

**Characterization of village chicken health and management practices in the Amatola
Basin of the Eastern Cape Province, South Africa**

By

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A Dissertation submitted in fulfillment of the requirements for the degree of the

MASTER OF SCIENCE IN ANIMAL SCIENCE

Department of Livestock and Pasture Science

Faculty of Science and Agriculture



University of Fort Hare
Together in Excellence

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November 2011

Declaration

I, Njongenhle Mhlanhlandlela Bernard NYONI hereby declare that this dissertation is my original work conducted under the Supervision of Prof. P. J. Masika, submitted for the Degree of Master of Science at the University of Fort Hare. It has not been previously submitted to any University. Reference has been accorded to other researchers' work and assistance received has been duly acknowledged.

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Abstract

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The majority of rural households in South Africa own village chickens which contribute significantly to their livelihoods. However, limited research has been conducted to characterize, understand and develop village chicken production in South Africa. This hinders the designing and implementation of village chicken-based developmental programmes that will benefit farmers in rural areas. Thus, it is imperative to initiate studies to describe village chicken production. This study was conducted to characterize village chicken production in Amatola Basin of the Eastern Cape Province of South Africa. Baseline information was gathered using a questionnaire survey of 81 identified from 7 out of 13 villages using snowball sampling technique. Consequently, 20 households were selected to participate in a monitoring study (from July 2010 to June 2011) through purposive sampling. Most (60%) chicken flocks were owned by women and mainly raised to meet household food requirements. Some (28.4%) farmers occasionally sold cocks and hens to neighbours, at an average price of R50 (USD7.55) per bird, as a way of culling their flocks and generating income. However, village chickens were mainly kept for food security rather than for their terminal benefit of cash. Although, all chicken flocks were produced under the scavenging feeding system, most (96%) flocks were provided with supplementary feed and drinking water. A majority (93.8%) of households also provided some form of shelter for their chickens. The mean cock to hen to chick ratio was 1:5:15. On average,

each household owned 17 (± 2 S.E.M.) chickens, and hens had 3.3 clutches per annum. Chicks hatched and chickens received as gifts represented the flock entries, while exits included mortality, consumption, sales and gifts or donations, in that order. Generally, both exits and entries were more pronounced in the summer season than in other seasons. Most (81.5%) farmers experienced chicken losses due to predation and health related problems. Parasitism ranked high amongst the village chicken health challenges. During monitoring, the endoparasites identified included nematodes, cestodes and protozoa. Coccidia were the most prevalent endoparasites. The chickens were also infested with a variety of ectoparasites namely: mites, lice, fleas and ticks. The sticktight flea *Echidnophaga gallinacean* was the most prevalent species. Although ectoparasite infestations were most pronounced in summer, almost all chickens harbored one or more of these parasites throughout the study period. The prevalence and intensity of parasite infestations were significantly ($P < 0.05$) higher in the summer season compared to the other seasons. This was followed by the autumn, spring and winter seasons, respectively. The majority (77.5%) of farmers resorted to alternative remedies, mostly medicinal plants, for treating diseases and controlling parasites. Medicinal plants were used because they were locally available, cheap and perceived to be effective. Therefore, village chicken production in the rural Eastern Cape Province is characterised by several challenges which counter the significant role chickens play in the livelihood of rural households.

Keywords: Ectoparasite, endoparasites, ethno-veterinary medicines, free-range, flock dynamics, rural, scavenging, season

Dedication

I dedicate this dissertation to my wonderful family: my inspirational father Bernard M. Nyoni who has always believed in me, my mother Nompumelelo Nyoni for her support, love and warmth, and to my beautiful sisters, brothers, nieces and nephews for being such a blessing in my life.

Acknowledgements

The success of this document was made possible by the contributions from a number of individuals and various institutions of which I gratefully acknowledge. My special thanks goes to my supervisor, Prof P. J. Masika for his professional, scientific, technical guidance and his untiring dedication to my work. You treated me like a son sir. The financial assistance from the National Research Foundation of South Africa (Project number UID 62298) is acknowledged with gratitude. I thankfully acknowledge the support and guidance from the Agricultural and Rural Development Research Institute (ARDRI), the Department of Livestock and Pasture Science and the farmers in the Amatola Basin, Eastern Cape Province who participated in this project. My sincere gratitude also goes to my family for their encouragement, unparalleled love, prayer, patience, and continued support and assistance. These include my parents Bernard M. Nyoni and Nompumelelo Nyoni, my sisters Dr H. P. Nkala, Nobuhle Mpufu, Nomazwe S. Nyoni-Gumbo, Sizanobluhle L. Phili, Sibongokuhle Nyoni and Nonhlanhla Nyoni, my brothers Hlengilizwe Nyoni, Walter Nkala, Mandla Gumbo and Gwabalanda Mpofu, my nieces Nomandla, Nkazimulo, Kimberly, Zoe, Shamiso and Inamandla, and nephews Maxwell and Liam. You are the best. I would also like to salute Dr. U. Marume and Ido Jubane for assisting me with data analysis. Dr. R. Makombe, Dr. B. Moyo, H. Nyoni, Dr P. Khumalo, Dr. M. Mwale, Dr. Gwaze, Dr. V. Maphosa and T. Sibanda are highly acknowledged for their critical comments on my work. I am also thankful for Zama Hlahleni's assistance in the field whenever it was necessary. I also, extend my gratitude to Siya Mazibuko and Agriculture Research Council (ARC) Institute for Soil Climate and Water for contributing data and information to this project willingly. I am ever mindful of and indebted to the ARC Onderstepoort Veterinary Institute (Parasitology division), South Africa for their assistance in identification of village chicken

ectoparasites. To those I did not mention by name, you are important and I am thankfully grateful for your priceless contributions. Finally, if it was not for the All-powerful God, my Father, I would have fainted along the way, thus I thank Him for upholding me with His righteous right-hand. Jesus you are my all.

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List of Abbreviation

ARC	Agricultural Research Council
ARDRI	Agricultural and Rural Development Research Institute
EVM	Ethno-Veterinary Medicine
FAO	Food and Agriculture Organization of the United Nations
FEOC	Faecal Egg and Oocyst Counts
FSH	Follicle Stimulating Hormone
ISCW	Institute for Soil Climate and Water
LH	Luteinizing Hormone
LHRH	Luteinizing Hormone Releasing Hormone
ND	Newcastle Disease
NRF	National Research Foundation
SEM	Standard Error of the Mean
SAS	Statistical Analysis Systems
SPSS	Statistical Package for Social Sciences

Chapter 1: Introduction

1.1 Background

Poultry production is an integral agricultural activity for most rural communities in Africa. It provides rural households with scarce animal protein in the form of meat and eggs and is a reliable source of petty cash (Kalita *et al.*, 2004; McAinsh *et al.*, 2004; Njenga, 2005). Rural poultry have also been reported to be used for traditional ceremonies and festivals in some cultures (Alders, *et al.* 2007); hence they contribute significantly to the livelihoods of the most vulnerable rural households in developing countries.

It is estimated that up to 70% of poultry products in the developing world are produced by resource-limited farmers and in family-managed poultry systems (Sonaiya, 2000), of which 80% are found in rural areas under the free range system (Alders and Spradbrow, 2001). However, rural poultry is not rated highly in the mainstream national economies because of the lack of measurable indicators (Alders and Spradbrow, 2001). In many African countries, rural poultry is generally described as low-input low-output enterprise. Rural farmers attach low value to poultry in relation to other livestock, and thus are often ignorant of small changes that could enhance the quality, health and productivity of their flock sizes (Acavomic *et al.*, 2005). An extra effort in the management of poultry housing, feeding, and animal health care will increase productivity significantly (Sonaiya, 2000; Bebora *et al.* 2005). The number of eggs per hen per year and flock sizes are generally low with relatively high mortality rates (Gondwe and Wollny, 2007; Mapiye *et al.*, 2008). Despite being low-output, poultry products are diverse and are utilized by the majority of people in rural areas (Tadelle *et al.*, 2003).

Although other poultry species which include ducks, turkeys, guinea fowl, quail, and pigeons are important in village systems, village chickens are the most important and major poultry species (Acavomic *et al.*, 2005). Village chickens are the predominant livestock species in many rural areas of the developing countries and comprise mainly of nondescript breeds (Ahlers *et al.*, 2007). Other names for village chickens include rural, backyard, indigenous, scavenging, traditional, local, native or family chickens (Moreki, 2010).

During the day these chickens are often left to scavenge for feed around the homestead and in the fields after crop harvests and then confined at night or left to roost on trees overnight. Occasionally, the chickens are given energy rich supplementary feed (Moreki *et al.*, 2010). Under such conditions village chicken production is greatly influenced by environmental conditions and health challenges. In fact, Acavomic *et al.*, (2005) reported that there is a constant disease challenge to scavenging chickens because of the different ages in a flock, possible transfer from wild birds, and constant use of the land by poultry. Parasitic infections also are ubiquitous and high infection load results in clinical disease (Oniye, *et al.* 2001). Since village chickens are kept with minimal input by resource-limited farmers, relatively high mortality, from whatever cause, tends to be tolerated. Parasitism ranks high among factors that threaten village chicken production (Muchadeyi *et al.*, 2007) and these birds are also highly susceptible to predation (Phiri *et al.*, 2007; Mungube *et al.*, 2008).

Chicken parasites and diseases are commonly controlled through the use of conventional drugs. These drugs are expensive for most rural farmers and may be unavailable in some developing

countries (Molento, 2009). In addition, most farmers in rural areas lack adequate knowledge on use of conventional drugs and have limited access, if any, to appropriate veterinary services (Masika and Afolayan, 2003). Thus, most communal farmers resort to alternative remedies referred to as ethno-veterinary medicines (EVM) as a measure of treating diseases and/or controlling parasitic infections (McDevitt *et al.*, 2006).

Characterization of village chicken production can be achieved when all the factors of the production environment and interaction between local chickens and human beings are described (Gondwe and Wollny, 2007). In this context, this entails evaluating chicken flock management in terms of feeding, housing and health; evaluating household flock structure and its characteristics; monitoring flock dynamics and identifying constraints and potentials of village chicken production. In addition, seasonal variation has to be considered as it is an important factor which influences village chicken production (Tadelle *et al.* 2003).

1.2 Problem statement and Justification

Although village chicken production significantly contributes to the lives of many rural people, it is greatly compromised by factors such as poor management practices; health challenges as well as adverse weather conditions. However, there is limited research on village chickens in South Africa. This makes village-chicken based developmental programs difficult to design and implement. Although some studies have been conducted in the Limpopo and Kwa-Zulu Natal Provinces on characterization of village chicken production (Swatson *et al.* 2002), the fact that village chicken production varies from area to area depending on the socio-economic, cultural and biological factors (Muchadeyi *et al.*, 2007), makes an investigation imperative in the Eastern

Cape Province. There is, therefore, need to characterize village chicken production in the Eastern Cape Province so as to contribute to the body of knowledge and lay a platform for modeling interventions to develop holistic improvement strategies. Furthermore, strategic increases in the production of rural poultry flocks will greatly assist in addressing the challenge of fighting poverty and malnutrition (Sonaiya *et al.*, 1998; Gillespie and Flanders, 2009).

1.3 Objectives

The main objective of this study was to characterize village chicken health and management practices in rural Eastern Cape Province of South Africa. The specific objectives of the study were to determine:

- i. the village chicken production management practices employed by rural farmers;
- ii. seasonal variation in village chicken flock dynamics and management practices;
- iii. seasonal prevalence of gastrointestinal parasites in village chickens; and
- iv. seasonal prevalence of ectoparasites in village chickens.

1.4 Null Hypotheses

- i. There are no differences in the management practices of the village chicken production systems employed by rural farmers;
- ii. There is no seasonal variation in village chicken flock dynamics and management practices;
- iii. There is no seasonal variation on the prevalence of endoparasite in village chickens;
- iv. There is no seasonal variation on the prevalence of ectoparasite in village chickens.

1.5 Chapter outline

While this chapter has provided a background to the study, identified the research problem and defined the objectives of the study, the next chapter goes on to review the available literature on village chicken production in order to situate the study within the context of other related studies. Chapter 3 is preoccupied with the village chicken production management practices in the rural Eastern Cape Province and then the seasonal variation in village chicken flock dynamics and management are detailed in Chapter 4. After establishing health challenges as one of the main causes of losses in chicken flocks, Chapter 5 gives a detailed description of the farmers' perceptions on these health challenges and management aspects. The health challenges are reported to be parasite infestations and parasitic diseases. Thus to ascertain these perceptions, Chapter 6 and 7 establish the seasonal prevalence of endoparasites and ectoparasites, respectively. Finally, the general discussion, conclusion and recommendations are given in Chapter 8.

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Chapter 2: Literature Review

2.1 Introduction

Village chicken production is common in rural areas of most developing countries and constitutes mostly locally unimproved chickens (Sekeroglu and Aksimsek, 2009). In these countries, village chicken production is based on traditional scavenging system (Branckaert *et al.*, 2000; Sharma, 2007). These chickens play a vital role in the livelihoods of rural communities in developing countries by supplying rural people with quality food in the form of meat and eggs, as well as additional income (Kalita *et al.*, 2004). In addition, village chickens have cultural, social and sanitary functions in everyday village life (Kitalyi 1998; Zaman *et al.*, 2004). Thus, the challenge of fighting poverty and malnutrition can be effectively met to a large extent by strengthening village chicken production (Sharma, 2007).

In spite of the above mentioned important roles, village chicken production has been neglected in areas of scientific research (Sekeroglu and Aksimsek, 2009). There is limited information on its characterization and development efforts to improve the management and breeding systems in South Africa (Swatson, 2002). Thus, this study was undertaken to characterize the village chicken production systems in terms of production practices, flock dynamics and factors affecting village chicken production in the Eastern Cape Province. This is envisaged to lighten the way of forthcoming researches in village chicken production in South Africa. Literature regarding village chicken production characterization was reviewed under the following subtitles: roles of village chickens and challenges of village chickens.

2.2 Roles of village chickens

Village chickens play a significant role in the livelihoods of resource-limited farmers, contributing to their incomes, wealth, insurance against shocks, diet quality, culture, religion, and tradition (Njenga 2005; Kimani *et al.*, 2006; Sonaiya, 2007). In Botswana, village chickens are reared for five main reasons: family consumption, source of income, prestige, traditional ceremonies, and barter trade (Moreki, 2010). Muhiye (2007), in Ethiopia, reported that the main objectives of chicken production are for sale (44%), replacement (34%) and consumption (20%). Mack *et al.* (2005) stated that although village chickens contribute significantly to the livelihoods of the vulnerable rural households in developing countries, not much assessment has been done in one of the poorest provinces in South Africa, the Eastern Cape. An understanding of the contribution of village chickens in terms of nutrition and income to resource-limited farmers is imperative.

2.2.1 Nutritional and socio-economic purposes

Chickens have provided nutrition to human beings since their domestication over 8000 years ago (Muchadeyi *et al.*, 2004). Village chickens are kept for protein nutrition and as a means of sustaining or improving livelihoods in rural areas (Mwale and Masika, 2009). Together with other livestock species, they make a vital contribution to the total household and farm enterprise (Karbo *et al.*, 2002). Aboe *et al.* (2006) affirms that village chickens play an important role in the economy of many rural areas. Muchadeyi *et al.* (2004) stated that given a choice, farmers would prefer chicken meat to other types of meat. The chickens provide their owners with economic and nutritional benefits with little or no inputs (Adongo 2004; Reta, 2009).

In Mozambique, Alders *et al.* (2007) reported that village chickens contribute to HIV/AIDS mitigation mainly through improved household food security and income generation. This was also affirmed by Moreki *et al.* (2010a) and Kingori *et al.* (2010). These chickens provide a source of high quality protein in the form of meat and eggs to many rural households (Aganga *et al.*, 2000). Eggs in particular, offer an important source of nutrition and are one of the best sources of quality protein. In addition, eggs supply various vitamins which include vitamins B6 and B12, and can be stored for several days under village conditions (Moreki, 2010). The most commonly reported nutrient deficiencies in both children and adults are vitamin A and iron (Sonaiya, 2007), which can be obtained from poultry meat and eggs. According to Goe (2005), some strategies employed by HIV/AIDS affected households to achieve food security include *inter alia* raising poultry and selling livestock products. Chicken and egg sales are decided by women (Aklilu *et al.*, 2007) and therefore provide women with an immediate income to meet household expenses (for example food items) instead of expecting men to provide the cash. Women describe poultry as the means that helps them to survive daily (Muchadeyi *et al.*, 2004; Aklilu *et al.*, 2007).

Village chickens can be slaughtered for home consumption or sold to buy groceries including vegetables and fruits which supply minerals and vitamins (Moreki *et al.*, 2010b). Furthermore, chickens can be sold to pay for clothing, medication, school requisites, as well as, transport fees to enable the sick persons to get to medical facilities for treatment, for example, antiretroviral (ARV) therapy (Moreki *et al.*, 2010). In agreement Muchadeyi *et al.* (2004) indicated that where food sources are low, chickens would be sold and the money used to buy food items for household consumption. Village chickens could also be sold to purchase small-stock (sheep and

goats), which contribute towards family needs through provision of milk, meat and skins (Moreki *et al.*, 2010).

In Ethiopia, village chicken keeping is perceived as the first step on the ladder for poor households to climb out of poverty (Aklilu *et al.*, 2007). They are also referred to as the last resource indicating it as the only capital that households have left when declining into poverty, for example, because of droughts (Reta, 2009). Village chickens and other poultry act as starting capital used to attain other livestock like cattle (Aklilu *et al.*, 2007; Musemwa *et al.*, 2008). Even after they get cattle, they continue keeping chickens because these birds are protectors of other livestock in that selling village chickens prevents the sale of other breeding flocks like sheep, goats and pigs when there is the need to cover immediate, but relatively small expenses (Muhiye, 2007).

In the research conducted in Centane district of the Eastern Cape Province, Mwale and Masika (2009) reported that the main role of village chickens was provision of meat. Moreki *et al.* (2010a) reported on the relative importance of chickens for food security rather than for income findings. According to Anderson (2001), rural households are vulnerable to uncertain events and often have insufficient resources to act as buffers during critical periods. In agreement, Reta (2009) also states that another important function of village chickens is their bartering value. Hens and cocks may be exchanged for farm implements in remote areas where there is no circulation of currency (Aklilu *et al.*, 2007). The extent to which chickens are used as buffers, however, depends on the socio-economic status of the rural households. Muhiye (2007) reported that when farmers start to own larger livestock like goats, sheep or cattle, the role of chickens

and other poultry shifts from cash income generation and buffering to the luxurious consumption of village chickens and eggs. For the poor, the consumption of meat and eggs from their own poultry is considered unaffordable (Muchadeyi *et al.*, 2004).

The digestive system of chickens is not very efficient in utilizing nutrients consumed thus making chicken faecal matter relatively rich in nutrients. This faecal matter can be used as manure to fertilize gardens to ensure constant supply of vegetables and fruits to the families (Moreki *et al.*, 2010) or sold to generate extra income (Njenga 2005). Chicken manure is regarded as of high value for vegetables in comparison to goat or cattle manure (Muchadeyi *et al.*, 2004; Kimani *et al.*, 2006), but its usage may vary across agro-ecological regions due to socio-cultural differences.

2.2.2 Socio-cultural purposes

In most rural communities village chickens are kept for cultural purposes, such as gifts, payment of bride price and for religious rituals referred to as socio-cultural activities (Aning, 2006). Chickens can be given to relatives and friends as gifts or as token of appreciation for services rendered (Muchadeyi *et al.*, 2004). The preferred taste of chicken meat makes households reserve them for special guests or ceremonial gatherings, such as marriage feasts, weddings or funerals. In most remote areas of developing countries, women who can provide men with food like a chicken dish are considered to be contributing to a stable marriage (Kingori *et al.*, 2010). Serving this is also a demonstration of respect to guests (for example in-laws), thus strengthening social relationships which is especially important for poor households (Muchadeyi *et al.*, 2004;

Aklilu *et al.*, 2007). Muchadeyi *et al.* (2004) also reported that village chickens may be used to maintain contact with relatives by entrusting the other family members with some chickens.

There are cultural traditions determining the consumption of village chickens that affect nutrition within some household. Muhiye (2007) reported that customarily, the meatiest and most nutritious parts of the carcass are served to men, for example, the meat on the gizzard, drumsticks and breast bones. It is believed that meaty viscera are especially good for improving the strength of old men and increasing their libido (Aklilu *et al.*, 2008). Aklilu *et al.* (2008) also stated that the lower-quality parts like the neck, wings and skin are served to women and children and as a consequence men consume more chicken meat. Thus in such setups nutritional imbalances within the household members are bound to occur.

For the poor, poultry meat is the only special meal they can afford during religious festivities like New Year, Christmas and Easter (Muhiye, 2007). Aklilu *et al.* (2007) stated that it has also become common for live birds to be given to sick people. Cocks are used as alarm clocks of dawn and as offerings to deities (Muhiye, 2007). White feathered chickens are believed to divert bad spirits that target a family member, and farmers in some remote areas attach more importance to such functions (Aklilu *et al.*, 2007). This explains why many households want to keep at least one chicken in their household (Aklilu *et al.*, 2008). In general, socio-cultural roles tend to be more important in areas with the poorest market access (Aklilu *et al.*, 2008). The magnitude of the roles of chickens differs with communities and it is inappropriate to extrapolate findings from other countries, provinces and districts which necessitated studies in Amatola

Basin. There are, however, challenges or constraints that farmers face when keeping these chickens which adversely affect village chicken productivity at the end of the day.

2.3 Challenges faced by farmers

Poor reproductive performance, poor growth rates, diseases, parasitism, mortality, predation and lack of organized markets are some of the major constraints in smallholder chicken production systems (Muchenje and Sibanda, 1997). Chicken productivity, as determined by the number of chickens that are sold, is low (Mwalusanya *et al.*, 2002). There is need to understand the constraints that village chicken producers face, which are complex in nature and varying among households due to the different biological, social and economic factors that influence production methods and, consequently, productivity levels (Mwalusanya *et al.*, 2002).

Since village chickens have low value compared to other livestock, villagers are often ignorant of small changes that could enhance the quality, health, productivity and numbers of chickens in their flocks. Not much has been done in the past to educate villagers in these small changes that would benefit poultry production (Acavomic *et al.*, 2005). Chicken rearers during a study in Zimbabwe were reported to have low levels of education (Mwale *et al.*, 2005). This is in agreement with Swatson *et al.* (2002) who reported that village chicken production is carried out with minimal agricultural, veterinary or marketing extension support. Households make use of their indigenous poultry rearing knowledge acquired over a long period of time. A study done in Vhembe district of the Limpopo Province by Swatson *et al.* (2002) showed that there are no farmers or poultry organizations from which households can obtain poultry husbandry

information. The authors also stated that chicken farmers tend to share relevant information with neighbors, usually when there is a disease outbreak or there is need to market chickens.

