

Ecto- and haemoparasites of chickens in Malawi with emphasis on the effects of the chicken louse, Menacanthus cornutus

By

Gilson Robin Njunga^{1,2}

¹Department of Veterinary Microbiology and Network for Smallholder Poultry Development, The Royal Veterinary and Agriculture University, Dyrlægevej 2, 1870 Frederiksberg C., Denmark

and

²Central Veterinary laboratory, P.O. Box 527, Lilongwe, Malawi.

Supervisors:

Dr. Anders Permin, Department of Veterinary Microbiology and Network for Smallholder Poultry Development, The Royal Veterinary and Agriculture University, Dyrlægevej 2, 1870 Frederiksberg C., Denmark.

Dr. Ole Kilpinen. Danish Pest Infestation Laboratory, Skovbrynet 14, 2800 Kgs Lyngby, Denmark.

Dr. W. M. Mfitlodze. Department of Animal Science, University of Malawi, Bunda College of Agriculture, Box 219, Lilongwe, Malawi.

SUMMARY

The purpose of this MSc study was to determine the prevalence of ecto- and haemoparasites of chickens from different production systems in Malawi, and thereafter to conduct a case-control experiment to assess the impact of *Menacanthus cornutus* on Black Australorp chickens. All chickens from the free-range system were infested with ectoparasites and 72% had haemoparasites. Only 8% of the chickens from the commercial system had ectoparasites and none from the semi-commercial harboured any parasites at all. Five lice, one mite, one flea and three haemoparasite species were identified with the following flock prevalences (free-range, % /commercial, %): lice *Menopon gallinae* (77/8), *Menacanthus cornutus* (74/0), *Goniodes gigas* (53/0), *Lipeurus lawrensis tropicalis*, (46/0), and *Goniocotes gallinae* (41/0); flea *Echidnophaga gallinacea* (62/0); mite *Cnemidocoptes mutans* (95/0); and haemoparasite *Plasmodium gallinaceum* (47/0), *Plasmodium juxtannucleare* (9/0), and *Aegyptinella pullorum* (25/0). In general, the level of ecto-and haemoparasite infestation was significantly higher during the dry season and the production system significantly influenced occurrence of all the parasites. Significant interactions occurred across age, season, production system and breed.

The on station study composed of 120 male and female Black Australorp chickens. Half of the chickens were infested with *Menacanthus cornutus*. There was a significant difference in egg production for the first 2.5 months after onset of laying, where the infested hens had a 15% reduction in average weekly egg production in grams. There was no significance difference in weight gains between the infested and the un-infested chickens. The possible reasons for the differences are discussed.

THE DEVELOPMENT PERSPECTIVE

Some of the major constraints to the smallholder livestock sub-sector in Malawi as stipulated in the National Livestock Master plan include: -

Low levels of animal health and husbandry practices resulting in high mortality rates especially young stock.

Inadequate database for planning, monitoring and evaluation of the livestock programs.

Limited organizational ability of the smallholder farmers.

Capacity of the Veterinary Department to deliver extension messages is limited.

Very few farmers own livestock.

The Danida Agriculture Sector Program Support preparatory Phase II (DASPS II)-Livestock component in the Department of Animal Health and Livestock Development attempted to address some of these constraints through three main intervention areas (before the program was suspended) as follows:

- a). Support to improvement of management of livestock for smallholder farmers.
- b). Development of Poultry Production Model for smallholder farmers.
- c). Enhancement of the capacity within the Veterinary Department to implement recommendations in the National Livestock Development Master Plan.

The work being reported in the thesis was funded by DANIDA, which actually is a fulfillment of the need to enhance the required human capacity for activity implementation. The results from the thesis have also provided some data on the prevalence of the poultry ecto-and blood parasites in Malawi and the potential danger that some of the ectoparasites can cause on the poultry industry. These results will thus provide some objective guidelines, which will facilitate planning of the possible control strategies.

The present study clearly demonstrated that ectoparasites are abundant in free-range production systems and that treatment against *Menacanthus cornutus* alone will increase egg-production by 15%.

ECONOMIC IMPLICATIONS OF THE POSSIBLE INTERVENTIONS

Not much work was done to assess economic implications of the study. However, the current cost of the conventional drug, cypermethrin (which according to literature is very effective in controlling chicken ectoparasites) which is U\$2.50/100mls bottle could be regarded as cost effective if the cost is distributed to all chickens that could be treated with one 100ml bottle. That is using the recommended dilution of 15mls in 20litres water, each bottle is sufficient to treat 1000 chickens; which mathematically will imply treatment cost per chicken is 0.25 of a US cent and each chicken costs about U\$3.00, thus the treatment cost is negligible.

ACKNOWLEDGEMENTS

I am highly indebted to the farmers of Ishmael village and Mr. Nthawanji for their kindness and willingness to allow me to carry out this work. Special thanks go to Mr. A. Ngunde and Mr. Mmodzi, for their full dedication in helping us to conduct the study. Dr. Annette Kjær Ersbøll is highly thanked for her guidance in statistical analysis. The Director of Department of Animal Health and Livestock Development (Mr. W. Lipita), Deputy Directors (Dr G. B. Matita and Dr G. W. Wanda) are thanked for the moral and material support they offered during the study period. The Danish International Development Agency (DANIDA) is thanked for the financial support, which enabled me to carry out the study. My wife Monica, children (Humphrey, Catherine, Gilson Jr.) and mother Esther are specially thanked for their moral support and endurance during my two-year of study. Finally, I am sincerely thank-full to my supervisors (Dr A. Permin, Dr O. Kilpinen and Dr W. M. Mfitlodze), for their encouragements and guidance throughout the study.

