Research Internship Veterinary Medicine

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Title **Prevalence of ectoparasites on chickens (*Gallus gallus domesticus*) in the Mnisi Area of Mpumalanga Province, South Africa.**

Abstract

Chickens from 13 villages in the Mnisi area are thoroughly examined over a period of four weeks to detect the presence of ectoparasites. Ectoparasite collection indicated that chickens in 92% of the households are infected with ectoparasites. One species of the order Siphonaptera (fleas), six species of the order Phtiraptera (lice) and three species of the order Acarina (ticks and mites) are recorded. Among all ectoparasites found, fleas were the most prevalent. Fleas isolated in 100% of the villages were only sticktight fleas (*Echidnophaga gallinae*). Lice were isolated in 85% of the villages investigated. *Menopon gallinae* is found in 77% of all investigated villages and thereby most abundant. Followed by *Gallacanthus cornutus* (38%), *Goniocotes gallina*e (31%), *Lipeurus caponis* (23%) and finally *Stenocrotaphus gigas* and *Eomenacanthus stramineus*, both occurring in 15% of the villages investigated. From the order Acarina, two tick and one mite species are found. The tick species, found in 85% of the villages, are *Amblyomma hebraeum* and *Haemaphysalis elliptica* (from both tick species only immature stadia are recorded). The mite species found in 6% of all investigated household is *Ornithonyssus bursa*. The purpose of this study is to examine and identify the currently occuring ectoparasites on chickens in rural villages in the Mnisi area.

1. Introduction

Poultry plays an important role in improving the nutritional status and income of many small farmers and those with small land holdings. Besides the nutritional and economic roles, poultry also plays a role in traditional religious customs.(1)

By living on the host, ectoparasites can cause (especially when in large numbers) several disorders. In poultry, ectoparasites are considered as a common cause of growth retardation, lowered vitality and poor body conditions.(2) Weight loss at the rate of 711 gram per chicken and a reduced egg productivity at the rate of approximately 66 eggs per chicken per year is observed, caused by ectoparasites.(3) The ectoparasites can instantly influence health and welfare by causing irritation, discomfort, tissue damage, blood loss, toxicosis, allergic reactions and dermatitis. These consequences can all lead to reduced quality and quantity of meat and egg production.(2)

Aside from these consequences, many ectoparasites are known to be vectors of several pathogenic agents, which are typically transmitted by the parasites to the hosts while feeding or (occasionally) defaecating. This may lead to serious diseases in various animals, including humans.(4,5)

The Mnisi area in the Mpumalanga province of South Africa has many villages where Shangaan people still live traditional lifestyles. There are several domestic animals such as cattle, donkeys, goats, dogs and chickens. The chickens (*Gallus gallus domesticus*) are mostly free-ranging and sometimes provided with night sheds made from local materials such as wire mesh and old corrugated iron. In some cases housing is not provided and the birds sleep on trees or roof tops. There is no documented information on prevalence of ectoparasites in poultry in the Mnisi area. In South Africa little has been done on ectoparasites affecting free-range chickens, hence it is imperative to determine the prevalence of several ectoparasites, that possible also are dangerous to man.

The aim of this study is therefore to examine and identify the currently occuring ectoparasites on chickens in rural villages in the Mnisi area. A questionnaire survey is conducted with the primary purpose of determining the prevalence and control of ectoparasites.

2. Materials and methods

2.1 Study area

Samples are collected from 49 households in 13 villages in the Mnisi area, province Mpumalanga, South Africa. Appendix 2 shows a map of the Mnisi area. The Mnisi community is located in the north-eastern part of the Bushbuckridge Municipality and covers about 29.500 hectare. The study area counts about 40.000 residents, divided in 8555 households of which many possess chickens.

2.2 Study animals

The research includes chickens (*Gallus gallus domesticus*) from different age groups and of either sex.

2.3 Parasitological examinations

A thorough examination of the chickens is performed for screening for ectoparasites. Several regions of the body are examined, including the head, the legs, the wings, the body and the cloaca. Detected ticks, fleas, lice and mites will be removed with a thumb forceps or a brush and dehydrated in 70% ethanol. Aside from the poultry, also the cracks and crevices within the sleeping area of the poultry will be investigated to ensure that parasites with nocturnal activities are also identified.

When heavy infestations of lice or mites are noticed in chicken sheds or nests, the ectoparasites are aspirated using a hand held vacuum cleaner. The parasites are then transferred in 70% ethanol.