Feed quality and availability for village chickens are challenges, although the range of feed stuffs for these chickens is probably greater than for herbivores (Acavomic *et al.*, 2005). Nutritional constraints in the use of most plant feedstuffs are probably greater in poultry than in ruminants, since poultry have a limited ability to utilize fibrous feedstuffs and are susceptible to a greater range of anti-nutrients and toxins compared to ruminants (Acavomic *et al.*, 2005). Similarly, the size of seeds and their resistance to being mechanically degraded can be disadvantageous. Chickens, however, are highly selective in what they consume, thereby overcoming physical deterrents such as spikes and thorns present in some potential feeds. They select insects and nutritious parts of plants that are inaccessible to other animal species (Kingori *et al.*, 2010).

2.3.1 Minerals and vitamins

It is possible that in the purely-scavenging systems mineral imbalances may occur, and also that vitamin deficiencies, especially A and E, may occur in environments where cereals are the main constituent of diets (Acavomic *et al.*, 2005). Deficiency of vitamins is likely to cause ill-health in chickens and reduced hatchability in eggs. Similarly, deficiencies of minerals, especially calcium, will cause problems with egg-shell quality and thus reduces hatchability and increases fragility of the eggs (Acavomic *et al.*, 2005). In areas where there are high deposits of heavy metals, or where scavenging chickens consume by-products from industrial sources and sewage sludge and slurry, it is possible that mineral toxicity may occur. However, neither vitamin nor

mineral deficiencies nor toxicities have been mentioned as problems for village chickens in literature.

2.3.2 Cereals and crop products

In purely scavenging chicken production systems, foodstuffs are not produced for consumption by chickens (Acavomic *et al.*, 2005). They are frequently left to scavenge seeds after harvest or from grasses and other weeds that are available. Thus the feed supply is variable and seasonal. Sometimes they are provided with supplementary waste seeds or by-products from cereal and other grains (Sonaiya, 2000). The provision of supplementary feed is indiscriminate and all age groups compete for the supplement (Muchadeyi *et al.*, 2004). In general, well-fed chickens have high growth rates and are fertile and less prone to diseases and parasitic infestations (Dessie and Ogle, 1996).

2.3.3 Protein

When giving supplementary feed to scavenging chickens, it may be practical to make use of a combination of unconventional protein sources rather than the expensive supplements (Swatson, 2003). This could overcome the protein quality limitations of scavenged diets. However, Smith (1990) and Ogle *et al.* (2004) stated that shortage of protein in scavenging feed resource base is not presumed to be a major constraint. Mapiye *et al.* (2008) also affirmed that chickens are expected to get adequate protein from scavenging insects and snails. In disagreement, Swatson (2003) acknowledged that protein is usually a limiting nutrient in village chicken production and stated that plants such as bambara nuts, cowpeas, and pumpkins can also be used as protein sources.

2.3.4 Housing

During daylight hours village chickens are frequently allowed to scavenge whatever food they can find in the local environment. In the evening these chickens are housed in varying ways (Mwalusanya *et al.*, 2002; Acavomic *et al.*, 2005). In some cases the chickens are allowed to roost in the branches of trees or in closed baskets hanging from trees (Acavomic *et al.*, 2005). However other facilities, such as baskets within the keeper's dwelling, are used in India (Acavomic *et al.*, 2005). These baskets can be located on the floor or in the rafter space within the dwelling. This is the most secure overnight location for avoiding predation and theft (Acavomic *et al.*, 2005). Other forms of housing include wooden or brick-build accommodation which is separate from the family dwelling. These houses tend to be less prevalent, primarily because of the cost of construction. Also brick-built housing tends to be difficult to clean and thus presents a potential threat due to the build-up of pathogens (Muchadeyi *et al.*, 2004). Studies in South Africa demonstrated that a majority of farmers provided housing for their chickens constructed with corrugated iron sheets, wooden poles and wire mesh (Moyo, 2009; Mwale and Masika, 2009).

Proper housing must not only provide an environment that moderates environmental impact but must provide adequate ventilation for birds to lay eggs in nest boxes, as well as to feed and sleep in comfort and security (Katie, 1990). The construction of proper housing using cheap, durable, locally available resources and skilled labour can go a long way in improving village chicken production (Kusina and Kusina, 1999). Mapiye *et al.* (2008) stated that resource-limited farmers use cheap and locally available material to build chicken houses. Furthermore, housing material normally depends on the size of the undertaking, land, capital, durability, warmth, ease of

cleaning and feeding, and on the attitude of the farmer (Kusina and Kusina, 1999). Village chicken studies conducted in communal areas of Zimbabwe highlighted the need for good housing to reduce losses from predators, diseases and environmental hazards (Kusina *et al.*, 2001; Pedersen, 2002). Lack of adequate housing contributes to chicken mortalities (Mapiye and Sibanda, 2005). Thus good housing is a prerequisite for any viable and sustainable chicken project. In most resource-limited households the condition of the chicken housing in terms of space, ventilation and cleanliness has adversely affected the health of village chickens-thereby exacerbating diseases and parasitic infestations.

2.3.5 *Chicken health problems*

2.3.5.1 Diseases

Poultry production has undergone rapid changes due to the introduction of modern intensive production methods, new breeds, improved bio-security and preventive health measures (Permin and Pedersen, 2002). In developing countries, however, adoption of this type of production has been limited due to the need for high inputs. The progress in industrial poultry production methods has thus had little effect on subsistence poultry production in the rural areas. In contrast to modern poultry production, village chicken production is often characterized by a range of diseases occurring concurrently (Permin and Pedersen, 2002). Swatson *et al.* (2002) reported that diseases and parasites were the major constraint to village chicken production in the Limpopo Province of South Africa.

There is a constant disease challenge to scavenging chickens because of the different ages of the chickens in a flock, possible transfer from wild birds, and constant use of the land by chickens

(Acavomic *et al.*, 2005). Since village chickens are kept with minimal input by resource-limited farmers, relatively high mortality, from whatever cause, tends to be tolerated. Although this is common where there is little input and less so with higher input systems, chicken-keepers aspire to have higher survivability and health in their flocks (Tadelle and Ogle, 2001; Perderson, 2002). Furthermore, commercial producers desire to ensure good health of village chickens to try and avoid the village poultry acting as reservoirs for diseases such as Newcastle disease and Avian Influenza.

The problem of diseases in village chickens is compounded by the interactions of different entities that are of significant importance to disease epidemiology (Permin and Pedersen, 2002). At the village level, contacts between flocks of different households, the exchange of birds as gifts or entrusting, sales and purchases are the main sources of infection transmission. Similarly, other domestic fowls and wild birds form another source of infection, because the chickens roam freely in the villages. Pandey (1993) suggested the need to develop appropriate epidemiological techniques for village poultry, because of the nature of the host-pathogen-environment interaction in village chickens. The complex nature of disease epidemiology in village chickens is found both in epizootic as well as in enzootic diseases (Perderson, 2002).

A majority of village chicken mortalities take place within the first 3–4 months after hatching (Wilson *et al.*, 1987). In agreement, Mapiye and Sibanda (2005) affirmed chick mortality as one of the major constraints in chicken production. For the same reasons the owners never include chicks when they refer to the flock size. The high mortality is believed to be caused by mismanagement, lack of fresh water and supplementary feed, predation and diseases (Pandey,

1993). Of these, diseases are believed to be the main limiting factor to the production of indigenous chickens (Aini, 1990). The degrees to which different diseases affect village chickens, however, vary from place to place depending on epidemiological conditions.

Little research has been published on rural poultry health, despite the fact that up to 80% of the poultry population in Africa and Asia is kept by the households as free-range chickens (Minga *et al.*, 1989; Aini, 1990; Henning *et al.*, 2009). Newcastle Disease is regarded as the principal factor limiting rural poultry production in all African and Asian countries (Henning *et al.*, 2009). Newcastle disease (ND) may kill up to 80% of household poultry in Africa (Bell, 1992; Alexander, 1997; Henning *et al.*, 2009), but is not expected to account for the high early mortality rate according to the authors. In addition, detailed epidemiology of the disease in the village situation is largely unknown (Yongolo, 1997; Henning *et al.*, 2009). Furthermore, studies have shown that other diseases are present in scavenging poultry communities (Cumming, 1992; Henning *et al.*, 2009). In Tanzania, Permin (1997) examined 600 live chickens and found a range of diseases. All chickens were also parasitised with one or more (up to 14 species) species of endoparasites, mostly *Cnemidocoptes mutans*, *Dermanyssus gallinae* and/or *Echidnophaga gallinacean*. Endoparasitic infestations cause anaemia and markedly impede chicken productivity thereby undermining the valuable contribution of chickens towards rural livelihood (Mwale and Masika, 2009). In agreement, Duncan and Hawkins (2010) stated that internal parasites live inside their hosts and rob their hosts of food or blood. It is, thus, fundamental to determine the prevalence of the village chicken internal parasites in Eastern Cape Province.

2.3.5.2 Internal parasites

Parasitism ranks high among factors that threaten village chicken production and has been reported to cause reduced growth, egg production, emaciation, and anaemia as well as mortality (Whitmarsh, 1997; Ruff, 1999; Kaufman *et al.*, 2007). Village chickens are highly susceptible to predation and most importantly to parasites (Phiri *et al.*, 2007; Mungube *et al.*, 2008). Mwale and Masika (2009) reported that the majority of farmers in Centane District of the Eastern Cape Province have problems with chicken parasites. The authors also stated that parasites were perceived to be the main contributor to chicken mortality (51.6%), whereas 34% of respondents alleged parasites to cause reduced growth rate and egg production.

Intestinal parasites are common in chickens in the backyard type poultry flocks. They can severely reduce the productivity of poultry and cause mortality in the most severe cases. The chickens pick up eggs of parasites directly by ingesting contaminated feed, water, or litter or by eating snails, earthworms, or other insects (intermediate hosts) which can carry the eggs, (Soulsby, 1982; Butcher and Miles, 2009). Mortality due to gastro-intestinal parasitic diseases was reported higher than that attributed to ND (Permin and Pedersen 2002). It should be noted that the presence of a few parasites does not usually cause a problem, however, large numbers can have a devastating effect on growth, egg production, and over-all health (Butcher and Miles, 2009; Donna, 2010). External parasites also have adverse effects on the well-being of chickens and hence need to be well understood.

2.3.5.3 External parasites

External parasites may cause considerable loss in chicken productivity, particularly lowered egg production (Dlamini, 2002; Mbaya, 2007). Serious parasite problems are more likely to occur in laying flocks than broilers (Mbaya, 2007). Common chicken external parasites range from lice, mites, fleas, to ticks (Nnadozie, 1996). Some of the ectoparasites, especially ticks and mites, are vectors of other poultry diseases such as Fowl pox, Newcastle disease, and possibly Pasteurellosis (Ruff, 1999; Denmark and Cromroy, 2006). Studies in some countries show that the prevalence of parasitic infestations in village chicken flocks is close to 100%, and in most cases individual chickens harbour more than one parasite type (Permin, 1997).

An earlier study revealed external parasites as a major constraint to chicken production in South Africa (Wilson, 1986). Various external parasites have been reported in village chickens, the most common ectoparasites in South Africa included mites, fleas, lice and ticks (Dlamini, 2002; Moyo, 2009). However, Moyo (2009) reported that fleas were the most common ectoparasite in the Eastern Cape Province of South Africa, but workers from other countries affirmed lice and mites as the most common (Davies, 1955; Roberts, 2000). In the Eastern Cape Province (South Africa), Moyo (2009) reported that farmers considered several external parasites to be a problem: mites (79.6%), stick tight fleas (64.5%), lice (10.8%) and ticks (6.5%). However, the report by Moyo (2009) does not account for the influence of seasonal variation on prevalence of ectoparasites.

Deaths resulting from infestations of external parasites are rare, but production losses often occur (Adene and Dipeolu, 1975). For example many external parasites suck blood which often causes

birds to become anaemic. Mites and lice have been reported to be the most destructive external parasites (Beyer, 1999; Biswas *et al.*, 2008). Occasionally other parasites such as fleas, ticks, and bedbugs infest poultry and cause problems. In fact, if external parasites are not controlled, chickens can become uncomfortable, at best. If the situation is allowed to continue unchecked, a chicken can become seriously ill and even die (Campbell, 1989). This can be particularly problematic in the warmer months, where a minor infestation can quickly multiply, with devastating consequences (Campbell, 1989). External parasites can easily be spread from chicken to chicken and are often a consequence of overcrowding and poor hygiene.

External parasites can be detected on the external surfaces of the body by way of a thorough physical examination in predilection sites (Ikpeze *et al.*, 2008). These parasites cause chick mortality attributed to starvation and immune depression under heavy infestation (Pickworth and Morishita, 2007; Biswas *et al.*, 2008). Periodical examination of the flock can help to detect an early infestation for prevention of an outbreak to a larger flock (Pickworth and Morishita, 2007). Moreover, many of the parasites have an environmental component so treating the environment is necessary for controlling infestations. Mungube *et al.* (2006) stated that in most of the developing countries inappropriate housing and lack of appreciable parasite control efforts also lower village chicken production potential. Therefore, it is imperative to urgently plan for novel approaches to counter parasitic infestations, diseases and their subsequent adverse effects on village chickens.

2.3.5.4 Control of health problems

Parasite infestations and diseases can be controlled effectively through the use of conventional drugs; however such drugs are associated with a number of limitations in rural communities. Such limitations include unaffordable prices, risk in misuse or abuse leading to ineffectiveness of the drugs, pollution of environment and residuals in chicken meat and eggs (Molento, 2009). However, the main reason limiting use of conventional drugs by most rural farmers in developing countries is poor access because of distance and exorbitant prices (Mwale and Masika, 2009). Thus, most rural farmers resort to alternative remedies and/or practices, especially ethno-veterinary medicines (EVM), when a disease or infection presents itself as a measure of control or treatment (McDevitt *et al.*, 2006).

Mathius-Mundy and McCorkle, (1989), defines EVM as people's knowledge, skills, methods, practices and beliefs about the care of their animals. Through trial and error, using their own indigenous knowledge, farmers incorporate use of conventional medicine and at times in combination with EVM (Moreki *et al.* 2010b). A range of ethno-veterinary practices in different combinations are used to treat and/or control different health problems as perceived by farmers in the Eastern Cape Province (Mwale and Masika, 2009). This is because, among other factors, South Africa is endowed with invaluable plant resources that are cheaply accessible to resource-limited farmers (Van Wyk, and Gericke, 2000).

Ethno-veterinary medicines are a major answer to the health problems faced by resource-limited farmers (Swatson, 2003; Gondwe and Wolly, 2007; Muchadeyi *et al.*, 2007), as communal farmers are subsistence-oriented and have limited use of technology and external inputs

(Gondwe and Wolly, 2007). The knowledge of EVM, however, like any other traditional knowledge system is transmitted orally from generation to generation (Confessor *et al.* 2009) and it is disappearing because of rapid socio-economic, environmental and technical changes (Mwale and Masika, 2009). This implies that this knowledge has high risk of being lost from generation to generation if nothing is done to document it for current and future use. Furthermore, research on EVM with village chicken production is limited in South Africa (Swatson, 2002). Mwale and Masika (2009) also stated that there is particularly dearth of information in the Eastern Cape province of South Africa on the use of EVM in village chickens. The use of EVM is presumed to lead to improved rural poultry health and productivity in developing countries (Guèye, 1997). Some other factors which cause ill-health and cannot be treated for do exist, and these factors also adversely affect village chicken productivity significantly.

2.3.5.5 Other cases of ill-health

Some cases of ill-health (a state of poor health) occur because of lack of nutritious feed, as well as the consumption of feedstuffs that contain toxic or anti-nutritional compounds (Acavomic *et al.*, 2005). Conversely, the consumption of feedstuffs with some anti-nutritional or toxic compounds may have beneficial effects because of their effects on the microflora and parasites within the gastro intestinal tract (Acamovic and Brooker, 2005). Ill-health amongst other factors such as weather, nutrition and low genetic potential may also have adverse implications on the productivity of village chickens.

Predation is a significant cause of loss in village chickens. Swatson *et al.* (2002) stated that predation is the second major constraint to village chicken production after diseases and

parasites. Young chickens below eight weeks of age are extremely vulnerable to predators, which can account for more than 80% of the mortality (Acavomic *et al.*, 2005). Huque (1989) reported that 18-32% of all chick mortalities are due to predation during the brooding period. Studies in Southern India also showed that 21% of all birds died because of predation and this amounted to 73% of all deaths (Natarajan *et al.*, 2004). Halima (2007) also reported that predation was one of the major village chicken production constraints in North West Ethiopia. Bell and Abdou (1995) also reported that a large proportion of village birds were being lost due to predators in some African countries. Reproduction is the key to ensuring continued existence of all organisms through generation of offspring which makes it imperative even to village chicken production.

2.3.6 Reproduction

Egg production and hatchability are compromised in hot conditions especially when humidity is high. Lack of viability and poor quality of eggs are due to a variety of reasons. These include the fact that eggs may become wet and dirty, which allows the transfer of bacteria through the shell into the contents. Secondly, exposure of eggs to high temperatures may lead to premature embryo death (Acavomic *et al.*, 2005). Village chicken productivity is inefficient, characterized by high reproductive wastage and low productive performance (Tadelle and Ogle, 2001; Perderson, 2002). Any management factors that have a positive effect on egg production and chick survival can be used to increase the output from village chickens (Mapiye *et al.*, 2008). The other challenge village farmers are faced with is that village chickens reach point of lay at 26-30 weeks (Perderson, 2002), and this is fairly late compared to layer breeds that normally reach point of lay at 18-22 weeks (Mapiye *et al.*, 2008).

2.3.7 Other major challenges

Some of the major constraints in village chicken production include: shortage of labor, neighborhood conflicts, damage of garden and crops, shortage of space, lack of financial capital and effect on family members' health as supported by (Aklilu, 2007). Productivity of laying chickens also decreases after a year in a production-line, thus laying chickens should be culled after two years. However, keeping of laying birds for a longer period to ensure continuous supply of eggs and chicks in rural communities is a common practice (Mengesha *et al.*, 2011). A better understanding and modulation of village chicken constraints can improve food security and raise standards of living of the rural families (Mapiye *et al.*, 2008).

2.3.8 Strategies against challenges

To harness the potential of village chicken Kitalyi (1998) suggests an approach, aiming at increasing flock productivity through improved extension services, farmer training and preferential treatment of chicks and the breeding stock. However, the causes, magnitude and consequent impact of the problems for the village chicken productivity under traditional management must be studied and well documented before attempting any technological intervention to improve village chicken production.

2.4 Summary of literature review

Village chickens contribute significantly towards rural communities in Africa, providing scarce animal protein in the form of meat and eggs as well as being a reliable source of petty cash. Despite the important roles of these chickens, their productivity is hampered by a number of challenges which include: nutrition, housing and health (diseases and parasites). Although

research has been conducted in other provinces in South Africa on characterization of village chicken production, there is, dearth of information in the Eastern Cape Province of South Africa. It is imperative to conduct a specific investigation in the Eastern Cape Province because of the fact that village production varies from place to place depending on the socio-economic, cultural and biological factors. Therefore, the main objective of this study was to characterize village chicken production in the rural areas of the Eastern Cape, South Africa.

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Chapter 3: Village chicken production practices in the Amatola Basin of the Eastern Cape Province, South Africa

(Submitted for publication to the African Journal for Agricultural Research)

Abstract

A majority of rural households in South Africa own village chickens which contribute significantly to their livelihoods, yet there is dearth of information on production practices of this enterprise. Thus, this study was conducted to determine the village chicken production practices in the Amatola Basin of the Eastern Cape Province. Data were gathered using a questionnaire survey of 81 households. They were identified from 7 villages using snowball sampling technique. Village chickens were mostly (60%) owned by women and mainly raised to meet household food requirements. Some farmers (28.4%) also occasionally sold their chickens to neighbours, at an average of R50 (USD7.55) per bird. Most chicken flocks (96%) were provided with supplementary feed and drinking water. A majority (93.8%) of households also provided some form of shelter for their chickens. Although most respondents (93.8%) confirmed the use of alternative remedies to control parasites and treat diseases, most chicken keepers (81.5%) experienced chicken losses due to predation and health related problems. Since this study was limited to the documentation of village chicken production, there is need for a further research to ascertain the extent to which chicken management practices and environmental variables affect village chicken production in this area.

Keywords: Ethno-veterinary medicines, free-range, resource-limited farmers, rural, scavenging chickens

3.1 Introduction

Chickens reared under the traditional extensive system constitute one of the important components of rural economy as they supply quality food in the form of meat and eggs, and additional income (McAinsh *et al.*, 2004; Mwale and Masika, 2009). Moreover, village chickens have cultural, social, nutritional, economic and sanitary functions in daily life in the villages (Kitalyi 1998; Zaman *et al.* 2004). Generally, these chickens are produced on a scavenging feed resource base. This means that local chickens live and produce in a broad spectrum of socio-economic and physical production environments (Alders *et al.*, 2007; Gondwe and Wollny, 2007). This environment includes feeding, housing, breeding and health management.

Currently, village chicken production is characterized by low productivity and is generally described as low-input low-output (Aboe *et al.*, 2006). The low productivity is caused by a number of factors, such as sub-optimal management, lack of supplementary feed, low genetic potential, predation and health challenges (Goromela *et al.*, 2006; Mungube *et al.*, 2008). The average number of eggs laid and clutches per hen per year is low and varies from place to place (Aganga *et al.* 2003; Muchadeyi *et al.*, 2007).

Development of village chicken production can be a sustainable way of helping to meet the welfare needs of rural populations and raise their living standards (Sonaiya, 2007; Mapiye *et al.*, 2008; Gillespie and Flanders, 2009). However, there is a dearth of information on research conducted to characterize, understand and develop the village chicken production in South Africa. This makes it difficult to design and implement village chicken-based developmental programmes that will benefit rural livelihoods (Muchadeyi *et al.*, 2005). Understanding the

production, management and breeding systems, and the associated factors affecting village chicken production, is essential to develop holistic improvement strategies (Branckaert and Guèye, 1999). Thus, this study was undertaken to determine the village chicken production practices in the rural Eastern Cape Province and lay a platform for forthcoming research.