INTRODUCTION

Location of Malawi

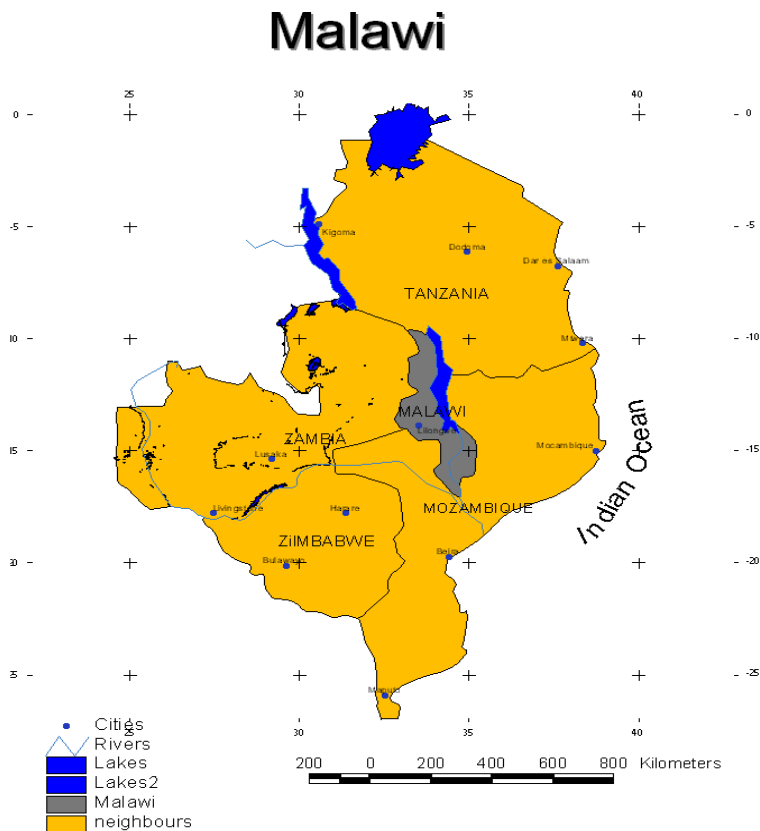


Figure 1. Showing the location of Malawi in relation to the neighbouring sub-saharan African countries.

Malawi is a country in Southern Africa, between latitude $9^{\circ} 45'$ and $17^{\circ} 16'$ South and between longitude 33° and 36° East. It is landlocked, bordered by Tanzania in the north and northeast, Mozambique in the east, south and southwest and Zambia in the west (Figure 1). The climate is sub-humid with temperatures ranging from 14°C to 23°C on high elevation areas and 30°C to 37°C along lakeshore and the Shire Valley. The country has two main seasons, the dry season, from May to October and the wet season, from November to April with rainfall ranging from 635 mm to 3,050 mm, with low rainfall in the low laying areas and high rainfall on high altitude and plateau areas (FAO report, 1995).

The Livestock Subsector

Livestock constitute a relatively small sub sector within Malawi agriculture; officially contributing around 7% of total Gross Domestic Product and below 20% of the value of total agricultural production (Anonymous, 1999). Small ruminants (sheep and goats), poultry and various conventional small stock e.g. rabbits contribute significantly to household food security. However,

poor husbandry practices along housing, nutrition and health care are typical across all livestock species resulting in sub-optimal exploitation of this farm animal genetic resource.

The Development Aspect

Livestock can play an important role in the reduction of poverty among the rural poor people. Inevitably, most of the existing livestock services in many developing countries target commercial rich farmers. In Malawi, over 80% of the population are poor people who live in rural areas. Such people have land-holding capacity of less than one hectare. Micro-credit institutions regard them not credit worthy (Haule et al, 2000). Poultry keeping among these people (particularly women) in poverty alleviation and gender mainstreaming projects is the most practical option since poultry keeping requires relatively less land and financial investment. Therefore, there is a great need to conduct various researches whose aim should focus on the best ways to promote rural poultry production and health.

Background And Justification Of The Thesis

Chicken population in Malawi is estimated to be 11 million with free-range chickens forming the largest proportion (Anonymous, 2000). The chickens are raised under three different management systems; the smallholder with a flock size of less than 50 birds, semi-commercial system with flock sizes ranging from 50 to 5000 and the commercial system where over 5000 birds are kept. In the village extensive poultry production however, the overriding constraint to expansion and increased productivity of the scavenging chicken population is their frequent decimation by Newcastle disease, predation, thefts and parasite infestations (Anonymous, 1999). At the local research station, a number of experiments on production parameters of the local village chicken are being done. National disease control strategies for the chickens are focused on NCD, IBD and Fowl Pox. Extension messages that are developed on parasites are biased towards endoparasites. Ectoparasites receive less attention in almost all the production systems, and there is no documentation for avian haemoparasites in Malawi. Pandey et al., (1992) reports that in extensive management systems, where the chickens have access to outdoor areas and not confined do have a greater diversity of parasites. These parasites are of great economic importance (Derylo, 1974, Gless et al, 1959, Panda and Ahluwalia, 1983). They cause anaemia due to blood loss, serve as mechanical carriers of poultry diseases and pathogens e.g. *Aegyptinella spp*, *Plasmodium spp*, etc.; or can act as intermediate hosts for a range of helminthes infections such as *Heterakis gallinarum*, *Choanotaenia infundibulum* etc. (Poultry digest, 1990, Permin et al., 1998). Little is known about the economic impact of *M. cornutus* on chickens. It is therefore justified that a detailed study of ecto- and haemoparasites of chickens, impact of the most prevalent ectoparasite (*M. cornutus*) on production of Blackaustralorp chickens is done. The results can be used in making Objective Decisions In Control Strategies.

Objectives

To isolate and identify the ecto- and haemoparasites, affecting chickens from different production systems in Lilongwe.

To determine the prevalence of the parasites identified from different poultry production systems.

To access the impact of lice (*Menacanthus cornutus*) on performance of Blackaustralorp chickens.

LITERATURE REVIEW

There are numerous external parasites of poultry. These can be classified into two major groups, those that are permanent parasites and those that are temporary parasites.

Taxonomically the parasites belong to the Phylum: Arthropoda, in the classes Insecta and Arachnida. The arachnida include the mites and the ticks (Order Acarina), and insects (the insecta) in the orders Phthiraptera, which include the suborders Mallophaga, (the chewing lice) and Siphonaptera (the fleas). The order Mallophaga has two superfamilies, Ischnocera and Amblycera (Soulsby, 1982).

Occurrence of ecto-and haemoparasites

Table 1 below shows occurrence of ecto- and haemoparasites in some of the tropical countries of the world.