2.4 Identification of ectoparasites

To determine the different louse, flea and mite species, the specimens are mounted on a microscope slide. For determining the tick species, mounting is not necessary.

2.5 Preparation of mites

For preparation of mites, the specimens are placed (after being conserved in 70% ethanol) in a small container. The specimens are cleared by placing a drop of lactic acid on a depression slide and transferring the mites to the acid with a forceps or artist's paintbrush. The mites are carefully heated over a flame, by moving the slide in and out of the flame. The mites must be continually checked under a stereomicroscope to see if they are cleared. When the mites are cleared they are ready to be mounted. A drop of Heinze's PVA medium is placed in the middle of the glass slide and the mite is transferred to the middle of the drop. A cover slip is placed

on the edge of the drop, touching the medium and gently lowering onto the specimen.

2.6 Preparation of fleas and lice

For identification of flea and louse species, the specimens first need to be mounted on a microscope slide. Therefore, the specimens that are conserved in 70% ethanol are now transferred in a 10% potassium hydroxide solution for clearing. When the specimens sink in the potassium 10% hydroxide solution, the abdomen can be pierced with a fine needle, to allow the potassium hydroxide to enter. The fleas now have to stay in the potassium hydroxide for 24 hours, while the lice remain in the potassium hydroxide for 16 hours. If the body contents are softened, pressure should be exerted on the abdomen with another suitably bent pin. The guts should now flow through the hole in the abdomen. This can be repeated several times until no opaque matter remains inside the body. After removing the body contents, the specimens are rinsed in distilled water and placed in 10% acetic acid for 15 minutes to neutralize the alkaline potassium hydroxide. The specimens are then passed through 40%, 80%, 95% and two changes of absolute alcohol (15 minutes in each different solution).(7)

After this preparation, the specimens can be preserved on a microscope slide. For preserving specimens for microscopic examination, several types of mounting media are in vogue.(8) In this study, used mounting media are:

2.6.1 Canada balsam

After two changes of absolute alcohol, the specimens are placed into clove oil overnight. The next day, the specimens are transferred in an small drop of Canada balsam on a microscope slide. Because the Canada balsam needs to dry to fixate the specimen, the microscope slide is placed in a horizontal position in a dust-free place to overnight. The next day another drop Canada balsam is placed on the specimen. A cover slip can be placed on the microscope slide.(7)

2.6.2 Entellan

Entellan is a water-free mounting medium. Because it contains toluene, it should be used with water-free specimens that have been processed with xylene previous mounting.(9) After being in two changes of xylene for 15 minutes the specimens can be placed in a drop Entellan on a microscope slide. A cover slip can be placed.

2.6.3 Euparal

A significant advantage of Euparal is that, in comparison to other mounting media, specimens can be directly transferred from alcohol in to Euparal. The cover slip can directly be placed on the microscope slide.(10)

2.7 Identification

After being mounted on a microscope slide, the fleas, lice and mites are ready for identification. Species determination is based on microscopic examination to study the morphological characteristics. Using an identification guide by Walker (1994) and the works of Emerson (1956), de Meillon (1961), Ledger (1980) and Walker (2013) the different species of ectoparasites are determined.(7,11-14)

2.8 Questionnaire

Questionnaires (appendix 1) are completed by the persons directly responsible for the management of the chickens after the chickens are being examined. By means of this questionnaire it will be charted whether ectoparasites are noticed and what methods the households in the Mnisi area (Mpumalanga) currently use to prevent ectoparasites infestations. Also information regarding the type of housing, feeding and occurring of sick/dying chickens is recorded.

3. Results

Ectoparasite collection indicated that 92% of the households visited are infected with ectoparasites (table 1). One species from the order Siphonaptera (fleas), six species from the order Phtiraptera (lice) and three species from the order Acarina (ticks and mites) are recorded.

Among all ectoparasites found, fleas were the most prevalent. Fleas isolated in 100% of the villages were only sticktight fleas (*Echidnophaga gallinae*). The six louse species are isolated in 85% of the villages investigated. The tick species are *Amblyomma hebraeum* (found in 85% of the investigated villages) and *Haemaphysalis elliptica* (found only in Shorty village). Only immature stadia of both tick species are recorded. The recorded mite species is *Ornithonyssus bursa.*