3.2 Materials and Methods

3.2.1 Study area

The study was conducted from July 2010 to June 2011 in the Amatola Basin of the Amathole District situated in the Eastern Cape Province of South Africa. The area has an altitude of 1 807 m above sea level, and lies within latitude 32° 31.00 - 32° 45.00 S and longitude of 26° 57.00-27° 02.00 E on the Eastern slopes of the Amatola mountain range. The temperatures in the area range from 4 to 9 °C in winter (June to August) season, 10 to 31 °C in the spring (September to November) season, 14 to 34 °C in the summer (December to February) season and between 14 to 29 °C in the autumn (March to May) season. The Amatola Basin receives an average annual rainfall of about 580-800 mm over the four seasons (ARC-ISCW, 2011).

3.2.2 Sampling procedure and data collection

Pre-tested questionnaires (Appendix 1) were administered to 81 households which kept village chickens identified through snowball sampling technique, where respondents were asked to give referrals to other persons believed to fit the study requirements. This sampling technique was used to ensure that only those households who owned chickens participated in this study. In addition, only individuals who were willing to participate in the research were considered. Information on village chicken production was gathered. Interviews were conducted with the

farmers and key informants, namely chairpersons, herbalists and agriculture extension officers. Farmers' perceptions on village chicken production constraints were also gathered.

3.2.3 *Statistical Analyses*

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS, 2009). Descriptive statistics, cross tabulation, and chi-square (χ^2) for association values were computed.

3.3 Results

3.3.1 *Household demography*

A reasonable number of household heads (49.0%) were over 60 years of age. Most households were female headed (53.0%). Although the majority of household heads (85.0%) were not employed, they had attained some form of education-at least up to primary level (58.0%). A majority of the families (62.0%) received some monthly financial income in the form of old age pension and government grants. A great portion of chicken flocks (60.0%) were owned by women, 36.0% were owned by men, and a few (4.0%) were owned by children. Most village chicken flocks were owned by persons above 60 years of age ($P < 0.05$). Although ownership translated to chicken management in terms of decision making, other household members such as children played a role in looking after the chickens. Respondents that owned the highest number of cattle had large chicken flocks also ($P < 0.05$).

3.3.2 Livestock inventory

Each household owned an average of 17 (± 2 S.E.M.) chickens. Most farmers (68.4%) also owned cattle, goats, pigs, sheep, and other poultry, such as geese and ducks as shown in Table 3.1. However, village chickens were ranked as most important livestock species by most farmers (60.5%). On average each hen had 11.3 eggs per clutch with hatchability of close to 68.0%. Hatchability levels were reported to be influenced by the effect of external parasites (1.2%), predation (8.6%), management (32.1%) and effects of weather (26.7%). Most farmers actually preferred buying eggs instead of eating those laid by their own chickens. Dogs were reported to eat some of the eggs especially from chickens that incubate eggs outside in bushes or in the cattle kraals. On average 5.2 chicks reach maturity. Most chicks are lost due to predation and ill-health, (24.1%) and (33.2%), respectively. Chicken production was not considered an economic venture by most respondents (60%). Instead they saw it as means to cater for household food requirements. Most farmers (91%) did not introduce new chickens to old flocks, but the few who did, neither inspected, vaccinated nor treated new chickens for diseases or parasites before introducing them to the flocks.

Farmers used different criteria when selecting chickens to be retained for production. The majority considered size (63.0%), others the breed (41.0%), color (16.0%) and yet some considered cost (14.0%). Old birds and those with poor productive performances were consumed as a way of culling the flocks.

Table 3.1: Other livestock owned by village chicken farmers

Livestock	Ownership (%)
Cattle and Goats	26.8
Cattle, Goats and Pigs	16.4
Cattle, Goats, Pigs and Sheep	7.3
Pigs	5.1
Cattle	4.6
Goats	3.2
Other Poultry (Geese and Ducks)	5.0

3.3.3 Roles of village chickens

Village chickens were mainly raised for consumption. Respondents considered village chicken meat a delicacy. However, there were a few (28.4%) farmers who occasionally sold some of their chickens to neighbours to get some income. The price for a mature chicken was R50 (USD7.55) on average. Most farmers (74.9%) acknowledged that the market for village chickens was available throughout the year. However, none of the farmers reported selling chicken eggs but a good number (43.2%) acknowledged consuming a few and reserving the rest for incubation. In most cases (63.6%) village chicken eggs were regarded only important for incubation purposes. A few chickens (13.6%) were used as gifts and donations to relatives and friends. Chicken manure was mostly (63.1%) used by respondents to fertilize their home gardens where they grew a range of vegetables. Village chickens were, however, not used in any rituals or traditional ceremonies.

3.3.4 Nutrition

All chicken flocks scavenged for feed; however, the majority of households (96.2%) provided feed supplements. In a few instances (21.4%), specific feed was prepared for chicks. Supplementary feed given to chicks was ground into smaller particles for easy consumption. A majority of respondents (96.1%) threw the supplements to the ground for chickens to pick, while the rest used some improvised feeding troughs. Village chickens were given supplementary feed (74.0%) twice a day (morning and evening), and in some cases (21.0%) just once a day, in the morning. There was, however, one respondent who gave supplementary feed thrice a day (morning, noon and evening). The supplementary feeds comprised of yellow maize, kitchen wastes, sunflower cake, grower's mash for chicks, and wheat. Most farmers (87.3%) bought

yellow maize to supplement their chickens. The quantities given as supplementary feed, however, were based on the individual farmers' judgment and varied from household to household. It ranged from as small as one handful (approximately 100g) of yellow maize grain to about five handfuls (approximately 500g) per day. Furthermore, most chicken flocks (96.2%) were provided with water from different sources which included wells (2.5%), boreholes (7.4%), streams (9.8%), ponds (11.1%), and taps (65.4%).

3.3.5 Housing

Different forms of housing structures were provided for the chickens. However, in a few cases chickens roosted on trees over night (3.6%) and/or in open spaces (3.6%) especially in the kraals. Only 5% of the farmers prepared nesting areas for the chickens. Chicken houses were constructed using a wide range of materials. All structures were roofed with iron sheets. A few structures (8.6%) had solid walls; some had wire mesh (14.4%), whilst most (77.0%) had a combination of iron sheets and wire mesh. Most of the floors were simply compacted soil (82.7%), while some were either cemented (6.2%). A few of the farmers provided some sort of bedding in the form of dry grass and/or crop residues (4.9%). Most chicken houses (96.7%) were cleaned approximately once a month on average.

Figure 3.1 shows an example of a village chicken housing structure in Amatola basin. The type of chicken shelters provided by the farmers depended on availability of resources (75.3%) and were designed in such a way that farmers could enter without complications (6.4%). In some instances (18.3%), however, the shelter provided was influenced by both availability of resources and security. A majority of farmers (59.3%) were of the opinion that the chicken house structures

they had adversely affected the growth and development of their chicken flocks. However, many did not have the financial means to make the necessary improvements.

3.3.6 Health Management

Most farmers (81.5%) acknowledged health related problems were a challenge. They ranged from diseases (20.7%), parasites (26.5%), a combination of parasites and diseases (49.9%), to wounds (2.9%). Figure 3.2 shows the respondents' perceptions on the causes of chicken mortality. The health challenges reported by farmers and remedies used are detailed in Chapter 5 below.

3.3.7 Extension services

Government extension workers specialize in providing advice on layer and broiler chicken production. Only 6.2% of the farmers in the current study acknowledged having had a chance to access some advice or information on chicken husbandry from extension officers. However, the current study revealed no association between advice or information received by respondents and village chicken flock sizes ($P>0.05$). Villagers shared some relevant information with neighbors, usually when there was a disease outbreak or when marketing the chickens.



Figure 3.1: An example of a village chicken housing structure in Amatola Basin

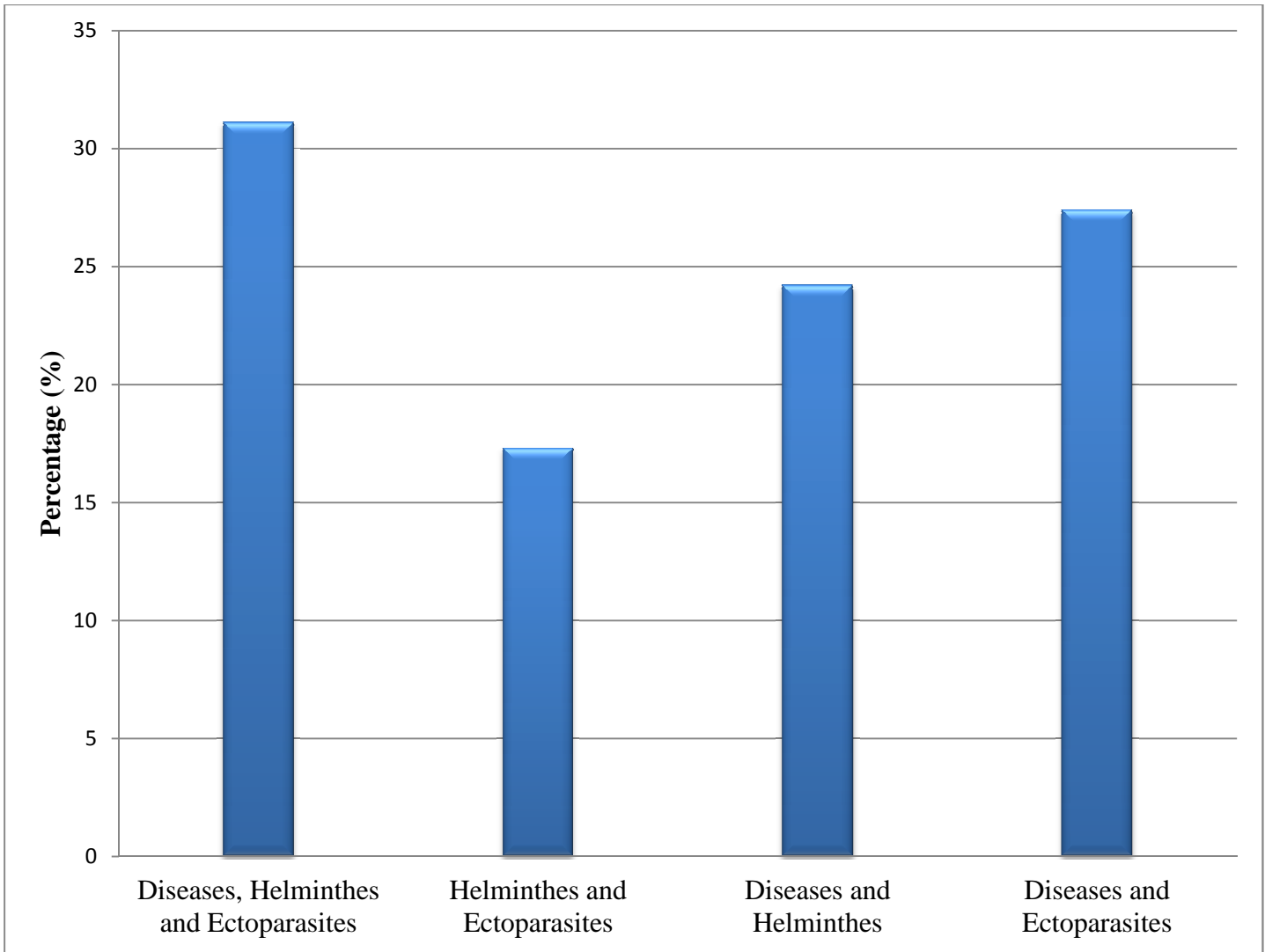


Figure 3.2: Health problems perceived to cause village chicken mortality by rural farmers

3.4 Discussion

The average number of village chickens owned per household was consistent with previous studies (Aning, 2006; Muhiye, 2007; Mwale and Masika, 2009). The small flock sizes may be mainly ascribed to the slow growth rate and poor egg production of village chicken as supported by Phiri *et al.* (2007). In addition, predation and ill-health may also be affecting increment of the flocks (Mapiye and Sibanda, 2005). Although some farmers also owned cattle, goats and sheep, these livestock were generally relatively low in numbers as compared to chickens; hence the latter were regarded as very important by most farmers.

Ownership of chickens was predominantly by women, a finding consistent with Halima *et al.* (2007) and Mwale and Masika (2009), which could be ascribed to the high number of female-headed households. However, in the few male-headed households, most men were the principal owners of village chickens which disagrees with Mwale and Masika (2009) and Moreki (2010). This deviation from the previous findings may be due to the fact that most men in the current study area were not employed and they did not have other larger livestock to concentrate on. Thus, to try and fulfil their responsibilities as principal household providers, men would retain the ownership of chickens. However, those men who also had other livestock in relatively large numbers also co-owned village chickens with other household members.

Selection of chickens was based on phenotypic characteristics, similar to findings in earlier studies (Njenga, 2005; Mogesse, 2007). Farmers valued the size of the chicken because it translated to the quantity of meat per bird, thus, reflecting the main role of these chickens - consumption. Although village chickens were mainly kept for food security, they could be sold

in cases of cash emergencies, a finding also affirmed in previous studies (Njenga, 2005; Mapiye *et al.* 2008; Mwale and Masika, 2009). This could be attributed to the fact that it is much easier to slaughter a chicken for consumption than other livestock such as cattle (Mwale and Masika, 2009). In addition, other livestock in the study area were few in number, hence the villagers found it imprudent to slaughter some for consumption. However, a study to quantify the chicken that farmers consume per annum will be worth undertaking.

Village chickens were not used in rituals or traditional ceremonies in contrast to earlier reports (Mafu and Masika, 2003; Mack *et al.*, 2005). Respondents, however, indicated that cattle and goats were the livestock normally used during cultural ceremonies, a finding consistent with the reports from the coastal region (Centane district) of the Eastern Cape (Mwale and Masika, 2009). However, village chickens were used for gifts, a finding similar to that of Mwale and Masika (2009) in Centane. Farmers acknowledged that meat from village chickens was a delicacy compared to that from broiler chickens. This could explain why they are used as gifts.

As also reported by Mapiye *et al.* (2008), productivity in terms of number of eggs laid per clutch, chicks hatched per clutch and chick survival to maturity was very low. The reported low hatchability could have resulted from the effect of external parasites which tended to bite and irritate chickens during incubation. When chickens are affected by external parasites they tend to leave their eggs often, and may abandon them completely in some cases. Low hatchability may have also resulted from production of infertile eggs, poor egg handling and both incorrect storage and improper incubation environment as supported by Cooper (2001). Furthermore, microbial infection of chicken eggs, caused by contaminated nests, and poor sanitation, results in low

hatchability (Cooper, 2001). Laid chicken eggs in the current study were regarded as important only for incubation purposes and not for, consumption, which may have been a strategy to counter the low hatchability, so as to grow their flocks.

Although supplementary feed was provided, village chickens depended mainly on scavenging for their nutritional needs, a finding consistent with Njenga (2005), Muchadeyi *et al.* (2007), and Mwale and Masika (2009). Feed supplementation was mainly maize grain, as observed in similar studies in Zimbabwe (Muchadeyi *et al.*, 2004), Ethiopia (Halima *et al.*, 2007) and South Africa (Mwale and Masika, 2009). Not only did scavenging affect nutrition, but also exposed the chickens to predation, diseases and parasites as also supported by Acamovic *et al.* (2005). In addition, chickens at different stages of growth are left to compete for the same feed a finding consistent with Muchadeyi *et al.* (2004) who reported that the provision of supplementary feeding was indiscriminate and all age groups mostly competed for the supplement. This non-preferential feeding might result in weaker groups, such as chicks getting sub-optimal nutrition (Tadelle and Ogle, 2001). Moreover, since the supplements were thrown to the ground, feed losses (especially small grains) were inevitable and chances of chicken exposure to internal parasites were increased.

The finding in the current study that the quantities given as supplementary feed were based on the individual farmers' judgment and varied from household to household was also reported by Mapiye *et al.* (2008). Chickens are known to require different amounts of nutrients, depending on the production stage (Tadelle and Ogle, 2001; Ogle *et al.*, 2004). It is not clear, however, whether the chickens got enough nutrients through scavenging and supplementary feeding.

Adequate hen nutrition, for example, is vital for ensuring fertility, increasing the number of eggs laid, and ensuring good survival rates of hatched chicks (Cooper, 2001). The fluctuations in the supply of feed resources require appropriate strategic supplementation programmes (Muchadeyi *et al.*, 2005). Frequency of feeding in terms of when, what, and how to feed and the quantity to feed are important aspects to consider in developing strategies to improve nutrition of village chickens (Mapiye and Sibanda, 2005; Mapiye *et al.*, 2008). Furthermore, most farmers in the current study provided clean water for their chickens, a finding in agreement with Mwale and Masika (2009), and this could be due to the proximity and availability of clean water in the area of study.

Village chickens are vulnerable to theft and easily predated upon when not sheltered. The finding of this study that most chicken flocks were provided with housing is concurrent with some recent studies (Muchadeyi *et al.*, 2007; Mwale and Masika, 2009). Provision of shelter for chickens mainly during the night was in agreement with previous reports (Muchadeyi *et al.*, 2004; Mwale and Masika, 2009). Most chicken keepers resorted to cheap and locally available materials such as mud, wooden poles, and corrugated sheets, as also reported by Mapiye *et al.* (2008).

The current study revealed that village chicken production was carried out with no extension support, a finding consistent with a study conducted in Limpopo Province (Swatson *et al.*, 2002). Farmers made use of their indigenous poultry rearing knowledge acquired over a long period of time which is consistent with Swatson *et al.* (2002). Although farmers shared some information on chicken production, there were no farmer organizations from which households could obtain chicken village chicken husbandry information or education. Village chicken production has not

been accorded the recognition it requires in terms of development and policy support by governmental institutions and non-governmental organizations, yet it contributes significantly to the livelihoods of rural people.

3.5 Conclusion

The current study revealed that village chickens play a very important role in the livelihoods of rural farmers by meeting their family food needs. Chicken flocks were provided with supplementary feed, water and some form of shelter. It is key, however, to retrieve information on flock entries and exits through monitoring chicken flock dynamics which are influenced by management practices. This will assist in establishing the major causes of gains and losses in village chicken flocks. Thus, the next chapter focuses on seasonal variations in village chicken flock dynamics and management practices.

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Chapter 4: Seasonal variation in village chicken flock dynamics and management practices in Amatola Basin of the Eastern Cape, South Africa

(Submitted for publication to the Tropical Animal Health and Production Journal)

Abstract

Seasonal variation and management practices influence village chicken flock dynamics. This study sought to determine the impact of seasonal variation in village chicken flock dynamics and management practices in Amatola Basin of the Eastern Cape Province, South Africa. Twenty households selected using purposive sampling participate in this study from July 2010 to June 2011. All chicken flocks were produced under the scavenging feeding system which increased vulnerability to predation, particularly of chicks. The mean cock to hen to chick ratio was 1:5:15. The highest flock sizes of 23.3 (\pm 2.05 SEM) were observed in the summer season, while the least of 17 (\pm 2.02 SEM) were observed in the winter season. On average, hens had 3.3 clutches, with a range of 2.8 to 3.6. Chicks hatched and chickens received as gifts represented the only entries observed, while exits included mortality, consumption, sales and gifts or donations, in that order. In general, both exits and entries were more pronounced in the summer season than in the other seasons. There was no significant difference ($P > 0.05$) in the consumption of chickens between the winter, spring and autumn season, however, chicken slaughters increased during the summer season. This was attributed to the occurrence of the festivities during this season. Chicks hatched were also more pronounced in summer compared to the other seasons. Some farmers occasionally sold cocks and hens as a way of culling their flocks and generating income. However, village chickens were mainly kept for food security rather than for their terminal benefit of cash.

Keywords: Demographics, free-range, husbandry, rural, scavenging chicken, season

4.1 Introduction

Village chickens are an important asset in most developing countries supplying the fast growing human population with high quality protein and generating some income (Guèye, 2009; Moreki *et al.* 2010). These birds are owned by individual households and are maintained under a scavenging system, with little or no inputs (Maphosa *et al.* 2005; Aboe *et al.* 2006). Earlier workers (Norris *et al.* 2007; Mapiye *et al.* 2008) reported that village chicken productivity falls far below desirable levels, which is attributed to inherent slow growth rates, high rearing mortalities and susceptibility to diseases (Alders *et al.* 2001), poor nutrition, housing and lack of proper health care (Kingori *et al.* 2010). However, for a sustainable livelihood, it is imperative that chicken farmers are able to provide surpluses to generate income while ensuring that domestic food supplies are secured (Swatson *et al.* 2002).

Sustainability in interventions to improve village chicken production lies in the basic understanding of the flock dynamics. However, a review of existing literature has shown that little information is available describing village chicken flock demography in South Africa (Swatson *et al.* 2002; Mwale and Masika, 2009). Some once-off surveys have been conducted in the Eastern Cape Province of South Africa (Moyo, 2009; Mwale and Masika, 2009). However, flock number and composition vary with season (Tadelle *et al.* 2003) and from area to area depending on management practices (Muchadeyi *et al.* 2007). It is imperative to ascertain how seasonal variations together with management practices influence village chicken population dynamics so as to estimate their contribution to the livelihoods of rural farmers (Muchadeyi *et al.* 2005). The current study sought to determine the effect of seasonal variation in village chicken flock dynamics and management practices.

4.2 Materials and methods

4.2.1 Study area

The study was conducted in the Amatola Basin of the Amathole District situated in the Eastern Cape Province of South Africa. The details of the study area are shown in Section 3.2.1.

4.2.2 Household selection

Twenty households were selected to participate in this study using a purposive sampling technique. This sampling was informed by a survey conducted earlier through the snowball sampling technique in the study area. Eligibility to participate in the study was based on willingness and ownership of at least 17 (± 2 SEM) chickens. The flock size used was informed by findings from a baseline study conducted earlier in the study area (Chapter 3). In addition, there had to be a literate member in the household who would be able to keep accurate records. Literacy was defined as the ability to record chicken entries and exits in the registers provided.

4.2.3 Data collection

Assessment of chicken flock inventory was accomplished through conducting monthly visits for a year. Chickens were classified into three categories; chicks (0 to 10 weeks old), hens and cocks (more than 10 weeks old).

At the beginning of the study each farmer was issued a file with a notebook and trained on how to record all entries and exits that occurred on chicken flocks. Chicks hatched and chickens received as gifts were recorded as entries into the flock, while mortality, those slaughtered and

sales comprised the exits. Gifts were recorded as either entries if the farmers were recipients or exits when they were the donors.