Country	Species identified	Source.
Nigeria	Menacanthus stramineus, Menopon gallinae, Gonoides gigas, Gonoicotes gallinae, Lipeurus caponis, Numidilipeurus tropicalis, Damalinia bovis, Bdelonyssus bursa, Megninia cubitalis, Dermanyssus gallinae, Echidnophaga gallinacea, Ctenocephalides felis.	Okaeme, 1988.
Zimbabwe	Argas persicus, Cnemidocoptes mutans, E. gallinacea, G. gallinae, M. stramineus, M. gallinae, Aegyptinella pullorum ^a , Leucocytozoon sabrazesi ^a , Trypanosoma avium ^a , Plasmodium gallinaceum ^a .	Permin et al., 2002
Mexico	M. stramineus, M. gallinae, Chelopistes meleagridis, Heterodoxus spiniger, Bovicola caprae, Bovicola limbata, Cuclotogaster heterographus, Columbicola columbae.	Aquirre-Urbe et al 1991
India	L. caponis, G. gigas, G. gallinae, C. heterographus, M. gallinae, Cimex lactularius, E. gallinaceum, percicus.	Mir et al, 1993.
Kenya	<i>Rhipicephalus pulchellus</i> , Rhipicephalus pravus, L. caponis, M. gallinae, heterographus	Nyaga et al., 1983.
Nepal	<i>M. gallinae</i> , <i>M. stramineus</i> , L. caponis, G. gigas.	Devi and Mishra, 1981.
Korea	L. caponis, G. dissimilis, G. gallinae, C. columbae.	Noh et al., 1989.

Cuba	Megninia ginglymura, mutans, D. gallinae.	Zaldivar et al., 1987.
Libya	L. caponis, C. heterographus, M. stramineus, G. dissimilis, G. gallinae, G. gigas, M. gallinae.	Gabaj et al., 1993.
Saudi Arabia	<i>M. pallidulus</i> , <i>M. cornutus</i> , M. stramineus, G. dissimilis, G. gallinae, M. gallinae, Amyrsdea sp.	Aldryhim, 1991.
Niger	<i>A. persicus</i> , <i>C. mutans</i> , M. gallinae, G. gallinae, L. caponis.	Tager et al., 1992.
Turkey	<i>M. gallinae</i> , <i>M. cornutus</i> , M. stramineus, G. gallinae, G. dissimilis, C. heterographus.	Dik et al., 1999.
Tanzania	<i>M. stramineus</i> , <i>E. gallinacea</i> , Rhipicephalus nymphs, mutans, D. gallinae.	Msanga and Tungaradza, 1985
Zambia	<i>M. gallinae</i> , <i>M. stramineus</i> , M. pallidulus, M. cornutus, G. gallinae, G. gigas, Lipeurus lawrensis tropicalis, L. caponis, C. mutans, D. gallinae, Ornithonyssus bursa.	Lumbwe, 2002.

^a indicate haemoparasites.

Table 1 .Occurrence of ecto- and haemoparasites in some of the tropical countries.

Prevalence of the ecto- and haemoparasites

In Ethiopia Abebe et al., 1997 reported different parasite prevalence in different management systems. The highest prevalence was reported in the free-range range chickens. In the cage system the only ecto-parasite found was the mite *D. gallinae*, in the semi-intensive system *G. gigas* had prevalence of 44.1%, *M. gallinae* (23.5%), *M. stramineus* (10.7%), *G. gallinae* (2.1%) and *D. gallinae* (0.92%). In the free-ranging chickens, *G. gigas* was 78.9% prevalent, *M. gallinae* (60.5%), *M. stramineus* (26.6%), *G. gallinae* (10.1%), and *C. heterographus* (14.7%).

In Zimbabwe Permin et al., (2002) reported 100% of the free-range chickens harbouring ectoparasites and 32% infected with haemoparasites. The most prevalent ones had the following prevalence (adult, % /young, %): *M. stramineus* (88/90), *E. Gallinacea* (74/72), *M. gallinae* (66/24), *C. mutans* (32/6), *G. gallinae* (22/0), and *A. persicus* (14/6). The haemoparasites were in old chickens with the following prevalences: *P. gallinaceum* (15%), *A. pullorum* (14%), *Trypanosoma avium* (5%) and *L. sabrazesi* (4%).

Fabiyi (1980) reported 100% free-range chicken infestation with *M. cornutus*, 95% with *G. gallinae*, 90% with *N. tropicalis*, 85% with *A. poweli*, 76% with *G. gigas*, 46% with *L. caponis* and 30% with *C. occidentalis* in Nigeria.

Manuel and Anceno (1981) in the Philippines found that all the 20 chickens in their study had *M. gallinae* and *L. caponis*, 16 had *M. pallidullus*, 17 had *G. dissimilis*, 15 had and 9 had *Oxylipeurus*

dentatus. Of the total number of parasites found, 75.8% were *M. gallinae*, 9.6% *L. caponis*, 8.3% *M. pallidulus*, 3.1% *G. dissimilis*, 2.0% *G. gallinae* and 1.2% *O. dentatus*.

These reports indicate that a large number of different ecto-parasites affect chickens at different levels of infestations in different ecological locations of the world.

Life Cycles

The length of the life cycle of the parasite is important for its infectivity. Short life cycles are necessary to compensate for low survival rates (Lumbwe, 2002).

Lice are permanent ecto-parasites, spending their entire life cycle on the host. The life cycle lasts approximately 3 weeks depending on the temperature and humidity. As many as 60 eggs are laid by the adult female louse and are glued to the host's feathers. A pair of lice may produce 120,000 descendants within a few months (Arends, 1997).

Mites do not spend their entire life cycles on the bird, except for the scaly leg mite. Adult mites spend most of their lives on the host but will wander from the bird into crevices and cracks. Adult female mites complete egg laying in two days and the number of eggs laid average 2 to 5 per female (Hinkle, 1996). DeVaney, (1980) reported that mammals might act, as temporary carriers for *A. persicus*, but completion of the life cycle require an avian host. The life cycle takes about 7 to 8 weeks in the warm dry season and longer during the cold season (Soulsby, 1982). The adults feed once a month and the females lay eggs after each meal. One batch consists of 20-100 eggs. The nymphs and adults are nocturnal in their behaviour and may survive without a blood meal for more than 5 years in cracks or other suitable places (Permin and Hansen, 1998).