Table 1 Ectoparasites isolated from chickens in 13 villages in the Mnisi area

	Fleas	Lice	Ticks	Mites
Athol	P	N	P	N
Clare A	P	P	N	N
Dixie	P	P	P	N
Gottenburg	P	P	N	N
Hlala Kahle	P	P	P	N
Hluvukani	P	P	P	N
Ludlow	P	P	P	P
Seville	P	P	P	N
Share	P	N	P	N
Shorty	P	P	P	P
Thlavekisa	P	P	P	N
Utah	P	P	P	N
Welverdiend	P	P	P	P

P = present; N = not found

3.1 Fleas

In the Mnisi area, fleas are present on chickens in all investigated villages. There are five flea families known to occur on chickens i.e. Ceratophyllidae, Leptopsyllidae, Pulicidae, Pygiopyllidae and Rhopalopsyllidae.(15) *Echidnophaga gallinacea*, from the family Pulicidae, is the only species found in the Mnisi area.

In the Mnisi area, infestation per chicken ranged from one to thousands of fleas. *Echidnophaga gallinacea* has a predilection to attach to bare spots on the skin.(16) In chickens, it mostly feeds on the comb and the wattle.(17) In this research, all of the *Echidnophaga gallinacea* fleas are found on the head and the neck. Most of the fleas were attached to the comb, the wattle, the upper eyelids and the chin. Figure 1 shows severe accumulation of thousands of *Echidnophaga gallinacea* on the neck and the chin. Fleas are also found on the upper eyelid, some chickens had difficulties opening the eyes due to swollen upper eyelids.

Figure 1 Heavy infestation with *Echidnophaga gallinacea* on a chicken in Athol village, South Africa

3.2 Lice

Lice are found on chickens in 11 of the 13 investigated villages in the Mnisi area. In South Africa, there are 16 louse species known to occur on chickens.(7) In the Mnisi area, six species are found. *Menopon gallinae* is found in 77% of all investigated villages and thereby most abundant. Followed by *Gallacanthus cornutus* (38%), *Goniocotes gallina*e (31%), *Lipeurus caponis* (23%) and finally *Stenocrotaphus gigas* and *Eomenacanthus stramineus*, both occurring in 15% of the villages investigated (table 2).

Louse infestation per chicken ranged from one to dozens of lice. The lice are mostly found on the ventral part of the chicken body. Figure 2 shows louse infestation on a chicken between the fluffy downy feathers. In the villages Athol and Welverdiend accumulation of lice eggs are found on the base of feather shafts.

Table 2 Presence of lice species in 13 villages in the Mnisi area, South Africa

	Menopon gallinae	*Gallacanthus cornutus*	*Goniocotes gallinae*	*Lipeurus caponis*	*Stenocrotaphus gigas*	*Eomenacanthus stramineus*
Athol	P	P	N	P	N	N
Clare A	N	P	N	N	N	N
Dixie	P	N	P	N	N	N
Gottenburg	N	N	N	N	N	N
Hlala Kahle	P	P	P	N	P	N
Hluvukani	P	N	N	N	N	N
Ludlow	P	N	P	P	P	N
Seville	P	N	N	N	N	N
Share	N	N	N	N	N	N
Shorty	P	N	N	N	N	N
Thlavekisa	P	P	P	N	N	N
Utah	P	N	N	N	N	P
Welverdiend	P	P	N	P	N	P