4.2.4 Data Analyses

Obtained data were converted to percentages, and tested for normality. Descriptive statistics were computed using PROC FREQ procedure of the Statistical Analysis Systems (2003). The generalized linear model procedure (SAS, 2003) was used to determine the effect of seasonal variations and management practices on flock dynamics. The Tukey's (SAS, 2003) test was used for multiple comparisons of means.

4.3 Results

The average flock sizes and how they varied in seasons is shown in Table 4.1. Flocks were largest in the summer season and lowest in the winter season. However, there were no significant differences ($P>0.05$) in flock sizes in autumn, winter and spring season. Flocks comprised of cocks, hens and chicks at an average ratio of 1:5:15. The highest flock sizes of 23.3 (± 2.05 SEM) were observed in the summer season, while the least of 17 (± 2.02 SEM) were observed in the winter season. Significantly higher proportions of chicks (in relation to number of hens) were recorded during the summer season, while the lowest ($P<0.05$) proportions were recorded in winter season as shown in Figure 4.1 (See Appendix 9.2 also for monthly variations). Chicks hatched and chickens received as gifts represented the only entries observed in the current study. However, the majority of these entries were chicks hatched. The number of eggs laid and chicks hatched was significantly ($P<0.05$) higher in the summer season compared to the other seasons as indicated in Table 4.1. Consequently, the total entries were higher ($P<0.05$) during this season.

On average, each hen had 3.3 clutches per annum and about 12 eggs per clutch, with hatchability of close to 70%. However, eggs laid per clutch varied in seasons and ranged from 6 to 19 in winter and summer respectively. Most hens incubated eggs outside the chicken structures in bushes and along the fences of kraals, this resulted in the farmers not knowing the actual eggs laid due to losses, especially eaten by dogs. Entries in the form of chicks hatched and gifts received were at 6.2 birds per month, on average. A few (15%) farmers consumed eggs laid, while the rest allowed the hens to incubate all the eggs.

Consumption of chickens and mortality of chicks, as major points of exits in the study, were more pronounced ($P < 0.05$) in the summer season than the other seasons as indicated in (Table 4.1). There were three isolated cases, where broody hens were preyed upon during incubation, outside chicken houses. Otherwise, adult chicken mortality was rare ($P > 0.05$) throughout the study period (Figure 4.1). Main causes of chick mortality as reported by the farmers were the cold weather, internal and external parasites, as well as predation. Other chicken exits included sales, and gifts (Table 4.1). Exits such as slaughters, sales and gifts (donations) were restricted to adult birds. However, more cocks than hens ($P < 0.05$) were used for such exits.

Farmers occasionally sold hens and cocks with undesirable characteristics as a way of culling their flocks and generating income. Such characteristics included poor egg production, small size, or bad temperament such as pecking other birds. Chickens were sold at an average of R50 (USD7.55) each. However, prices were negotiable depending on the size of the chicken, the relationship between the farmer and the customer, and how desperate the farmers were for cash. Sales were generally low in all seasons but peaked during the summer season as indicated in

Table 4.1: Seasonal least-square means (\pm SEM) of village chicken flock sizes, entries and exits

		Season			
		Summer	Autumn	Winter	Spring
Entries					
	Chicks hatched	11.3 \pm 1.05 ^c	4.1 \pm 0.4 ^a	4.5 \pm 0.9 ^a	6.8 \pm 0.5 ^b
	Gifts	0.7 \pm 0.23 ^a	0.3 \pm 0.13 ^a	0.3 \pm 0.13 ^a	0.4 \pm 0.05 ^a
	Total Entries	11.4 \pm 2.75 ^c	4.2 \pm 0.4 ^a	4.6 \pm 0.9 ^a	7.4 \pm 0.65 ^b
Exits					
	Consumed	2.6 \pm 0.03 ^b	0.9 \pm 0.8 ^a	1.2 \pm 0.76 ^a	1.3 \pm 0.5 ^a
	Mortality	5.1 \pm 0.75 ^c	2.6 \pm 0.02 ^b	1.9 \pm 0.65 ^a	2.8 \pm 0.5 ^b
	Sales	2.3 \pm 0.06 ^c	0.2 \pm 0.15 ^a	0.4 \pm 0.05 ^a	0.3 \pm 0.13 ^a
	Gifts	1.6 \pm 0.43 ^b	0.1 \pm 0.05 ^a	0.1 \pm 0.05 ^a	0.7 \pm 0.5 ^b
	Total Exits	13.7 \pm 0.86 ^b	4.1 \pm 1.34 ^a	3.1 \pm 1.02 ^a	3.5 \pm 1.05 ^a
Flock size		23.3 \pm 2.05 ^b	19.4 \pm 1.73 ^a	17.0 \pm 2.02 ^a	18.5 \pm 2.02 ^a
Change in flock size		2.5 \pm 0.94 ^c	-0.9 \pm 0.2 ^a	1.0 \pm 0.46 ^b	0.5 \pm 0.29 ^b
Flock size ranges		19 to 27	16 to 26	12 to 24	13 to 24

^{abc}Values in the same row with different superscripts are significantly different (P<0.05)

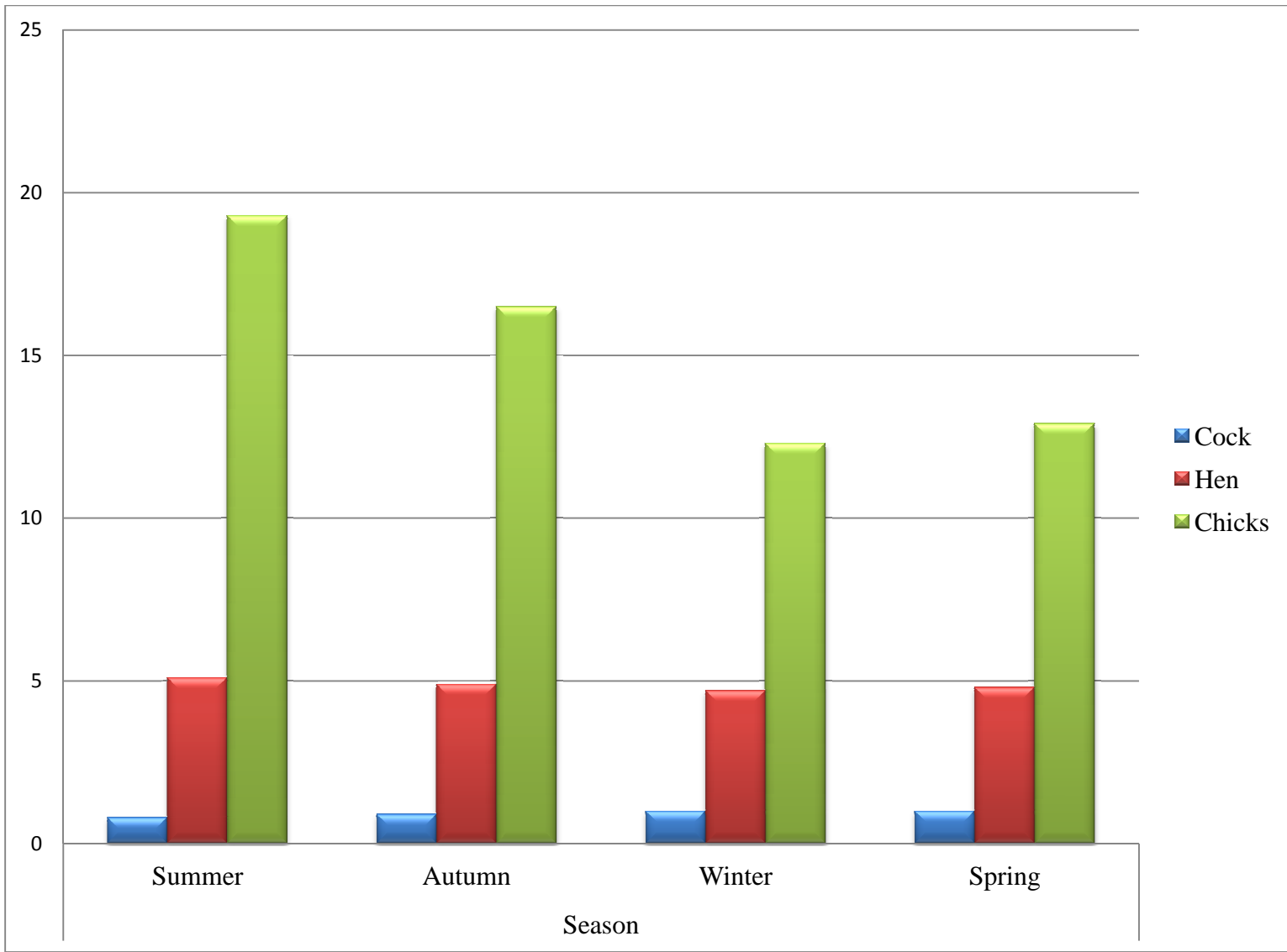


Figure 4.1: Seasonal least-square means of different classes of village chickens

4.4 Discussion

This study revealed that village chicken flocks varied in various seasons of the year, with more exits than entries of adult chickens recorded. The limited entries in relation to exits showed that flocks were sustained by offsprings to replace aging and lost breeding stock which agrees with a report from a similar study in Malawi (Gondwe and Wollny, 2007). Village chickens had multiple roles as also previously observed by researchers in other countries (Dessie and Ogle, 2001; Gondwe and Wollny, 2007), which accounted for their exits. However, similar studies in other African countries demonstrated chicken exits which were not observed in this study. These exits included exchanges of breeding stock and use of chickens for sacrifice (Dessie and Ogle, 2001; Gondwe and Wollny, 2007). This variation may be attributed to the fact that village chicken production varies from area to area depending on the socio-economic, cultural and biological factors (Muchadeyi *et al.*, 2007).

The observed increase in chicks hatched after the winter season can be attributed to increased photoperiod which initiates reproductive development (Wingfield *et al.* 2000). When there is sufficient exposure to day-length, light energy is converted into nerve impulses in the hypothalamus of the birds. These nerve messages stimulate the release of luteinizing hormone releasing hormone (LHRH), which travels in the bloodstream to the anterior pituitary to stimulate the production and release of follicle stimulating hormone (FSH) and luteinizing hormone (LH) (Lewis *et al.* 2010). This process does not occur until the hypothalamus is functionally mature (able to respond to both light and hormone feedback mechanisms). The FSH and LH act at the level of the ovary or testes to stimulate follicle and sperm production,

respectively (Robinson and Renema, 1999; Lewis *et al.* 2010), consequently increasing chicken productivity.

Closely related to increased daily light exposure, the abundance of feed in the summer season supports egg production. The birds get abundant animal protein by picking up worms, snails and insects during the summer season (Alders *et al.* 2009), which improves chicken productivity. The observed predation of chicks in the current study concurs with earlier reports which established that village chicken production systems are characterised by low survivability and high mortalities of chicks (Pickworth and Morishita, 2007; Biswas *et al.* 2008). The high levels of predation among chicks can be attributed to the scavenging system which exposed them to predators. Although predation of adult chickens was rare in the current study, some predation related losses were observed where hens nested and incubated outside chicken houses as a result of poor housing management. This may be due to the fact that as a result of changes in physiological status, broody hens become weaker (Shanta *et al.* 2006) and thus vulnerable to predators.

Chick mortalities in the cold season could have been due to some of the extremely cold temperatures (4°C) experienced in the current study area. Halima *et al.* (2007) also reported cold related chick mortalities in a similar study in Ethiopia. This may be due to poorly developed thermoregulation in chicks (Aulie, 1976) which causes them to die easily when they are exposed to low temperatures. Conversely, the high number of chicks hatched observed in the summer season translated to high chick mortalities, mainly due to predation. Furthermore, the hot and humid atmosphere prevailing during the summer season created a favorable environment for the

development of parasites and parasitic diseases (coccidiosis and helminthiasis). The high number of parasites in this season could have also resulted in high chick mortalities and reduced growth performance. This could be attributed to the fact that chicks are usually less resistant as compared to hens and cocks.

Previous researchers reported that most rural farmers resort to the use of EVM for controlling parasitic infections and treating diseases (McDevitt *et al.* 2006; Muchadeyi *et al.* 2007; Mwale and Masika, 2009) which is concurrent with what farmers acknowledged in the present study. However, it is imperative to detail the study of EVM used and how they are used to ascertain their efficacy against health challenges as well as educate the farmers on how best to use these alternative remedies.

Chicken flocks in the present study were mostly composed of chicks, hens, and cocks, respectively. It was prudent for farmers to raise more hens than cocks as this enhances a faster growth of the chicken flocks due to increased number of laid eggs and subsequently chick hatched. Thus, hens were mostly retained for breeding purposes whilst most cocks were consumed or sold in cases of emergencies. This finding is similar to previous reports (Tadelle *et al.* 2003; Mammo *et al.* 2008), which indicated that hens were retained in flocks and only slaughtered when seen to be unproductive or very old. Farmers could also be advised to exchange breeding stock with other farmers to improve the productivity of their chickens and avoid the possibility of inbreeding. However, this may present a possibility of introducing diseases across chicken flocks. Thus farmers have to consult the veterinary services for advice about the best practices to do so.

The study revealed that some farmers used village chickens as gifts mainly during the festive season as a way of nurturing their social networks of friends, relatives and neighbors. These were significant gifts because farmers viewed village chickens as a delicacy as supported by Moreki *et al.* (2010). The peak of chicken slaughters for consumption was observed in the summer season. This could be primarily associated with the occurrence of the festive season (Christmas and New Year) during this time of the year. The association of season with some exits was also reported by Gondwe and Wollny (2007). Besides farmers' organoleptic preferences, the option of slaughtering a chicken could have been affordable compared to other larger livestock such as goats, pigs, sheep and cattle. Mwale and Masika (2009) reported that chickens are mainly kept for family food security. This also concurs with findings of the current study.

Research on village chicken production in several developing countries has shown that eggs per clutch, clutches per year and hatchability vary widely, ranging from 6-20, 1.1-4.5 and 50-86%, respectively (Missohou *et al.* 2002; Iqbal and Pampori, 2008; Alders *et al.* 2009; Olwande *et al.* 2009). This may be attributed to variation in management practices as supported by Pedersen (2002), who demonstrated a correlated poor management and poor egg production. Similarly, cock to hen ratio varies from season to season and from place to place. Kaudia and Kitalyi (2002) reported a one cock for 2.9 hens in Kenya, yet Mopate and Lony (1998) observed a cock to hen ratio of 1:6 in Chad. Gondwe and Wollny (2007) also reported a different ratio of one cock to 4.7 hens compared to a ratio of 1:5 in the present study. These differences may be attributed to the variation in the roles of chickens across cultures. For example, Gondwe and Wollny (2007) reported that farmers used chickens in communal ceremonies such as funerals

which were not observed in the present study. In addition, the skewed ratio observed in this study is attributed to the fact that farmers preferred selling cocks to hens as highlighted earlier.

Besides socio-cultural and management differences, Norris et al (2007) reported that egg production, flock composition and dynamics may be affected by type of breed. For example, the Venda breed which is late maturing has fewer clutches per annum compared to the early maturing Naked Neck breed of the same age (Norris et al 2007). Ideally, the number of clutches will translate to number of chicks hatched per annum, though this may also depend on the number of eggs laid and hatchability per clutch. Thus, breed differences affect number of entries per annum. However, the current study did not focus on this subject. Future studies are recommended to establish the effect of village chicken breed on productivity.

4.5 Conclusion

Basically entries observed during the study were due to chicks hatched and chickens presented as gifts, while exits included consumption, gifts, sales, cold, parasitism and mortality due to predation. Migration of chickens in and out of flocks was highest in the summer season, followed by autumn, spring and winter seasons, in that order. Interventions must focus on improving the productivity of chickens as increases in flock size will improve the livelihoods of rural farmers in terms of food security and income generation. Furthermore, extension services for village chickens must take note of the fact that improving reproductive performance alone will not guarantee increased flock sizes if mortality is not reduced. In an effort to combat such uneconomic losses, it is imperative to establish causes of mortality. Chicken farmers perceived parasites and diseases to be one the main casues of mortality. Thus, it is imperative to capture

detailed information on these health management aspects. Having established the impact of seasonal variations on flock dynamics in this chapter, the next Chapter focuses on health challenges encountered by farmers and the methods they used to control diseases and parasites.

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Chapter 5: Health challenges and remedies used by farmers in village chicken production in Amatola Basin of the Eastern Cape Province, South Africa

(Submitted for publication to the African Journal for Agricultural Research)

Abstract

Scavenging chickens are usually prone to diseases and parasitic infestations. However, information is lacking on village chicken health, despite the fact that up to 80% of the chicken population in most developing countries is kept by rural households as village chickens. The objective of this study, therefore, was to determine village chicken health problems and the remedies applied to manage these problems. Data were gathered using a questionnaire survey of 81 households identified through snowball sampling technique. Most farmers (81.5%) acknowledged that their chickens had health problems. The health problems encountered were diseases (16.9%), parasites (21.6%), both parasites and diseases (40.7%), and wounds (2.4%). Diseases and parasites adversely affected productivity by causing mortality, reducing growth and minimizing egg production at all stages of growth. The majority (77.5%) of farmers made use of local knowledge in the form of medicinal plants for treating diseases and controlling parasites, mainly because the plants were locally available, cheap and perceived to be effective. Further studies are recommended to establish the prevalence of the perceived health challenges as well as the efficacy of alternative remedies used by farmers.

Keywords: Diseases, ethno-veterinary, medicinal plants, parasites, rural

5.1 Introduction

Despite the fact that up to 80% of the chicken population in Africa and Asia is kept by rural households as free-range or village chickens (Aini, 1990; Henning *et al.* 2007), information on

the health of these village chickens is scanty. Village chickens are usually kept by resource-limited farmers with minimal input, hence relatively high mortality, regardless of cause, tends to be tolerated (Acavomic *et al.* 2005). Production of village chickens is often characterized by parasitic infestations and concurrently a range of diseases (Permin and Pedersen, 2002). This is attributed to poor health management practices which exacerbate diseases and parasitic infestations culminating in losses through compromised production performance and mortality (Perdersen, 2002; Kaufman *et al.* 2007). Although this is experienced more in cases where there is little input and less so with higher input systems, chicken-keepers aspire to have higher survivability and health in their flocks (Tadelle and Ogle, 2001; Perdersen, 2002).

Various conventional drugs for treating diseases and controlling parasites of chickens have been effectively developed globally (Maphosa et al, 2004). Since the Eastern Cape Province is one of the poorest in South Africa (Shigadhla, 2008), most resource-limited farmers cannot access these drugs due to lack of funds (Mafu and Masika, 2003; Mwale *et al.* 2005). As a result, the majority of these farmers resort to using alternative remedies, such as ethno-veterinary medicines (EVM) to control or treat diseases (Mapiye *et al.* 2008; Mwale and Masika, 2009). The objective of this study, therefore, was to determine health problems of village chickens as perceived by farmers and the remedies they applied to manage these problems.

5.2 Materials and Methods

5.2.1 Study area

The details on the description of the site are given in Section 3.2.1.

5.2.2 *Sampling procedure and data collection*

The sampling procedure and data collection details are outlined in Section 3.2.2.

5.2.3 *Statistical Analyses*

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS, 2009). Descriptive statistics and cross tabulation were computed.

5.3 Results

5.3.1 *Health challenges*

About 82% of the farmers acknowledged that their chickens had health problems which varied from; diseases, internal and external parasites, and wounds as indicated in Section 3.3.6. Farmers indicated that the diseases and parasites had adverse effects on chickens which included, in order of priority, mortality (31.1%), reduced growth (26.3%) and low egg production (24.1%). Some (36.8%) farmers were of the opinion that disease incidents varied with season, being more prevalent in summer than in winter. However, the majority did not notice any seasonal differences in chicken health problems.

5.3.2 *Control remedies used against health challenges*

The majority of farmers (70%) affirmed that they treated diseases and controlled internal parasites. Although phytotherapy using *Aloe ferox* was most commonly used (82.7%) form of remedy to treat diseases and control endoparasites, a few of the farmers (6.5%) used a conventional remedy: Terramyicn powder (oxytetracycline HCL). Similarly, most respondents (74.1%) controlled external parasites using alternative remedies such as medicinal plants, while a

few (3.7%) also used Karbadust (carbaryl 5%), a conventional drug. Alternative remedies used in control of external parasites are shown in Table 5.1. Farmers did not have any program for controlling chicken health challenges. The remedies were administered in the same way for different chicken age groups.

Table 5.2 shows the medicinal plants used by farmers against diseases and parasites. The popularity of phytotherapy was attributed to the fact that farmers were able to get them locally (63%), and were perceived as effective (46.9%) and cheap (2.1%). Farmers' experience in the use of alternative remedies ranged from 10 to 50 years, and mainly depended on information shared orally amongst family members and relatives (70.6%), neighbours (12.9%), local leaders (9.5%) and friends (6.4%).

As depicted in Table 5.1, some farmers also used a range of chemicals to control chicken external parasites. These chemicals included insecticides Kemprin (Cypermethrin 20%) and Blue death (phenothrin 0.3%), disinfectants Madubula and Jeyes fluid (carbolic acid 13%), Doom spray (d-phenothrin 0.4%) and used petrol engine oil.

Table 5.1: Remedies used in the control of External parasites in village chickens

Remedy	Application method	Farmers using remedy (%)
Kemprin (Cypermethrin 20%)	Dipping/dusting	2.3
Plants (Juice, cold/hot ash)	Dipping/dusting	36.9
Madubula (carbolic acid 13%)	Dipping	28.7
Jeyes Fluid (carbolic acid 13%)	Dipping	16.7
Doom Spray (d-phenothrin 0.4%)	Spray	3.2
Used petrol engine oil	Smearing	3.2
Blue death (phenothrin 0.3%)	Dusting	2.3

Table 5.2: Medicinal plants used in controlling parasites and treating diseases

Scientific Name	Common/ local name	(%) Farmers using the plant	Disease or Parasite controlled	Preparation method	Route of Administration	Age/stage of control
<i>Aloe ferox</i> Mill	Bitter or red aloe/Ikhala	77.5	Diseases and Internal Parasites	Chop leaves, mix with cold water	Drinking/oral	All stages
<i>Lippia javanica</i> (Burm.f.) Spreng	Lemon bush/Inzininiba	22.7	External Parasites	Burn the whole leaf to ash, the smoke drives away parasites	Aerosol	All stages (especially laying hens)
<i>Euphorbia ingens</i>	The tree of twins/Umhlontlo	2.3	External Parasites	Crushed and soaked in water (infusion)	Smearing	All stages
<i>Calpurnia aurea</i>	Natal Laburnum/Umhlahlampetu	7.5	External Parasites	Crushed and soaked in water overnight (infusion)	Dipping	All stages
<i>Cultia pulchella</i>	Warty-fruited clutia/Umbheza	4.4	External Parasites	Crushed and soaked in water for a while/ overnight (infusion)	Dipping	All stages

5.4 Discussion

In the current study chicken health challenges (diseases and parasites) may be attributed to the scavenging system (Chapter 3) used by the farmers as reported in previous studies (Acavomic *et al.* 2005; Henning *et al.* 2007). Allowing different chicken age groups to move and feed together exposes young chicks to diseases. However the adults may not be affected because some may be resistant while others may be carriers. In addition, the chicken flocks utilize almost the same land consistently, resulting in a build-up of disease causing organisms, which exposes them to diseases and parasites. The system also exposes the chickens to possible transfer of diseases from wild birds as supported by Acavomic *et al.* (2005). Furthermore, while scavenging for their food, chickens came in contact with flocks of different households at village level which increased their susceptibility to diseases and parasitic infestations. Thus even farmers with few chickens were faced with more or less the same chicken health challenges.