The female flea lays up to 20 eggs at a time and about 400-500 during her lifetime. The rate of development of the flea to adult stage greatly varies depending on temperature and humidity. The life cycle is, however completed in one to two months under optimal conditions (Soulsby, 1982, Arends, 1997).

The life cycles of the haemoparasites require some arthropod vectors. The vectors of avian malaria are mainly the mosquitoes *Mansonia spp.*, *Aedes spp.*, *Culex spp.*, and *Armigeres spp.* (Permin and Hansen, 1998) and *A. persicus* (the soft tick) transmits *A. pullorum*. During blood sucking, the sporozoites are transferred from the mosquito salivary glands to the bloodstream of the host infecting macrophages and fibroblasts. In the liver cells, merozoites are produced. After two generations, the merozoites are released into the blood stream where they enter erythrocytes. The life cycle of the *A. pullorum* occurs by the multiplication of the organism. The parasites are seen in erythrocytes as either initial bodies or as marginal bodies (Permin and Hansen, 1998).

The length of the life cycle for the ecto- and haemoparasites of poultry show variations depending on the species of the parasite. This influences the method to use in order to control them within a production system.

Clinical signs

The clinical signs depend largely to the species of the parasite involved. Permin and Hansen, (1998) reports that infection with *A. persicus* may cause ruffled feathers, poor appetite (anorexia), diarrhoea, emaciation and lowered production. Furthermore, occurrence of diseases (*Leucocytozoon spp.*, *Aegyptinella spp.*) may be a sign for *A. persicus* infection. Birds infected with skin mites will have a change of behaviour due to the itching effect of the mites. This will be followed by emaciation, reduction in egg production, anaemia and sometimes death. *C. mutans* burrow the skin underneath the scales of the legs, causing inflammation with exudates and subsequently keratinization of the legs. In chronic cases lameness and malformation on the feet are seen (Permin and Hansen, 1998, Arends, 1997). Stick tight flea infestation is associated with irritation, blood loss followed by anaemia and death may occur. Soulsby, (1982) reports that heavy infection of avian malaria can cause mortalities ranging from 30% to 80%. In other cases, an indirect effect on hatchability has been observed (A. Permin, pers. comm.).

Pathological lesions

Ecto- and haemoparasites have different pathological effects on their hosts. *M. stramineus* may consume blood by puncturing soft quills near the bases and gnawing through the covering layers of the skin itself (Arends, 1997). This causes multi-focal skin lesions on the affected birds. *C. mutans* causes inflammation with exudates and subsequently keratinization of the legs (Permin and Hansen, 1998). Fabiyi (1980) indicated that *A. poweli*, *M. cornutus*, *N. tropicalis* and *G. gallinae* were associated with pathological conditions like severe emaciation, droopiness and reddened scabby skin in chickens. Blood sucking parasites (*A. persicus*, *E. gallinacea*, *D. gallinae*, *M. cornutus*) are known to cause severe blood loss leading to anaemia and death. Haemoparasites also cause anaemia and death by invading the erythrocytes, which consequently are destroyed by the bird's autoimmune system.

Control of the ectoparasites

Different methods are used to control ectoparasites of chickens. In Malawi, there are no specific control strategies in place for free-range village chickens. Commercial farmers usually use conventional drugs to control internal parasites. Some traditional farmers however, use ethno-veterinary drugs and some unconventional methods such as the use of kerosene to control fleas. However, external parasites of poultry are primarily controlled by the use of pesticidal chemicals (Devaney, 1986). A number of chemical compounds are used in the control of poultry pests. The most common ones include Organophosphates such as Malathion and Dichlorvos, Carbamates such as Carbaryl, and the Pyrethroids (Permethrin and Pyrethrin). Devaney (1986) reported that pyrethroids represented about 30-90% of the pesticides used to control *Ornithonyssus sylviarum* and lice whilst Malathion was used against *Neoschoegastica americana* in the USA. In the Philippines, Manuel et al (1981) found carbaryl, chlordane, malathion, pfspray and dichlorvos to be highly effective against *Megninia cubitalis* if applied at 5-day interval at manufacturers' recommended dosages.

Insecticides can be applied to birds as a powder, or dust or in liquid spray, dip or mist (Lumbwe, 2002). When applying the insecticide, the birds' feathers should be parted so that the chemical reaches the skin.

Premises could also be treated against the chicken mite, *D. gallinae*, bed bags and ticks because these spend part of their life cycle away from the bird (Arends, 1997).

Habit variations and pest biology among ecto-parasite species are important considerations when control measures are to be implemented. Accurate parasite identification is a prime necessity for proper integrated control (Lumbwe, 2002).

Different researchers have published conflicting reports about economic importance of the chicken body louse (*M. stramineus*). Some report no significance difference in egg production, weight gain and feed conversion efficiency between two groups of laying hens, one with *M. stramineus* and the other group without (Stockdale et al., 1960, Warren et al., 1948, Clayton et al., 1994). Others report significant differences between the two treatments (Edgar et al., 1950, Gless et al., 1959, DeVaney, 1975).

RESULTS

Ectoparasites

Five species of chewing lice (genera: Mallophaga), one species of fleas (genera: Siphonaptera) and one species of mite (genera: Acari) were found in this study. The lice included *Menacanthus cornutus*, *Menopon gallinae*, *Gonoides gigas*, *Goniocotes gallinae* and *Lipeurus lawrensis tropicalis*. The flea was *Echidnophaga gallinacea* and the mite *Cnemidocoptes mutans*. No ticks were isolated and no single parasite was caught from the corrugated cardboard traps.

Haemoparasites

Three species were identified, *Plasmodium gallinaceum*, *P. juxtannucleare* and *Aegyptinella pullorum*.

