IJASVM

International Journal of Agricultural Sciences and Veterinary Medicine

ISSN : 2320-3730
Vol. 3, No. 2, May 2015

www.ijasvm.com

E-Mail: editorijasvm@gmail.com or editor@ijasvm.com

International Journal of Agricultural Sciences and Veterinary Medicine

ISSN 2320-3730 www.ijasvm.com
Vol. 3, No. 2, May 2015

Research Paper

A DIAGNOSTIC SURVEY OF EXTERNAL PARASITES OF FREE-RANGE CHICKENS, IN THE RURAL AREAS OF EASTERN CAPE, SOUTH AFRICA

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External parasites are regarded as the basic causes of retardation in growth, poor conditions and lowered production in free-range chickens. However, information is lacking on the occurrence of external parasites of free-range chickens in the rural areas of the Eastern Cape, South Africa. A study was conducted to determine the occurrence and identity of external parasites in free-range chickens. Fifty chickens were randomly selected and examined for external parasites. The majority (96%) of chickens examined, harboured at least one species of external parasite; Fleas (*Echidnophaga gallinacea*) (50.7%); lice *Menopon gallinae* (12.4%); *Menacanthus stramineus* (5.3%) and *Knemidocoptes mutans* (0.57%). Age, sex and physiological status of the chickens influenced the burden of E gallinacea. Cocks, broody hens and hens had a significantly ($P < 0.05$) higher loads of external parasites than chicks. Different types of external parasites were found to be present in free-range chickens in the study area.

Keywords: Free-range chickens, External parasites, Infestation, Occurrence

INTRODUCTION

Almost every household in rural areas of South Africa keeps free range chickens mainly for food security, socio-economic, religious and cultural aspects (Swatson *et al.*, 2001; and Mwale and Masika, 2009). However their rearing system differs, depending upon the prevailing agro ecosystem and the resources available (Kumaresan *et al.*, 2008). Free-range chicken production systems are run by farmers implementing their local knowledge of breeding, feeding and health practices (Abdelqader *et al.*, 2007; and Nyoni and Masika, 2012). Under this system the free-range chickens have good

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adaptation to harsh environmental conditions. Low-input low-output production system for free-range chickens conforms well to the socio-economic conditions of rural farmers. However inappropriate housing and lack of appreciable pest control efforts also reduce chicken productivity because of parasitic infestation (Mungube *et al.*, 2006).

Like other domestic livestock species, free range chickens (*Gallus gallus*) also suffer from serious health and productivity consequences when infested by external parasites (Mungube *et al.*, 2008). They are at constant risk of infestation by external parasites, mainly lice, mites (feather, body and leg mites), and soft ticks, which is attributed to their feeding habit, because they scavenge and forage for feed to meet their nutritional requirements (Poulsen *et al.*, 2000; Permin *et al.*, 2002; Mungube *et al.*, 2006; and Nyoni and Masika, 2012) hence exposing themselves to parasites infestations. External parasites affect the chickens by causing irritation, loss of weight, skin lesions that may be site of secondary infection, sucking blood, hence leading to anemia and death at times (Mullen and Durden, 2002). Irritation results in chickens concentrating at scratching their bodies at the expense of feeding (Permin *et al.*, 2002) hence they do not perform as expected. Lice cause multi-focal skin lesions on the affected birds and leg-scale mites cause inflammation with exudates and subsequently keratinization of the legs (Permin and Hansen, 1998; Njunga, 2003; and Prelezov and Kolnarski, 2006). In addition, external parasites act as mechanical or biological vectors transmitting a number of pathogens (Salam *et al.*, 2009). Fleas are a vector of bacterioses (*Bartonella* spp., *rickettsiosis*) and the intermediate host for filarid and cestode parasites and viroses (Merck Veterinary Manual, 2006).

The occurrence and intensity of parasitic infestations may be influenced by a number of epidemiological factors including host, sex, age, breed and environment (Nadeem *et al.*, 2007). There is a lack of information on the occurrence of external parasites of free-range chickens in rural areas of the Eastern Cape, South Africa. Hence the present study was conducted to examine the occurrence of external parasites in free-range chickens and to determine the most prevalent parasite which would inform subsequent experiments.