Ogle *et al.* (2004) stated that shortage of nutrients, such as protein, in scavenging feed resource base is not presumed to be a major constraint. This is because village chickens are expected to get adequate protein from scavenging insects and snails (Mapiye *et al.* 2008). However, in contrast, Swatson *et al.* (2002) reported that protein is usually a limiting nutrient in village chicken production. In the current study, farmers were uncertain of the quantity and quality of feed each bird got during scavenging and through supplementation. Thus, it is possible that deficiencies of nutrients such as proteins, mineral and vitamins may have occurred. Deficiencies could have led to poor growth and development of chickens as well as vulnerability to health challenges as supported by Pedersen (2002). Furthermore, Acavomic *et al.* (2005) stated that some cases of ill-health occur because of lack of feed and nutrients, as well as the consumption

of feedstuffs that contain toxic or anti-nutritional compounds. Improved nutrition and management could result into reduced losses coupled with improved productivity that could improve the general livelihoods of the farmers.

Most farmers in the current study perceived parasites and diseases as the main contributors to mortality of chickens. This is contrary to previous studies of Adene and Dipeolu (1975), and Mwale and Masika (2009) who reported that parasites were perceived to be the main cause of chicken mortality in rural areas. The deviation from previous studies could be because these researchers focused on parasites while the current research focused on all health challenges. However, it should be noted that these are farmer perceptions. Validation studies would have to be conducted so as to confirm the farmers' perceptions.

In cases where no seasonal variations in the prevalence of diseases and/or parasitic infestations were reported, it is possible that these farmers did not render enough attention to their chickens. Few farmers actually inspected their chickens. This made it difficult for diseases and parasitic infestations to be detected between seasons. The condition of the material used for constructing house structures may also have constituted a favourite hiding place for external parasites aggravating chances of ectoparasite infestations within a flock.

As observed in previous research done in Kwa-Zulu Natal (Swatson *et al.* 2001), Limpopo (Swatson *et al.* 2002) and in the coastal areas of the Eastern Cape (Mwale and Masika, 2009), most farmers resorted to the use of medicinal plants to treat diseases and control parasites, regardless of farmers' level of education. This is because South Africa is endowed with

invaluable medicinal plant resources that are cheap and accessible to resource-limited farmers (Masoko *et al.* 2007). Most farmers had difficulties in accessing conventional drugs because of what was considered to be high costs by the majority of the respondents who are pensioners dependent on social grants (approximately USD168 per month) for their livelihoods. An extra expense on chicken drugs could have presented more strain on the farmers' meagre income. In addition, lack of extension services on chicken husbandry had a significant effect on access to drugs because most (93.8%) farmers did not know appropriate drugs to be used in the treatment of chicken diseases or parasites.

Aloe ferox was widely used and perceived to be a miracle plant used for almost any ailment. This plant is found abundantly in the Western and Eastern Cape Provinces of South Africa and has been part of the traditional healing practices among the indigenous people for centuries (Van Wyk *et al.*, 2002). *Aloe ferox* has also been reported to be used in the control of; ticks and tick-borne diseases (Masika and Afolayan, 2002; Moyo and Masika, 2009); diseases and internal parasites in village chickens (Dold and Cocks, 2001; Mwale and Masika, 2009). This plant contains aloin, a compound used as a stimulant-laxative (Schmelzer *et al.* 2010). In a study on toxicology of *A. ferox* leaf extract in rats, Mwale and Masika (2010) reported that this plant is potentially toxic if used continuously for more than 14 days at 400mg/kg. However, in the current study farmers chopped fresh leaves and put them in drinking water for chickens to drink. In this way an infusion is made, which is far lesser concentrated compared to toxic levels reported by Mwale and Masika (2010). This could explain why no toxicity of the use of this plant has been reported amongst these farmers.

Calpurnia aurea (Aiton) Benth was previously reported to be used for the treatment of diseases and control of parasites both in humans and animals (Abebe and Ayehu, 1993; Tadeg *et al.* 2005). Farmers in South Africa use the leaves and powdered roots of *Calpurnia* spp. to kill lice, maggots and to relieve irritation on animals (Adedapo *et al.* 2008). Soyelu and Masika (2009) reported that the leaves of *Calpurnia aurea* (Aiton) Benth were used to treat maggot-infested wounds. Moyo (2009) also affirmed the practice of the use of *Calpurnia aurea* leaves to control ectoparasites in Amatola Basin. *Calpurnia aurea* possesses quinolizidine alkaloids which are toxic against external parasites such as lice, ticks, fleas (Waka *et al.* 2004; Zorloni, 2007; Adedapo *et al.* 2008; Moyo, 2009). Thus this medicinal plant could have been effective in the control of chicken external parasites.

Masika and Afolayan (2002) reported the use of *Lippia javanica* for the control of tick-borne diseases. Mwale and Masika (2009) further reported the use of the same plant in the control of external parasites in laying hens, in the coastal areas of the Eastern Cape, which is consistent with the findings of the current study. This plant contains essential oils, such as geranial, neral, limonene, germacrene-D, camphor, linalool, β -caryophyllene and myrcene, which are effective in killing and/or repelling external parasites (De Wolff, 2007; Matlebyane *et al.*, 2010; Magano *et al.* 2011). Thus this validates the use of this plant by the farmers to control external parasites.

Although research on the chemistry and pharmacology properties of *Euphorbia ingens* has not been exhaustive, its profile toxicity levels have been established to be high (Schmelzer *et al.* 2010). The latex of this tree is extremely toxic and can cause severe skin irritations, blindness and severe illness to humans and animals if swallowed (Schmidt *et al.* 2002). Conversely, the

plant has also been discovered to possess medical properties, if correctly applied, treating skin diseases, skin and eye infections, and wound healing (Van Wyk, and Gericke, 2000). However, Schmelzer *et al.* (2010) reported that its use as traditional medicine should be discouraged because of its toxicity. Thus, farmers must be cautioned on the possible dangers of using this plant. From the results of a study by Moyo (2009), 100% concentrated *Cultia pulchella* juice was reported to be effective in the control of chicken fleas. Thus use of *C. pulchella* may be recommended but caution should be taken as the juice of this plant produces irritant effects on humans (Watt and Breyer-Brandwijk, 1962).

Karbadust (carbaryl 5%) is an insecticide dusting powder prescribed for use in poultry, however, very few (3.7%) farmers reported using it. This was attributed to its inaccessibility in terms of cost and distance (Mwale and Masika, 2010). This conventional drug (Karbadust) is effective against red mites and tampanes. Moreki *et al.* (2010) alluded to Karbadust as a common chemical dust used by the farmers across the districts in Botswana. Although disinfectants (Madubula and Jeyes fluid) used by farmers in the current study may have been effective because of their chemical properties, they are however, corrosive and may adversely affect the skin and eyes upon prolonged and repeated usage (Chem Alert Report, 2009). If the tar acids and sodium hydroxides contained in these disinfectants find their way to water bodies, they have the potential of being lethal to aquatic life (Chem Alert Report, 2009).

Although Doom Spray and Blue death are effective in the environmental control of parasites, , they are not recommended for use on animals and thus have the potential to cause, toxicity in the chickens and contamination of their products. Doom Spray (d-phenothrin 0.4%) contains a type

1 pyrethroid (d-phenothrin) with a low level of toxicity registered for use against external parasites (Go *et al.* 1999). Blue death (permethrin 0.03%) is also a broad spectrum synthetic pyrethroid insecticide used against a variety of insects. Farmers must be cautioned on the dangers of using such chemicals not prescribed for their chickens.

Although use of used petrol engine oil may have been effective in controlling external parasites such as ticks as earlier reported by Moyo (2009), it should not be encouraged. This is because used oil contains heavy metals such as zinc, copper and lead which can either kill or become concentrated in both plants and animals (Savinov *et al.* 2003). Furthermore, upon consumption in plants or animals, these heavy metals might be harmful to humans.

The use of chemicals which are not prescribed for use in chickens, such as Kemprin (a garden insecticide) indicates an element of ignorance, whereby farmers are not aware of what to use to mitigate the village chicken health problems they are faced with. This could also be a sign of desperation, with farmers having no other option but to use whatever resource is available. This is dangerous, however, because it could result in undesired poisoning and possible residues in the chicken products (eggs and meat) as reported by Molento (2009).

5.5 Conclusion

The study revealed that village chickens were reported to be affected by health challenges (parasites and parasite-induced diseases) which were the main contributors to chicken mortality. Farmers used a wide range of remedies to control these health challenges. However, medicinal plants were the most common remedy. *Aloe ferox* was the plant used to control internal parasites

and treat diseases, while *L. javanica* was mostly used for external parasites. Alternative remedies were perceived to be very effective in treating diseases and controlling parasitic infestations. It is crucial to establish the seasonal prevalence of the parasite infestations to ascertain the perceptions of farmers. The subsequent chapter outlines the seasonal prevalence of endoparasites in the village chickens.

5.6 References

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Chapter 6: Seasonal prevalence of gastrointestinal parasites in village chickens: the case of Amatola Basin, South Africa

(Submitted for publication to the Journal of Parasitology Research)

Abstract

Endoparasites impede chicken productivity by decreasing growth rate, causing diarrhea as well as increasing mortality, in extreme cases. A study on the prevalence of gastrointestinal parasites in village chickens was carried out in Amatola Basin. This was designed to establish the seasonal prevalence of endoparasites in village chickens. A total of 20 households were selected through purposive sampling to participate in this investigation. Monthly compound sampling of fresh faecal matter was conducted in each household, for a year. Nematode and cestode eggs and coccidian-oocysts were determined by the modified quantitative McMaster (floatation) technique. Qualitative sedimentation technique was used to determine trematode eggs. The prevalence and intensity of endoparasites were significantly ($P < 0.05$) higher in the summer season compared to the other seasons. This was followed by the autumn, spring and winter seasons, respectively. Nematodes had the highest number of genera observed which included *Ascaridia galli*, *Heterakis gallinarum*, *Trichostrongylus tenuis* and *Syngamus trachea*. For cestodes, *Raillietina cesticillus* and *Choanotaenia infundibulum* species were identified. However, *C. infundibulum* only occurred in the summer season. Protozoa coccidian-oocyst had the highest prevalence and number of counts throughout the study. There were no trematodes demonstrated in this study. The high prevalence of endoparasites in the study area, especially in the summer season, suggest that the chickens may be heavily parasitized.

Keywords: Endoparasites, helminthes, rural, scavenging, free-range, season

6.1 Introduction

Village chickens (*Gallus domesticus*) improve rural farmers' livelihoods nutritionally and socio-economically (Matur, 2002; Mwale and Masika, 2009). However, these chickens are exposed to various health challenges. In most rural communities, this is attributed to management practices such as scavenging feeding a system which predisposes the chickens to the parasites and diseases (Oniye, et al. 2001). Endoparasitic infestations are very common in village chickens. The chickens pick up the endoparasites in infective stages; directly by ingesting contaminated feed, drinking contaminated water, or by eating infected snails, earthworms, or other insects as vectors (Butcher and Miles, 2011). These parasites may compete for nutrients and damage or block the gastro-intestinal tract thus markedly impeding performance of the birds and increasing susceptibility to other diseases (Soulsby, 1982). Endoparasites may ultimately cause morbidity and mortality, in the most severe cases, thereby undermining the role of village chickens in the farmers' livelihoods.

The main groups of gastro-intestinal parasites in chickens are nematodes, cestodes, trematodes and protozoa. However, the trematode infestations are not very common in chickens (Luka and Ndams, 2007; Oniye et al. 2001). Nematodes are the most significant chicken helminthes species both in number of species and the extent of damage they cause (Luka and Ndams, 2007; Pam et al. 2006). Protozoa (coccidia oocysts) are common in chicken production and may produce moderate to severe clinical symptoms (Merck Veterinary Manual, 2011). The severity of endoparasitic infestations, however, is primarily determined by the concentration of parasite eggs and oocysts in the chickens' environment (Magwisha et al. 2002; Permin and Hansen, 1998). Other factors such as nutrition, type of breed, age and health status of the chicken also contribute

in the significance of the infestation. Furthermore, the parasitic load varies with the seasons being generally heavier in summer months than in winter months (Salam et al., 2009).

Previous research in different countries demonstrated various endoparasites of village chicken (Luka and Ndams, 2007; Mwale and Masika, 2010; Simainga et al. 2010). Mwale and Masika, (2010) conducted a once-off study in the coastal region of the Eastern Cape Province (South Africa) to determine the prevalence of gastro-intestinal parasites in village chickens. However, this study did not account for the influence of seasons on the prevalence of these parasites. Furthermore, there is dearth of information in the inland region on the prevalence of endoparasites in village chickens. Therefore, this study was designed to determine seasonal prevalence of endoparasites in village chickens.

6.2 Materials and Methods

6.2.1 Study area

This study was conducted in the rural Eastern Cape Province of South Africa. Details on the description of the sites are given in Section 3.2.1.

6.2.2 Household selection

Household selection details are described in Section 4.2.2.

6.2.3 Temperature and humidity inside the chicken shelters

Data loggers (Major Tech-Elandsfontein, South Africa), placed in chicken houses of the participating households, were used to record daily temperatures and relative humidity inside chicken shelters throughout the monitoring study.

6.2.4 Collection of faecal samples

Fresh faecal compound samples of village chickens were collected early morning from chicken houses. This exercise was done monthly in each participating household. The collected samples were preserved in 10% formalin and stored in a fridge at 4°C before laboratory analysis.

6.2.5 Laboratory analysis

A modified quantitative McMaster (floatation) technique was used to determine faecal worm egg counts. According to procedures by Hansen and Perry (1994), four grams of faecal matter were mixed with 56 ml of saturated solution of sodium chloride (floating medium). The mixture was filtered through a tea strainer into a test-tube. While stirring the filtrate in the test tube, a subsample was withdrawn using a Pasteur pipette, filled both sides of the McMaster counting chamber, and left to stand for 5 minutes before the sub-sample of the filtrate was examined under a 10 × 10 magnification compound microscope. The helminthes eggs and coccidian-oocysts were identified using a combination of keys by Soulsby (1982) and Foreyt (2001). The number of eggs and oocysts per gram of faeces was obtained by multiplying the total number of eggs counted in the two chambers of the McMaster slide by the dilution factor of 50 (Whitlock, 1948). Assessment and identification of faecal matter for trematode eggs was carried out using the sedimentation technique and keys developed by Foreyt (2001), Soulsby (1982) and Uhlinger (1991).

6.2.6 Statistical analyses

Prevalence was calculated as the number of chicken flocks infested with a particular parasite species, divided by the total number of chicken flocks sampled. Faecal egg and oocyst counts

(FEOC) were logarithmically transformed using \log_{10} to normalize the data. PROC GLM of SAS (2003) was used to determine the effect of season on prevalence of faecal egg and oocyst counts. Comparison of means was done using the PDIFF procedure (SAS, 2003). PROC CORR (SAS, 2003) was also used to determine the correlations of seasonal mean temperature and relative humidity with faecal egg and/or oocyst counts.

6.3 Results

All chicken flocks examined were infected with various species of gastrointestinal parasites namely: nematodes, cestodes and protozoa. However, prevalence of each species varied with season as shown in Table 6.1. Mixed infections of nematodes, cestodes and protozoa were common in the summer season of the current study (Table 6.1). The highest number of endoparasites species observed were nematodes. Nematode eggs encountered were for *Ascaridia galli*, *Heterakis gallinarum*, *Trichostrongylus tenuis* and *Syngamus trachea*, out of which *H. gallinarum* and *A. galli* were the most prevalent especially in the summer season. For cestodes, *Railletina cesticillus* and *Choanotaenia infundibulum* species were identified. However, *C. infundibulum* only occurred in the summer and autumn seasons. Protozoa coccidian-oocysts were the most prevalent endoparasites through out the study, followed by the cestode *R. cesticillus* and the nematodes *A. galli* and *H. gallinarum*, respectively.

The effect of season on the endoparasites egg and oocysts counts in village chickens is shown in Figure 6.1 (See Appendix 9.3 also for monthly variations). The prevalence and intensity of endoparasites were significantly ($P < 0.05$) higher in the summer season compared to the other seasons. This was followed by the autumn, spring and winter season, respectively, as indicated in

Figure 6.1. However, the prevalence of internal parasites in the winter and spring seasons were not significantly different ($P>0.05$). Coccidian-oocysts had the highest counts amongst all gastrointestinal parasites. However, for egg counts, *H. gallinarum* had the highest values throughout the study, while *T. tenuis* had the least values which were almost consistent throughout the study (Table 6.1). *Raillietina cesticillus* initially had the lowest egg counts but increased when the seasons changed from cold to hot (Figure 6.1). There was a significant positive correlation of mean prevalence of endoparasites with mean temperature and relative humidity as shown in Figure 6.2. Appendix 9.4 shows monthly variations in mean prevalence of village chickens endoparasites.

The comparison of seasonal mean temperature and relative humidity inside and outside chicken houses is shown below in Figure 6.3 (See Appendix 9.5 also for monthly variations). Mean temperatures inside and outside chicken houses were almost similar. Relative humidity inside chicken houses during summer was higher than the environmental humidity by about 9%.

Table 6.1: Seasonal prevalence (%) of gastro-intestinal parasites of village chickens

Parasites	Season			
	Winter	Spring	Summer	Autumn
Nematodes				
<i>Ascaridia galli</i>	31.58	42.11	68.42	57.89
<i>Capillaria</i> species	10.53	10.53	21.05	15.79
<i>Heterakis gallinarum</i>	26.32	31.58	68.42	52.63
<i>Trichostrongylus tenuis</i>	0	5.26	10.53	10.53
<i>Syngamus trachea</i>	36.84	36.84	47.37	36.84
Cestodes				
<i>Choanotaenia infundibulum</i>	0	0	26.32	15.79
<i>Raillietina cesticillus</i>	26.32	36.84	78.95	65.78
Protozoa				
Coccidia-oocyst	52.63	57.89	89.47	73.68

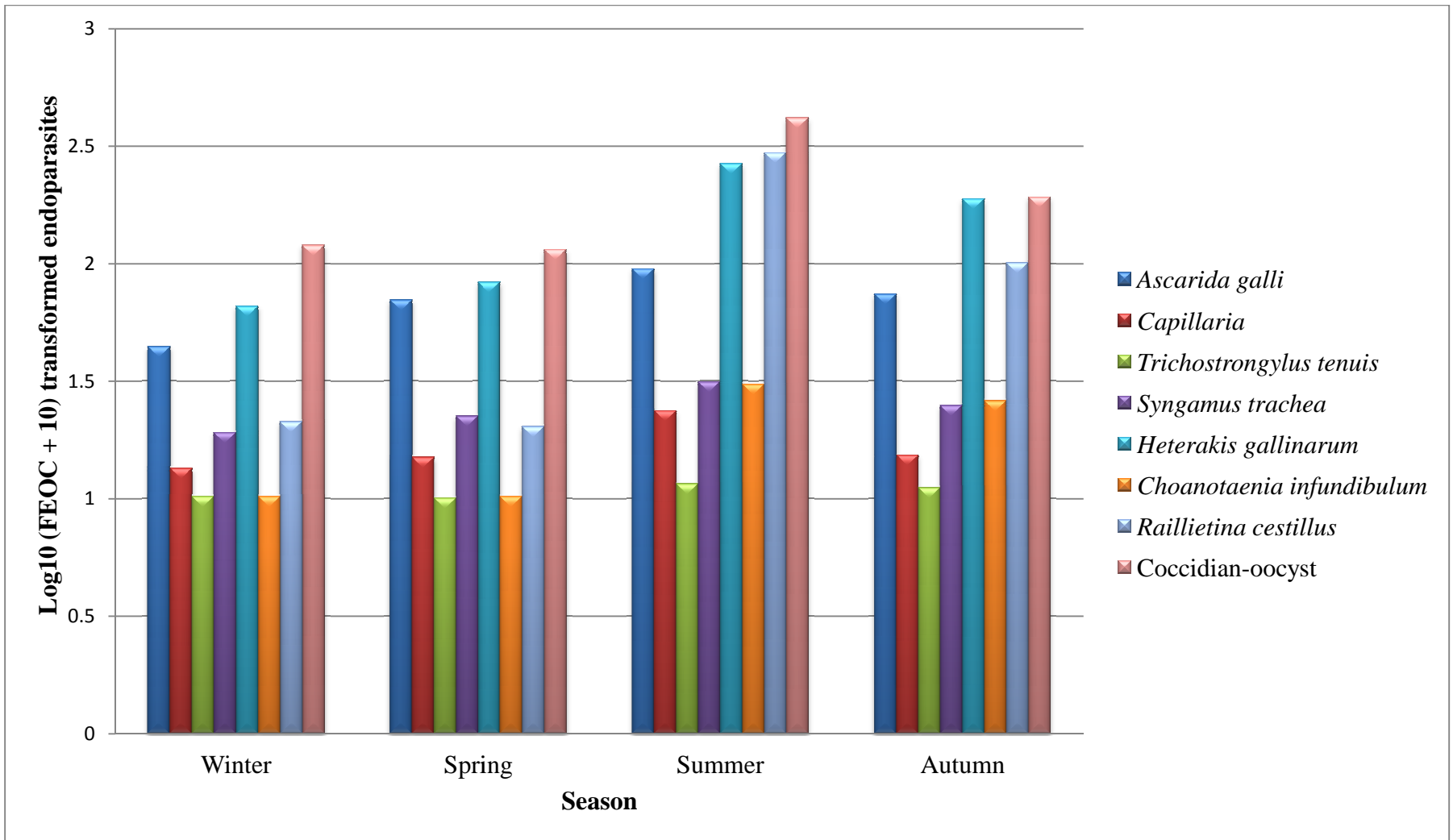


Figure 6.1: Effect of season on log₁₀ (FEOC + 10) transformed endoparasites in village chicken