Prevalence

Overall, lice had the highest frequency of occurrence, with a 100% prevalence in the free-range production system closely followed by the scaly leg mite, *C. mutans* with a prevalence of 95%. Among the lice species, *M. gallinae* and *M. cornutus* were equally prevalent. During the dry season *E. gallinacea* was highly prevalent (90%) but the prevalence dropped to 36% during the wet season. No parasites were isolated from the semi-commercial production system and *M. gallinae* was the only parasite isolated from the commercial system with a prevalence of 8% (Table 1). The differences between prevalences from the different production systems were significant for all parasites ($p < 0.0001$). Haemoparasites were isolated from 136 out of 190 chickens, all from the free-range production system and the most prevalent was *P. gallinaceum* (Table 1). There was significantly ($p < 0.0001$) higher prevalence of *C. mutans* among older chickens compared with young ones (Table 2). There were also significantly ($p < 0.0001$) higher prevalences of *M. cornutus* and *E. gallinacea* during the dry season compared to wet season. In general, levels of parasitic infestations were higher during the dry season than the wet season except for *C. mutans* and lice infestation levels which were reduced by 26.0% and 20.0% respectively (Figures 2 and 3).

Infestation model

There were no visible parasitic increases on the 5 cocks for the first 3 weeks after inoculation. In the 4th week, the parasitic load was estimated at over 3000 parasites per bird, and in the 5th week, it was estimated to be over 5000 parasites per bird (Figure 4).

Weight gain

There was no difference in weight gains between the two groups in the first two months of the experiment (Figure 5.) though the infected chickens appeared to have weighed slightly more than the control group from the third month. Analysis of variance however showed no significant ($p > 0.05$) difference in the weight gains between the two groups.

Egg production

The control hens started laying eggs at 17 weeks old and were followed by the infested group at 18 weeks 1 day old. After 70 days of egg collection, 757 eggs had been collected from the control hens and 635 from the infested hens, representing a 15% difference. Daily production was generally higher in the control hens than the infested ones (Figure 6.). This difference was found to be statistically significant ($p < 0.05$).

Post mortem changes

Two chickens, which died, one from each group was found infected with *Escherichia coli* and coccidiosis respectively. All 15 chickens that were slaughtered from each group after the experiment had no significant macroscopic skin lesions, but a lot of fat covered the entire sub-dermal tissue.

DISCUSSION

Prevalence

In the present study, 100% of the chickens from the free-range production system harboured ectoparasites, whereas only 8% in the commercial system and none from the semi-commercial were infested with ectoparasites. This is comparable to a recent study in Zambia, Lumbwe (*unpublished* 2002) which reported high prevalences of ectoparasites in domestic free-range chickens and included all the species found in this study.

The most prevalent parasite in this study was the scaly leg mite *C. mutans* with a significantly ($p < 0.0001$) higher prevalence in old chickens than in young ones. This parallels a report from Zimbabwe (Permin et al., 2002) where *C. mutans* as well as *M. gallinae* and *G. gallinae* were found to have high prevalences in adult birds. Among the lice species, *M. cornutus* showed the highest prevalence during the dry season and *M. gallinae* was the most common during the wet season. This can probably be attributed to changes in the humidity since *M. cornutus* has been reported to have a particular high prevalence in hot and humid areas of Nigeria (Fabiya, 1980, Fabiya, 1988). Many other investigations have found *M. gallinae* to occur with highest prevalence, (Torres et al., 1974, Adene, 1975, Lunkashu, 1974, Buriro and Akbar, 1978, Manuel, 1981, Manuel and Anceno, 1981, Umeche and Eno, 1987, Orkursoy and Yilmaz, 2002 and SangvarAnond, 1993). In contrast to other reports from neighbouring countries, (Permin et al., 2002, Msanga and Tungaraza, 1985, Lumbwe, 2002) *M. stramineus* was not isolated from this study. Misidentification of these two very similar lice species in the earlier work could be a possibility, as supported by work in Nigeria where some reports the presence of *M. cornutus* (Fabiya, 1986) and others report high prevalence of *M. stramineus* in Nigeria (Okaeme, 1988, George et al, 1992, Agbede, 1981).

P. gallinaceum was the most prevalent haemoparasite. It is considered to be highly pathogenic to chickens with mortality risks in the range of 30-80% (Soulsby, 1982). Presence of *A. pullorum* which is believed to cause anaemia, diarrhoea, and fever in chickens (Levine, 1985) may be an indicator of presence of *Argus persicus* which is a vector for this blood parasite even though it was not isolated from the traps that were set up.

Effect

Significant ($p < 0.05$) interactions occurred among age, season, production system and breed (table 2). Overall, the free-range system strongly favoured occurrence of all the parasites. In Ethiopia, Abebe et al., (1997) reported significant ($p < 0.05$) differences in the occurrence of ectoparasites among different management systems where most parasites were found in the free-range and semi-scavenging systems. This clearly indicates that the parasites infect the chickens either through contact with other infected chickens or from the environment as they scavenge together in this system. However, Ugochukwu and Omije (1986) reported multiple ectoparasitic infections from commercial farms, which had poor sanitation in Nigeria.

Occurrence of *C. mutans* and *E. gallinacea* was significantly ($p < 0.0001$) affected by breed (Table 2) where the exotic breeds (hyaline and Blackaustralorp) had higher parasitic burdens of these two species compared with the indigenous chickens. The explanation for this is yet to be found. The seasonal interactions (Table 2) could be attributed to climatic differences, as especially humidity was much higher in the wet season. The reasons for reduction in levels of infestation during the wet season for *C. mutans* and overall lice infestation levels are not clear.

The results from the case-control study indicate that *M. cornutus* infection has no effect on the growth rate of the Blackaustralorp chickens. There have been conflicting reports on the effect of chicken louse on the growth rate of chickens. Some studies have found no significant effects of *M. stramineus* infestations (Stockdale et al., 1960, Clayton et al., 1994, Warren et al., 1948), whereas others have reported significant reductions in the weight gain, Panda and Ahluwalia (1983), Edgar

et al., (1950), Gless et al., (1959), and DeVaney, (1975). It is therefore difficult to draw any conclusions from this study because the chickens were fed *ad libitum*, which may have allowed them to compensate for any energetic cost due to ectoparasite infestations.