MATERIALS AND METHODS

Study Site

This study was conducted at Amatola Basin, in Amathole District of the Eastern Cape Province of South Africa. Three villages out of 13 in the Basin were randomly selected. The villages lie at an altitude of 1 807 m above sea level and within 32° 31'00''S, 26° 57'00''E on the eastern slopes of the Amatola mountain range (Bembridge et al. 1982). The summer minimum temperatures range from 19 ºC and a maximum range is 31 °C. In winter, the average minimum temperature is 7 °C while the maximum temperature is 21 °C. The area receives an average annual rainfall of 580-800 mm (ISCW, 2008).

Data Collection

Amatola Basin was stratified into villages, from which Komkhulu, Ndlovhura and Zixinene villages were randomly selected. Subsequently snowball sampling technique was used to select 7, 11 and 12 households with chickens respectively. Meetings were held with the selected farmers to explain details and implications of the study. Chickens were given feed either out in the open or in their shelter depending on whether the chickens were housed or not, so that they could

be easily caught and examined for the presence of external parasites. Fifty chickens comprised of 12% cocks, 26% hens, 24% broody hens and 38% chicks, non-descript breed, belonging to different age groups were examined for external parasites. A whole body inspection was done and all external parasites seen were collected and put into labeled bottles containing 70% ethanol to preserve the parasites. Further identification was done with the aid of a dissecting microscope (Kyowa optical model 5DZ-PL-Italy), using keys by Wall and Shearer (2001) and Walker *et al.* (2003).

Data Analysis

Data collected were analyzed using GLM procedures of Statistics Analysis Systems (SAS, 2003) comparison of means was performed using the PDIFF procedure of (SAS, 2003).

RESULTS

Of the fifty chickens examined for external parasites (96%) were infested with one or more species of external parasites and 4% were not infested at all. Of all the parasites collected 80% came from households with poor housing for chickens and those who keep dogs and cats and 20% came from neither of the above. It was observed that of the 30 households which participated in the study 70% shared accommodation with chickens whereby chickens are kept in the kitchens overnight and released the following morning. The occurrence of various chicken external parasites found in the different predilection sites is summarized in (Table 1). Most of the fleas attach on sites without or less feathers. A total of 1 211 external parasites were collected from the chickens. There were four species of lice (*M. gallinae. M. stramineus*, *Gonoides gigas* and *Gonoicotes gallinae*, two of mites (*Dermannyssus gallinae*, *K. mutans*), one tick species (*Rhipicephalus sanguines*) and one flea species (*E. gallinacea*). Echidnophaga gallinacea had a significantly higher ($P > 0.05$) occurrence in old chickens than in young ones. The occurrence of *Knemidocoptes* mutans was insignificant ($P < 0.05$) compared to other parasites, and it mostly infested adult chickens. The mean load of external parasites varied significantly ($P > 0.05$) with chicken classes (Table 2).

DISCUSSION

The study revealed that external parasites occur among free-range chickens in the study area. Almost all the chickens were found to harbor more than one type of external parasites. This

Table 1: External Parasite of Chickens with their Location and Occurrence

External Parasite Species	Location	% Prevalence
Echidnophaga gallinacean	Comb, wattles, eyelids and around ears	50.7
Menopon gallinae	Thigh, breast and areas near cloaca	12.2
Dermannysus gallinae	Entire body	10.1
Rhipicephalus sanguineus	Breast and around ears	8.3
Gonoides gigas	Thigh, breast and areas near cloaca	6.5
Gonoicotes gallinae	Base of feathers	6.1
Menacathus stramineus	Thigh, breast and areas near cloaca	5.3
Knemidocoptes mutans	Lower limbs	0.57

Table 2: Mean Load of Various External Parasites Species on Naturally Infested Free-Range Chicken Classes

Class	*E. gallinacea*	*M. gallinae*	*G. gallinae*	*G. gigas*	*M. stramineus*	*D. gallinae*	*R. sanguines*	*K. mutans*
Chicks	4.39±1.96^{c}	1.86±0.71^{c}	0.31±0.55^{c}	0.53±0.29^{d}	0.39±0.71^{b}	0.78±1.20^{c}	0.42±1.12^{d}	0.00±0.13^{d}
Hens	16.31±2.49^{a}	4.86±0.91^{a}	2.36±0.70^{a}	1.72±0.37^{b}	1.94±0.90^{a}	2.22±1.12^{b}	1.41±1.42^{c}	0.63±0.12^{b}
Broody hens	15.58±1.88^{a}	2.64±1.18^{b}	1.05±0.53^{b}	1.23±0.28^{c}	1.22±0.68^{a}	6.03±1.48^{a}	3.89±1.07^{b}	0.33±0.16^{c}
Cocks	9.33±2.94^{b}	4.17±1.07^{a}	2.00±0.83^{a}	3.50±0.43^{a}	1.83±1.10^{a}	0.50±1.74^{c}	8.83±1.67^{a}	1.00±0.19^{a}