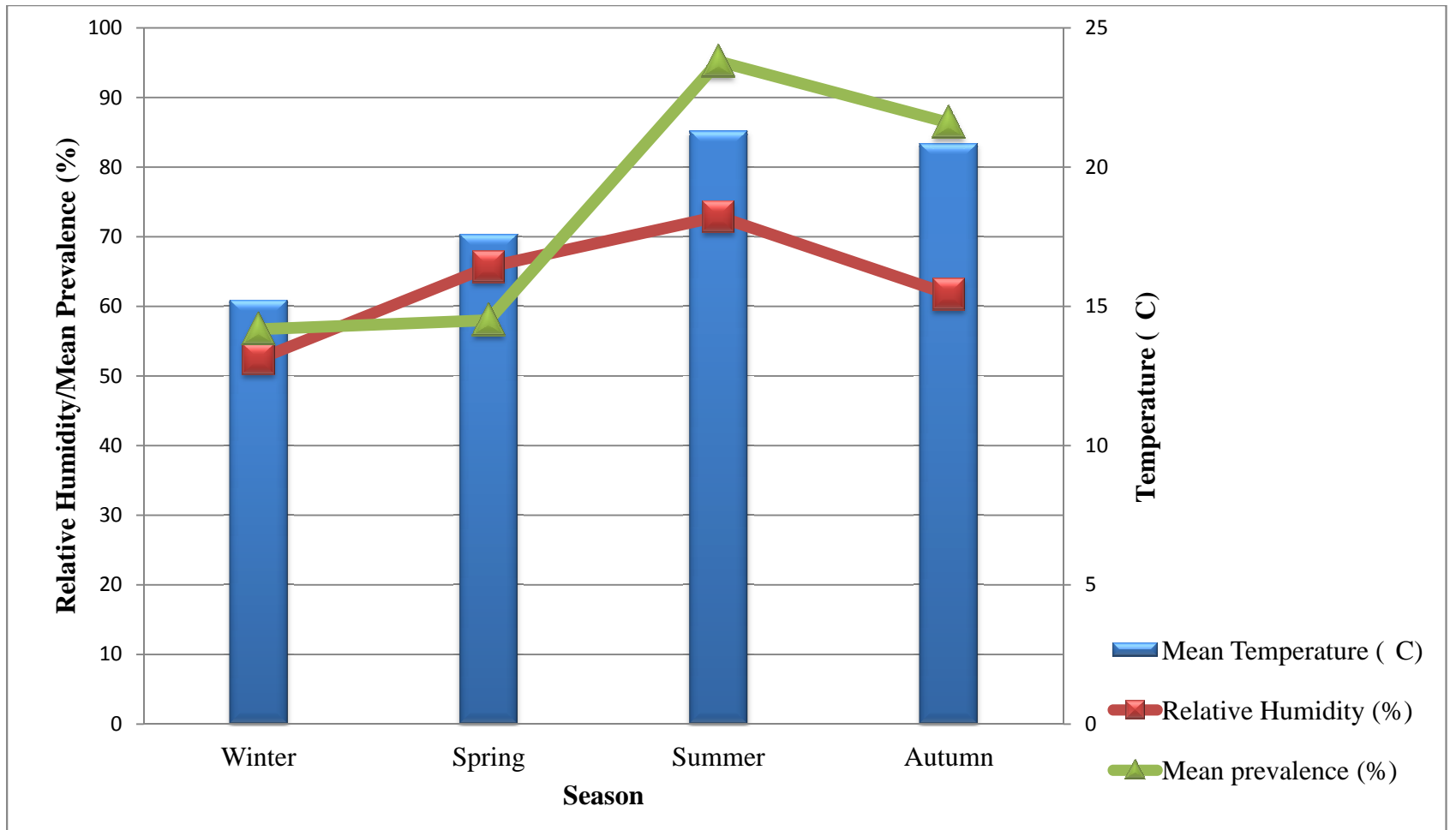


Figure 6.2: Seasonal mean temperature, relative humidity and prevalence of endoparasites in village chicken

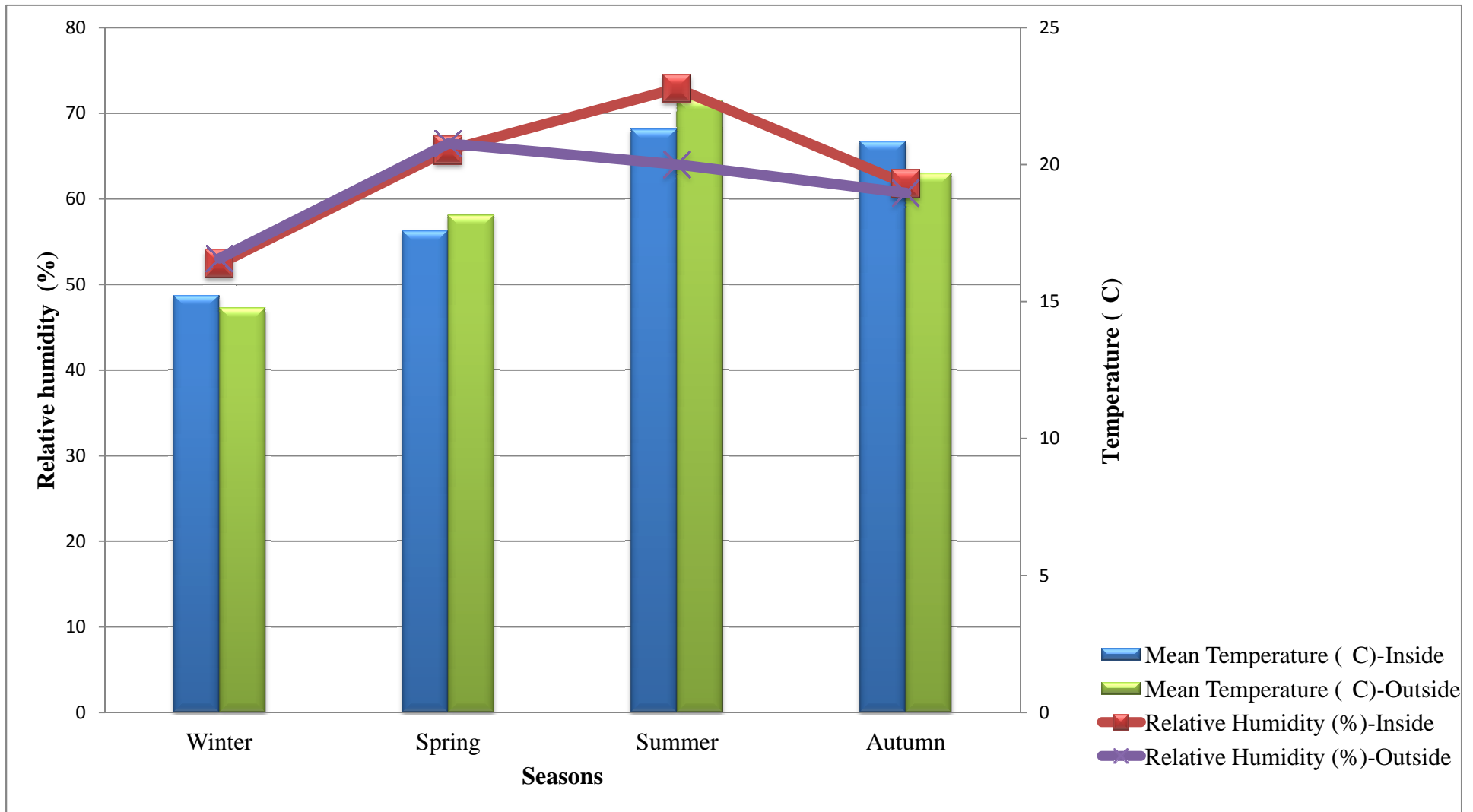


Figure 6.3: Comparison of seasonal mean temperature and relative humidity inside and outside chicken houses

6.4 Discussion

This study revealed a high prevalence of village chicken endoparasites which is consistent with findings recorded by Matur *et al.* (2010) and Mwale and Masika (2009) who reported 98.0% and 100% prevalence, respectively. The high values of faecal egg counts and coccidian-oocysts, especially in the summer season, suggest that the chickens were heavily parasitized. The multiplicity of gastro-intestinal parasites demonstrated in the current study agrees with previous research (Muhairwa *et al.* 2007; Mwale and Masika, 2010; Nnadi and George, 2010). The plural parasite infestations show the serious extent of helminthosis in the village chickens (Matur *et al.* 2010). This is also supported by Permin *et al.* (1997) who reported that in nature, scavenging chickens often harbour more than one gastro-intestinal parasite species. Scavenging exposes chickens to virtually all types of environment and hence, predisposing them to various forms of infections (Matur *et al.* 2010). High prevalence of gastro-intestinal parasites contribute to major production losses such as mortalities, reduced growth rate, poor egg lay and feed conversion efficiency as reported by previous research (Ruff, 1999; Nnadi and George, 2010). This is particularly true for conjoint infestations with helminthes and coccidia whose combined effects on host metabolism could be devastating (Nnadi and George, 2010).

Throughout the current study nematodes were the most common parasites, a finding consistent with Matur *et al.* (2010) who reported that nematodes constitute the most important group of helminth parasites of poultry in number of species. In the coastal region (Centane District) of the Eastern Cape Province, Mwale and Masika (2010) reported that nematode *H. gallinarum* and the protozoa coccidian-oocyst were the most prevalent parasites. However, the current study revealed that besides coccidian-oocyst and *H. gallinarum*, cestode *R. cesticillus* and nematodes

A. galli were amongst the most prevalent parasites. The differences observed may be attributed to different agro-ecological zones in which these studies were conducted, variation in management practices and possibly the strain/breed (Nadeem *et al.* 2007) although the genetic potential is unknown. The high prevalence of *A. galli* is noteworthy because previous studies have incriminated this parasite as the most common parasite of poultry (Luka and Ndams, 2007; Pam *et al.* 2006). *Raillietina cesticillus* is highly pathogenic, thus its high prevalence is also important. The current study also revealed a fairly low prevalence of *Capillaria* species contrary to a report by Mwale and Masika (2010). These workers only conducted a once-off prevalence study which did not account for seasonal variation and this may have not been a comprehensive reflection of the situation on the ground.

The finding that the prevalence and intensity of endoparasites varied in seasons in the current study concurs with what Soulsby (1982) established earlier. The author reported that during the summer season, the hot and humid weather tends to favor the development of these parasites. In addition, in a similar study Permin and Hansen (1998) stated that optimal temperatures (between 20 and 30 °C) and high relative humidity (92%) prevailing in the summer season led to a positive response in parasites population. Consequently, cestode *C. infundibulum* was actually observed only during the summer and autumn season. Thus endoparasites perpetuate markedly when high temperatures coincide with high humidity. Previous investigations in sheep and goats also recorded higher parasitic infestations during the summer season (Mbuh *et al.* 2008; Rumosa-Gwaze *et al.* 2009). Chicken shelters also created a more favorable environment for parasite development by increasing relative humidity in summer by about 9% above normal. This agrees with previous research which stated that village chicken housing favors development of parasites

thereby impeding productivity significantly (Sonaiya, 2000; Bebora *et al.* 2005). Conversely, the hot-dry weather during the spring season adversely affects egg and oocyst development (Merck Veterinary Manual, 2011). However, the prevalence of *T. tenuis* was surprisingly low and almost constant throughout the study, yet it was expected to exponentially increase during hot-wet summer season as reported by Soulsby, (1982). It is strongly suspected that most of the eggs and larvae of this parasite could not survive the hot and dry weather during spring which affected its prevalence throughout the study.

Similar studies conducted in Tanzania (Permin *et al.* 1997) and Nigeria (Luka and Ndams, 2007) did not demonstrate any trematodes which is consistent with results from the current study. However, this finding disagrees with reports from the coastal region of the Eastern Cape (Mwale and Masika, 2010). Seasonal variations in the availability of free standing water could have limited exposure to snails which are the intermediate hosts of trematodes. The gradient of the study area is sloppy and does not allow water to settle hence snails could survive as intermediate host.

Endoparasites are known to cause interference with host metabolism (Nnadi *et al.* 2007), thereby undermining the contribution of village chickens to rural livelihoods. It is imperative for appropriate interventions to be explored in order to alleviate the problem of endoparasite burden in village chickens. However, besides seasonal variations, there are other possible compounding factors such as management practices and chicken breeds which could explain the variations observed in parasite prevalence.

6.5 Conclusion

In general, faecal egg and oocyst counts were highest in the summer season than in the other seasons. This implies that seasonal variations had an effect on the prevalence of endoparasites. More research on health and management of village chickens are recommended to promote chicken production as another source of income and protein to the poor people. Furthermore, it will be essential for future studies to estimate the effect of endoparasites prevalence and intensity on village chicken productivity. However, ectoparasites may also impede chicken productivity, thus it is imperative to determine their seasonal prevalence. The next chapter is preoccupied with seasonal prevalence of ectoparasites in the study area.

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Chapter 7: Seasonal prevalence of ectoparasites in village chickens: the case of Amatola Basin, South Africa

(Submitted for publication to the Journal of Parasitology Research)

Abstract

Village chickens have a significant role in the livelihoods of rural people. However, as they scavenge for feed, they are usually, exposed to ectoparasites, which pose a serious threat to their health. This study was, therefore, carried out to establish seasonal prevalence of ectoparasites in village chickens of Amatola Basin, South Africa. Twenty households were selected using a purposive sampling technique to determine the seasonal prevalence of ectoparasites, from July 2010 to July 2011. For each participating household, one bird per class (cock, hen and chick) was random sampled and inspected for ectoparasites, on a monthly basis. Village chickens were infested with a variety of ectoparasites namely: mites, lice, fleas and ticks. The prevalence and intensity of different ectoparasites were highest in summer, followed by autumn, then spring and lowest in winter. The sticktight flea *Echidnophaga gallinacean* was the most prevalent species with an overall prevalence of 47%, 73.3%, 96% and 87.3% in winter, spring, summer and autumn, respectively. Conversely, lice *Cuclotogaster heterographus* had the least overall prevalence and was only in summer on hens. The prevalent mites were *Knemidocoptes mutans*, *Dermanyssus gallinae* and *Ornithonyssus bursa*, while lice included *Cuclotogaster heterographus*, *Liperus caponis*, *Goniodes gigas*, *Menopon gallinae*, *Menacanthus cornutus* and *Goniocotes gallinae*. *Argas walkerae*, *Haemaphysalis silacea* and *Amblyomma hebraeum* were the ticks species observed on chickens. Although ectoparasite infestations were most pronounced in summer, almost all chickens harbored one or more of these parasites throughout the study.

Keywords: Ethno-veterinary medicines, external parasites, free-ranging, resource-limited, rural, season

7.1 Introduction

Although village chickens contribute significantly towards the livelihoods of rural people, these birds are susceptible to health challenges especially parasite infestations (Mwale and Masika, 2009). As they scavenge for feed, village chickens get exposed to ectoparasites which markedly impede their productivity directly and/or indirectly. Direct effects include irritation, discomfort, tissue damage, anaemia, toxicosis, allergies and dermatitis which in turn retard growth, reduce egg production and lower chicken vitality (Kaufman et al. 2007; Mbaya, 2007; Salam et al. 2009). Severe infestations, especially in the warmer months, where minor infestations can quickly multiply, may result in devastating consequences such as mortality (Campbell, 1989). External parasites may also indirectly affect chicken health by acting as mechanical or biological vectors transmitting a number of pathogens (Ruff, 1999; Denmark and Cromroy, 2006; Salam et al. 2009).

Wilson (1986) alluded to external parasites as a major constraint to chicken production in South Africa. Prevalence of ectoparasitic infestations in village chicken flocks is close to 100%, and in most cases, an individual chicken harbours more than one parasite type (Permin, 1997). Common village chicken ectoparasites include lice, mites, fleas and ticks (Nnadozie, 1996; Dlamini, 2002; Moyo, 2009). Mites and lice have been reported to be the most destructive external parasites (Beyer, 1999; Biswas et al., 2008).

A once-off prevalence study of village chicken external parasites was conducted in Amatola Basin of the Eastern Cape Province by Moyo (2009). However, Moyo (2009) could not account for the effect of season on the prevalence of the ectoparasites. Thus, this study sought to establish seasonal prevalence of ectoparasites in village chickens.

7.2 Materials and Methods

7.2.1 *Study area*

The details of the description of the site are given in Section 3.2.1.

7.2.2 *Household selection*

Section 4.2.2 gives a detailed description of the household selection procedure.

7.2.3 *Temperature and humidity inside the chicken shelters*

The description of capturing temperature and humidity inside the chicken shelters are given in Section 6.2.3.

7.2.4 *Sampling of chickens*

Monthly random sampling of one bird per class (cock, hen and chick) in each participating household was carried out to examine chickens for parasites. The head, combs, eyelids, wattles, neck, feathers, breast, back, wings, shafts, legs and other external surfaces of the chicken were thoroughly examined.

7.2.5 Collection and identification of ectoparasites

The collection procedure for ectoparasites was adopted from Ikpeze et al. (2008). Specimen bottles, each containing 75 % alcohol, to which few drops of 5 % glycerine had been added, were labeled with different parts of the chicken as well as the class of chicken examined. Ectoparasites were collected from chickens with either pin-forceps or blunt forceps; sufficient care was taken to prevent damage both to the chickens and the morphological features needed for subsequent identification of the ectoparasites. The identification of collected samples was conducted at the Agriculture Research Council (ARC) Onderstepoort Veterinary Institute of South Africa.

7.2.6 Data Analyses

The obtained data were analyzed using Statistical Analysis System (SAS, 2003) for descriptive statistics - frequencies, means and standard deviations. The generalised linear model procedures were used to compare prevalence of parasites between chicken classes (SAS, 2003). Prevalence of ectoparasites was also compared between seasons and among farmers depending on the control remedies they used. Prevalence was calculated according to Thrustfield (1995) as number of chicken flocks/household infested with a particular parasite species, divided by the total number of chicken flocks sampled, as shown below.

$$P = \frac{d}{n} \times 100$$

Where P is the prevalence, d is the number of chickens infected by a single ectoparasitic species at a particular given time and n is the number of individuals in the population at risk at that particular time.

7.3 Results

Village chickens were infested with an assortment of ectoparasites namely: mites, lice, fleas and ticks. Table 7.1 shows the effect of seasonal variations on the prevalence of ectoparasites in cocks, hens and chicks. More often than not, each bird harbored more than one type of parasite. The correlation of mean temperature and relative humidity with the mean prevalence of each ectoparasite in seasons is shown in Figure 7.1 (See Appendix 9.6 also for monthly variations). Some ectoparasites which included *Haemaphysalis silacea*, *Amblyomma hebraeum*, *Cuclotogaster heterographus* and *Menopon gallinae* were not demonstrated in winter when mean temperature and relative humidity were low (Figure 7.1). Conversely, the highest prevalence of ectoparasites was observed in summer when mean temperature and relative humidity were at their highest peak. Thus, ectoparasites were more pronounced during the hotter and humid months compared to the colder and dry months of the study.

Among the ectoparasites, the stick tight flea *Echidnophaga gallinacea* was found to be most prevalent in all chicken classes (Table 7.1). It had a mean prevalence of 47%, 73.3%, 96% and 87.3% in winter, spring, summer and autumn, respectively. This parasite was mainly identified on the head region, especially on the wattles, combs and around the eyelids.