The non-infected hens reached point of lay earlier than the infected hens and the egg production remained high in this group throughout the experimental period. An analysis of variance for the average weekly production in grams for the entire 10 weeks of laying study period shows a significant difference in the egg production (Figure 6). This is in accordance with other reports (Edgar et al., 1950, Gless et al., 1959, DeVaney, 1975, Yagi et al., 1975). Ectoparasitic infections may cause severe irritation and result in loss of egg production and reduction in body weight (Khan, 1979). This is a likely explanation for this study as evidenced by severe preening, dust bathing and feather pecking from the infected chickens as observed by the authors though not quantified. The major limitation to this study was that the separation of cocks from hens resulted into one group of infested and another single group of control hens. This compromised the replications.

There were no gross pathological post-mortem skin lesions on the chickens that were slaughtered from the two treatments. This disagrees with Derylo (1974), who reported skin changes on leghorns chickens, which were infested with *M. stramineus*. Probably the genetics predispose chickens to skin changes. White leghorns are skinny egg type birds, which do not accumulate a lot of fat as seen in the dual-purpose Blackaustralorp birds.

Based on these results, it is clear that avian ecto-and haemoparasites are present in Malawi, some of which are reported to be of great economic importance in literature. Practically, results from this study will be used in development of extension messages for the farmers regarding the best time to apply pesticides and which ones to use.

Economic analysis

The 15 control hens had laid 112 more eggs than the infected ones within the 71 days of the study period. Average cost of an egg in Malawi is 0.09US cents. This translates to a loss of US\$10.08 to one farmer who has 15 hens within 71 days of laying. In this case, if the losses are computed for all the farmers in the village, the sum will be quite substantial for the poor people, which could have otherwise be avoided if the hens were treated against the ectoparasites.

CONCLUSION

All the chickens in the scavenging production system have ectoparasites of some kind throughout the year with particular high parasitic loads during the hot season. Haemoparasites do affect more than half of the chickens even though clinical diseases they cause are not reported. Some of these parasites are known to be of economic importance. The occurrence of ectoparasites was highly influenced by production system, season and age of the bird. To minimize this problem, application of suitable pesticide routinely and particularly just prior to the hot season is recommended in the scavenging production system. As long as sanitary measures are followed in the commercial and the semi-commercial systems, these parasites seems not be a major problem. Further research to access the impact of these parasites on health and production performance of the scavenging chickens including cost effectiveness of control strategies is suggested.

REFERENCES

- Abebe, W., Asfaw, T., Genete, B., Kassa, B., Dorchie, P.H., 1997. Comparative studies Of external parasites and gastrointestinal helminthes of chickens kept under different management system in and around Addis Ababa (Ethiopia). *Rev. Med. Vet.* 148(6), 497-500.
- Adene, D. F., Dipeolu, O.O., 1975. Survey of blood and ectoparasites of domestic fowls in Ibadan, Western State of Nigeria. *Bulletin of Animal Health and Production in Africa.* 23, 333-335.
- Agbede, R. I. S., 1981. A survey of ectoparasites and ectoparasitic conditions of animals in Zaria, Nigeria. *Journal of Animal Production and Research.* 1:2, 179-180.
- Derylo, A., 1974. Studies on the economic harmfulness of biting lice (mallophaga). I. The influence of biting lice infestation on the state of health of hens and turkeys. *Medycyna Weterynaryjna.* 30: 6, 353-357.
- De Vaney, J. A., 1976. Effects of the chicken body louse *Menacanthus stramineus*, on caged layers. *Poultry Science.* 55: 1, 430-435.
- Edgar, S. A., and King, D. F., 1950. Effect the body louse *Eomacanthus stramineus* on mature chickens. *Poultry Science,* 29, 214-9.
- Emerson K. C., 1956. Mallophaga (chewing lice) occurring on domestic chickens. *Journal of Kausas Entolomol. Soc.* 29 (2), 63-79.
- Gless, E. E., and Raun, E. S., 1959. Effects of chicken body louse infestation on egg production in the hen. *Poultry Science.* 27: 641-642.
- Fabiyi, J. P., 1980. Survey of lice infesting domestic fowl on the Jos Plateau, Northern Nigeria. *Bulletin of Animal Health and Production in Africa.* 28 (3), 215-219.
- Fabiyi, J. P., 1986. Exclusion in Nigeria of chickens and guinea fowls from the host range of *Menacanthus stramineus* (Mallophaga: Insecta). *Revue-d'Elevage –et-de-Medicine-Veterinaire-des Pays-Tropicaux.* 39 (3-4), 377-379.
- Fabiyi, J. P., 1988. Lice infestations of domestic chickens in Nigeria. *Bulletin of Animal Health and production in Africa.* 36 (4), 390-394.
- Fabiyi, J. P., 1996. Association between duration of humid season and geographical distribution of patterns of different species of chewing lice (Mallophaga: Insecta) infesting domestic chickens in Nigeria. *Journal of Parasitology.* 82 (2), 1034-1036.
- George, J. B. D., Otodo, S., Ogunileye, J., Adedimiyi, B., 1992. Louse and mite infestation in domestic animals in northern Nigeria. *Tropical Animal Health and Production.* 24 (2), 121-124.
- Haule, A.P., and Jere, J., 2000. Report on Participatory Situational Analysis of Livestock production by small holder farmers in Lilongwe west and Kasungu RDPs DASPS-II Pilot sites, Lilongwe, Malawi, pp1-7.
- Hinkle, N., 1996. Insects and Pests on Poultry. Extension Services Series, University of Nebraska.
- Kettle, D.S., 1995. *Medical and Veterinary Entomology*, 2nd Ed. CAB international, UK pp383-458.
- Khan, M. H., 1976. Control of Poultry lice with some newer insecticides. *Indian Veterinary Journal.* 56: 9, 739-743.
- Levine, N. D., 1985. *Veterinary protozoology.* 1st.ed, Ames, Iowa State University Press.
- Lumbwe, H., 2002 (unpublished). The occurrence of ectoparasites on indigenous chickens among smallholder farmers in Chongwe district of Zambia. University of Malawi, Lilongwe.
- Lunkashu, M. I., 1974. Bird-lice (Mallophaga) of domestic poultry in Moldavia. *Parazyty-Zhivotnykh-Rasteni.* 10, 87-111.
- Manuel, M. F., 1981. The ectoparasites (lice and mites) occurring on domestic chickens in the Philippines. *Philippine Journal of Veterinary Medicine.* 20 (1), 87-100.
- Manuel, M. F. and Anceno, T. A., 1981. Distribution of lice (Mallophaga) on the body of