Note: ^{a,b,c,d} Means within a column with different superscript letters differ significantly

observation is in accordance with other workers (Prevezov and Koinarski 2006; and Sychra *et al.*, 2008). The external parasites identified included fleas, lice, ticks and mites. The findings are in agreement with Ashenafi and Eshetu (2005). However fleas were the most common in this study which concurs with Mungube *et al.* (2008) who also reported fleas to be most common on free-range chickens in Kenya. However, the results are in contrast with results of Ashenafi and Eshetu (2005) who recorded lice to be the most common. Beside climatic condition, these investigators did their work in different ecological locations where differences in breed and general husbandry practices would account for the difference in findings. Echidnophaga gallinacea had a significantly higher occurrence in old chickens than in young ones. The frequency of *E. gallinacea* (50.7%) was comparable with the findings of Mungube *et al.* (2008) who recorded occurrence of 56.7% in a study conducted in Kenya. Also a study conducted in Zimbabwe (Permin *et al.*, 2002) reported high prevalence of *E. gallinacea* 72% in adult chickens and 74% in chicks. While in India quite a low prevalence of (6.7%) was reported (Rani *et al.*, 2008). 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 (Magwisha *et al.*, 2002). In addition, longer period of study might show the prevalence pattern of the parasites compared to the shorter one. The bigger sample sizes depict true reflection of what is on the ground compared to smaller sample sizes, hence the variation encountered.

In this study households with dogs and cats reported many cases of fleas in chickens. This is attributed to the fact that fleas also attack dogs and cats (Soulsby, 1982; and Mungube *et al.*, 2006). Fleas can move from one livestock to another when the environment is not conducive for their survival. In the rural set up dogs and cats are rarely dipped and this provides a breeding place for these

The predilection sites of external parasites vary with animal species. Fleas were attached to the combs, wattles, and around the eyes of the chickens. This finding is in agreement with Soulsby (1982). The predilection sites are soft tissues and where there is less feather coverage. This is why naked-neck chickens are very susceptible to flea infestation (Shanta *et al.*, 2006).

The study also revealed the occurrence of four species of lice, a result similar to those reported by Chaddha *et al.* (2005) who also identified *M. gallinae. M. stramineus, G. gigas* and *G. gallinae*. However, Mukaratiwa and Khumalo (2012) reported five spices, which

included Lipeurus caponis. Most of these lice species are cosmopolitan and apparently highly adaptive to various geographical regions and climatic conditions (Njunga, 2003; and Prelezov and Kolnarski, 2006). In addition, external parasites can cohabit without causing any harmful effect on each other (Adang *et al.*, 2008). It also suggests that the prevailing environmental conditions and free-range management system are favourable to their simultaneous development. Menopon gallinae was the most dominant as has been reported previously by several workers (Saxena *et al.*, 2004; Ashenafi and Ashetu, 2005; Prelezov and Koinarski, 2006; and Mukaratiwa and Khumalo, 2012). There was no significant difference in the *M. gallinae* load on cocks and hens. This is a similar observation as that of Senlik *et al.* (2005). Sex related physiology may not confer any differences in infestations. The study revealed the presence of *G. gigas* in free-range chickens. Similar findings had been reported by Permin *et al.* (2002), Sadiq *et al.* (2004) and Sychra *et al.* (2008). This could be due to that they are primarily found in tropic and subtropic climate (Gabaj *et al.*, 1993). The high prevalence of lice in this study could be attributed to warm temperatures that are found at Amatola which provide conducive environment for their multiplication.