P = present; N = not found

Figure 2 Lice on feather shafts of chicken in the Mnisi area

3.3 Mites

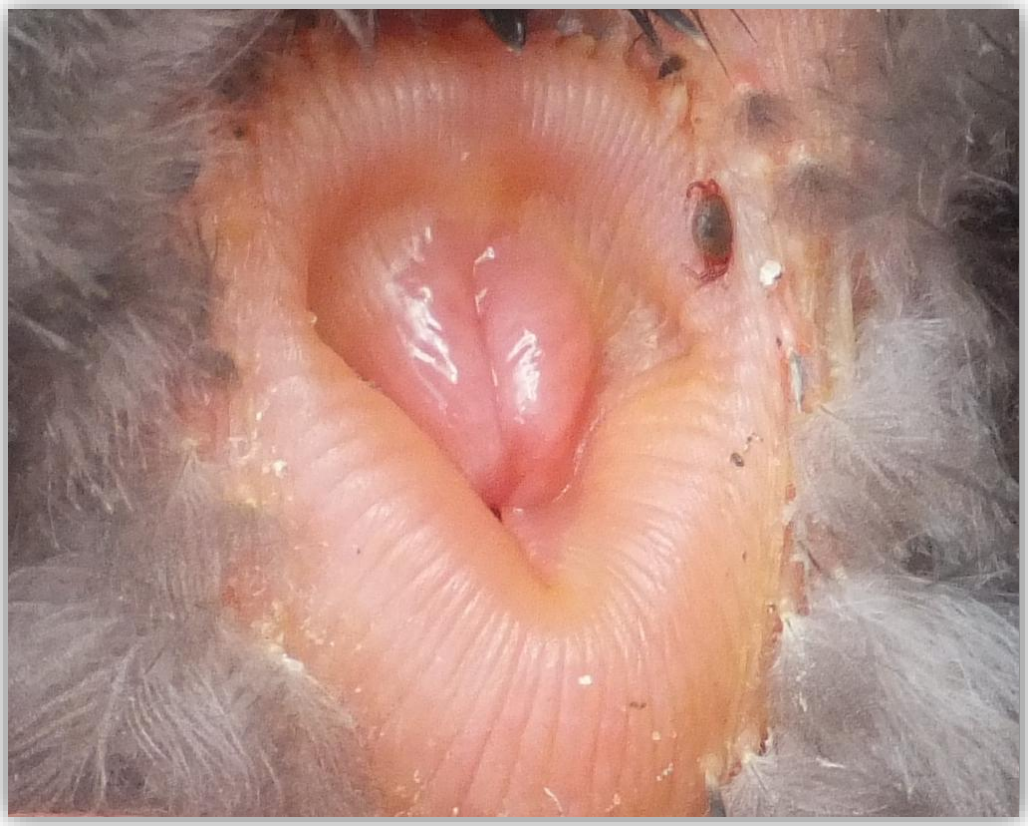
Ornythonyssus bursa, also called the tropical fowl mite, is found on chickens in three households. In one household in Ludlow village there was a heavy mite infestation. Mites are found on the chickens and chicken nests were heavily infestated. During inspection, thousands of mites were visible crawling on the chicken nests.

On chickens, mites prefer the ventral part of the body. They are numerous around the vent and accumulate on a few feathers.(18) This is the region where the mites are found on chickens in the Mnisi area.

3.4 Ticks

Ticks (only immature stadia) are found on chickens in 11 of the 13 villages (85%). No adult ticks were collected and none of the investigated flocks bore any signs of a tick infestation. Infestation per chicken ranged from one to dozens of ticks. The highest amount of ticks in one household is found in Thlavekisa; 183 ticks are found on only six chickens. The two tick species found are *Amblyomma hebraeum* (11 villages) and *Haemaphysalis elliptica* (only found in one household in Shorty village). The ticks are mostly found on the head and the neck (figure 3). One *Amblyomma hebraeum* tick is found in the cloaca of a chicken in Dixie village (figure 4).

Figure 3 Chicken with *Echidnophaga gallinacea* and *Amblyomma hebraeum* infestation on chin and neck in Hluvukani village, South Africa



Figuur 4 *Amblyomma hebraeum* in cloaca in Dixie village, South Africa

4. Discussion

Results show that ectoparasites are common in rural chickens in the Mnisi area. In all of the examined villages, ectoparasties are detected. Due to the fact that most chickens are free-ranging (and thereby hard to catch), it was not always possible to examine a standard amount of chickens per household. In the examined households, ectoparasite collection indicated that 92% of the households is infected with ectoparasites. Data from the questionnaire indicated that 73% of the owners that had been interviewed had noticed ectoparasites on their chickens.

Only 23% of the owners interviewed treat the chickens against ectoparasites. One of the causes of high ectoparasite infestations in the Mnisi area is possibly that chicken owners in rural communities have poor access to conventional drugs because of distance and exorbitant prices. This results in using no or using alternative insecticides for controlling ectoparasites, which is less effective.(19) Besides that, chicken sheds in the Mnisi area are mostly made of old corrugated iron and wire mesh and in the sheds there are plenty of cracks and crevices, what makes effectively cleaning the sheds very difficult. Excessive ectoparasite infestation can be reduced by

cleaning the complete chicken shed with insecticides and thereby killing ectoparasites.(20) In the Mnisi area, every chicken owner that owns a shed, cleans it. 84% of the sheds are cleaned by just removing dirt, without using insecticides. The remaining 16% uses King Kong, Blue Death powder, dip, Jeyes fluid and Karbadust.

4.1 Fleas

As described before, the only flea species found in the Mnisi area is *Echidnophaga gallinae*. Many of the chickens are heavily infested.