- native chickens (*Gullus gullus domesticus*). Philippine Journal of Veterinary Medicine. 20 (1), 50-57.
- Anonymous, 1999. Malawi National Livestock Development Master Plan pp 1-6. Malawi Livestock annual census., 2000 (unpublished). Lilongwe.
- Njunga, G. R., Permin, A., Kilpinen, O., Mfitlodze, W., 2003 (*submitted*). Ecto-and haemoparasites of chickens in Malawi. Pp2-18.
- Noordhuizen, J.P.T.M., Frankena, K., Trusfield, M.V., Graat, E.A.M., Eds. 2001. Application of Quantitative Methods in Veterinary Epidemiology. Wageningen Pers, Netherlands. Pp 35-48.
- Okaeme, A.N., 1988. Ectoparasites of Guinea fowl (*Numida meleagris galeata pallas*) and local domestic chicken (*Gallus gullus*) in Southern Guinea Savana, Nigeria. Veterinary research communications. 12, 270-280.
- Okursoy, S., and Yilmaz, F., 2002. Prevalence of species of lice in chickens in the province of Bursa. Turkiye- Parazitoloji-Dergisi. 26 (1), 71-75.
- Panda, D. N., and Ahluwalia, S. S., 1983. Effect of *Menacanthus stramineus* and *Lipeurus tropicalis* infestations on weight gain in broiler birds. Indian Veterinary Journal. 60: 2, 85-87.
- Pandey, V. S., Demey, F., Verhulst, A., 1992. Parasitic diseases: A neglected problem In Village Poultry in Sub-Saharan Africa. In: Pandey, V.S., and Demey, F. (Eds.). Village poultry production in Africa. Rabat, Morocco, pp.136-141.
- Permin, A., Esmann, J.B., Hoj, C.H., Hove, T., Mukaratirwa, S., 2002. Ecto-, endo- and haemoparasites in free range chickens in the Goromonzi District in Zimbabwe. Preventive Veterinary Medicine. 54 (3), 213-224.
- Permin, A., and Hansen, J., 1998. The Epidemiology, diagnosis and control of poultry parasites. FAO. Rome, Italy.
- Petrie, A., and Watson, P., 2000. Statistics for Veterinary and Animal Science. Blackwell Science, pp 44-50.
- SangvarAnond, A., 1993. studies on prevalence and outbreak of ectoparasites in native chickens in central part of Thailand. Kasetssart Journal of Natural Sciences. 27 (2), 194-203.
- Saulsby, E. J. L., 1982. Helminths, Arthropods and protozoa of Domesticated Animals, 7th ed. Baillière Tindall, East Sussex, UK.
- Stockdale, H. J., and Raun, E. S., 1960. Economic importance of the Chicken Body Louse. Journal of Economic Entomology. 53: 421-423.
- Torres, P., Franjola, R., Yanez, L., Diaz, V., Gonzalez, E., Montecinos, M. I., 1974. Preliminary Study of the helminthes and arthropods of *gallus gallus domesticus* in Valdivia Province, Chile. Bulletin-Chileno-de-Parasitologia. 29 (3-4), 115-117.
- Ugochukwu, E. L., and Omije, F. A., 1986. Ectoparasitic fauna of poultry in Nsukka, Nigeria. International Journal of Zoonoses. 13 (2), 93-97.
- Umeche, A., and Eno, R. O. A., 1987. A survey of parasites of chickens from poultry farms in Calabar, Nigeria. Revista-Latinoamericana-de-Microbiologia. 29 (2), 133-136.
- Warren, D. C., Eaton, R., Smith, H., 1948. Influence of infestations of body lice on egg production. Poultry Science. 27: 641-642.
- Yagi, A. L., Abdel-Razig, M.T., Osman, O.M., 1975. Studies on the action of Neguvon against The poultry louse *Menacanthus cornutus* (Schommer, 1913). Bulletin of Animal Health And Production in Africa. 23: 2, 181-184.

TABLES AND FIGURES

Table 1 Prevalence of ecto-and haemoparasites found on domestic chickens from different production system and seasonal (dry & wet) prevalences from the scavenging system.

Parasite	Scavenging			Semi-commercial % (n=45)	Commercial % (n=65)
	Overall % (n=190)	Dry % (n=90)	Wet % (n=100)		
Lice	100	100	100	0	8
<i>M. cornutus</i>	74	96	54	0	0
<i>M. gallinae</i>	77	88	73	0	8
<i>G. gigas</i>	53	61	45	0	0
<i>G. gallinae</i>	41	52	30	0	0
<i>L. l. tropicalis</i>	46	50	42	0	0
Fleas	62	90	36	0	0
<i>E. gallinaea</i>	62	90	36	0	0
Mites	95	96	95	0	0
<i>C. mutans</i>	95	96	95	0	0
Haemoparasites	72	77	67	0	0
<i>P. gallinaceum</i>	47	53	41	0	0
<i>P. juxtannucleare</i>	9	12	8	0	0
<i>A. pullorum</i>	25	23	26	0	0

n= number of chickens examined

Figure 2. Illustrating changes in *C. mutans* levels between the two seasons.

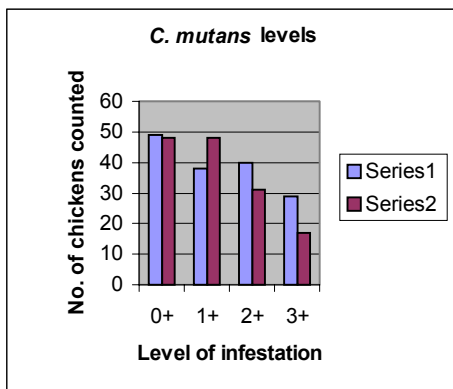
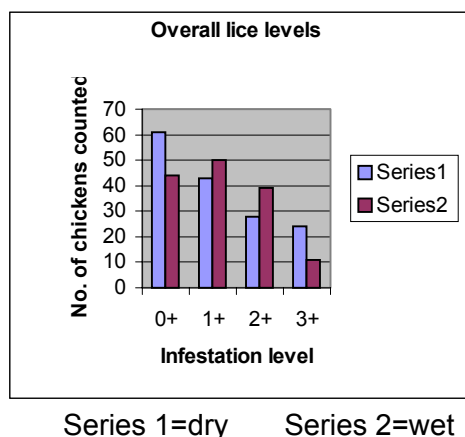


Figure 3. Illustrating changes in overall lice levels between the dry and the wet season.