The mite *D. gallinae* exhibited high occurrence and infested mainly broody hens. Broody hens have high prolactin levels which depress the immune system of the chicken to resist parasite infestation (Shanta *et al.*, 2006). The farmers in this study reported that *D. gallinae* coupled with high temperatures is responsible for egg abandonment by the broody hens as also previously reported by Mungube *et al.* (2008). This adversely affects hatchability as the broody hens would leave the eggs. Dermanyssus gallinae is most prevalent in summer and the conditions will be favorable for its growth and multiplication (Mungube *et al.*, 2008). The study also revealed that *D. gallinae* parasitizes humans, this concurs with (Mungube *et al.*, 2008) especially where they share accommodation with chickens. However, in such instances farmers are quick to intervene in the control of the external parasites because they are also affected

In this current study the mite, *K. mutans* had the least prevalence and this concurs with the findings of Shanta *et al.* (2006) who also recorded *K. mutans* being the least indentified parasite. Knemidocoptes mutans was mostly found in adult chickens and the findings are in agreement with (Permin *et al.*, 2002; Arends, 2003; and Shanta *et al.*, 2006). This could be attributed to genetic factors. Morishita *et al.* (2005) reported that a genetic predisposition to knemidocoptes infections has been suggested, based on the observations that only a few chickens in a flock become infected.

Rhipicephalus sanguines ticks, the dog tick, were one of the external parasites infesting chickens. The presences of *R. sanguines* which mainly infests dogs may be attributed to chickens scavenging through a wider area that exposes them to the source of infestation. Free range chickens scavenge for food in grassy areas where the ticks mostly stay searching for the host. Also this type of tick attacks any warm blooded animal (Jacobs *et al.*, 2001). Controlling of ticks by dipping of dogs could probably reduce the incidence of tick infestation in free range chickens.

The infestation levels of the cocks were significantly different from the hens. High

infestation levels of external parasites in cocks and broody hens revealed in this study agrees with findings by Okursoy and Yilmaz (2002). This could be attributed to the fact that that the male sex hormone testosterone makes the chicken more susceptible to parasitic infestation and mean parasitic burden is high in cocks (Shanta *et al.*, 2006). Furthermore, broody hens have increased levels of prolactin which depresses the body immune system (Jiang *et al.*, 2005) and this probably explains why they were severely infested. On the other hand, broody hens usually spend most of their time incubating and less time is devoted to grooming, preening, parching and rocking. This could have contributed to the high levels of external parasite infestations. In addition adult chickens scavenge through a wider area of the farmers' homesteads and beyond that makes them more exposed to the source of infestation (Permin *et al.*, 2002; and Shanta *et al.*, 2006). As a result, they have a diversity of parasites (Abebe *et al.*, 1997) than chicks which are sometimes confined.

The study revealed the presence of fleas, lice, mites and tick in the study area. Most of the free range chickens examined had some external parasites of some kind. This showed that external parasites occur among free-range chickens in the study area. The findings confirm farmers' perceptions that external parasites of chickens occur in their flocks and are one of the major challenges to chicken production in rural areas.

ACKNOWLEDGMENT

The authors are very grateful to the Govan Mbeki Research and Development Centre for funding the study and to the farmers of Amatola Basin for their willingness to participate in the study.

REFERENCES

1. Abdelqader A, Wollny C B A and Gauly M (2007), "Characteristics of Local Chicken Production Systems and their Potential Under Different Levels of Management Practice in Jordan", *Tropical Animal Health and Production*, Vol. 39, pp. 155-164.
2. Abebe W, Asfaw T, Genetes B and Dorchics P H (1997), "Comparative Studies of the External Parasites and Gastrointestinal Helminthes of Chickens Kept Under Different Management System in and Around Addis Ababa, Ethiopia", *Review on Medical and Veterinary*, Vol. 148, pp. 497-500.
3. Adang K L, Oniye S J, Ezealor A U, Abdu P A and Ajanusi O J (2008), "Ectoparasites of Domestic Pigeon (*Columba livia domestica*, *Linnaeus*) in Zaria, Nigeria", *Research Journal of Parasitology*, Vol. 3, No. 2, pp. 9-84.
4. Arends J J (2003), "External Parasites and Poultry Pests", in Saf Y M, Barns H J, Glisson J R *et al.* (Eds.), *Diseases of Poultry*, p. 923, Iowa State University Press, Ames, IA.
5. Ashenafi H and Eshetu Y (2005), "Ectoparasites of Local Scavenging Chickens of Central Ethiopia", *Ethiopian Journal of Science*, Vol. 28, No. 1, pp. 69-76.
6. Bembridge T J, Steyn G J and Tuswa N (1982), "Present Land Use: Field Crops in Amatola Basin", Report No 7/81 Ardri, University of Fort Hare, Alice.
7. Chaddha D, Agnihotri R K and Katoch R (2005), "Incidence of Ectoparasites in Poultry in Polam Valley of Himachal Pradesh", *Journal of Veterinary Parasitology*, Vol. 19, No. 1, pp. 57-61.