Table 7.1: Seasonal variation of ectoparasite prevalence in different village chicken classes

Species	Seasonal prevalence (%) of chickens infected											
	Winter			Spring			Summer			Autumn		
	Cock	Hen	Chick	Cock	Hen	Chick	Cock	Hen	Chick	Cock	Hen	Chick
<i>Ornithonyssus bursa</i>	0	66		14	78	22	32	88	36	18	82	36
<i>Dermanyssus gallinae</i>	0	25	0	11	52	16	25	54	38	11	54	28
<i>Knemidocoptes mutans</i>	66	42	0	74	46	0	80	66	0	74	53	0
<i>Echidnophaga gallinacean</i>	69	48	24	83	80	57	100	100	88	88	100	74
<i>Argas walkerae</i>	37	0	0	46	25	5	48	46	22	46	36	11
<i>Haemaphysalis silacea</i>	0	0	0	22	11	0	30	16	5	22	11	0
<i>Amblyomma hebraeum</i>	0	0	0	16	0	0	25	22	5	22	16	0
<i>Cuclotogaster heterographus</i>	0	0	0	0	16	0	0	32	0	0	25	0
<i>Liperus caponis</i>	0	16	0	11	16	11	16	32	22	14	28	22
<i>Goniodes gigas</i>	5	16	0	22	22	11	25	36	25	11	28	11
<i>Menopon gallinae</i>	0	0	0	9	14	0	14	23	0	14	16	0
<i>Goniocotes gallinae</i>	5	16	0	22	22	0	25	36	16	11	28	5
<i>Menacanthus stramineus</i>	11	11	0	22	22	22	36	42	25	28	36	23

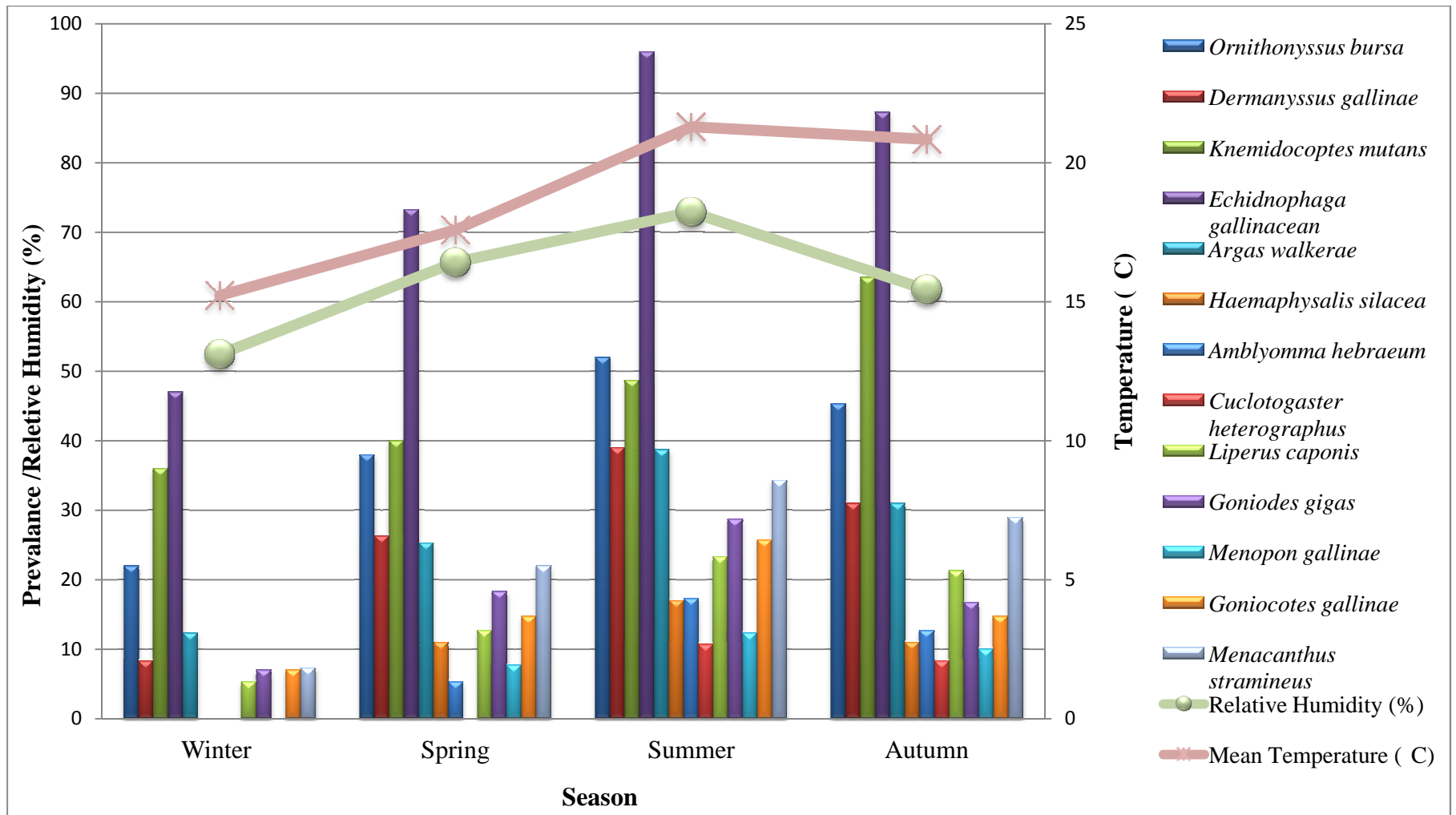


Figure 7.1: Seasonal mean temperature, relative humidity and prevalence of ectoparasites in village chickens

Although *Knemidocoptes mutans* (scaly leg, burrowing mite) lesions were mostly ($P < 0.05$) found in cocks, they were generally evident on the legs of older birds (cocks and hens) than in chicks. The skin mites and lice, on the other hand, were more ($P < 0.05$) associated with the hens than other classes of chickens. The red mite *Dermanyssus gallinae* and tropical fowl mite *Ornithonyssus bursa* were also identified in all chicken classes especially ($P < 0.05$) in the summer season.

Fowl ticks *Argas walkerae* were found attached to the skin of the birds especially under the wings throughout the monitoring study. Hard ticks *H. silacea* and *A. hebraeum* were also observed on the heads and necks of all chicken classes. The highest prevalence of ticks was observed in cocks followed by hens and chicks, in that order (Table 7.1). The summer season demonstrated the highest prevalence of all tick species, while winter had close to zero prevalence. Some samples of *Haemaphysalis silacea* and *A. hebraeum* were also found away from the birds inside chicken shelters.

Mature lice and clusters of white lice eggs were detected at the base of feather shafts and along the barb upon spreading the feathers in the neck, wing, shaft, and vent. Lice were mostly found beneath and on the wings, and feather shafts of affected chickens. The lice species identified were *C. heterographus*, *L. caponis*, *G. gigas*, *M. gallinae*, *M. cornutus* and *G. gallinae*. The neck louse *C. heterographus* had the least mean prevalence of all the ectoparasites throughout the study. This parasite was restricted to hens ($P < 0.05$) and only observed in the summer and spring seasons. Typical symptoms of feather-loss due to shaft louse *M. gallinae* infestation, and *M. gallinae* eggs on feather were observed in all classes save for the chicks, while *G. gallinae*, *G.*

gigas and *L. caponis* affected all classes of chickens. However, *M. gallinae* infestation was generally pronounced in hens than the cocks.

7.4 Discussion

The present study revealed the prevalence of various ectoparasites, an observation that is in accordance with earlier reports (Kaufman et al. 2007; Mbaya, 2007; Moyo, 2009). These ectoparasites have been reported to cause irritation, loss of feathers, anemia and death in severe cases Soulsby (1982). Thus, ectoparasites adversely affected village chicken productivity especially during summer season where infestations were relatively high and multiple. However, the plurality of ectoparasites in this study is not consistent with previous reports from other places (Prelezov and Koinarski 2006; Sychra et al. 2008; Salam et al. 2009) which only found lice in village chickens. The differences in the observations may be attributed to the varying climatic conditions of the geographical locations where the studies were conducted. Different climatic conditions (temperature and humidity) may have altered the population dynamics of the parasites as supported by Magwisha et al. (2002).

Prevalence and intensity of ectoparasite infestations is positively correlated with temperature, both being higher in warmer than in cooler months (Nadeem et al. 2007). Therefore, the increased prevalence of ectoparasites during summer can be attributed to the required optimum temperatures and relative humidity for the development of parasites and decreased resistance of birds to the parasites in high temperatures resulting in heavy infestations (Salam et al. 2009). The increased relative humidity in chicken shelters (Figure 6.3) also contributed to parasite development. Overall prevalence of ectoparasites differed greatly with previous reports from

Czech Republic (Sychra et al. 2008), Bulgaria (Prelezov and Koinarski, 2006), Nigeria (Salam et al. 2009) and Zimbabwe (Permin et al. 2002). Population dynamics of ectoparasites could have been influenced by different climatic conditions, geographical factors and periods of the study as supported by Magwisha et al. (2002).

In an earlier report by Ashenafi and Eshetu (2005), lice were recorded to be the most prevalent chicken parasite. However, the present study revealed that *E. gallinacea* was the most common ectoparasites which concurs with a study conducted in Kenya (Mungube et al. 2008). This observation is also consistent with an earlier report by Moyo (2009) in the rural Eastern Cape Province, although the current study had a higher prevalence. The comparison of seasonal variations in ectoparasite infestations is crucial in understanding the trends of these parasites which will assist in devising informed health management practices. Furthermore, farmers must be concerned about the prevalence of heavy infestations of *E. gallinacea* as this can cause death especially in chicks (Mungube et al. 2006).

In the current study hens were more susceptible to mites and lice infestation compared to cocks and chicks. This may be attributed to the fact that hens, especially when broody, have high prolactin levels which suppress the immune system of the chicken (Shanta et al. 2006), thereby increasing vulnerability to infections. Furthermore, this could have been a result of increased chance of contact (time and surface area) between these parasites and the hosts during incubation. These parasites, especially mites *D. gallinae*, are responsible for severe irritations which lead to egg abandonment by broody hens (Mungube et al. 2008).

Knemidocoptes mutans was found in adult birds, a finding consistent with previous reports (Soulsby, 1982; Shanta et al. 2006). This parasite is highly contagious. Thus, although *K. mutans* was associated with adult chickens in the present study, chicks that may have been infested with this parasite were yet to show symptoms of scaly legs, which require time to develop (Soulsby, 1982; Urguhart et al., 1988). Accumulation of the crust as a result of *K. mutans* infection may interfere with flexion of the joint causing lameness, and arthritis or loss of toes in severe cases (Ikpeze et al. 2008).

Hard ticks *H. silacea* and *A. hebraeum* were among the ectoparasites that infested village chickens in the current study. Scavenging chickens were exposed to these parasites in grassy areas where ticks were also scouting for hosts. Tick-bites lead to blood loss and damage to the skin, causing skin irritation, weakening of the flock as well as mortality in severe cases (Nyangiwe et al. 2008; Moyo and Masika, 2009). Like all other ectoparasites, the prevalence of ticks was pronounced during the summer season because of a favorable environment (mean temperature and relative humidity) for tick development.

Findings of the prevalence of lice species in the current study concur with a report by Salam et al. (2009) save for *M. cornutus* which was not prevalent in this study. Epidemiological factors such as differences in breed, management practices and climatic condition, may account for variation in the observations. An earlier research conducted in the current study area (Moyo, 2009) revealed the prevalence of only four lice species, yet in the current study six were observed. *Cuclotogaster heterographus* and *L. caponis* were the lice species not reported by Moyo (2009). This may be due to the fact that Moyo (2009) conducted a once-off study yet the

present study accounted for the seasonal variation of ectoparasites. Chicken class related physiology conferred differences in *C. heterographus* infestations, as this parasites was only restricted to hens. In agreement with Moyo (2009) there was no significant difference in *M. gallinae* infestation between cocks and hens. However, this louse was not found on chicks which agrees with a report by Ikpeze et al. (2008). This may be attributed to the fact that adult village chickens scavenge through a wider area compared to chicks, which makes them more susceptible to a diversity of infestation (Shanta et al. 2006).

7.5 Conclusion

The prevalence of each species of ectoparasites was more prevalent during the hot and wet summer season compared to the other seasons of the monitoring study. In addition, the intensity and multiplicity of ectoparasites was highest in summer, and lowest in the winter season. Further studies are recommended to determine the effect of the prevalence of ectoparasites on village chicken productivity.

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Chapter 8: General Discussion, Conclusion and Recommendations

8.1 General Discussion

Village chickens constitute a major part of poultry industries in many developing countries (Spradbrow, 1997). These chickens contribute significantly to the livelihoods of poor households economically as a starter capital, accessible protein source, and source of income and exchange of gifts to strengthen social relations (Gondwe, 2004; Van Marle-Köster et al., 2008). Although village chicken production is a common agricultural activity in the developing countries, the rearing management systems vary from area to area depending on the prevailing agro ecosystems and available resources (Kusmarresan, et al. 2008; Van Marle-Köster et al., 2008). The current study sought to characterize village chicken production in the rural Eastern Cape Province of South Africa.

Farmers kept chickens mainly for household consumption, and sold some for income generation in cases of emergencies. Although village chickens scavenged for feed, they were erratically provided with drinking water and energy-rich supplementary feed, mostly yellow maize and kitchen wastes. Farmers also provided shelter for their chickens during the night. Chicks hatched and chickens received as gifts represented the only entries observed. Chicken flock exits included mortality, consumption, sales and gifts or donations, in that order. In general, both exits and entries were more pronounced in the summer season than in the other seasons. There was no significant difference ($P>0.05$) in the consumption of chickens between winter, spring and autumn, however, chicken slaughters increased during the summer season. This was attributed to the festive month which fell in this season a finding consistent with Gondwe and Wollny (2007). Predation accounted for most of the chicks lost, especially in summer when most hatchlings were

observed. Besides predation, other cases of chicken mortality were demonstrated. These deaths were suspected to be health related as informed by the baseline study.

Parasite infestations and parasite-induced diseases were the major health challenges reported by farmers. Consequently, chicken flocks were monitored to confirm farmers' perception on parasitic infections. The prevalence and intensity of endoparasites were significantly ($P < 0.05$) higher in the summer season compared to the other seasons. Nematodes had the highest number of genera observed which included *Ascaridia galli*, *Heterakis gallinarum*, *Trichostrongylus tenuis* and *Syngamus trachea*. The cestodes identified were *Raillietina cesticillus* and *Choanotaenia infundibulum* species. Coccidian-oocysts were prevalent and had the highest number of counts, however no trematodes were observed throughout the study. This multiplicity of gastro-intestinal parasites concurs with previous research (Mwale and Masika, 2010; Matur et al. 2010) which shows the prevalence of helminthosis in chickens.

A variety of ectoparasites infested village chickens. These were: mites, lice, fleas and ticks an observation that is consistent with earlier reports by (Kaufman et al. 2007; Moyo, 2009). Ectoparasites cause irritation, loss of feathers, anemia and death in severe cases (Soulsby, 1982). The prevalence and intensity of the different ectoparasites were highest in summer, followed by autumn, then spring and lowest in winter. The *Echidnophaga gallinacean* was the most prevalent species throughout the study, while *Cuclotogaster heterographus* was the least and was only observed on hens in summer. The prevalent mites included *Knemidocoptes mutans*, *Dermanyssus gallinae* and *Ornithonyssus bursa*, while lice were *Cuclotogaster heterographus*, *Liperus caponis*, *Goniodes gigas*, *Menopon gallinae*, *Menacanthus cornutus* and *Goniocotes*

gallinae. Tick species observed were *Argas walkerae*, *Haemaphysalis silacea* and *Amblyomma hebraeum*.

The high prevalence of parasites in the study area, especially in the summer season, suggests that chickens in the study area were heavily parasitized. Besides health related losses, predation claimed a high number of chickens especially chicks during scavenging although predation related losses were rare for adult chickens. As a result most cases of chicken losses were chicks especially in summer when most chicks were hatched.

Instead of using orthodox drugs to treat diseases and control parasites, farmers resorted to alternative remedies, mainly plants, because of exorbitant prices of drugs, a finding which agrees with Molento (2009). Other reasons for using medicinal plants included the fact that they were locally available and perceived as very effective. In addition, farmers did not have access to agricultural extension services; as a result they lacked adequate knowledge of the conventional measures for treating diseases and controlling parasite infestations. However, the baseline study did not retrieve information on seasonal flock dynamics in village chickens. Monitoring the flock demographics assisted in establishing the contribution and constraints of chicken production in the rural areas of the Eastern Cape Province.

8.2 Conclusion

Although village chickens are mainly kept for subsistence, they may be sold in cases of emergencies to generate income or used as gifts to strengthen social relations which make them significant in the lives of rural households in the Eastern Cape Province. However, these

chickens are raised with minimum input in terms of feed, housing and general health management aspects. Village chicken production is mostly affected by predation and health challenges. Predation accounts for the majority of chick mortalities especially during the summer season. Parasitism ranked high in the health challenges that affected village chickens. The prevalence, intensity and multiplicity of both endoparasites and ectoparasites were higher in hot-wet summer compared to the other seasons. The endoparasites demonstrated were nematodes, cestodes and protozoa. Coccidian-oocysts were the most prevalent endoparasites throughout the study, followed by the cestode *R. cesticillus* and nematodes *A. galli* and *H. gallinarum*, respectively. Village chickens were infested with a variety of ectoparasites namely: mites, lice, fleas and ticks. The sticktight flea *Echidnophaga gallinacean* was the most prevalent ectoparasite. Farmers mainly used medicinal plants against the parasites and parasite-induced diseases encountered. Thus, village chicken production in the rural Eastern Cape is characterized by low-input and constraints that counter the productivity of these chickens.

8.3 Recommendations and future research

For the productivity of chickens to increase significantly, farmers need to improve the feeding, housing and health management. Farmers must develop a proper program for feeding, housing, breeding and management of health aspects. Extension services are also imperative to assist farmers with basic chicken husbandry. Uneconomic chicken flock exits, for example, through predation and chick mortality may be countered by confining young chicks in chicken shelters.

Future studies are recommended to determine the quality and quantity of chicken farmers consume per annum. This will highlight the protein percentage village chickens contribute to the

livelihoods of rural people. Future research could also estimate the quality and quantity of feed each bird consumes during scavenging. This will assist in coming up with adequate supplementation for the chickens. In addition, it is imperative for future studies to determine the effect of the prevalence and intensity of parasites on village chicken productivity.

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						(Specify)
Numbers						

9. Fill in the table below.

Poultry		Village chickens	Ducks	Geese	Turkeys	Pigeons	Guinea Fowls	Other (Specify)
Grand total								
Entries:	Offspring since 2009							
	Bought							
	Gifts/Donations							
Exits:	Mortality							
	Consumed							
	Ceremonies							
	Gifts/Donations							
	Sold							

10. State the general price range in this area of the types of poultry that you have in the following Table

Poultry	Village chickens	Ducks	Turkeys	Guinea Fowls	Pigeons	Other (Specify)
Price /I						

11. Rank your livestock according to importance

Livestock	Rank according to importance 1=most important 2=fairly important 3=least important 4=not important
Cattle	
Sheep	
Goats	
Poultry	
Donkeys	
Other? Specify _____	

12. What is your criterion for rankings the above livestock species? 1.) Finances 2.) Draft power 3.) Food 4.) Prestige 5.) Ease of management 6.) Other (Specify) _____

13. If you bring in chickens (as presents, bought etc) how do you introduce them in the flock?

14. On average, how many eggs do your chickens lay a year? _____

15. What is the number of chicks hatched per batch? _____
16. Give a reason for the number of chicks hatched per batch?

17. How many chicks survived to maturity _____
18. State the reason(s) for the number of chicks that survived to maturity-

19. Is chicken production an economical practice to you? 1.) Yes 2.) No
State the reasons for the above mentioned answer _____
20. What is your selection criterion for the chickens you farm with? 1.) Size 2.) Type/(Breed)
3.) Color 4.) Finances 5.) Other? Specify _____

Section C: Nutrition

21. Do you feed your chickens? 1.) Yes 2.) No
22. Do you give specific feed to your chickens at different stages of growth (chick, grower and mature)? 1.) Yes 2.) No
23. What method do you use for feeding your chickens? 1.) Feeding troughs 2.) Throw to the ground 3.) Other? Specify _____
24. What type of supplementary feed do you give to your chickens? 1.) None 2.) Maize grain 3.) Wheat 4.) Sorghum 5.) Millet 6.) Kitchen wastes 7.) Sunflower 8.) Other (Specify) _____
25. Frequency of feeding? 1.) Once a day 2.) Twice a day 3.) Thrice a day 4.) Anytime 5.) Other (Specify) _____
26. For how long do your chickens scavenge for feed per day?

Give a reason for the answers(s) above? _____
How does the season (cold and hot) affect nutrition of your chicken

27. Do you provide water for your poultry (chickens)? 1.) Yes 2.) No
28. What are the sources of water for your chickens? 1) Borehole 2.) Well 3.) Spring 4.) Stream 5.) Dam/pond 5.) Spilled water 7.) Other (Specify) _____
29. State the quality of water your chickens drink. 1.) Clean cool 2.) Muddy 3.) Salty 4.) Smelly 5.) Dirty 6.) Other (Specify) _____

Section D: Housing

30. Do you provide housing for your village chickens? 1.) Yes 2.) No
31. If no, where do your chickens stay over night? 1.) Open space, 2.) Trees 3.) Other? Specify _____

32. If yes, what type of structure do you use for housing your chickens? 1.) Roofed 2.) Solid wall 3.) Floor 4.) Crop residues/grass 5.) Soil/Earth 6.) Other (Specify) _____
- 33.
34. Why did you decide to use the materials and structures mentioned above? 1.) Security 2.) Convenience 3.) Cost 4.) Other? Specify _____
35. Do you clean the chicken houses? 1.) Yes 2.) No
36. Do you collect chicken faecal matter for use as manure? 1.) Yes 2.) No
37. Is there another way you would have liked to build the fowl run? 1.) Yes 2.) No
38. If so, why? _____
39. How would you like it to be built?

40. What are the implications of your type of housing on productivity of chickens? 1.) Increases 2.) Decreases 3.) No effect 4.) Other/ Specify _____

Section E: Chicken Health Management

41. Do you normally experience any health problems in your village chickens? 1.) Yes 2.) No
42. If yes, what are the various health problems? 1.) Diseases 2.) Parasites 4.) Both 5.) Hunger 6.) Wounds 7.) Other? Specify _____

43. On their degree of prevalence, rank these

	Fatality 1=Yes 2=No	1=most prevalent 2=moderate 3=least prevalent 4=not prevalent
Diseases		
Internal parasites		
External parasites		

Parasites

44. How do you tell that the chickens are infested with the said parasites? 1.) Dullness
2.)Scratching 3.) Reduced Feed Intake 4.) Fluffed Feathers 5.) Other (Specify)

- _____
- a.) Internal parasites _____
- b.) External parasites _____

45. Give a description of the answers given above:

- a.) Internal parasites _____
- b.) External parasites _____

46. What are the impacts of the parasites on chickens? 1.) Reduced growth 2.) Reduced egg production 3.) Both 4.) Death 5.) Other Specify _____

47. What are the seasonal differences in the occurrence of the parasites?

- Internal parasites _____
- External parasites _____

48.

Do they affect a few HH, whole village, or various villages? 1.) Few HH 2.) Whole village 3.) Various 4.) Villages

- a.) Internal parasites
- b.) External parasite

49.

How do you control these parasites in humans if necessary.