Series 1=dry Series 2=wet

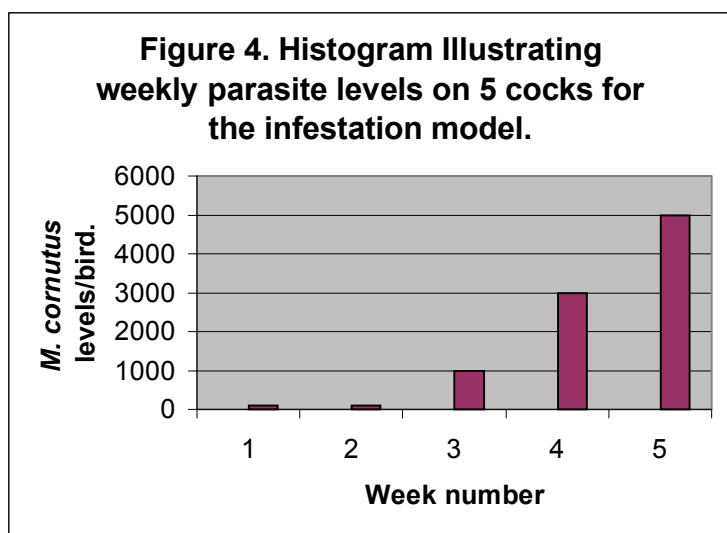


Table 2. Effects of, Age, Production system, season and breed and their interactions on the occurrence of the most important parasites.

Parasite sp.	Effects				Interactions				P-value
	Age	Prodsyst	Season	Breed	Age X Season	Sex X Season	Prodsyst X Season	Age X Prodsyst X Season	
<i>M.cornutus</i>	-	+	+	-	+	+	+	+	0.0001
<i>M.gallinae</i>	-	+	-	-	+	-	+	-	0.0001
<i>G.gigas</i>	-	+	+	-	+	-	-	-	0.0335
<i>G.gallinae</i>	-	+	-	-	-	-	-	-	0.0001
<i>L.l.tropicalis</i>	-	+	-	+	-	-	-	-	0.0175
<i>E.gallinacea</i>	-	+	+	+	-	-	-	-	0.0001
<i>C.mutans</i>	+	+	+	-	+	-	-	-	0.0001
<i>P.gallinaceum</i>	-	+	+	-	-	-	-	-	0.0213

+ = Significant (p<0.05) - = Not significant

Figure 5. Illustrating the weight gains between the infected and the non infected chickens for a period of four months

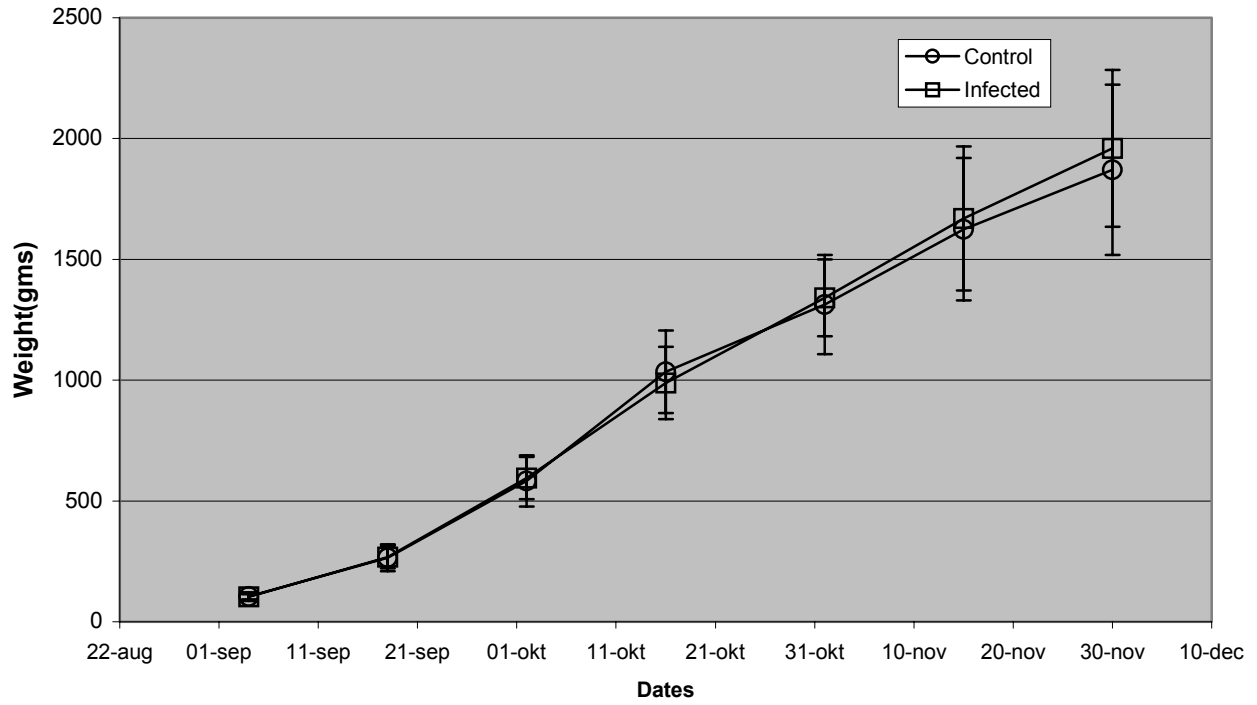


Figure 6. Illustrating average weekly egg production per hen per day (gms) between the two treatments.