8. Gabaj M M, Beesley W N and Awan M A O (1993), "Lice of Farm Animals in Libya", *Medical and Veterinary Entomology*, Vol. 7, pp. 138-140.

9. Institute for Soil Climate and Water (ISCW) (2008), Agromet Section 079/221 L.A, Climate Annual and Monthly Totals and Averages, Pretoria.

10. Jacobs P A H, Fourie L J, Kok D J and Horak I G (2001), "Diversity Seasonality and Sites of Attachment of Adult Ixodide Ticks on Dogs in the Central Region of Free State Province South Africa", *Onderstepoort Journal of Veterinary Research*, Vol. 68, pp. 281-290.

11. Jiang R S, Xu G Y, Zhang X Q and Yang N (2005), "Association of Polymorphisms for Prolactin and Prolactin Receptors Genes with Broody Traits in Chickens", *Journal of Poultry Science*, Vol. 84, pp. 839-845.

12. Kumaresan A, Bujarbaruah K M, Pathak K A, Chhetri B and Haunshi A S (2008), "Analysis of a Village Chicken Production System and Production Performance of Improved Dual Purpose Chickens Under a Subtropical Hill Agro-Ecosystem in India", *Tropical Animal Health Production*, Vol. 40, pp. 395-402.

13. Magwisha H B, Kassuku A A, Kyvsgaard N C and Permin A (2002), "A Comparison of the Prevalence and Burden of Helminth Infections in Grower and Adult Free-Range Chickens", *Tropical Animal Health and Production*, Vol. 34, pp. 205-214.

14. Merck Veterinary Manual (2006), Merck and Company, Incl. Whitehouse Station, NJ, http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/71600.htm, Downloaded 12/09/09.

15. Morishita T Y, Johnson G, Johnson G, Thilsted J, Promsoponen B and Newcomer C (2005), "Scaly Leg Mite Infestation Associated with Digit Necrosis in Bantam Chickens (*Gallus domesticus*)", *Journal of Avian Medicine and Surgery*, Vol. 19, No. 3, pp. 230-233.

16. Mukaratiwa S and Khumalo M P (2012), "Prevalence of Chewing Lice in Free-Range Chickens from Selected Rural Localities of Kwazulu-Natal, South Africa", *International Journal of Applied Research Veterinary Medicine*, Vol. 10, No. 1.

17. Mullen G R and Durden L A (2002), *Medical and Veterinary Entomology*, Academic Press, London.

18. Mungube E O, Baun S M, Tenhagen B A, Wamae L W, Nzioka S M, Muhammed L and Nginyi J M (2008), "Prevalence of Parasites of the Local Scavenging Chickens in a Selected Semi-Arid Zone of Eastern Kenya", *Tropical Animal Health and Production*, Vol. 40, pp. 101-109.

19. Mungube E O, Bauni S M, Muhammed L, Okwach E W, Nginyi J M and Mutuoki T K (2006), "A Survey of the Constraints Affecting the Productivity of the Local Scavenging Chickens in the Kionyweni Cluster, Machakos District", Kari Katumani, Annual Report.

20. Mwale M and Masika P J (2009), "Ethno-Veterinary Control of Parasites, Management and Role of Village Chickens in Rural Households of Centane District in the Eastern Cape, South Africa", *Tropical Animal Health and Production*, Vol. 41, pp. 1685-1693.

21. Nadeem M, Khan M N, Iqbal Z, Sajid M S, Arshard M and Yaseen M (2007),

"Determinants Influencing Prevalence of Louse Infestations of Layers of District Faisalabad (Pakistan)", *British Poultry of Science*, Vol. 485, pp. 546-550.

22. Njunga G R (2003), "Ecto- and Haemoparasites of Chickens in Malawi with Emphasis on the Effects of the Chickens Louse, Menacanthus Cornutus", MSc Thesis, Royal Veterinary and Agriculture University, Copenhagen, Denmark.

23. Nyoni N M B and Masika P J (2012), "Village Chicken Production Practices in the Amatola Basin of the Eastern Cape Province, South Africa", *African Journal of Agricultural Research*, Vol. 17, pp. 2647-2652.

24. Okursoy S and Yilmaz F (2002), "Prevalence of Species of Lice Chickens in the Province of Bursa", *Turkish Society for Parasitology*, Vol. 26, pp. 71-75.