Echidnophaga gallinacea, also known as the sticktight flea, infests a wide variety of birds and mammals in tropical and subtropical regions worldwide.(16,21) In those regions it is known as an important ectoparasite in chickens.(21) The occurrence is probably because of relatively poor standards of husbandry and favourable climatic conditions for development of the parasites.(24) *Echidnophaga gallinacea* has previously been recorded in South Africa. In some regions of the country, *Echidnophaga gallinacea* is reported to be the most ordinary flea on dogs, however the fleas are also known to attack chickens and other animals.(22,23)

The fleas have negative effects on their hosts. Chickens mostly have accumulations of *Echidnophaga gallinacea* around the eyes, comb, wattle and other bare spots.(23) The fleas cause irritation and tissue damage.(19) Ulcerations can be caused by both cuts from the mouthparts as well as infections due to subcutaneously laid eggs. The resulting infection, blood loss, or both, can compromise growth and even kill young chickens.(17) Older chickens suffer aneamia, reduced egg production and may also die from a heavy infestation.(21) Besides direct effects from *Echidnophaga gallinacea*, flea infestation is recorded to co-occur with fowl pox (*Avipoxvirus*, type *Fowlpox virus*) in poultry and bubonic plague (*Yersinia pestis*) in burrowing owls (*Athene cunicularia*).(17)

Besides occurring on chickens and other animals, *Echidnophaga gallinacea* is also reported on man.(23,25-27) The flea-borne rickettsiose murine typhus (*Rickettsia typhi*) is a febrile disease distributed among humans worldwide.(28) DNA from *Rickettsia* spp. is previously amplified from *Echidnophaga gallinacea* fleas in Egypt (infection rate 100%).(29) Additional studies, using a large sample of *Echidnophaga gallinacea* from South Africa, are needed to determine the infection rate in South Africa, to determine

if humans or animals are, in fact, exposed to *Rickettsia* spp. and to establish the pathogenicity of the agent.

4.2 Lice

Six different louse species are found in 85% of the investigated villages in the Mnisi area. During examination of the chickens, it was not always possible to collect all lice, because the lice crawl through feathers quickly. The six lice species that are collected all belong to the chewing lice (Phthiraptera: Amblycera, Ischnocera) and are common on domestic chickens worldwide.(12,30) Amblyceran lice are important ectoparasites in chickens. While mostly living on the skin, the lice cause irritation, restlessness, overall weakening, cessation of feeding, loss of weight and reduced egg production. The skin lesions may possibly become sites of secondary infection. *Eomenacanthus stramineus* is one of the most pathogenic species, because of its hematophagous features. It can cause anaemia, heavy multi-focal skin lesions or even death of infested birds.(30)

Menopon gallinae and *Eomenacanthus stramineus* both are known to carry *Pasteurella multocida* in the digestive tract, a pathogen of importance because it is not only pathogenic for chickens, causing the mass epidemics of fowl cholera, but also for man. In man the infection appears mainly as a pleuritis, pneumonia or even encephalitis.(31)

4.3 Mites

Ornithonyssus bursa is found in three households in three different villages. The mite is known to be almost entirely restricted to warm and tropical regions and is previously recorded in South Africa.(18)

The nests and chickens in one household in Ludlow village were heavily infested. In that household, inspection revealed thousands of mites crawling on the chicken nests. The mites are also found on the investigated chickens in that household. It is unknown why this is the only heavily infested household. In the other investigated households in the Ludlow village, there are no mites found and in other villages the infestation was not that severe.

In chickens, *Ornithonyssus bursa* leads to crustae, thickening of the skin and cracks and scabs around the cloaca. The productivity may be decreased. The mites can migrate from chickens to man during handling or move into homes. *Ornithonyssus bursa* can also bite humans.

The bites are irritating and can be mildly to intensely painful. Several lesions can occur after being bitten, some individuals react to the bite with prolonged itching and painful dermatitis. Papules most commonly occur after being bitten. Macules, diffuse erythema, vesicles, urticare and hemorrhagic necrosis may also be seen.(18,32)

Other then the red mite, *Dermanyssus gallinae*, which is thought to transmit diseases by being vector of several pathogenic agents i.e. avian cholera, avian smallpox, equine encephalomyelitis and *Salmonella enteritidis*, *Ornythonyssus bursa* has not been implicated in vectoring diseases.(33) The western equine encephalomyelitis virus has been isolated from *Ornithonyssus bursa* mites, however, there is no evidence that the virus is actually transmitted by the mite.(27)

4.4 Ticks

Species of both soft and hard ticks are known to occur on chickens.(3) In the Mnisi area, only hard ticks are found. The recorded species are *Amblyomma hebraeum* and *Haemaphysalis elliptica.* From both tick species, only immature stages are found. Immature ticks of eight Ixodid tick species are known to occur on birds in South Africa.(34)