- Internal parasites _____.
- External parasites _____

Poultry Diseases

50. Give a description of the signs for the diseases that are prevalent.

51. Rank these diseases according to morbidity (if knowledgeable)

Disease	Rank according to which are the most common 1=most common 2=moderate 3=least common 4=not prevalent
New Castle	
Avian Cocidiosis	
Dirrhoea	
Fowl cholera	
Fowl coryza	
Fowl pox	
Marek's disease	
Other (Specify)	

52. What are the seasonal differences in the occurrence of the disease?

Cold Season _____

Hot Season _____

53. Do they affect a few HH, whole village, or various villages? 1.) Few HH 2.) Whole village 3.) Various Villages

54. How do you tell that the chickens are infested with the said parasites? 1.) Dullness 2.) Scratching 3.) Reduced Feed Intake 4.) Fluffed Feathers Other (Specify) _____

55. Have these diseases got any effect on you and/or people in your HH? 1.) Yes 2.) No

56. If yes, how? _____

Section F: Control of Parasites and Diseases

57. For the mentioned problematic parasites and diseases, do you normally control them?

a.) Internal parasites 1.) Yes 2.) No

b.) External parasites 1.) Yes 2.) No

c.) Disease 1.) Yes 2.) No

58. If yes, how do you control parasites and diseases? 1.) Conventional Drugs 2.) Traditional Practices 3.) Both 4.) None 5.) Other (specify) _____

a.) Internal parasites _____

b.) External parasites _____

c.) Disease _____

59. Why do you use Ethno-veterinary practices to control parasites and treat diseases? 1.) Cheap 2.) Locally Available 3.) Highly Effective 4.) Other? Specify

60. If ethno-veterinary practices are not used, why? 1.) Religion 2.) Culture 3.) Not Interested 4.) Not knowledgeable 5.) Other? Specify _____

61. Which conventional drug(s) do you use to control the most prevalent parasites and diseases?

a.) Internal parasites _____

b.) External parasites _____

c.) Disease _____

62. If using conventional drugs please fill in the table below.

Conventional drug (s)	Source	Quantities used	Parasite/ diseases controlled	Mode of application	Frequency of application	Cost	Age of chickens treated

63. Where do you keep the drugs after using them?

64. If using EVMs or both conventional drugs and EVM, please fill in the table below.

Ethno-Veterinary Practice	Type of parasite controlled	Preparation method	Application method	Frequency of application	Precautions taken when using the remedies
Used oil					
Paraffin					
EVM-Plant(s) Names	1				
	2				
	3				
	4				
Ash					
Cow dung					
Soil					
Diesel					
Jeyes fluid					
Madubula					
Smoke					
Other? Specify					

65. Which of the above is most effective? _____

66. Why do you say so?

67. Fill in the following table if medicinal plants are used?

Plant name	Source	Preparation method	Parasite/ diseases controlled	Mode of application	Frequency of application	Age of chickens treated	Precautions when using these remedies

68. State any control methods used at a specific period in the production cycle

	Specific periods of control 1=Laying chick Stage 2=Adult Stage 3=All Stages 4=Brooding 5=Other? Specify _____
Diseases	
Internal Parasites	
External Parasites	

69. For how long have you been using these practices in your chicken flock? 1.) <2 yrs 2.) 2-5yrs 3.) 6-10 yrs 4.) 11-20 yrs 5.) >20 yrs

70. Where did you get this knowledge from? 1.) Extension Agents 2.) Family 3.) Local Leaders 4.) Neighbors 5.) Friends 6.) Other? Specify _____

71. If yes, how? For;

a.) Internal parasites _____

b.) External parasites _____

c.) Disease _____

72. How do you ensure that the plants you use do not become extinct? _____

73. How does season (cold and/or hot) affect the control of parasites and diseases?

a.) Internal parasites _____

b.) External parasites _____

c.) Disease _____

Section G : Extension Services

74. What advice do you get from the extension officers on how to manage village chickens?

75. Where else do you get advice concerning the management of village chickens? _____

Section H: Marketing

76. Do you sell your chickens and/or chicken products (meat and eggs)? 1.) Yes 2.) No

77. What markets are available? 1.) Formal 2.) Informal 3.) Both 4.) Other? Specify

78. Describe the nature of the market:

79. What are the reasons for the market of choice? 1.) Accessibility 2.) Profitability 3.) Availability 4.) All above mentioned 5.) Other? Specify _____

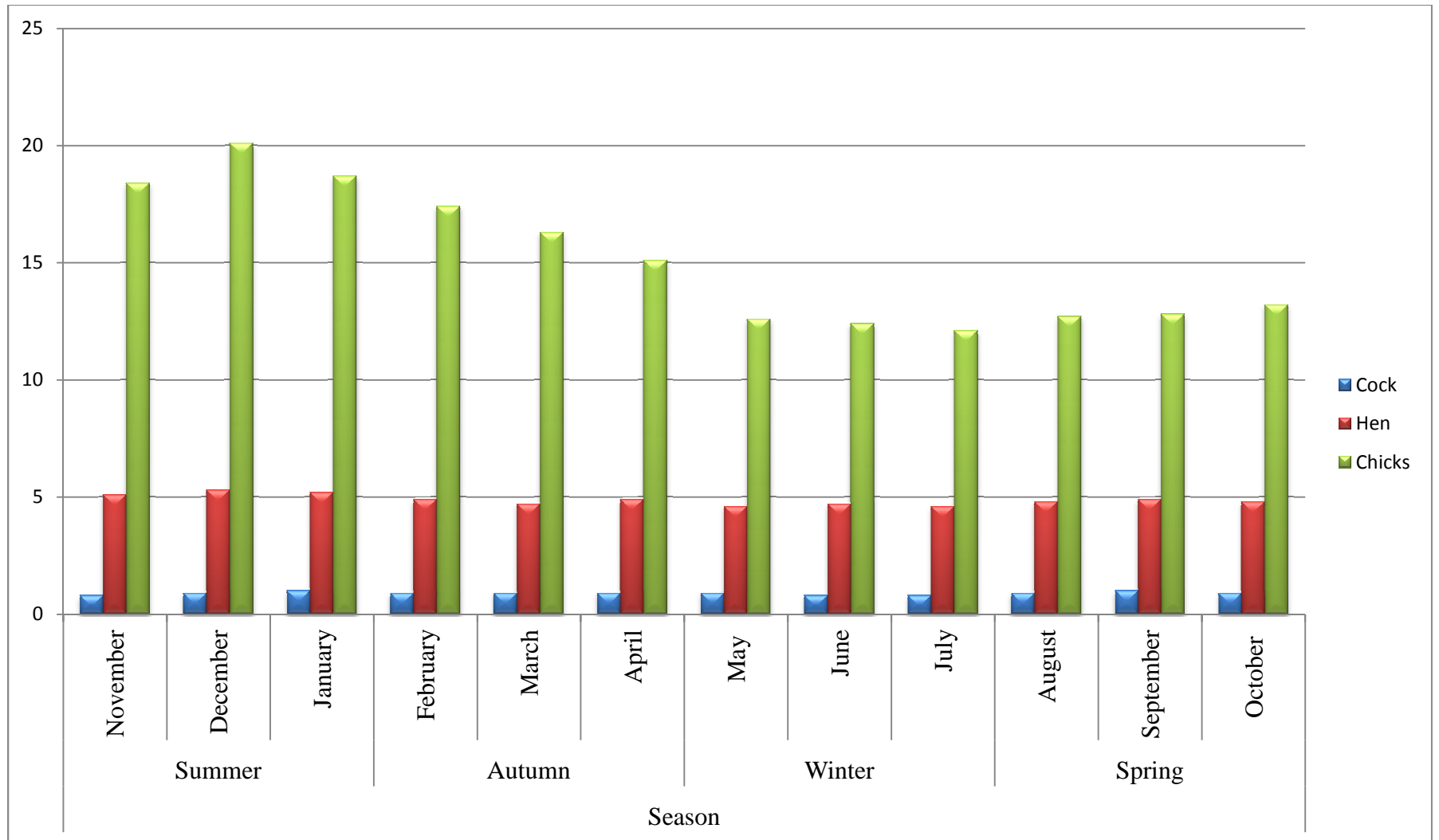
80. Do you buy village chickens and/or chicken products (meat and eggs)? 1.) Yes 2.) No

81. Where do you buy them from? 1.) Local farmers 2.) Hawkers (middlemen) 3.) Business centers (townships) 5.) Other? Specify _____

82. When are the markets most available? 1.) Cold season 2.) Hot season 3.) Other? Specify

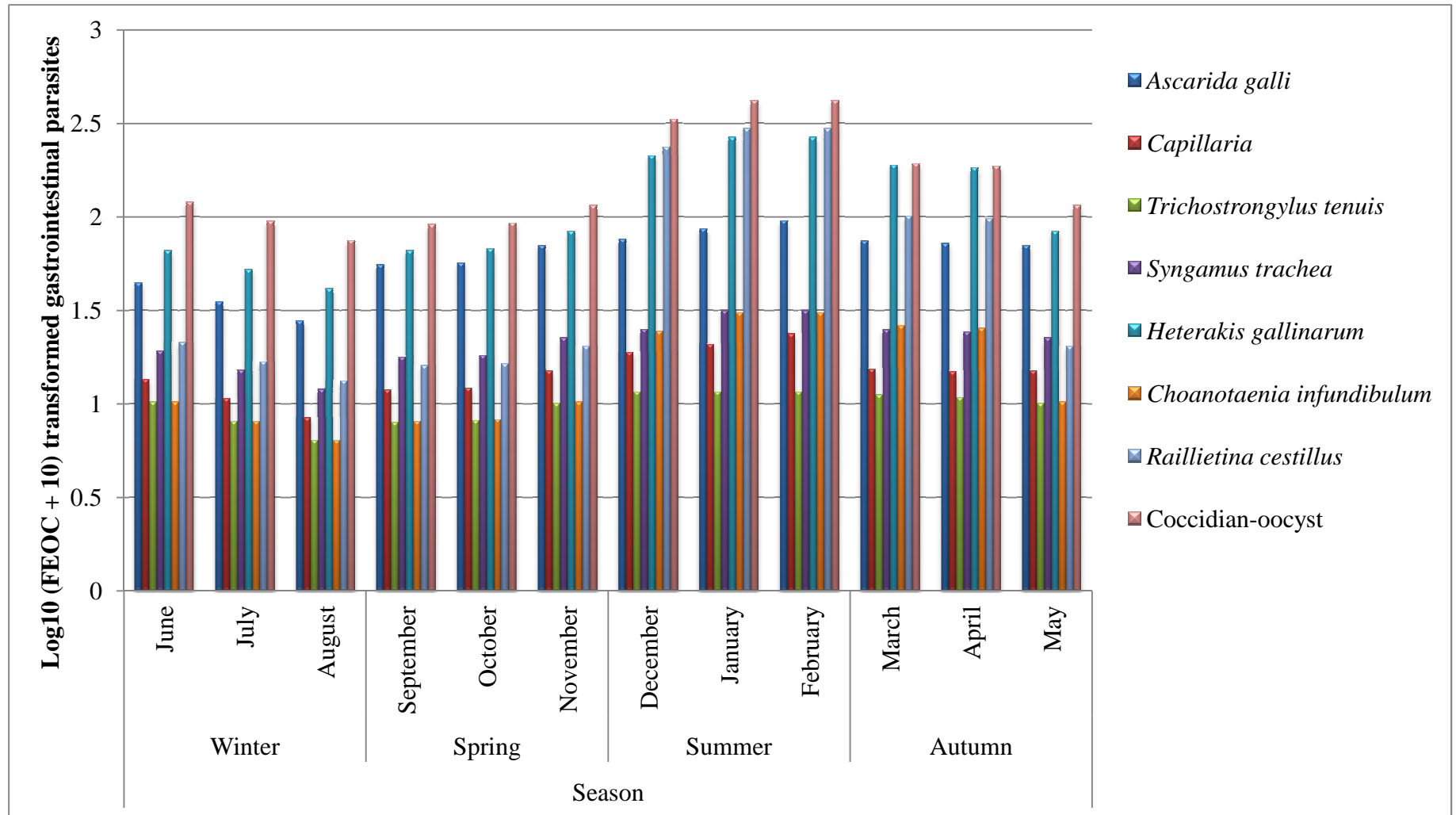
83. What are your market preferences?

Appendix 9.2: Monthly least-square means of different classes of village chickens



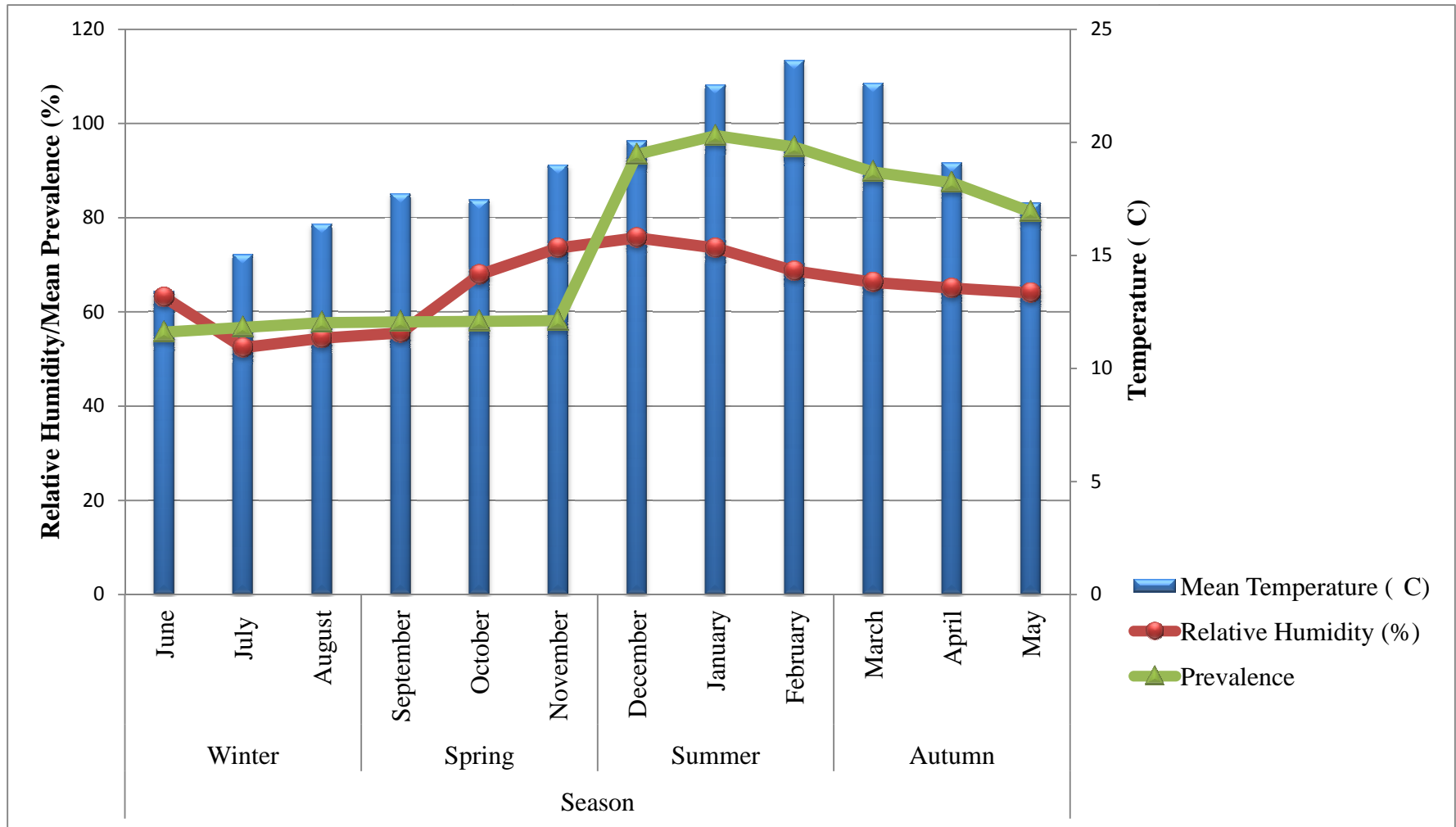
Least-square means of different classes of village chickens

Appendix 9.3: Effect of month on log₁₀ (FEOC + 10) transformed gastrointestinal parasites in village chickens



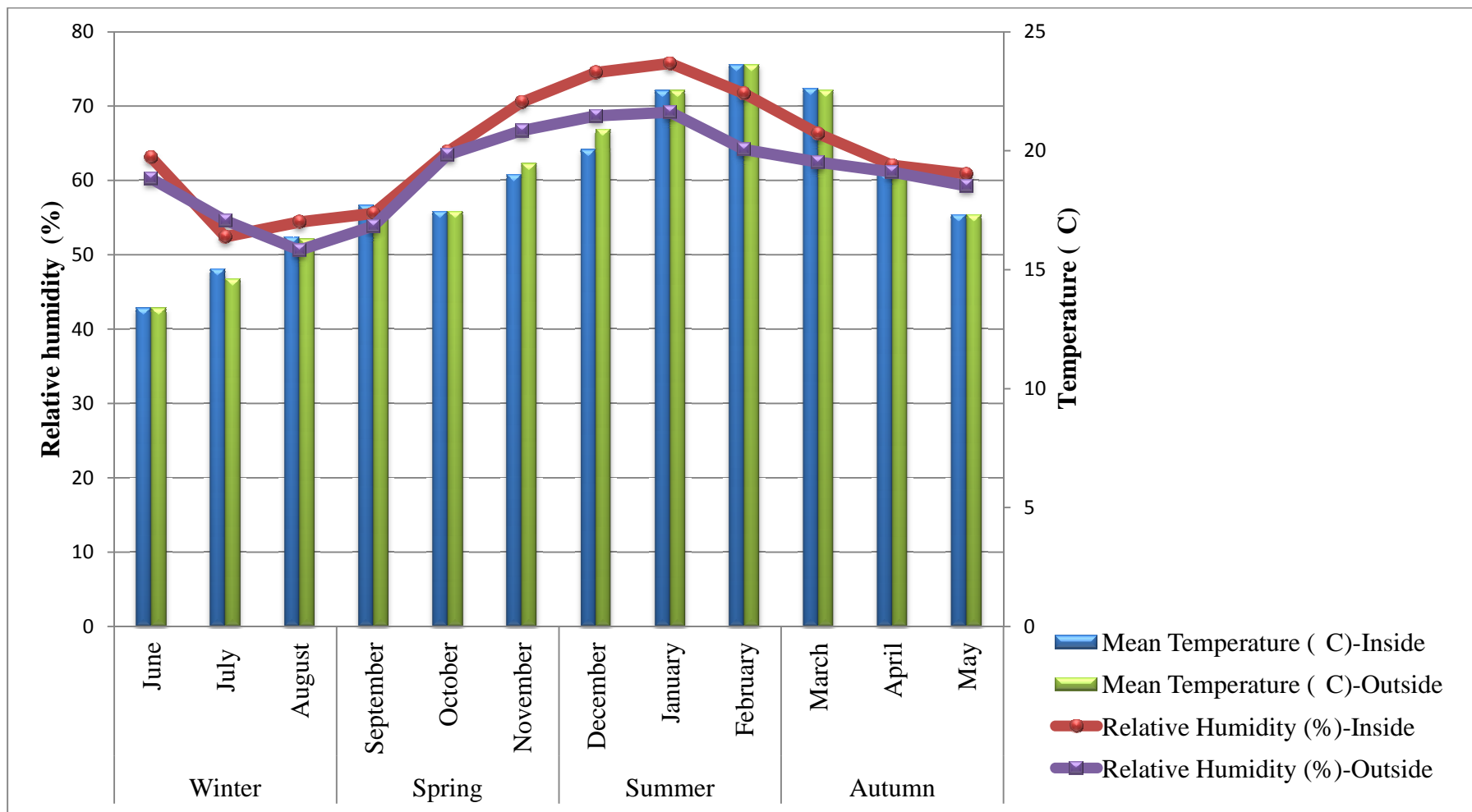
Log₁₀ (FEOC + 10) transformed gastrointestinal parasites in village chickens

Appendix 9.4: Monthly mean temperature, relative humidity and prevalence of village chicken endoparasites



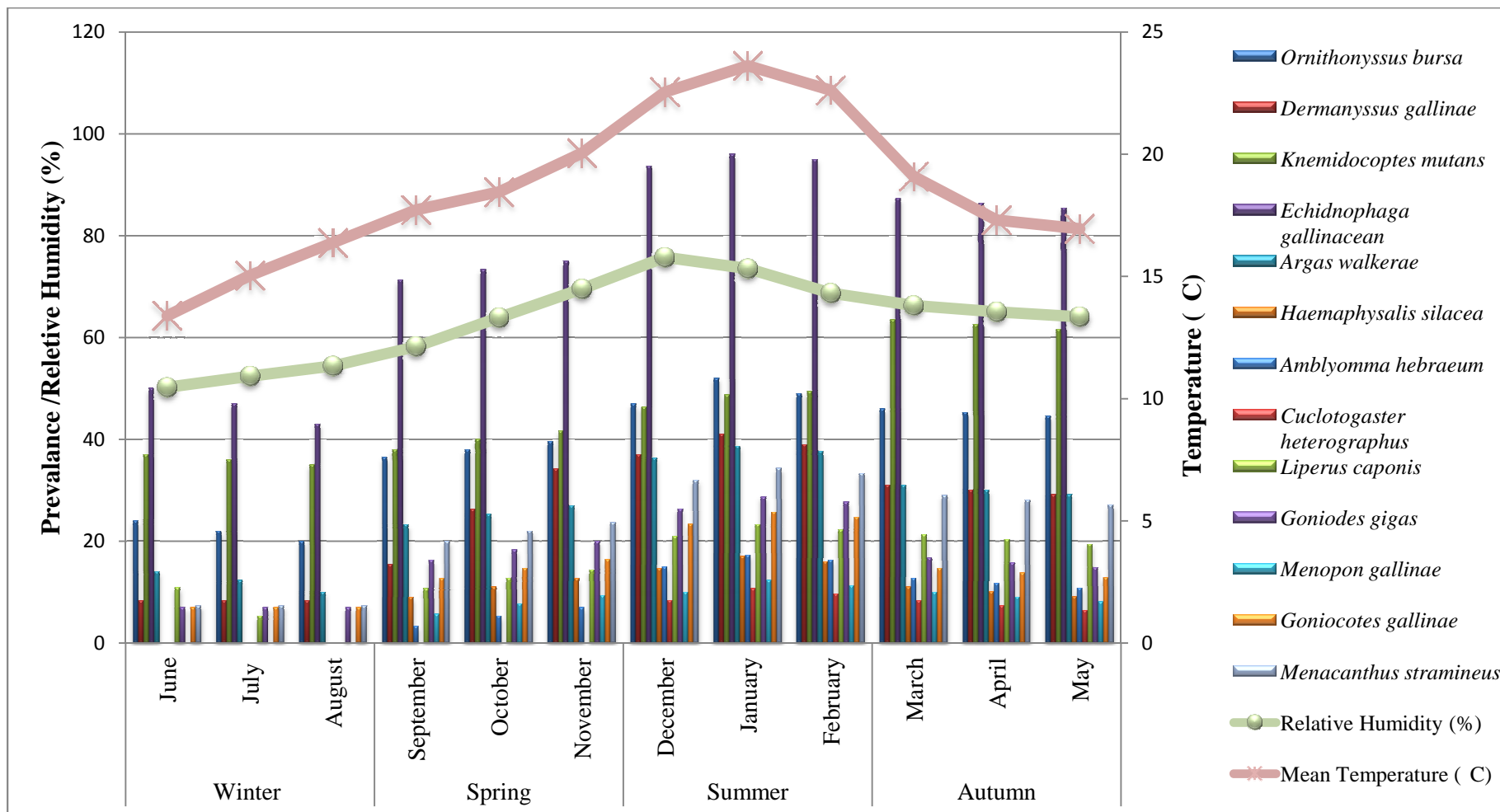
Mean temperature, relative humidity and prevalence of village chicken endoparasites

Appendix 9.5: Comparison of monthly mean temperature and relative humidity inside and outside chicken houses



Comparison of mean temperature and relative humidity inside and outside chicken houses

Appendix 9.6: Monthly mean temperature, relative humidity and mean prevalence of village chicken ectoparasites



Mean temperature, relative humidity and mean prevalence of village chicken ectoparasites