25. Permin A and Hansen J (1998), "The Epidiomelogy, Diagnosis and Control of Poultry Parasites", FAO, Rome, Italy.

26. Permin A, Esmann J B, Hoj C H, Hove T and Mukaratirwa S (2002), "Ecto-, Endo-and Haemoparasites in the Free-Range Chickens in the Goromonzi District in Zimbabwe, Preventative Veterinary", *Medicine*, Vol. 54, No. 3, pp. 213-224.

27. Poulsen J, Permin A, Hindsbo O, Yelifari L, Nansen P and Bloch P (2000), "Prevalence and Distribution of Gastro-Intestinal Heliminths and Haemoeparasites in Young Scavenging Chickens in Upper Eastern Region of Ghana, West Africa, Preventative Veterinary", *Medicine*, Vol. 45, pp. 237-243.

28. Prelezov P N and Koinarski K T (2006), "Species Variety and Population Structure of Mallophaga (*Insecta: phthiraptera*) on Chickens in the Region of Stara Zagora", *Bulgarian Journal of Veterinary Medicine*, Vol. 9, No. 3, pp. 193-200.

29. Rani N, Lalitha J and Abdul B S (2008), "Prevalence of Ectoparasites of Chickens Reared Under Different Systems of Management", *Journal of Veterinary Parasitology*, Vol. 22, No. 2, pp. 57-61.

30. Sadiq N A, Adejinmi J O, Adedokun O A, Fashanu S O, Alimi A A and Sofunmade Y T (2004), "Ectoparasites and Haemoparasites of Indigenous Chickens (*Gallus domesticus*) in Ibadan and Environs", *Tropical Veterinary*, Vol. 21, No. 4, pp. 187-191.

31. Salam S T, Mir M S and Khan A R (2009), "Prevalence and Seasonal Variation of Ectoparasites Load in Free-Range Chickens of Kashmir Valley", Tropical Animal Health and Production, Doi 10.1007/s11250-009-9324-9.

32. Saxena A K, Kumar S, Gupta N and Sing S K (2004), "Prevalence of Lice (*Phthiraptera amblycera*) on Fowls of Uttar Pradesh", *Journal of Parasitic Disease*, Vol. 28, pp. 57-60.

33. Senlik B, Gulegen E and Akyol V (2005), "Ectoparasite of Domestic Pigeons (C.I. *domestica*) in Bursa Province", *Turkiye Parazitoloji Dergisi*, Vol. 29, No. 2, pp. 100-102.

34. Shanta I S, Begum N, Anisuzzama A S, Bari M and Karim M J (2006), "Prevalence and Clinico-Pathological Effects of Ectoparasites in the Backyard Poultry", *Bangladesh Journal of Veterinary Medicine*, Vol. 4, No. 1, pp. 19-26.

35. Soulsby E J L (1982), *Helminths, Arthropods and Protozoal of Domesticated Animals*, Bailliere Tindall, London, UK.

36. Statistical Analysis Systems Institute (2003), "SAS User's Guide: Statistics", Version 6, SAS Institute Inc., Cary, NC, USA.

37. Swatson H K, Nsahlai I V and Byebwa B K (2001), "The Status of the Smallholder Poultry Production in the Alfred District of KwaZulu Natal, South Africa: Priorities for Intervention, Livestock Community and Environment", Proceedings of the 10th Conference of the Association of Institutions for Tropical Veterinary Medicine, pp. 143-149, Copenhagen, Denmark.

38. Sychra O, Harmat P and Literak I (2008), "Chewing Lice (*Phthiraptera*) on Chickens (*Gallus gallus*) from Smallyard Flocks in the Eastern Part of the Czech Republic", *Veterinary of Parasitology*, Vol. 152, Nos. 3-4, pp. 344-348.

39. Urquhart G M, Armour J, Duncan J L, Dunn A M and Jennings F W (1996), *Veterinary Parasitilogy*, 2nd Edition, Backwell Science Ltd., London.

40. Wall R and Shearer D (2001), *Veterinary Ectoparasites: Biology, Pathology and Control*, 2nd Edition, Blackwell Science.

41. Walker A R, Bouattour A, Camicas J L, Estrand-Perna A, Horak I J, Latif A A, Pegram R G and Preston P M (2003), *Ticks and Domestic Animal in Africa: A Guide to Identification of Species*, 1st Edition, Bioscience Report Publication, Scotland, Edinburgh, UK.

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