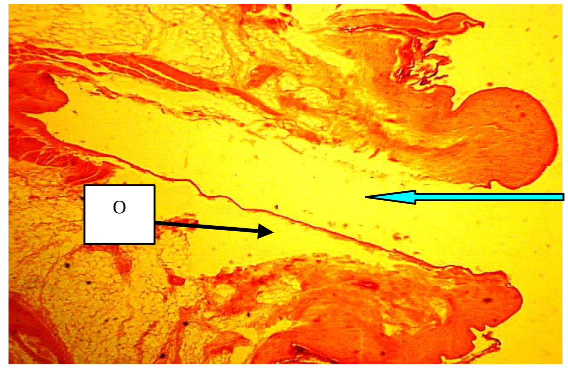

Fig. 3: A section of the head skin (comb) showing parasitic track caused by *Echidnophaga gallinacea* (thick arrow) and oedema/loose tissue (O) (magnification X100, HE stain)

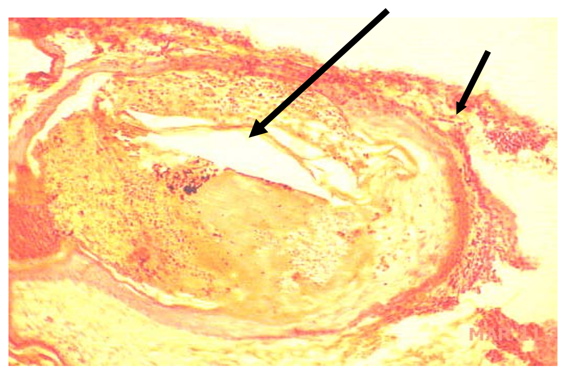

Fig. 4: A histological section of the leg skin showing a cross section of *Cnemidocoptes mutans* (thick arrow) in a pouch, covered by highly proliferative *stratum corneum* (parakeratosis; thin arrow) (magnification x100, HE stain)

was not observed in this study. Microscopic examination revealed that 80 (55.6%) chicken had leg lesions (Fig. 4). The 62 (77.5%) of these were attributed to *Cnemidocoptes mutans* while 18 (22.5%) were due to other causes. The 64 (44.4%) of the leg skin sections examined for histopathology had no lesion, 19 (13.2%) had mild lesions, 50 (34.7%) had moderate lesion while 11 (7.6%) had severe lesion. There was an association between the occurrence of leg gross and microscopic lesion and the presence of *Cnemidocoptes mutans.*

Among the age groups, there was a significant difference in occurrence of gross leg lesions among age groups and between agro ecological zones but not between chicken sexes. Difference in occurrences of the microscopic lesions of the leg skin among chicken age groups and between agro ecological zones was statistically significant ($p<0.05$) while that between the sexes was not ($p>0.05$). These differences may be attributed to exposure of these birds to the infested environment over time since adults are more exposed than chicks while the difference in geographical and climatic factors exhibited by these agro ecological zones could be the cause of varied prevalence of leg lesions between these agro ecological zones.

CONCLUSION

However, the study has described the gross and microscopic picture of lesion due to natural ectoparasitic infestation in indigenous chicken; compared lesions among bird age groups (chicks, growers and adults) and between sexes and agro ecological zones (LH1 and LM5) which has not been documented earlier. Such information will be useful while planning and prioritizing disease control activities among indigenous family poultry in order to increase their productivity.

ACKNOWLEDGEMENTS

The technical staff in the Department of Veterinary Pathology, Microbiology and Parasitology, the local guides and smallholder farmers from various villages in Embu and Mbeere where the study birds were purchased are appreciated for their indefatigable support and cooperation while sourcing for and processing of the study material.

REFERENCES

Arends, J.J., 2003. External Parasites and Poultry Pests. In: Diseases of Poultry, Calnek, W.B., H. John, W.C. Beard, L.R. McDougald and Y.M. Saif (Eds.). 11th Edn., Iowa State Press, Ames, Iowa, pp: 905-930.