The hard tick *Amblyomma hebraeum* is also known as the South African bont tick and only occurs in Southern East Africa. Immature stages feed on several animals and they are also known to feed on ground frequenting birds. It is known that the nymphs and larvae mainly attach on the head and the neck. In the Mpumalanga province, where the Mnisi area is located, the life cycle of *Amblyomma hebraeum* continues throughout the year.(14)

Amblyomma hebraeum is most important for transmission of *Ehrlichia ruminantium*, the causative agent of heartwater in cattle, sheep, goats and wild antilopes. Besides distributing heartwater, *Amblyomma hebraeum* can also cause tick typhus in man by transmitting the bacteria *Rickettsia africae* and *Rickettsia conorii*. In cattle, benign theileriosis can be caused by the same tick transmitting the prozotoan *Theileria mutans*. The long mouthparts can cause sores, which often become infected with bacteria leading to acsessation. Besides infection with bacteria, the blowfly *Chrysomya bezziana*, is attracted by the wounds and the larvae of the fly can cause severe myiasis.(14)

Haemaphysalis elliptica, the southern African yellow dog tick, is found on chickens in one household in the Mnisi

area. The tick is common on domestic dogs in South Africa, especially in rural areas.(35) Immature stages of *Haemaphysalis elliptica* are not yet recorded infesting chickens, though immature stages of other *Haemaphysalis* species are known to occur on other birds in South Africa.(34) *Haemaphysalis elliptica* is the only proven vector of *Babesia canis rossi*, the cause of virulent babesiosis in dogs.(36)

While known to occur on chickens in South Africa, there are no soft ticks found on chickens in the Mnisi area. The soft tick *Argas* spp. is thought to be causing many deaths because of the blood-sucking habit and also acting as a vector of *Aegyptionella* spp. and *Borrelia* spp.. The larvae can cause tick paralysis in chickens.(37,38) *Ornithodorus* spp., another soft tick, also occurs on chickens in Africa. The ticks are nocturnal. Bites from this tick are painful and the ticks are known as the major vector of Relapsing fever in man.(6,39) There are some reasons that soft ticks are not found during this study in the Mnisi area. The nymphs and adults of *Argas* spp. for example, are temporary obligate parasites and only visit chickens when feeding.(37) The sheds, if available, are examined, however, sometimes the sheds were hard to examine due to size and height. *Argas* spp. and *Ornithodorus* spp. could have possibly been found if the parasite is searched for in the chicken sheds at night.(39) Another reason is because, during this research project, it was winter time in the Mnisi area. It could be that the temperature was not optimal for development of the soft ticks. For example, the optimal temperature for development of *Argas* spp. is 22-28°C.(3)

Because chickens in the Mnisi area are commonly heavily infested with ectoparasites and the ectoparasites found on chickens in the Mnisi area are not only negatively affecting chickens but may also affect human health, improving ectoparasite control is recommended. There is need for an enlightenment campaign for chicken owners on the consequences and hazards of ectoparasite infestation. Proper sanitation and the use of certain chemicals in the approved manner also help in the control of ectoparasites. Veterinary assistance to the chicken owners needs to be extended. Further research to access the ectoparasites impact on health and production performance of the chickens in the Mnisi area is suggested, cost effectiveness of control strategies included. Studies on seasonal variation on different ectoparasite species infesting poultry should be carried out to determine

the appropriate time of the year for control strategies.

As noticed before, additional study on *Echidnophaga gallinacea* and its infection with *Rickettsia* spp. is recommended.

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6. Appendices

6.1 Appendix 1: Questionnaire used in the baseline survey of determining the prevalence and control of ectoparasites in the Mnisi area

Date:…… House number:…… Village:……

Amount of chickens examined:……

What poultry do you keep (chickens, ducks, geese)? ……

How many chickens do you have? ……...

What do the chickens eat? ……

Where do they sleep (sheds, on top of trees)? ……

Do you see parasites on your chickens? Yes / No

- What do you see? ……

Do you see sick chickens? Yes / No

- What do you see? ……

Do you see chickens lying on their sides and unable to get up? Yes / No

Do you treat chickens against ectoparasites? Yes / No

- What do you use? ……...
- How often? ……

Do you clean the poultry sheds? Yes / No

- What do you use? …….

- How often? …….

Comments:

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6.2 Appendix 2: Map of the Mnisi area with its villages