Jordan, F.T.W., 1990. Poultry Diseases. 3rd Edn., Bailliere Tindall, Philadelphia, pp: 251-252.

Kirmse, P., 1966. Cnemidocoptic mite infestations in wild birds. Bull. Wildlife Dis. Assoc., 2: 86-99.

Luna, L.G., 1968. Manual of the Histological Staining Methods of the Armed Forces Institute of Pathology. 3rd Edn., McGraw Hill, New York.

MAFF, 1986. Manual of veterinary parasitological techniques. Technical Bulletin No. 18, Ministry of Agriculture, Fisheries and Food, HSMQ, London, pp: 118-124.

Magwisha, H.B., A.A. Kassuku, N.C. Kyvsgaard and A. Permin, 2002. A comparison of the prevalence and burdens of helminth infections in growers and adult free-range chickens. Trop. Anim. Health Prod., 34: 205-214.

Maina, A.N., 2005. Prevalence, intensity and lesion associated with gastrointestinal parasites of indigenous chicken in Kenya. M.Sc. Thesis, University of Nairobi, Kenya.

Martin, S.W., A.H. Meek and P. Willberg, 1987. Veterinary Epidemiology, Principles and Methods. Iowa State University Press, Ames, Iowa, pp: 32.

Mbuthia, P.G., 2004. *Pasteurella multocida* in indigenous chicken and ducks in Kenya. A study of carrier status, susceptibility, molecular diagnosis and pathogenesis. Ph.D. Thesis, University of Nairobi, Kenya.

Ndegwa, J.M., P. Norrish, R. Mead, C.W. Kimani and A.M. Wachira, 2000. A research process and methodology focussing on indigenous Kenyan chickens. Proceedings of the International Network for Family Poultry Development Symposium During the 21st World's Poultry Congress, August 20-24, 2000, Montreal, Canada, pp: 3-12.

Njue, S.W., J.L. Kasiiti, J.M. Macharia, S.G. Gacheru and H.C.W. Mbugua, 2001. A survey of the disease status of Village chicken in Kenya. Proceedings of Association of the Institutes of Tropical Veterinary Medicine (AIMVT) Conference, August 20-23 2001, Copenhagen, Denmark, pp: 36.

Onduru, D.D., L. Gachimbi, F. Maina, F.N. Muchena and A. der Jager, 2002. Sustaining agricultural production in semi arid area of eastern Kenya: A case study of Mbeere District. INMASP Report No. Ke-03.

Permin, A. and J. Hansen, 1998. Epidemiology, Diagnosis and Control of Poultry Parasites. Food and Agriculture Organization of the United Nations, Rome, Italy, pp: 1-157.

Permin, A., J.B. Esmann, C.H. Hoj, T. Hove and S. Mukatirwa, 2002. Ecto-, Endo- and Haemoparasites in free range chicken in the Gomoronzi District in Zimbabwe. Prev. Vet. Med., 54: 213-224.

Prelezov, P.N., N.I. Groseva and D.I. Goundasheva, 2006. Pathomorphological changes in the tissues of chickens, experimentally infected with biting lice (Insecta: Phthiraptera). Vet. Arhiv., 76: 207-215.

Rupley, A.E., 1997. Manual of Avian Practice. 1st Edn., Saunders Publication, Philadelphia, pp: 254-263.

Shanta, I.S., N. Begum, A. Anisuzzaman, S.M. Bari and M.J. Karim, 2006. Prevalence and clinico-pathological effects of ectoparasites in backyard poultry. Bangladesh J. Vet. Med., 4: 19-26.

Wall, R. and D. Shearer, 1997. Veterinary Entomology. 1st Edn., Chapman and Hall, London, pp: 43-95.

Wall, R., 2007. Ectoparasites: Future challenges in a changing world. Vet. Parasitol., 148: 62-74.